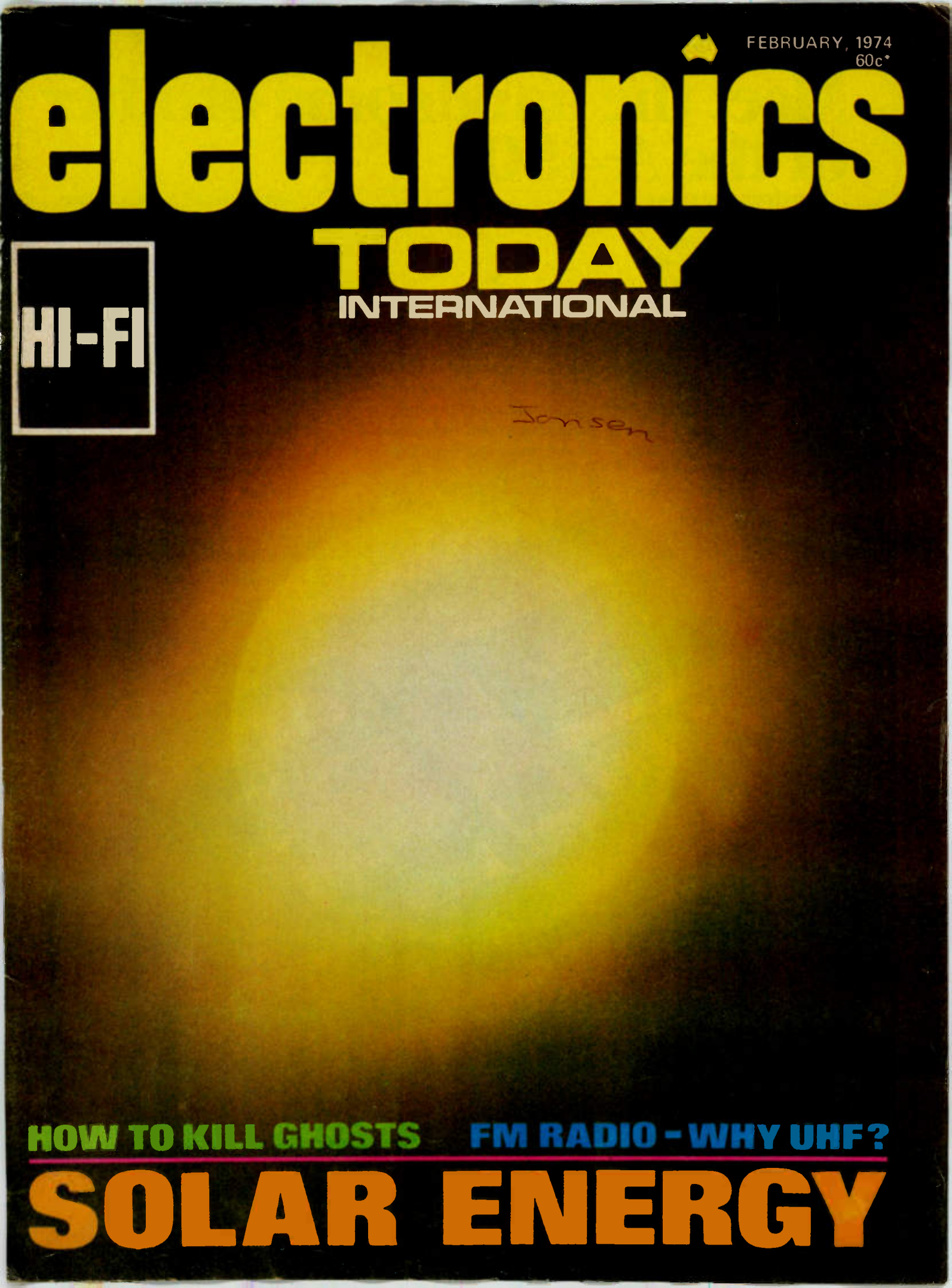
FEBRUARY, 1974
60c*

electronics TODAY INTERNATIONAL

HI-FI



HOW TO KILL GHOSTS

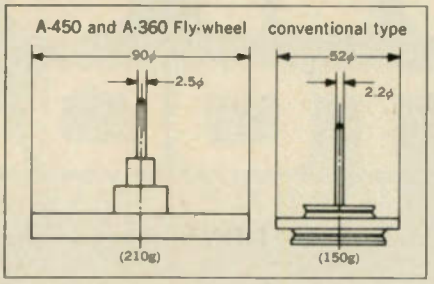
FM RADIO - WHY UHF?

SOLAR ENERGY

Meet the handsome brother of the A-450.

Everybody who knows anything about cassette decks today knows about our remarkable TEAC A-450.

What makes it truly remarkable is its wow and flutter rating: 0.07%. Just like the most expensive reel-to-reel tape decks. This 0.07% figure comes from the fact that the A-450 employs an entirely new Tape Transport System which includes our own hysteresis synchronous outer-rotor motor; an extremely large,



heavy fly-wheel; a flat drive-belt; and a new slipping mechanism to provide optimum reel hub tension. All finely engineered to a tolerance of 1 micron or less.

Not to mention its built-in Dolby* Noise Reduction System, 3-stage Bias and Equalization controls, and High Density Ferrite Heads. Among its host of features.

Everyone knows something about our A-450. Including you.

So now witness its ambitious brother. The TEAC A-360. It's got the same 0.07% wow and flutter rating, Dolby system, Heads, and most of the other features as the A-450. At a lower price.

Check out the A-360 at your local stereo shop.

A-360

TEAC.
The sound of perfection

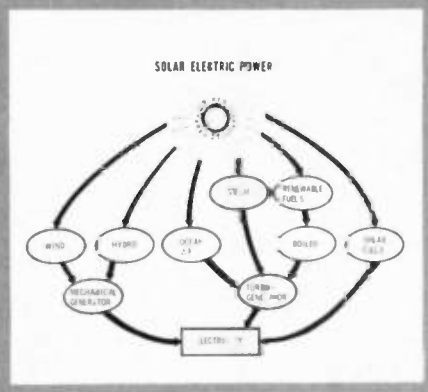
AUSTRALIAN DISTRIBUTORS: Australian Musical Industries P/L., 155 Gladstone St., Sth. Melbourne. Vic., 3205. Phone: 69 5888 — 619 Pacific H'way., St. Leonards, N.S.W. 2065. Phone: 439 6966 — Arena Distributors. 273 Hay St., East Perth. Phone: 25 9993 — Sth. Aust. Truscott Electronics Pty, Ltd., Hindmarsh Square. Adelaide. Phone: 23 3024. OCEANIC DISTRIBUTORS: New Zealand: Direct Imports (N.Z.) Ltd., 590W Southhampton Street. Hastings. Phone: 89 184 — Fiji: D. Jeevan & Sons. 87 Cumming Street. (G.P.O. Box 148). Suva. Phone: 22710 — New Guinea: Paul Mow & Co., Box 449, Lae. Phone: 2953.

* 'DOLBY' is a trademark of Dolby Laboratories, Inc.

electronics TODAY INTERNATIONAL

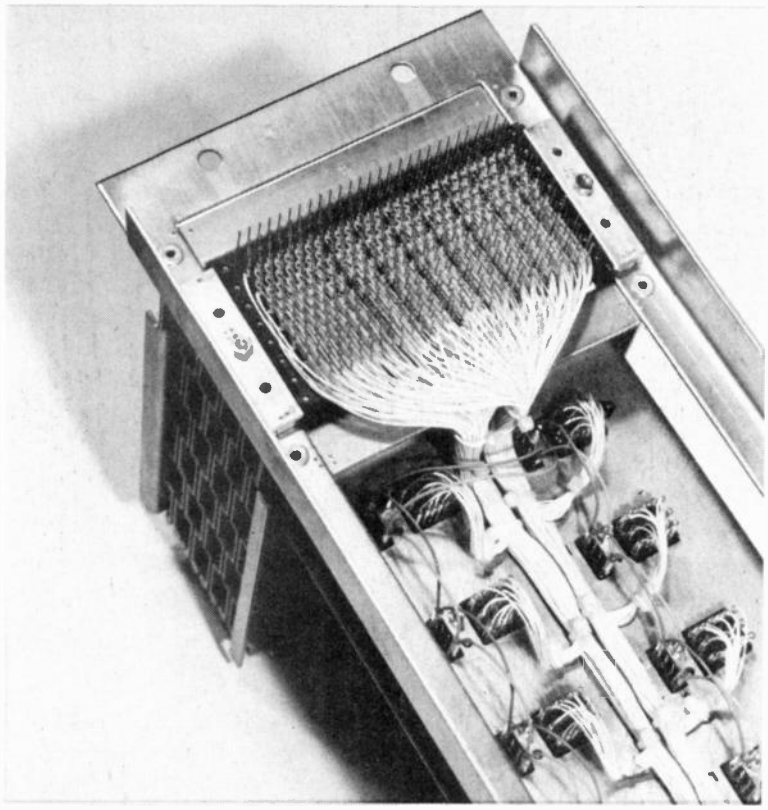
FEBRUARY 1974 Vol. 3, No. 11

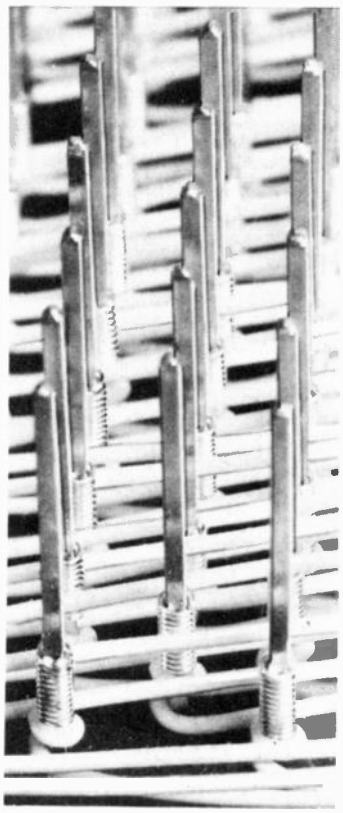
COVER: Solar energy can provide mankind with 178 billion megawatts of electrical energy – and there are innumerable other energy sources! (full report page 24 onwards – this issue).



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: Ad Media Group of South Australia, 12-20 O'Connell Street, North Adelaide S.A. 5006. (67-1129). 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 in 1973 by Conpress Printing Ltd., 65 O'Riordan St., Alexandria N.S.W. Distributors: Australian Consolidated Press.
(*Recommended and maximum price only.)

Teflon wire the new look in industrial wire and cables..





for • Computer and data processing equipment • Instrumentation and Control • Telecommunications • Meteorology • Aeronautics • Mining • Factory process control • Microwave Ovens • Lighting

Wire Wrapped Computer Rack using Philips 30AWG — 0.25 mm 300 Volt Teflon* Hook up Wire.
Unit by courtesy of Summit Electronic Systems.
*Du Pont Registered Trademark

PHILIPS

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

38.2302

Collyn Rivers
Editorial Director

Brian Chapman
Technical Editor

Michel Calluaud
Consultant Editor

Barry Wilkinson
Engineering Manager

Clive Davis
Art Director

Bob Izzard
Production Manager

Howard Jenkins
Advertising Manager

Terry Marsden
Assistant Advertising Manager

John Bleasby
Advertising Representative
(Sydney)

Clarrie Levy
Advertising Manager
(Melbourne)

Ken Morrisey
Advertising Production

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

Robert Evans
Advertising Manager

Electronics Today International
36 Ebury St., London SW1.
Telephone: 01-730-2139

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

ENERGY— a phony crisis

ENERGY is both the key and limiting resource in an industrial society. Its ready availability is a prerequisite for many of our social and environmental goals.

But despite new-found fossil reserves, we cannot use these at a growth-compounded rate for an indefinite period of time. We must seek and develop alternative sources of supply.

Contrary to the near-hysterical reports in the daily press, there is no long-term shortage of energy, for as Britain's Economist magazine pointed out recently, there are many thousand possible ways of releasing energy from storage in matter.

Such methods range from our presently inefficient 20 000 BTUs released by burning a pound of petrol — 250 million BTUs obtained from the fission of the U-235 isotope in a pound of natural uranium — to the staggering 260 thousand million BTUs expected from the fusion to helium of a pound of hydrogen.

Solar energy, despite its low unit density and terrestrial variability, can provide the Earth with 178 billion megawatts of electrical energy. Compare this with the current US generating capacity of about half a million megawatts.

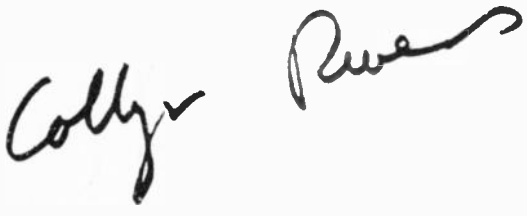
Current projections assume a 13 year doubling time for world energy consumption. If this is accurate, the energy that will be consumed in the year 2034 will provide a projected world population of 18 billion people with a per capita energy consumption equal to that currently used in the USA.

Despite this apparently enormous increase in demand, the actual energy required is precisely 0.2 per cent of that available from solar energy alone!

There is no long-term energy crisis — and there will not be one for hundreds of years to come unless the nature of mankind changes in an unimaginable way.

In the short term there will be shortages of petroleum products — but nothing like the extent that so many forecast. For the mechanism of supply and demand is a complex and sophisticated matter, and it is very likely that the present price increases will create a glut rather than a shortage of petroleum products — which in turn will cause the price to fall once again.

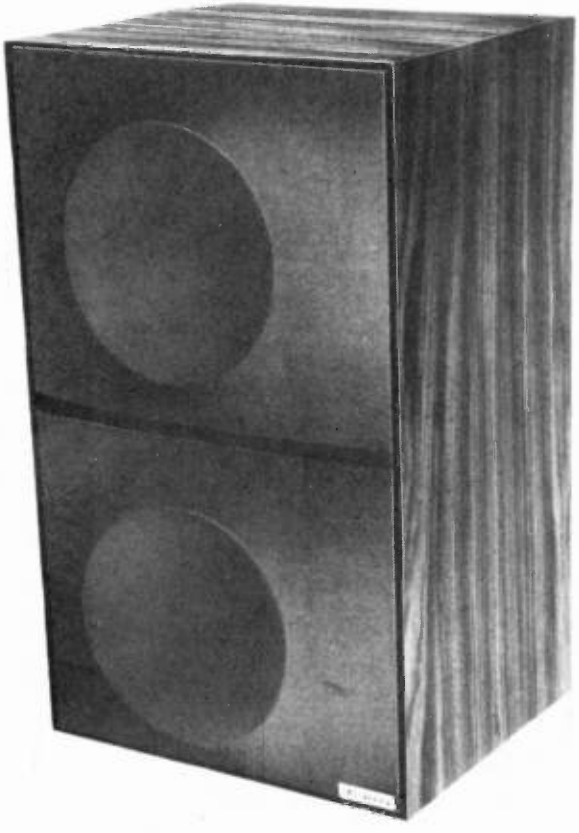
In this issue, ETI special correspondent Dr. Peter Sydenham looks at the overall energy situation — and sees little cause for alarm.



Since we started ETI three years ago, all costs have risen 35 to 40 per cent. Despite this, we have maintained our cover price at its original 50 cents — but now inflation has finally forced us to go up in price — to 60 cents — a 20% increase.

ULTRALINEAR IS HERE

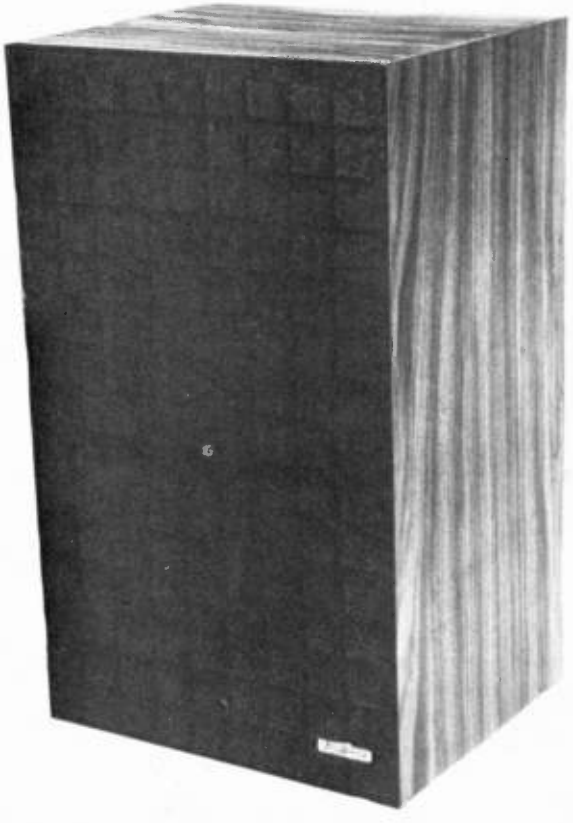
THE MOST TALKED ABOUT SPEAKERS AT THE SYDNEY AND MELBOURNE HI FI SHOWS. AT INCREDIBLE PRICES.



MODEL 200

DRIVERS 12" Air Suspension Woofer.
5" Sealed Midrange.
2½" Super Tweeter.
FREQUENCY RESPONSE 28Hz to 20,000 Hz
CROSSOVER FREQUENCIES 1500 Hz and 4000 Hz
MINIMUM POWER REQUIREMENT 10 watts RMS.
MAXIMUM POWER HANDLING 60 watts RMS
NOMINAL IMPEDANCE 8 Ohms
COLORS AVAILABLE: RED, BLUE, BLACK, BROWN, TIMBER WALNUT FINISH
SIZE: 24 3/8" H x 14½" W x 12" D

PRICE $139 EACH



MODEL 150

DRIVERS 12" Air Suspension Woofer.
2½" Super Tweeter.
FREQUENCY RESPONSE 32 Hz to 20,000 Hz
CROSSOVER FREQUENCIES 2500 Hz
MINIMUM POWER REQUIREMENT 5 Watts RMS
MAXIMUM POWER HANDLING 40 Watts RMS
NOMINAL IMPEDANCE 8 Ohms
COLORS AVAILABLE: ORANGE, CHARCOAL TIMBER WALNUT FINISH
SIZE: 24 3/8" H x 14½" W x 12" D

PRICE $119 EACH

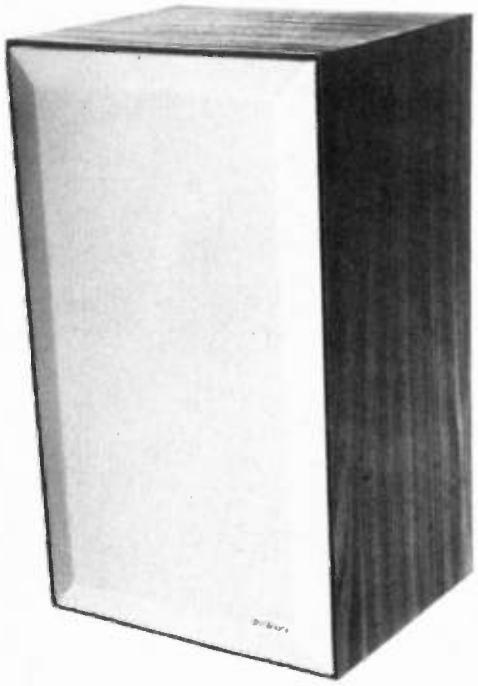
AVAILABLE FROM

SYDNEY: Autel Systems Pty. Ltd., 412-4377; Dyna Stero, 51-7071; S.G.Everets, 602-7859; Appollo Hi-Fi 560-9019.
NEWCASTLE: Hi-Fi; Taree Photographics; CANBERRA: Pacific Stereo. MELBOURNE: Radio Parts; S.A. Sound Spectrum; TAS: Belcanto Audio; W.A. Arener Distributors; BRISBANE: Tel Air.

ULTRALINEAR IS HERE

- *DESIGNED FOR THE FUTURE*
- *5 YEARS PARTS AND LABOUR WARRANTY*
- *AUTOMATIC CIRCUIT OVERLOAD BREAKER.*

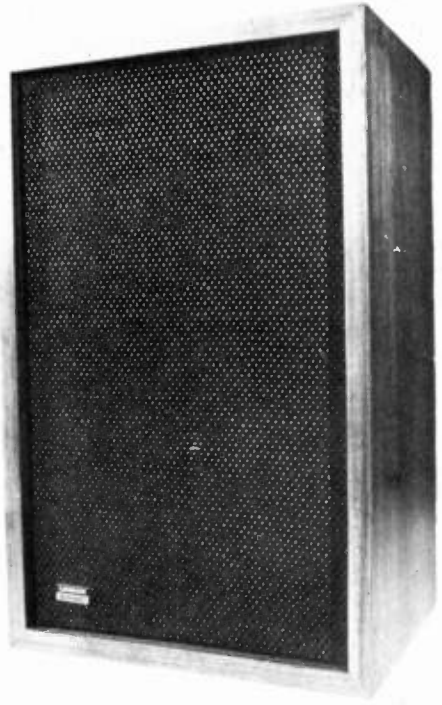
MODEL 100



DRIVERS 12" Twin Cone Woofer.
2½" Super Tweeter.
FREQUENCY RESPONSE 37 Hz to 20,000 Hz.
CROSSOVER FREQUENCIES 2500 Hz
MINIMUM POWER REQUIREMENT 5 Watts RMS
MAXIMUM POWER HANDLING 30 Watts RMS
NOMINAL IMPEDANCE 8 Ohms
COLORS AVAILABLE: RED, BLUE, BLACK, BROWN.
TIMBER WALNUT FINISH
SIZE 24 3/8" H x 14½" W x 12" D

PRICE $94 EACH

LINEAR SOUND 82



* 1 year parts and labour warranty
* As reviewed in Aust. Hi-Fi Speaker Guide Vol II
DRIVERS 8" Acoustic Suspension Woofer
1½" Pressure Dome Tweeter
FREQUENCY RESPONSE 37 Hz 20,000 Hz
CROSSOVER FREQUENCIES 2300 Hz
MINIMUM POWER REQUIREMENT 3 Watts RMS
MAXIMUM POWER HANDLING 25 Watts RMS
NOMINAL IMPEDANCE 8 Ohms
COLORS AVAILABLE: BROWN
TIMBER WALNUT FINISH
SIZE 21½" H x 13" W x 9¾" D

PRICE $69 EACH

SOLE AUSTRALIAN AGENTS

LINEAR SOUND PTY. LTD.

639 PACIFIC HIGHWAY CHATSWOOD Phone: 412-4352.

THE BIG APPEAL

Some people want the big sound. This is it. Sony's gleaming TA-1150 amp delivers a whacking 35W RMS per channel — enough to comfortably drive two of the finest speakers on the market today — Sony's massive top-of-the-line SS-7600 Ultra Linear Systems that put the Sydney Opera House in your living room. Add Sony's beautiful belt-drive SS-5520 turntable and you've got a complete system that friends would pay money to hear.

Specifics: The Sony TA-1150 has two tape recorder inputs, frequency response 12 Hz-20 kHz, harmonic distortion less than 0.2% at rated output. All desirable controls and inputs. Direct coupling circuit.

The Sony PS-5520 turntable features aluminium diecast platter and belt drive for faithful and flawless reproduction. Diamond stylus and induced magnet type stereo cartridge.

The Sony SS-7600 Ultra Linear Magnetic Circuit speaker system features 3-way, 3-speaker combination with 12" woofer, 5" mid range and 1" horn type tweeter. Power handling capacity 100W. Front panels are detachable to reveal individual brilliance controls.

SONY®

Distributed by JACOBY KEMPTHORNE SERVICES

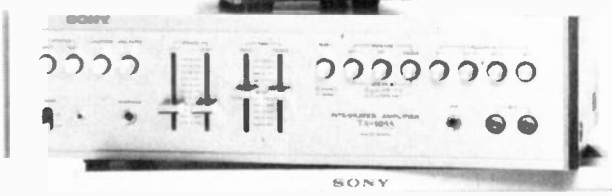
SYDNEY: 26 2651, MELBOURNE: 329 6966. ADELAIDE: 93 2338/9. BRISBANE: 44 4488, PERTH: 81 3422, LAUNCESTON: 25 322. CANBERRA: 95 2100. Agents: NEWCASTLE: 61 4991. FAIRY MEADOW: 84 8022.

JK5987

SONY AMPLIFIES VALUE!

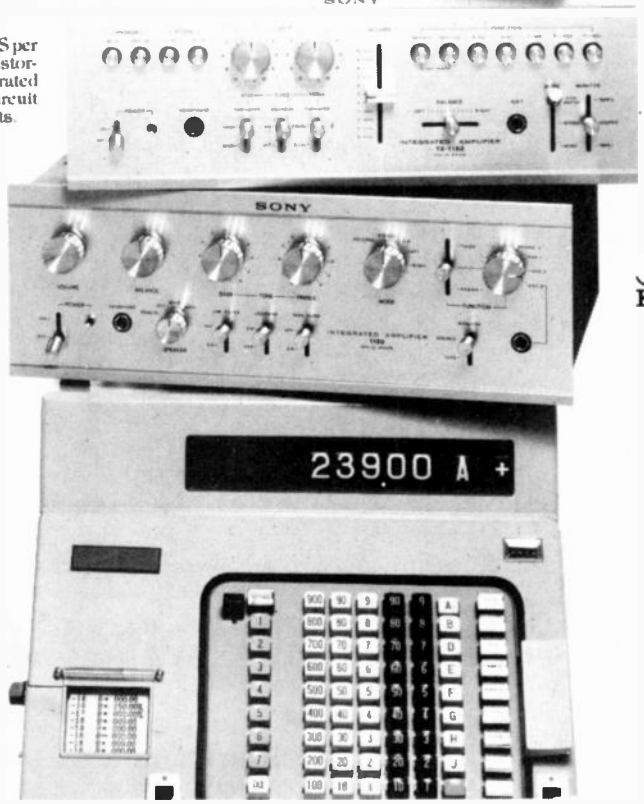
TA-88
Neatest way yet devised of keeping two books apart and two hearts together. 11W RMS per channel at 8 ohms and an astounding performer for its compact size.

TA-1055
Wider power bandwidth, low distortion, high stability, excellent transient response. 23W RMS per channel at 8 ohms. All push button and slide controls. Inter recorder dubbing between two tape recorders possible.



TA-1150
Abundant power (30W RMS per channel at 8 ohms), low distortion — (less than 0.2% at rated output). Direct coupling circuit and two tape recorder inputs.

TA-1130
High power (65W RMS per channel) combined with low distortion (less than 0.1% at rated output). Superb de luxe preamplifier using 8 FET's. Separate base and treble tone controls.



You want the best amplifier for the money, right? Sony's Big Four amplifiers fit perfectly into all price ranges for power centres of exceptional quality and reliability. So you get the ideal, strongly-beating heart of your music system with the added benefit of Australia's best warranty to back it. Sony have the best service set-up in the country and a full 12 months guarantee on parts. Chances are, however, you won't need it. Because it's Sony. Ask anyone.

SONY®

JACOBY KEMPTHORNE SERVICES

SYDNEY: 262651, MELBOURNE: 3296866, ADELAIDE: 932338/9, BRISBANE: 444488, PERTH: 813422, LAUNCESTON: 25322. Agents: CANBERRA: 479010, NEWCASTLE: 614991, FAIRY MEADOW: 848022.

SN 632

Linear Design

BRINGS ON THE NEW

Here's the quality amplifier that has everything—

including a low price

$149

DESIGN FEATURES:

The Linear Design 2500, is a brand new all silicon solid state amplifier which uses high quality components and provides a host of facilities.

Our engineers, whose concept of the ideal amplifier is "a straight line with gain", designed special NPN/PNP circuitry for the pre/amp sections to meet the parameters they wanted for low noise and accurate equalization, and designed ITL/OTL-QC output stages for stability and reliability.

The use of a massive alloy extruded rear section with integral heatsinking, provides more than adequate dissipation of heat.

Great care in manufacture is the "order of the day", and every amplifier is subject to stringent testing, and must meet the published specifications.

We, at Linear Design, believe our engineers have produced the best "value-for-money" amplifier available.

Did we?

Compare our amplifier to any other under $200. We think you'll take ours home.

SPECIFICATIONS

OUTPUT POWER:— 25 Watts RMS per channel, both channels driven into 8 ohms.
TOTAL HARMONIC DISTORTION:— Less than 0.2% from 20 Hz to 20 kHz up to 25 watts RMS.
FREQUENCY RESPONSE:— 10 Hz to 200 kHz +0, −3 dB.
POWER BANDWIDTH:— 20 Hz to 50 kHz (+1 dB).
DAMPING FACTOR:— Greater than 60, 20 Hz to 20 kHz.
INPUT SENSITIVITIES:— (Input IMP. 47K0hm); PHONO 2.5mV at 1 kHz; AUX 250mV; TUNER 250mV; TAPE 1 250mV; TAPE 2 250mV.
TAPE OUTPUT:— TAPE 1 22mV (For DIN connection); TAPE 2 250mV.
SIG. TO NOISE:— PHONO Better than 70 dB, 'A' weighted (Ref. to 5mV); AUX Better than 75 dB, 'A' weighted (Ref. to 250mV); TUNER Better than 75 dB, 'A' weighted (Ref. to 250mV); TAPE Better than 75 dB, 'A' weighted (Ref. to 250mV).
FILTERS:— HIGH 3 dB at 6 kHz, 12 dB/octave; LOW 3 dB at 100Hz, 6 dB/octave; LOUDNESS +9 dB at 60Hz, +3 dB at 10kHz.
TONE CONTROLS:— BASS CONTROL ±15 dB at 50Hz; TREBLE CONTROL ±15 dB at 10kHz.

The Linear Design 2500 amplifier is covered by a 2 year warranty.

DISTRIBUTORS: **BJD Electronics Pty. Ltd.**

202 Pelham St., Carlton, 3053 Vic. Ph. 347-8255.
190 Willoughby Road, Crows Nest, 2065 N.S.W. Ph. 439-4201

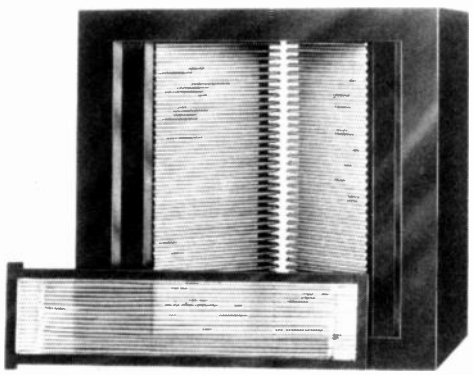
LIGHT YEA

Threadbare though the word "revolution" has become, the ESS amt 1 loudspeaker marks a revolution in high fidelity reproduction through its incorporation of the Heil Air Motion Transformer, developed and perfected by Dr. Oskar Heil, of Heil Scientific Laboratories, Inc., over the last four and one half years. This exciting new device gives the ESS amt 1 the first authentically new approach to sound generation in fifty years.

By utilizing the Heil Air Motion Transformer the ESS amt 1 breaks completely with sound generating principles that stretch back, unchanged, to the earliest acoustic phonographs. From turn-of-the-century "talking machines" through today's most sophisticated component systems, the air pressures you hear as sound have been created by the direct push of a diaphragm surface moving forward and backward to get air motion. As the diaphragm surface works directly against the air its movement must be as great, and as rapid, as the required air movement—and this holds true for cones, electrostatic panels, piezoelectric crystals, traveling wave transducers and even ionized air devices that have an ionized cloud moving "forward and backward" just like a paper cone.

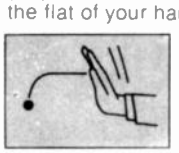
The Heil Air Motion Transformer, used as the mid and high frequency reproducer in the ESS amt 1, departs dramatically from this traditional concept of sound reproduction. By squeezing air instead of pushing it, it effectively creates *fives times* more air movement than the direct push of an equivalent flat surface and accelerates transducer design light years ahead. The Heil Air Motion Transformer has no "piston" surface, no voice coil, no elastic suspension devices, no significant mass, no "forward-backward" motion, no resonances, and is so light and simple that it carries a lifetime warranty.

Instead of trying to displace air molecules with the forward-backward motion of a flat or cone surface, the Heil Air Motion Transformer harnesses the power-purchase of a pneumatic "lever" and by applying small squeezing forces over a large surface area produces air movements *five times greater* than an equivalent "pushing" piston surface. And whereas the energy applied to a piston driver is used to push a cone that pushes the air, the Heil Air Motion Transformer squeezes air *directly*. As a result of this greater, more direct and near massless transfer of energy, the Heil Air Motion Transformer approaches instantaneous acceleration for flawless transients, has no "cone breakup" to create coloration, and shows distortion figures as fine as modern electronics to recreate the sharpest of images, the cleanest of attacks and the highest harmonics with a clarity and immediacy never before experienced.



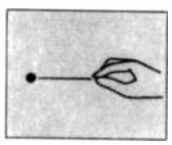
The Heil Air Motion Transformer—The loudspeaker of the future.

To form a picture of the completely new technique by which the Heil Air Motion Transformer generates sound, imagine trying to set a cherry pit, a low mass object (air), into motion with a high mass object, the flat of your hand (cone and voice coil).



This is obviously a technique of low effectiveness because the great mass of your arm and hand relative to the small mass of the cherry pit prevents rapid movement and results in a poor transfer of kinetic energy from your arm to the cherry pit. Result: the pit can never move faster than your hand pushes it. Moreover, when trying to accelerate your hand rapidly and stop it suddenly, the great inertial force created by the mass of your arm results in sluggish starts and overhanging stops. All the dynamic drama of music is removed.

And yet for all its shortcomings, this is the way sound has been reproduced since the acoustic phonograph. Now imagine placing the cherry pit between your fingers and squeezing. The result: high effectiveness in the transfer of kinetic energy from your finger to the cherry pit, great movement of the cherry pit with a small but powerfully effective lever-like movement of only the tips of your fingers.



This analogy describes the ESS Heil Air Motion Transformer's principle. Sound is squeezed into the air instead of pushed toward it. A light small surface only .5 mil thick and made of a recently perfected plastic having enormously high internal molecular damping is formed into multiple interfacing cavities. The volume of these cavities alters in response to electro-magnetic forces generated by a uniformly distributed conduction cortex and projects sound outward with an almost perfect transfer of kinetic energy. The entire moving system is only two inches by five inches and its mass is effectively equivalent to only *three-quarters of a linear inch* of air across its surface—by contrast a conventional cone mechanism is effectively equivalent to one to three feet of air. This permits the moving system to react exactly with the input signal and results in an incredibly accurate conversion to sound waves, a conversion realized by the listener as vastly superior definition, clarity and spatial proportionality. Music is reproduced to scale with a distinctiveness to each individual timbre that marks the difference between merely satisfactory reproduction and sound as clear as light.

The ESS amt 1 combines the amazing Heil Air Motion Transformer with a newly developed ten inch woofer which has an oversize, deep-drawn frame assembly and a powerful magnet to permit exceptional excursions at the highest possible acceleration. The woofer is critically designed for clean, impactful low frequency response and exciting transient capabilities that precisely complement the open articulation of the Heil Air Motion Transformer. The ESS amt 1 triumphs over time and space by recreating in all its past, distant grandeur, every nuance of the original performance. Nothing we say, or can say, will adequately prepare you for the ESS amt 1's incredible new aural freedom, clean, clear and airy as light.

RS AHEAD

The AMT-1 is available from the following leading capital city retailers. Distribution will be expanded as and when stock permits.

N.S.W.

AUTEL SYSTEMS PTY. LTD., 639 Pacific Highway, Chatswood, Sydney, 2067. Phone: 412 4377

CONVOY TECHNOCENTRE, Cnr. Plunkett & MacLean Sts., Woolloomooloo, Sydney, 2011. Phone: 357 2444

INSTROL HI-FI CENTRE, 91a York Street, Sydney, 2000. Phone: 29 4258

KENT HI-FI PTY. LTD., 432 Kent Street, Sydney, 2000. Phone: 29 2743, 29 6973

VIC.

DOUGLAS TRADING, 185-191 Bourke Street, Melbourne, 3000. Phone: 639321

INSTROL HI-FI (VIC.) PTY. LTD., 375 Lonsdale Street, Melbourne, 3000. Phone: 67 5831

SOUTHERN SOUND PTY. LTD., 963 Nepean Highway, Moorabbin, Melbourne, 3189. Phone: 97 7245

and also at:

337 La Trobe Street, Melbourne, 3000. Phone: 67 7869

QLD.

STEREO SUPPLIES, 95 Turbot Street, Brisbane, 4000. Phone: 21 3623

S.A.

NO DEALER YET APPOINTED

W.A.

ALBERT'S HI-FI CENTRE PTY. LTD., 282 Hay Street, Perth, 6000. Phone: 21 9902, 21 5004

PERTH HI-FI CENTRE, 396 Murray Street, Perth, 6000. Phone: 22 4409

LESLIE LEONARD HI-FI, Shop U8, Upper Level, City Arcade, Hay Street, Perth, 6000 Phone: 22 3243

TAS.

NO DEALER YET APPOINTED

ESS amt 1

Recommended retail price $628.00 per pair
See any of the dealers listed for a demonstration of the AMT-1 or for further information contact

ESS Inc., ET2, c/o 220 West St., Crows Nest, N.S.W. 2065. Ph. 43 3228

Heil Air Motion Transformer is the registered trademark for ESS loudspeaker systems incorporating design principles invented by Dr. Oskar Heil and licensed exclusively to ESS Inc.

DOUGLAS
SELLS SOUND FOR LESS!

AKAI GXC 46-D
HI-FI cassette stereo tape deck

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

New Tariff Reduction Brings
New Lower Price
NOW ONLY

$255

**POST YOUR CHEQUE OR ORDER TODAY!*

DOUGLAS TRADING for HI-FI SOUND

185-191 BOURKE STREET, MELBOURNE – PHONE 63 9321

Complete range of fabulous Memorex tapes and Jensen Hi-Fi speakers

Capitol 2®

the tape that doesn't tax your head

Introducing the perfected iron-oxide tape . . .
Capitol 2.
The one that reduces friction between your tape and the tape head.
The world's finest iron oxide tape (20-20,000 Hz) — a lot more stable and a lot less expensive than most.

Comes in singles and stakpaks . . .
tape lengths C 60, C 90, C 120.
High output low noise cassette tapes with exclusive Cushion-Aire® backcoating.
Great results on all cassette recorders.

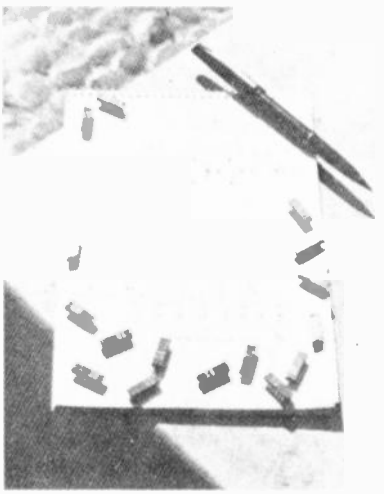
Capitol 2 . . . the iron-oxide tape.

EMI

Distributed by EMI (Australia) Ltd.,
International Leaders in Electronics,
Records and Entertainment.

news digest

"WRITE WHILE READ" RANDOM-ACCESS MEMORY



A high-speed bipolar random-access memory that accepts data at the same time its contents are being read has been developed by the Signetics Memory Products Department.

The new "write while read" RAM is designed for use in scratch-pad memories, control stores, buffer memories, and as the memory element in high-speed accumulator registers.

Known as the model 82S21, the RAM is a 64-bit TTL (transistor-transistor logic) device that has been organized into 32 words of two bits each.

Manufactured in a 24-pin dual-in-line ceramic package, the device features a 25-nanosecond read access time, buffered address lines, latches and decoding circuits on the chip, bit-masking control lines, a "chip enable" control line, protected inputs, and open-collector outputs that are capable of delivering 48 milliamperes each. Signetics and Signetics International will market the memory worldwide.

RADIOACTIVE/ELECTROMAGNETIC LINK

The European Nuclear Research Organisation (CERN) at Geneva have discovered a possible link between radioactivity electricity and magnetism.

Previously, physicists Weinberg and Salam had proposed that nuclear interactions caused by the so-called "weak force" responsible for radio-activity could be considered as electromagnetic interactions.

But, until recently the results of all relevent experiments were negative.

Now however, it seems as if Weinberg and Salam could be correct, for high energy neutrinos from CERN's 28 GeV accelerator, shot through a bubble chamber, have collided with neutrons without changing into electrons or mesons.

This result, insignificant though it may seem to the non-nuclear physicist is of profound importance, for it points to some link between the 'weak force' and electromagnetism which may perhaps be seen as different aspects of a similar phenomenon.

NEW TECHNOLOGY FOR LIGHTNING-STRUCK CABLES

A long-standing problem — affecting telecommunications authorities everywhere — is the effect of lightning strikes on underground telephone cables.

Research carried out by Australian Post Office technical staff working on the problem has shown that the standard types of plastic jacketted telephone cable are unsuitable in areas where lightning strike conditions are prevalent.

In such areas the lightning causes a high potential between the surrounding earth and the lead sheathing of the cable.

In many cases, these strikes cause the formation of micro holes in the lead sheating and plastic covering of the cable.

These tiny holes, in turn, cause a loss of dry-air pressurisation in the cable below acceptable levels, a factor — indicated on the specialised dry-air flow alarm systems — which in itself is the first indication that something is wrong.

To meet A.P.O. requirements, Austral Standard Cables has introduced a new standard cable type which, it is hoped, will combat the effect of lightning strike.

This is a paper insulated unit-twin plastic jacketted cable with a plain galvanized steel wire armour applied

ETI/HONEYWELL COMPUTER CONTEST

This contest — details of which were published in ETI late last year — has proven to be extra-ordinarily successful, not only for the quantity of entrants but also for the very high standard of entries.

Our judges have now selected a number of finalists — names of whom are listed below.

We hope to have picked four winners about the time that this issue is published.

Winners will be notified by telegram and full details published as soon as possible.

G. J. Harris
Warren Julian
Mrs. T. Hillman
W. Hartley
C. J. Wilson
J. Wilson
W. A. Whitbourn
K. A. Galbraith
F. Ryan
John Read
W. M. Rahmann
F. Ryan
Wilbur Wright
D. R. Woodrow
M. B. Gallagher
Barbara Jones
K. F. Trudgett
Ian Hopkins
Peter Wild
David Chapman
Geoffrey Major
John Read
G. A. Bundell
Victor Tarhanoff
P. N. Gore
D. L. McNeil
R. Gayler
A. Breadmore
Jeff Salmon
Gregory McRae
Robert Herkes
John English
Mervyn Beamish
Peter Salmon
G. Farne Sang
Edward Sike
Warwick West
C. MacKinnon
Mark Witcomb
M. Blakey
E. Raymond
Robert McIntosh
Marshall Hodgekiss
F. M. Clark
S. Skevington
Irving Tang

over the plastic jacket without normal jute or bitumen servings.

The armouring acts as a conductor to reduce the electrical earth potential resulting from the lightning strike and prevent electrical breakdown of the cable.

Results with these new A.S.C. armoured cables will be closely watched in the lightning storm season.

One point which has not been finally determined is whether the lightning works 'inside out or outside in'.

Does the charge build up a massive current in the conductor wires, causing the micro holes as a result of electrical pressure? Or is it a case of a charge penetrating the casing from outside?

The answers to these and other problems will be studied in all areas of Australia where lightning strikes frequently occur.

SATELLITE COMMUNICATIONS FOR AUSTRALIA

A symposium on "Satellite Communications for Australia" will be held in Melbourne on May 27th-29th, 1974. Sponsored by the Radio Research Board, the symposium is being organized by the Australian Post Office Research Laboratories.

Its objective is to bring together all those with a technical interest in the subject, at a time when Australia is investigating the use of a satellite communication system in the national telecommunication network.

There will be four sequential sessions, covering satellite communication systems, antennas, hardware, and propagation and digital techniques. Both review and research papers, from Universities, Institutes of Technology, Industry, and Government Departments will be included. Printed copies of all papers will be distributed to those attending.

Further details of the symposium, and registration forms, can be obtained from:—

Senior Assistant Director-General,
A.P.O. Research Laboratories,
59 Little Collins Street,
MELBOURNE, 3000.

There is no charge for attending the symposium, but registration forms should be returned by April 30th, 1974.

WORLD VCR LICENCE

BASF has obtained a licence from Philips to manufacture and market video cassettes for the Philips VCR system.

The cassettes are available in VC 30, VC 45 and VC 60 (30, 45 and 60 minute) versions.

The 3M company has similar VCR rights from Philips. Both 3M and BASF are expected to market their cassettes internationally.

JAPAN'S SUNSHINE PROGRAMME

Goals for Japan's "sunshine program", a national project to bring new energy sources into practical, large-scale use (C&EN, October 8, 1973, page 4), have been made more specific.

Among targets for 1985 recommended by the Industrial Technology Council (an advisory group to the Ministry of International Trade and Industry) are 100 000-kW. generating stations powered by solar energy and geothermal heat, production of one million cubic metres a day of synthetic natural gas, and new methods of producing hydrogen.

TEXAS INSTRUMENTS ATTACK H-P CALCULATOR MARKET

Texas Instruments has just introduced a very advanced hand-held calculator intended to compete directly with the Hewlett-Packard HP-35.

Priced at US$169.95, and to be sold intially only by direct mail the calculator drastically undercuts H-P's current US price of US$295.

Bill Terry, vice-president of H-P's told an industry reporter that the new TI SR50 appeared to be directly competitive.

MALAOY MAKER

Stockhausen-haters may find some basis for dislike of contemporary music in a report from two West German psychiatrists, Marie-Luise Fuhrmeister and Eckart Wiesenhutter.

In their report, published by the German Research Service, the shrinks studied 208 musicians in three symphony orchestras.

Those who frequently or predominantly played modern classical music were more prone to nerves, irritation and aggressiveness, and suffered more from insomnia, earaches — and believe it or not — impotence.

ADVENT TO MARKET VIDEO-BEAM TV

The Advent Corporation is currently making definate plans to market its video beam TV projection system.

Intended primarily for very large domestic rooms, business and institutional use, the system projects signals from normal TV, video, or CATV sources onto a screen 122 cm high x 183 cm wide.

The unit will be priced at US$2495 and production is expected to commence in April.

Advent are well known in the audio field for their range of loudspeakers and cassette recorders.

TV INTRUDER DETECTOR

No matter how conscientious a security guard may be, it is virtually impossible for him to monitor closed-circuit TV screens for protracted periods.

A system, developed by Information Processing Systems of Belmont, California, takes the responsibility from the guard by triggering an alarm signal if there is any change in the displayed video image.

The system samples the video image, integrating energy levels in the video signal and detecting changes in the energy content.

I bought a Marantz 4 channel amplifier because I refuse to be stuck with an electronic antique.

Not one to tolerate obsolescence (planned or unplanned), I considered the stereo vs. 4-channel question carefully, then purchased a *Marantz* amplifier for three compelling reasons.

One, *Marantz* has Dual Power. This means you get full power of four discrete amplifiers working all the time. When you're listening to regular 2-channel tapes and records you can combine the power of all four channels into the front speakers. This means even if you're not ready to commit yourself to a complete 4-channel system, you can buy *Marantz* now and when you get the other two speakers just flip a switch. You have 4-channel. Meanwhile, you're not compromising 2-channel because you're getting more than twice the power for super stereo.

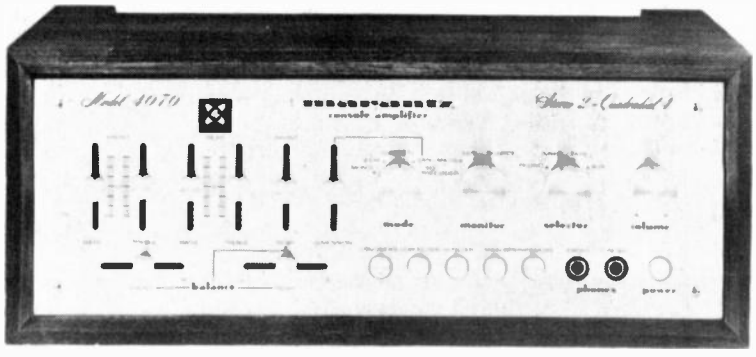
Reason number two, *Marantz* amplifiers feature the exclusive plug-in plug-out pocket for 4-channel matrix decoders. You can update any *Marantz* unit when and if you wish by purchasing an inexpensive Decoder module. An example of the use of this pocket would be the new full-logic SQ decoders soon to be available, or any other future developments in 4-channel systems. With a *Marantz* you need only plug in our module. On the other hand, if you buy a unit today, with everything built-in, you will not be able to take advantage of any new technology without going to great expense, and paying for items such as the cosmetics of an accessory chassis, and power supply circuits, etc. In fact you will be stuck with an electronic antique.

Reason number three, *Marantz* amplifiers have Vari-Matrix, a built in circuit that will synthesize 4-channel sound from any stereo source (including your stereo records and tapes) and will also decode any matrix encoded 4-channel records. Since the Vari-Matrix is a synthesizer, and will provide 4-channel sound from any program source, it will always be useful.

I chose the *Marantz* model 4070 Quadradial Amplifier because it suits my needs perfectly. It delivers more than 35 watts RMS power per channel for stereo, and more than 15 watts RMS power per channel for 4-channel. And it's literally loaded with features. However your requirements may be different to mine. In which case you can own the Model 4140 with 140 watts RMS total power and 4 beautifully illuminated VU meters. Or you might want the model 4230 Quadradial Receiver. It's got all the *Marantz* 4-channel features, plus FM & AM tuners, and a completely built-in Dolby noise reduction system that you can use with your tape recorder and cassette deck.

The point to remember is this — whichever *Marantz* 4-channel unit you do buy, you can buy it today without worrying about it being obsolete tomorrow. And when you buy *Marantz*, you know you're buying the best.

Look over the *Marantz* line of superb quality amplifiers, receivers and speaker systems at your *Marantz* dealer soon, he will help you select a *Marantz* system that's just right for you.

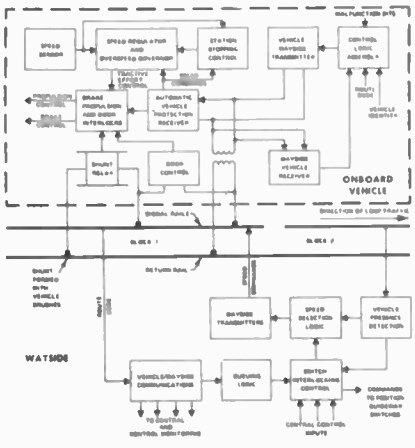


For brochure and dealer list write to:
AURIEMA (A'ASIA) PTY. LTD., P.O. BOX 604, BROOKVALE. 2100

marantz.
We sound better.

news digest

RAPID TRANSPORT SYSTEM



The USA's General Railway Signal Co, has recently delivered an automatic vehicle control system for 'Airtrans', an automated personal rapid transport system for use at Dallas/Fort Worth Regional Airport, the world's largest airport.

Operating on 21 km of concrete guideway the system controls all functions associated with vehicle movement, route switch positioning, door operation, routing, station stopping, performance monitoring, supervisory control, and communications.

The overall system has three major subsystems: Automated Vehicle Protection (APO), Automatic Vehicle Operation (AVO), and Automatic Vehicle Supervision (AVS).

The AVP subsystem monitors merge and diverge guideway switches. The diverge switch contains a divert gate which is positioned and locked by a GRS electric switch machine. Before a vehicle moves through a diverge switch, the divert gate is positioned and locked, and its position detected for correspondence with the switch. Unless the divert gate is positioned and locked, clearing of the route through the switch is not permitted. The signals on the approach to the switch are set as if the block located at the switch were occupied, preventing an approaching vehicle from moving closer than one block of the switch block.

The block relays report to a wayside logic unit, which checks the condition of blocks in advance of the vehicles to establish safe operating speeds. This logic unit also checks the position of guideway switches, and at least four clear blocks are required to permit a vehicle to proceed at its maximum speed of 27 km/h.

The AVO subsystem performs speed regulation and programmed station stopping, and interfaces with the vehicle's propulsion and braking systems to control speed in response to speed limit commands.

The programmed stop equipment, triggered from the wayside, brings the vehicle to a smooth stop in accordance with stopping profiles generated by a digital logic unit, which provides an output proportional to the distance to the stopping point.

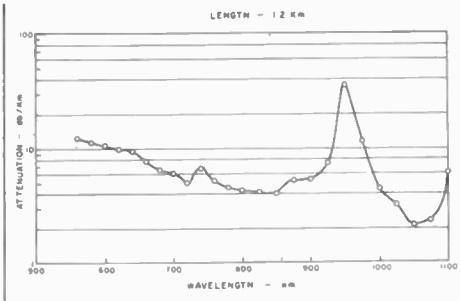
The AVS subsystem is used for routing, performance monitoring, and line supervision from central control. Each vehicle contains vehicle-to-wayside communications equipment and a programmable controller for handling train identification information and routing data.

ANTISTATIC FIBRES

Antistatic fibre will soon be available from ICI's plant in Britain (Imperial Chemical Industries, Aycliffe, UK).

The new fibres, say ICI, are the first ever to be produced with truly conductive properties. Based on either polyester or nylon, they contain small amounts of particulate carbon embedded on the surfaces – but forming an integral part of each fibre.

Although there are countless applications throughout science, and industry, initial marketing areas will be in carpeting and industrial fabrics – two areas where spark supression is often an important safety consideration.



Curve shows spectral attenuation of multimode optical waveguide (step index).

OPTICAL WAVEGUIDE ATTENUATION LOWERED

Scientists at Corning's Research and Development Laboratories have measured attenuation of 2.1 ±0.5 dB/km at 1050-nm wavelength through a 1.2 km length of multimode optical waveguide.

They attribute success with low-loss waveguides to Corning's unique fabrication methods with fused silica type glasses that minimize scattering losses at the core/cladding interface and impurity absorption losses.

In a paper published in *Applied Physics Letters,* Drs. Donald B. Keck, Robert D. Maurer and Peter C. Schultz predicted that the ultimate lower limit of attenuation in glass optical waveguides would be about 2 dB/km at wavelengths beyond 800 nm.

Their calculations were based on waveguides showing attentuation of 4 dB/km.

Low-loss optical waveguides have created worldwide interest in the possibility of communicating in coming decades with photons instead of electrons, allowing the transmission of much more information.

DECCA/BASF DEAL

Britain's Decca organisation has signed a three-year agreement with BASF to press, release and distribute BASF records and pre-recorded cassettes in the UK.

LUXMAN SQ 507A AMPLIFIER

Our acoustical consultants Louis A. Challis and Associates retested the Luxman amplifier reviewed in our January 1973 issue.

They advise us that their previously quoted figures for total harmonic distortion were incorrect.

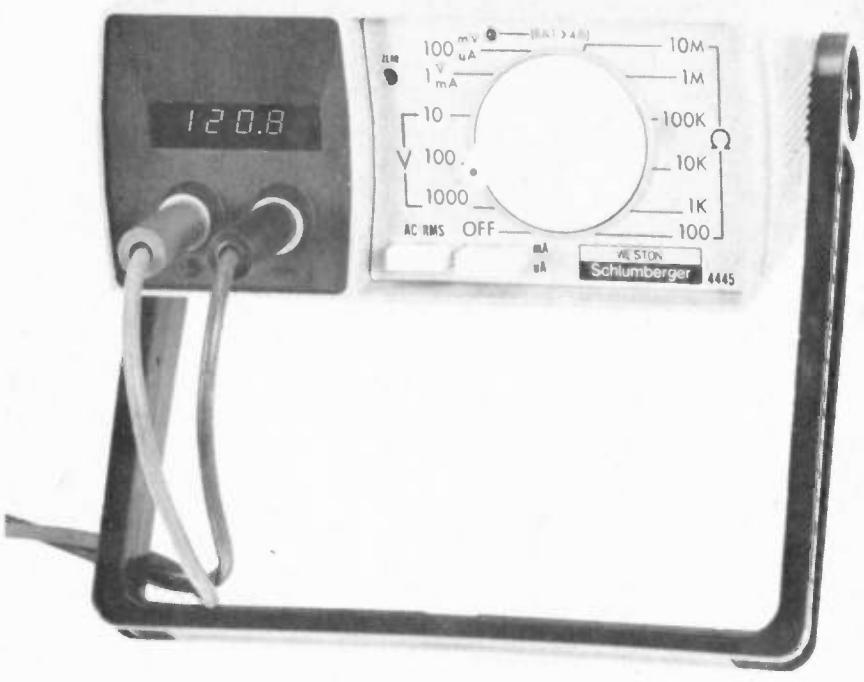
Actual total harmonic distortion at rated output is:

100 Hz	1 kHz	6.3 kHz
0.06%	0.04%	0.03%

Louis A. Challis and Associates apologize to the Lux Corporation for this error.

TRUE R.M.S

DIGITAL MULTIMETER



$389

+ Sales Tax.
Availability ex-stock.

FEATURES

- True R.M.S. A.C. measurements.
- Dual slope conversion for stability and accuracy.
- Self contained battery pack provides up to 10 hours use.
- 240V Battery charger supplied as standard equipment.
- Automatic blanking of digits not in use to conserve battery life.
- Fully-overloaded protected by fuses, externally replaceable.
- Shock-proofed high impact case.
- 20 ranges at 3½ digit resolution covers 200mv – 100v. A.C. & D.C.
- 200Ω – 20 megohms.
- Plug in shunts are available to extend A.C./D.C. current ranges.

SCHLUMBERGER INSTRUMENTATION AUSTRALIA PTY.LTD.

MELBOURNE:	S.I.A., 112 High Street, Kew. Telephone 86-9535
SYDNEY:	S.I.A., 134 Willoughby Road, Crows Nest. Telephone 439-7650
BRISBANE:	L. E. Boughen, 30 Grimes Street, Toowong. Telephone 70-8097
ADELAIDE:	Fairey Aust., 433 Poultney Street, Adelaide. Telephone 23-4435
PERTH:	Dawson Instruments, 70B, Hale Road, Wembley Downs. Telephone 41-4117

news digest

RED/GREEN LED's

Under a contract from NASA, Bowmar Canada has developed a single LED that can change colour — from red to green — depending on current levels.

Whilst the device has an efficiency of 1% to 2% for red light, and 0.1% to 0.2% for green light, both will be seen subjectively as being of similar brightness because the human eye is approximately 10 times more sensitive to green.

SOVIET LASER JOURNAL

The U.S.S.R. Academy of Sciences will begin publication this month of a monthly journal dealing with laser applications.

The journal will be entitled "Quantum Electronics" and will be published by Sovetskoye Radio. Nobel prize winner Nikolai Basov is editor-in-chief.

Articles by foreign contributors as well as Soviet writers will be included.

Additional information can be obtained by contacting the Information Department, Embassy of the Union of Soviet Socialist Republics, 1706 18th Street, N.W., Washington, D.C.2009. USA.

(We have contacted the U.S.S.R. Embassy in Canberra — but they have little knowledge about it).

AUSTRALIA ORDERS OVERSEAS

A contract worth US$6 million has been placed with Mohawk Data Systems, Herkimer, USA for data entry and communications systems to be used in Australia's Social Security network. Equipment to be supplied includes 67 MOS processors and 200 key stations.

COMPUTER PROGRAM IMPROVES BUS SERVICES

Bus journey speeds in Glasgow City Centre have been improved by an average of eight per cent throughout the working day. This improvement has been achieved by means of new timings for the 95 traffic signals in the computer-controlled area traffic scheme.

The Corporation of Glasgow and Greater Glasgow Passenger Transport Executive cooperated in testing for the first time a new system known as BUS TRANSYT. This method has the effect of favouring buses because signal timings are designed to minimise total delay to all vehicle occupants, in contrast to the earlier systems which were designed to reduce the journey times of all traffic without distinction.

This latest experiment in Glasgow is part of the programme of research of Britain's Transport and Road Research Laboratory (Dept. of the Environment, Crowthorne, Berks), into ways of improving public transport, and an improvement of this order over a whole city centre is an important contribution towards solving the problems of more efficient bus operations in urban areas.

SIMULATOR FOR AUSTRALIAN "SEA KINGS"

Britain's Link-Miles Division of The Singer Company (U.K.) Ltd has received a contract from the Australian Government to build a flight simulator for the "Sea King" Mk50 helicopter, ten of which have been ordered from Westland Helicopters Ltd.

The simulator complex, which will take approximately two years to complete, will be installed in New South Wales.

The complex will comprise two main elements, a reproduction of the aircraft flight deck containing two pilot stations, mounted on a three degree of freedom motion system, and a reproduction of the sonar and radar operations compartment which is floor mounted.

Singer's simulator will enable all *Sea King* aircrew training to be carried out under realistic conditions without the use of surface vessels and submarines.

It will permit the maintenance of crew efficiency without using aircraft fuel or taking up often crowded airspace; it also eliminates disclosure of tactical operating techniques to unauthorised observers.

news digest

3M TO MAKE CrO_2 TAPE

3M have announced that they have signed a licensing agreement with DuPont that enables 3M to manufacture magnetic tape utilizing dioxide pigment.

At the same time, 3M announced plans to introduce a CrO_2 cassette worldwide around March 1, 1974.

In making the announcement, John E. Povolny, vice president of the firm's Magnetic Audio/Video Products division, said that 3M would be purchasing only the oxide from DuPont and that all tape manufacturing would be done internally.

"As with all of our other magnetic products, we will manufacture our own polyester bases, binders and mechanical parts so that we are in complete control of the product quality," Povolny said. 3M has plants which also supply the oxides for its other magnetic tape products.

To set it apart from other CrO_2 products now on the market, the new Scotch brand chrome cassette will feature 3M's "Posi-Trak" backing – currently incorporated in its High Energy and Low Noise/High Density cassettes.

JAPAN ENERGY CUTS

Japan has set maximum oil and electric power cuts at 15% for major industries beginning January 16, superseding the voluntary 10% reduction, based on originally planned consumption already in effect.

The revision in mandatory controls – 20% cutbacks were expected January 1 – reflect the year-end easing of Arab oil embargoes.

Enforcement of oil supply controls, involving government screening of corporate production, distribution, and consumption plans for fuel, may be delayed somewhat as Tokyo works out details of implementing its emergency powers.

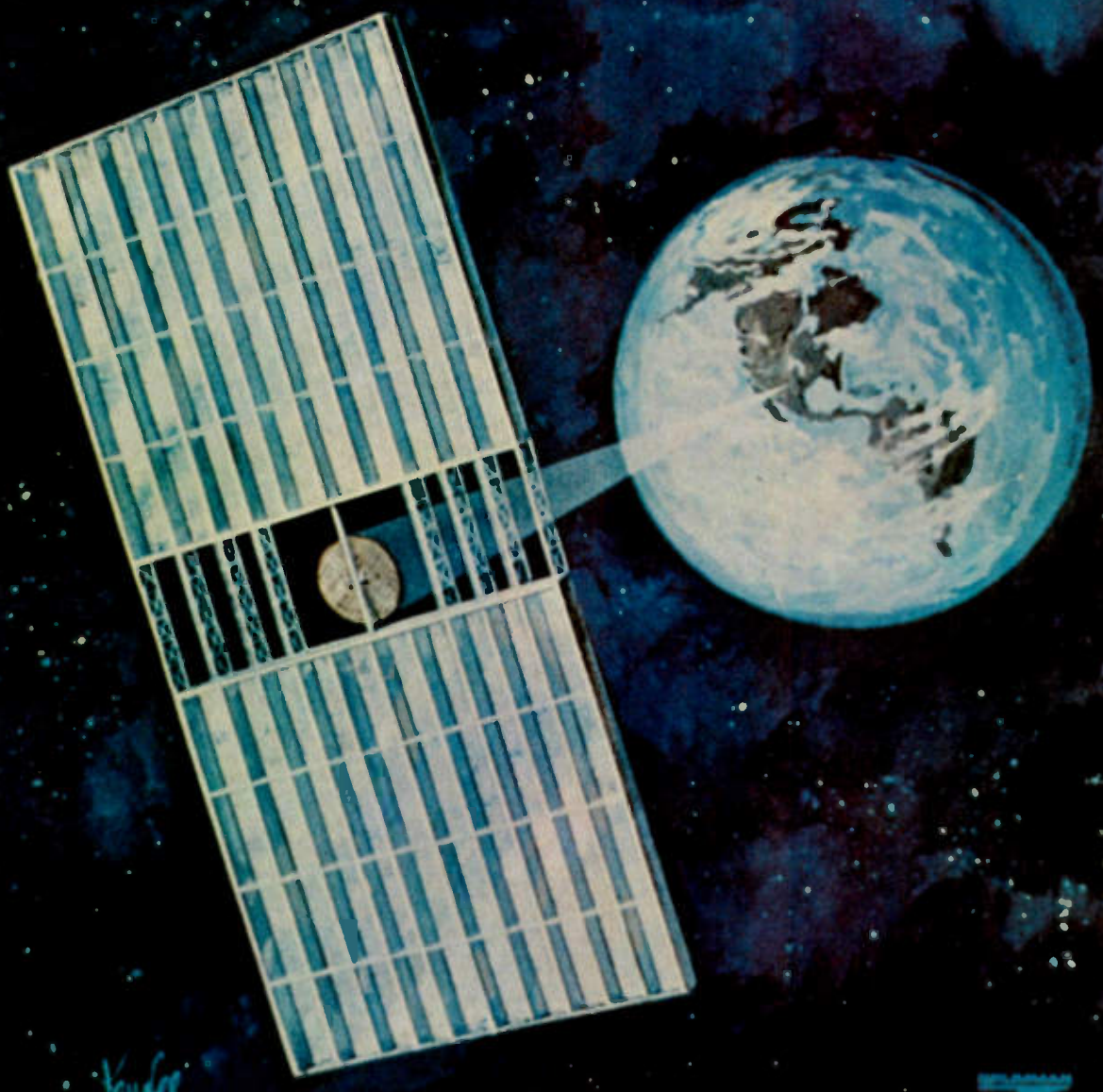
TUNABLE LASER

A highly stable, widely tunable dye laser has been developed by Dr. Shaoul Ezekiel and co-workers at Massachusetts Institute of Technology.

A major factor in the stability is use of a free-flowing stream of rhodamine 6G dye, rather than clear cell containers that can acquire burned-on impurities.

The laser has been used to obtain analytical spectra in the visible region with a resolution of two parts in one thousand million, 1000 times better than resolution from spectrometers.

SOLAR POWER
- a partial energy solution?



The global energy crisis is constantly in the news — ETI correspondent Dr. Peter Sydenham reports.

Homo Sapiens thrives on crisis — the bomb, population explosion, future shock, permissiveness, conservation, Watergate — and now energy. As each gains favour for front page news, we learn of the problem in sensational, often distorted, ways. As though we had been dropped into it totally unprepared.

We are seldom told of the individuals, groups and institutions that have long been studying the problem behind the scenes.

The net result is a gradual change to other tactics — evolution not revolution. Sensationalism merely speeds the process a little, probably with the detrimental addition of panic measures.

If the problem really does exist, a solution is adopted, if not the crisis melts away, making room for the next.

OUR current concern relates to the shortage of *suitable* energy fuels — not of energy itself. Suddenly we learn that there is barely 10 years' reserve of oil remaining in Australia. In other countries the cry is similar; the shortage is for oil only, in fact, for we have become too dependent on it.

The solution, we are apparently led to believe, is in solar energy, but that in itself is a vague statement. Apart from nuclear fusion and fission, geothermal and tidal sources (moon induced), all other energy that we have, ultimately comes from the sun. Oil, natural gas, hydroelectricity, coal, wood and chemical conversion, each stem originally from the sun's radiated energy. The various paths to electrical forms of energy are shown in Fig. 1.

The industrial revolution of the 19th Century was the product of freely available coal. Oil was something of a novelty then. This century saw the boom in the use of oil. It rapidly replaced coal, being more convenient to use for transportation. The economy developed engines and vehicles to use oil — and the vicious circle was created.

THE NUCLEAR ALTERNATIVE

For a while, in the 1950's, it seemed that nuclear power would solve the energy needs once and for all. It could provide enormous amounts of energy from a very little quantity of fuel. If we could make *big* reactors then smaller ones would ultimately result. (Today we know that the smallest is around 20 tonnes — mainly because of the shielding needed).

As time passed it became clear that vast quantities of dangerous radio-active by-products were being 'swept under the carpet'. Radiation hazard became an unacceptable price to pay. Nuclear developments subsequently slowed as the cost of improved shielding and safe practices pushed the capital costs up way beyond the slightly falling costs of conventional fossil-fuelled generating stations. Today the nuclear alternative is seldom more economic than traditional means. But even now, as we are prepared to divorce nuclear generation as not so worthwhile, we learn that scientists of the U.S. Atomic Energy Commission, AEC, have disclosed that Boron-11 could be fissioned "producing virtually no lingering radioactivity". It still remains to be done, but its potential is apparent, for without the radioactive hazard the costs would fall dramatically.

While the nuclear versus conventional competition raged, oil was coming into greater use — more vehicles, larger vehicles, higher speeds, larger aircraft, home heating, plastics production and even into base-load power stations. But now it is running out, causing a supply problem and rising costs. A replacement for oil is needed urgently. The decision on which way to go to find substitutes is a complex one for there are many alternatives.

The Middle-East countries have intensified the oil problem by reducing their oil production rate. But what appears to be their short-term gain might well turn out to be their long-term loss, for the major powers are clearly redoubling their efforts to find replacements. They can, and undoubtedly will, find alternatives that are financially acceptable and politically sound.

THE AUSTRALIAN PANIC

Like other technologically advanced communities, our energy needs have risen sharply with time. Australian oil fields produce 75% of our own oil needs at present, but proven reserves are only good for ten more years (exploration is revealing less and less for a given expenditure as the more obvious sources are located).

By contrast we have at least 100

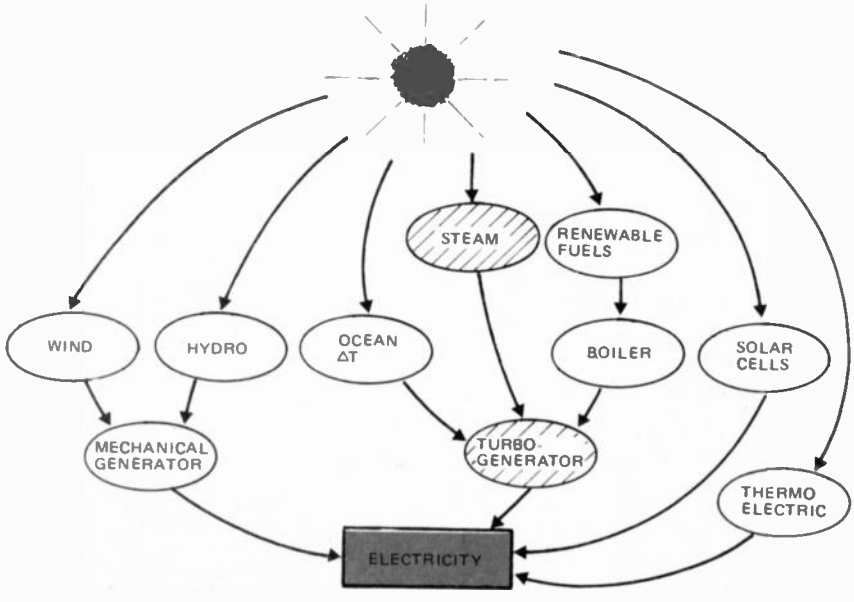


Fig. 1. Methods of harnessing sun power to provide electricity.

Orbiting solar stations may beam energy back to earth in microwave form. Figure 4 shows further details.

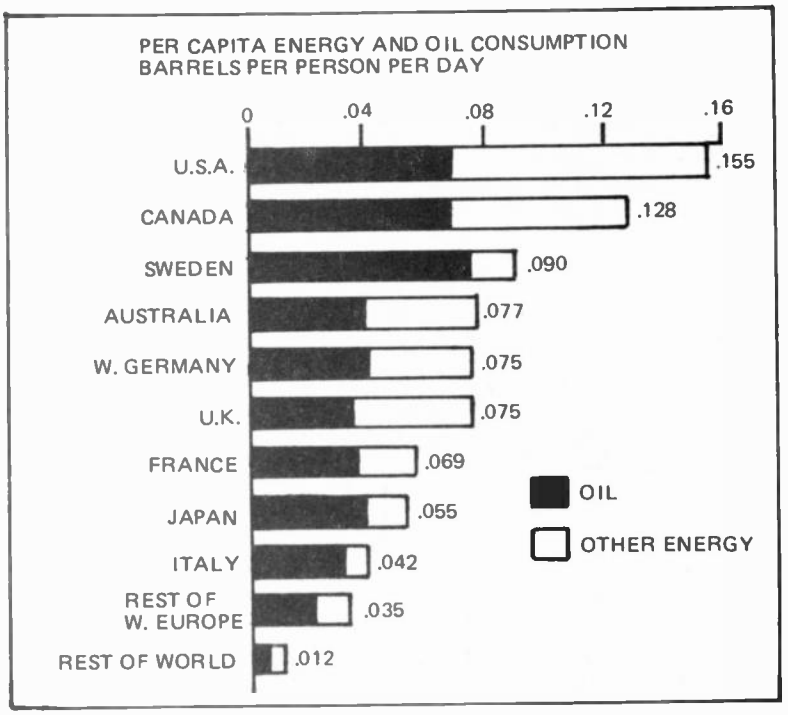


Fig.2. Energy consumption per person shown in terms of barrels of oil. One barrel weighs approx. 140 kg (approx. 44 galls.).

ANNUAL CONSUMPTION

Year	World	USA	Australia
1800	.006	.001	
1900	.03	.01	
1970	0.3	0.1	1×10^{-3}
2000	1	0.2	3×10^{-3}

OPERATING ENERGY RESERVES (IN Q)

Year	World	USA	Australia
Coal	30	6	0.5
Oil	6	1	1×10^{-2}
Natural Gas	6	1	0.1
TOTAL FOSSIL	42	8	0.6
Hydroelectric p.a.	0.1	0.01	10^{-4}
Geothermal (Natural)	2×10^{-3}	3×10^{-4}	–
Fission (Thermal)	?	0.2	0.1 – 0.2

The above figures are the energy reserves, where methods are sufficiently developed to make some substantial economic energy contribution in some part of the world.

POTENTIAL ENERGY RESERVES

Resource	World	USA	Australia
Fission (Fast Breeder)	200	20	10 – 20
Solar (Per Annum)	1000	50	50
Geothermal (Hot Rock)	~1000	>40	Small
Fusion D-T	10^6	10^5	?
D-D	10^{10}	10^8	10^8

1Q = 10^{18} Btu = 1×10^{21} joule = 3×10^{14} kWh = 3×10^{13} watt year.
= 3×10^{10} tonnes of black coal at 12,000 Btu per lb.
= 2×10^{11} barrels (140 kg) of oil.
= 2×10^{14} std ft^3 of gas.

Fig.3. Energy known reserves, potential reserves and consumption.

years of useable quality coal – but coal is not as convenient as oil, nor does it burn as readily.

Our experts estimate that one-third of our energy consumption goes in transportation, a third in electricity generation (75% from fossil fuel, 25% from hydro schemes) and a third in low-temperature heating. We could get by without oil from the ground: it would, however, require enormous capital cost to convert coal to petroleum products in order to cope with current transport, industrial and domestic fuel needs.

There is no easy solution – nor is there a unique answer. What is emerging from the debate, however, is the realisation that many significant sources of available energy are not being tapped. By breaking down accepted opinion we have been made aware that the problem is not one of fossil fuel versus nuclear. Rather it is to look at other alternatives such as direct solar power, sewage decomposition, combustion of products such as wood, wheat and algae, and decomposition of water to produce hydrogen.

Some new approaches seem radical – almost humorous in some cases! The Australian Army has a pig-sewage system producing combustible gases – a dozen pigs can power a house. The Chairman of the Australian Academy of Science Committee on Solar Power (Professor Watson-Munro) has suggested, among many other things, that our annual 15×10^6 tonnes of waste wheat straw could yield 10% of our total energy needs. The Irish burn peat (a fuel that is little more than rotted grass roots) in several power stations.

It is usually the comparative cost per energy unit that decides which fuel is to be used in a given situation. Generally the unit cost falls as the size of plant grows. Most new approaches will need a huge scale of generation to reduce the cost to a point comparable with oil or coal. It is a fact of technology that money must be spent to even see what might result. We are at the turning stage now – the problem is to decide which way to go.

SUPPLY AND DEMAND

To gain an idea of the quantity of energy involved let us look around the globe to see how much is used and how much is left.

The daily consumption (back in 1970) of oil and other energy forms by the various countries is contrasted in Fig. 2. (A barrel is 140 kg of oil). Note how dominant oil has become. Eight kilograms of oil per day per person may not seem much but there is an enormous number of people. Oil cannot flow for ever.

The growth rate of total global annual consumption is shown in Fig. 3. The magnitudes are expressed in Q – a rather large unit (3×10^{14} kWh). In thirty years' time the world will need fuel equivalent to 30 000 million tonnes of high-grade coal – each year!

Two other tables published by Professor Watson-Munro are also given in Fig. 3. These show that the proven reserves will exceed the 1 Q, 2000 A.D. need by a factor of 42. They also show that the potential reserves run to thousands of millions of times this figure so there is really no problem of energy availability.

Ignoring nuclear methods, for they have already had millions of dollars invested toward their 'successful' development, we see from the figures of potential energy sources that solar power is the obvious next choice to consider for exploitation. Australian energy needs by 2000 A.D. are envisaged to be $3\ 10^{-3}$ Q. Our available share of solar energy is potentially 50 Q.

It is, therefore quite reasonable that our experts are recommending research on solar methods. The Academy of Science Committee has suggested two million dollars a year for five years to start the ball rolling. But Roger Morse, who heads the CSIRO solar developments, suggests we must put forty billion dollars into it over the next 30 years. Professor Bockris, of the South Australian Institute of Solar and Electrochemical Energy Conversion, bids somewhere between, with estimates of fifteen million dollars per annum for research and development, coupled with a gradual solar complex development of three hundred million dollars a year. These figures seem to be guess-timates rather than well considered estimates (perhaps even misquoted as they have usually appeared so far only in the news media, not in considered reports). The Federal Minister for the Environment and Conservation, Mr. Cass, has commissioned a report from Professor Blevin of Flinders University on the direction of solar energy research – Professor Blevin predicts that we will devote two million dollars per year for the next 10 years.

Overseas, the US Atomic Energy Commission has already recommended to the President that US7370×10^6 be spent over the next five years to explore ways to use coal, the sun and geothermal heat in order to rid the US of the need for the bulk of its Arabian oil. This is part of Project Independence. It hints strongly at more use of nuclear power and suggests stepping up the research on nuclear fusion. The report also favoured direct use of solar power – heating and cooling of buildings in particular. We await the Presidential pleasure on any implementation of the recommendations – for any US gains from research will also be ours. One US Senator has independently suggested spending $\$13{,}400 \times 10^6$ to completely rid the US of need for Arab fuel.

An expert of Arthur D. Little Inc., a US contract research firm, has estimated that a one per cent swing to direct solar power would save 10^8 barrels of oil a year.

Around 1970, the National Petroleum Council was requested by the US Department of Interior to take a good look at the US energy outlook. This 380 page report, compiled by 200 experts over three years and released in summary form in four languages, is but one of many reports appearing in recent times.

THE COSTS

The current capital cost of atomic energy in the US is between US$450 and US$650 per kilowatt – in simple terms this amount of equipment (generators, switching stations, lines, substations) is needed to get a kilowatt of electrical energy into a house. In Australia hydroelectricity comes at US$300 a kilowatt, coal fired turbines go as low as US$160 a kilowatt. It is easy to see why atomic power did not sweep the field.

The cost of solar power, until recently, was measured in thousands of dollars per kilowatt, but reports now anticipate methods that can provide power at US$200 per kilowatt.

So much for the problem and approaches. Let us now look at the 'new' alternatives in more detail. It must be realised though that the pace is moving so fast that we can only report on how it is *now.*

SOLAR SOLUTIONS

The sun is a vast nuclear-power station releasing gigantic amounts of energy into space. On an average day the energy falling on the surface of the earth is about 1 kW. m^{-2} providing around 1000 Q of energy per annum. Estimates of the area that would be needed to power the total world energy needs vary wildly – the average being around 1000 km² (to suit the 2000 A.D. need).

We already use solar power via wind, burnable timber, food growth, salt evaporation, fruit drying, etc., but only in a small way compared with what is available. The main energy problem is, however, not that we lack energy itself but that we lack energy of the right form. That is, as direct electricity and storable, transportable fuels.

The major difficulty with the sun's energy is that it is not constantly available at a given place, and that it is not immediately storable at reasonable cost. Furthermore, it comes in what the energy experts classify as a low grade form, for it is characterised by a low spatial energy density which results in low temperatures unless concentrated.

Low grade energy-needs account for 50 per cent of our current use of electricity, but to produce electricity from solar radiation in a form that suits the already invested capital plant

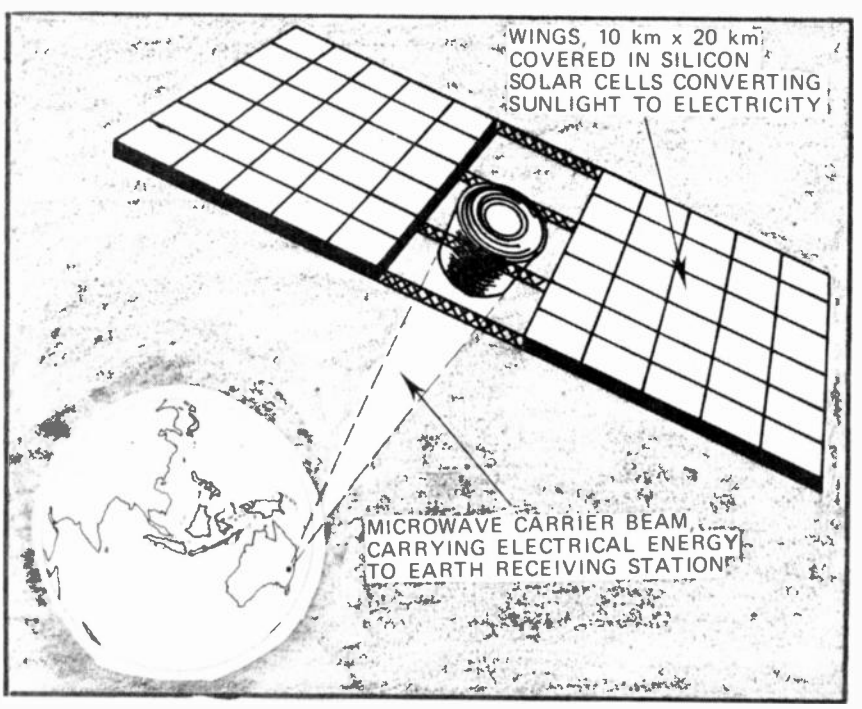


Fig.4. Satellite solar power station. (Artist's portrayal).

SOLAR POWER

(our appliances, the distribution system, industrial machines, etc.), would need enormous expenditure.

The solar challenges (there are many others as we will see) in the energy crisis are to find economic ways to convert the low-grade large area radiation into electricity, into fuel to power engines, and to provide adequate storage.

Methods available to us for using solar radiation divide into techniques using direct low-grade conversion, or indirect, via concentrators.

Looking back into history we see that solar engines in one form or another, have been in vogue since 1860. By the 1920s they were close to being economic compared with the other fuels of the period. (A concentrator was operating in Egypt in 1913 but the ready availability of oil at that time deterred further serious large-scale solar research).

COLLECTION AREA

Although 1 kW of energy falls on a square metre (at least while the sun gets through) we are, as yet, unable to convert it to useful power at much better than 25 per cent efficiency at the best. Assuming the sun shines onto the receiver for 25 per cent of the average day we see that the best devices (the dearest!) will only produce 50-60 W per m^2 in practice.

The daily per capita need is now about 20 kW.h per day so each head of population would require 16 m^2 of intercepted sunshine. Australia alone, therefore, would need about 300 km^2 of collection area. These figures show that the 1000 km^2 estimate given earlier for the entire world is optimistic — Australian needs only account for 0.003 of the total.

The 300 km^2 estimate for us represents a sunshade over one-tenth of, say, the Australian Capital Territory. However, estimates by our experts, that have appeared in the media, run as high as 3000 km^2 by 2000 A.D.

Regardless of the method of conversion, the same area would be needed in an earth installed station unless the conversion efficiency can be raised or the exposure time improved.

SATELLITE SOLAR POWER STATION (SSPS)

If the solar collector could operate above the Earth's atmosphere, it would intercept 1.35 $kW.m^2$ for more than half the day, thus greatly increasing the output for a given area. If it catered for countries with large time differences, the load would be more constant, averaging the demand and reducing the storage needs. Two people recently in the news — Professor Inglestam of Sweden and Peter Glaser of the US have each suggested orbiting solar stations such as that shown in Fig. 4. These would beam 10 000 Megawatts back to Earth, in microwave energy form. The microwave energy would then be intercepted by a 6 km paddock of Schottky diodes. The scheme may seem far fetched, but the cost estimates predict a similar capital cost per kilowatt as current nuclear alternatives.

There are many foreseeable difficulties to such a scheme — not the least is the need for solar conversion cells at a cost of a thousand times lower than the current market price. Furthermore it cannot be entertained on a small scale — around \$15 000 x 10^6 is the estimate. As other concepts can be expanded on a smaller scale it is more reasonable to expect development to proceed along other lines. Consider the political traumas that would result if the project were half-way through and a fusion-power breakthrough produced energy at \$100 a kilowatt, precisely where and when it was needed.

TERRESTIAL PHOTOVOLTAIC FACTS

Photovoltaic solar cells (those that produce electric current when solar radiation falls on their sensitive surface) have been highly developed to power many spacecraft. Considerable experience in their use is now available but the cost, running as high as \$100 000 per m^2 has prohibited their serious deployment to date.

Cost data taken from the space industry must be treated with caution, for in space the main design factors are reliability and efficiency — not cost per kilowatt produced. Such cells have around 10% efficiency but more recent developments, using organic photovoltaic methods, although only five per cent efficient, might be produceable at \$10-100 per m^2, thus providing an economic solution where plenty of sun area exists.

One US company that has moved in to cover the terrestial uses of its solar

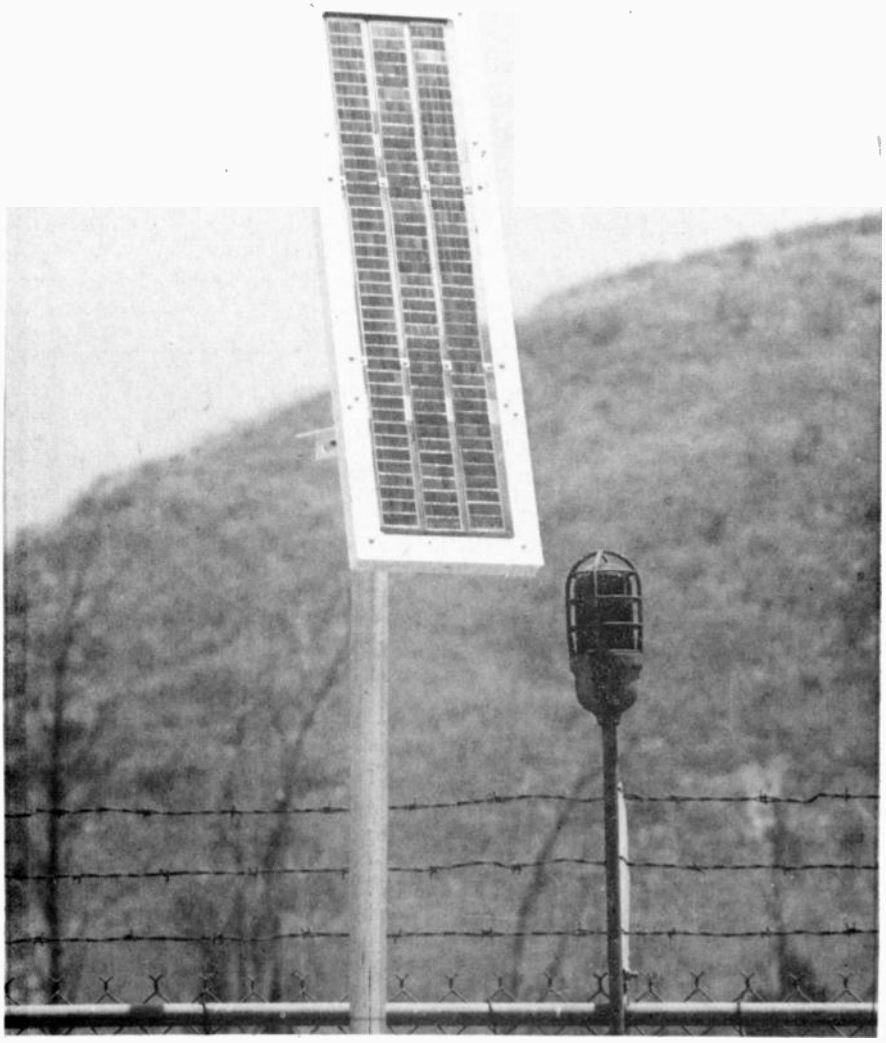
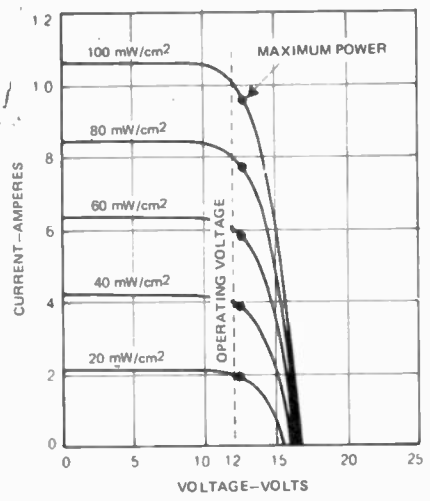


Fig.5. Spectrolab photovoltaic solar array.

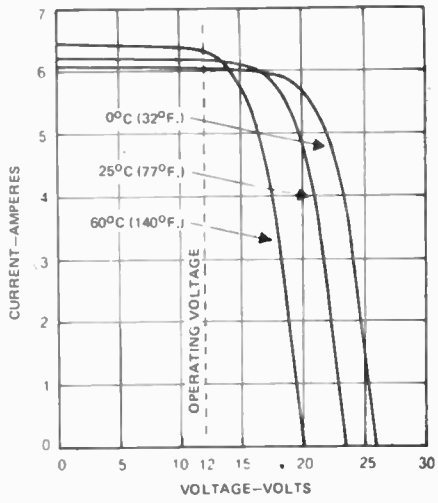
experience is Spectrolab (they provided silicon-solar cells, or light energy convertors, LEC as they call them, for 100 of the US spacecraft). So far they have marketed units with ratings 1-1000 W. Although expensive compared with mains power there are many applications where they win out. The annual costs for 100 W capability of diesel generator, primary thermoelectric and their LEC modules are stated as being $9000, $2000 and $1200 respectively. By comparison, at three cents a kilowatt/hour, mains electricity costs a mere $25 for 100 watts for one year.

Spectrolab have supplied many units for powering remote meteorological stations, off-shore ocean platforms, radio beacons and forest fire-phones. Fig. 5 shows the panel used to provide 10 W at 12 V. It consists of strips of semiconductor photocells that are encapsulated in a synthetic tube. The tube reduces reflective losses and provides mechanical protection.

The output characteristics of a 12 V, 100 W array are given in Fig. 6. Note that the power decreases as the temperature rises — it is quite usual for such cells to rise to well above 60°C in direct sunlight dropping their efficiency. The 100 W array weighs 20 kg and is 2 m^2 in area — this represents an efficiency of 5% in converting sunlight into useable power. As this is the current state-of-the-art, it is clear why no one seriously suggests using solar cell arrays as factory roofs.



Array Power as a Function of Voltage Sunlight Intensities. Air Temperature 25° C. Array Temperature 40°C.



Voltage-Current Characteristics vs. LEC Temperature. 12V 100W Array, 100 mW cm^2 intensity.

Fig. 6. Performance characteristics for LEC arrays.

FLAT PLATE ABSORBERS

Continuing with our discussion of the use of direct low-grade solar energy use, we logically move on to consider the collection of the thermal energy in a suitable material as heat, thereby producing a temperature rise.

The simplest way to consider this approach is to place a bottle of water in the sun. It will rise about 6°C if unpainted and twice this if blackened. By careful design of the absorber the absorption can be raised still further — the limit appears to be around 350°C. Typical state-of-the-art flat plate absorbers use layers of gold, silicon nitrides, a silicone oxide, plus many others on a steel substrate to accept and retain the incident energy — the process is similar to the blooming of lenses to improve their transmission.

In this application, not only must optical properties be considered but mechanical ones as well — corrosion by dust, thermal cycling, high temperature and reliability to name a few. To obtain temperatures above 350°C it is generally agreed that optical concentration will be needed. Fig. 7 shows graphs produced by Dr. Horwitz of the Sydney University Physics School — it shows the temperature attainable for surfaces with various X.a/e ratios. X is the optical concentration factor — unity for direct sunlight, a is the mean absorbance of the surface — the energy accepted, e is the thermal emission of the same surface — the energy reradiated. From this graph we can see that we need to push up the ratio a/e to increase the temperature. If it is unity — a typical black surface — then the graph shows that 1 kW per m^2 sunlight intensity will produce just 90°C. It has been suggested that a/e ratios to 20 are feasible giving the 350°C mentioned above. The costs of coatings should be an insignificant part of the total cost of a flat plate absorber ($2 per m^2 is forecast) so the problem now is to find surfacing covers that have a/e as high as possible. It is clear from the curves that no significant law of diminishing returns applies, and that high grade energy might even be feasible without concentration. For best efficiency it seems that the surface should be in a vacuum.

Fortunately the bulk of domestic and commercial heating requirements need heat at around 100°C so it is understandable why considerable effort has been expanded on the development of water heaters. A single unit — many are already used and are commercially available — consists of copper sheets that sandwich water circulation coils. They are not coated in any sophisticated way — they do not need to be, for the water should not boil in the absorber. The cost for a unit to suit a domestic hot water service is around $250. It would take only six years to pay this off in equated off-peak hot water heating charges. It is, however, still necessary to have a back-up heater and storage to cope with those dull days. The idea is not restricted to houses — a large indoor swimming pool in London is heated in this way.

Research on flat plate absorbers is world-wide. Our own CSIRO (Division of Mechanical Engineering in Melbourne) enjoys an international reputation for work on rock storage, solar stills and domestic heaters. A design for a house is shown in Fig. 8.

Having absorbed the energy and created heat it is necessary to transfer it to the place of use — where it is to be used directly, or converted to another form. Convective or pumped water, or steam flow, is one method but not the most efficient. Heat-pipes appear to be the answer, for their effective thermal conductivity is thousands of times better than the best practical conductor — copper. They also act as a rectifier enabling heat to flow in one direction only. The construction of a heat pipe is

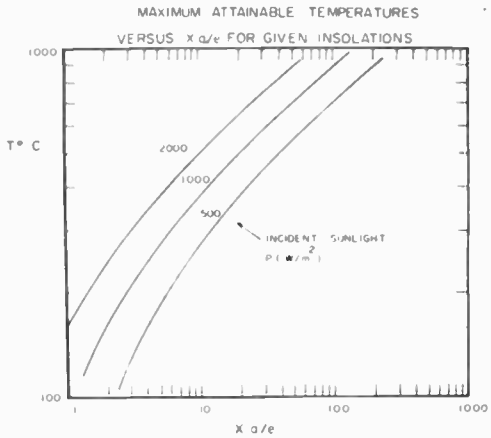


Fig. 7. Temperature rise for flat plate absorbers depends on increasing the absorbance and reducing the reflectance.

SOLAR POWER

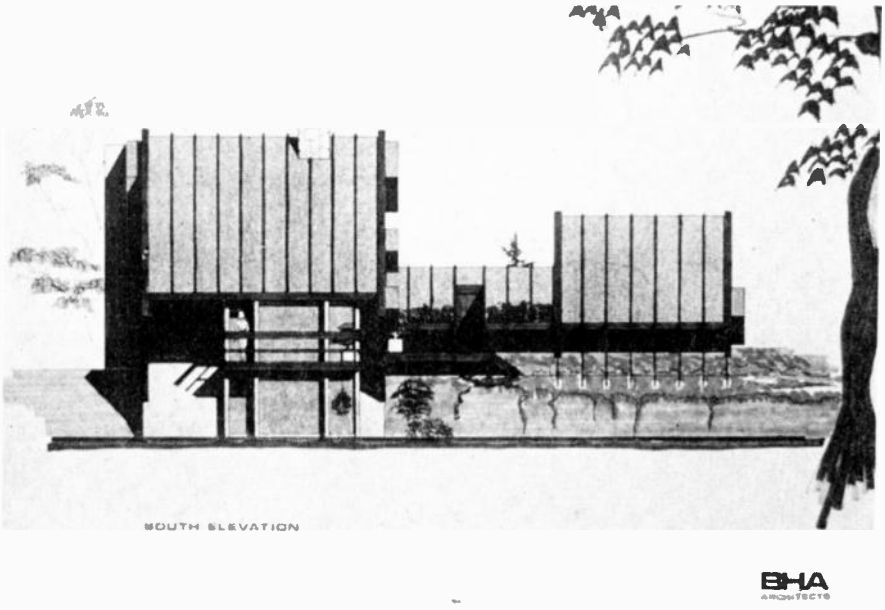


Fig.8. Flat-plate solar absorbers form an essential part of the external wall cladding of this house to be built in Atlanta, USA, (Artist's impression).

incredibly simple – see Fig. 9. (Heat pipes are now sold commercially for cooling heat sinks, see ETI, November, 1973).

A variety of liquids are being studied for use in heat pipes – water to steam for lower grade heat; potassium and Dowtherm (a proprietry compound) for high temperature work involving concentrators. Philips have announced the suitability of a NaF_2 and CaF_2 mixture. This can store 350 kW per m^3 but at a temperature of 745°C. (Heat can be stored efficiently by the latent heat process – heat pipes, therefore, include storage as well as pumping action). The current search in this area of solar research is to find a compound capable of storing heat at 300°C, preferably as a solid to liquid transition.

CONCENTRATORS

As we have seen, current technology is unable to provide the high grade thermal energy (up to 500°C) needed to power existing turbine generators. But if optical concentration (X greater than 1) is used then it is possible to go to extremely high temperatures. For most high-grade energy needs, an optical concentration of 20 seems adequate.

One well-known concentrator is the Odeillo solar furnace built high up in the French Pyrenees. It has an X value of 16 000 and produces heat at 3800°C. The feeder mirrors are 300 m^2 in area so the problem of tracking the sun is not trivial. The University of N.S.W. have a less ambitious solar furnace.

Several U.S. Universities are well on the way with concentrator research. The University of Minnesota (in collaboration with Honeywell) and the University of Arizona are studying parabolic trough collectors. These 3 by 1 m horizontal troughs rotate to face the sun. A tube collector, at the focus of each, pipes away the energy to the site of demand – Fig. 10. The optimum collector size seems to be in modules of 12 by 3 m as this suits transport and maintenance requirements.

The term solar farm has emerged of late – it is depicted in Fig. 11. The catchers would also provide shade for the soil, encouraging growth.

THERMOELECTRIC GENERATION

Heat applied to a thermocouple will provide a voltage difference across it – the reverse of a thermoelectric cooler which provides cooling by passing a current through it. The thermoelectric junction, therefore, is a heat pump.

Solid-state matrices – made from bismuth compounds – are commercially available in self-contained power packs. The General Instrument Telcan unit is shown in Fig. 12. In this the matrix is heated by high-grade energy – combustion of methane, propane or butane. The unit illustrated produces 50 W at 24 V and consumes 5 kg of liquified gas per day – at a comparable cost to the photovoltaic method. At least one group in Australia (Physics Department of the University of New England) is studying this method with a view to direct use of sun radiation or with a combustion process. The efficiencies of thermolectric methods are being pushed up to as high as 35% but there are many practical details to be overcome yet.

BIOLOGICAL METHOOS

Sunlight produces plant growth; plants can either be burnt or processed to provide portable fuels that have a higher energy density per unit mass. Direct combustion is, however, only 1 or 2% efficient so the cost would be at least ten times that of coal. A better approach is to produce other fuel forms – methanol, hydrogen and methane for example. Waste wheat straw from the wheat crop is said to be able to provide 10% of our needs.

Throughout this discussion we have repeatedly mentioned the production of hydrogen. It is a most significant possibility for although it does not have to be produced by solar means only it could well be the answer to the portable (and other) fuel needs.

HYOROGEN FUELS

Although electricity is convenient to use at the point of need, it is not as ideal a form of energy as might be thought. Firstly, half of the cost of a mains supply to the customer arises from transmission and distribution. Secondly, it is not always possible to incorporate storage (pumped-water to high levels is the only economic means at present, and not all locations have suitable topography). The consequence of this is that generating

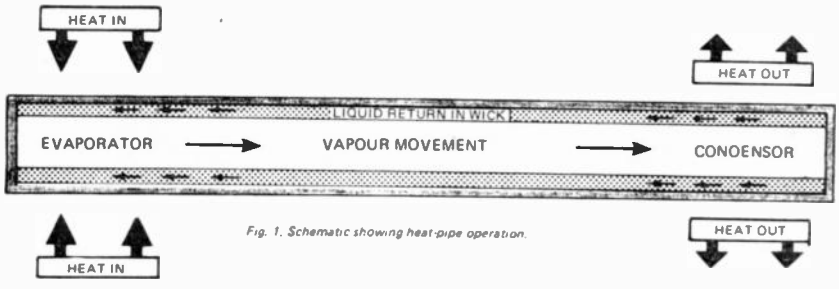


Fig. 1. Schematic showing heat-pipe operation.

Fig.9. Heat pipe principle.

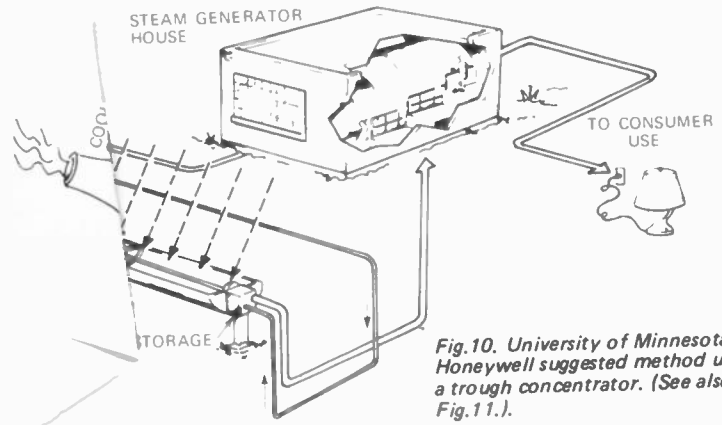


Fig.10. University of Minnesota/ Honeywell suggested method using a trough concentrator. (See also Fig.11.).

...rmally run at a load factor of ...nstead of the ideal unity.

For these reasons the energy economy relies much on transportable fuels (petroleum products and coal) — more than three-quarters in fact. The prime combustible ingredient in petrol is hydrogen so rather than use the already available coal, solar or nuclear energy to produce hydrocarbon fuels (at considerable expense) it is more logical to go direct to hydrogen, via electrolysis of water for instance. This point certainly hasn't been missed by the energy experts overseas but comparatively little has been said about it in Australia.

Any idea of the danger of hydrogen fuel should be dismissed; it is just like any other fuel. Provided it is stored properly there is little risk. The much publicised danger in early airships was entirely due to the weak 'pressure' vessel used to contain it near the presence of oxygen in the air.

Already, University of California staff are running a car on hydrogen. The modification is simple and the storage volume needed is comparable with petrol. (In 1971, I inspected and drove a hydrogen-powered Ford Anglia in Sydney. The engine was unmodified, and ran very smoothly. Exhaust pollution was virtually zero — Editor). By switching to a hydrogen economy as soon as possible we would be conserving the remaining oil for more efficient purposes such as lubrication and the economic manufacture of plastics.

Staff of the Department of Applied Science at Brookhaven National Laboratory in New York recently published a paper (Science, 29th June 1973) on hydrogen as a fuel. The following remarks are extracted from it.

The cost of transmitting hydrogen by pipeline is only one-tenth of that for distributing electricity. It can be easily stored, and pipe-lines, already existing for natural gas distribution, could be used when natural fuels expire. The pipe-line grid acts as an effective storage system, levelling out the demand seen by the generator. Estimated costs to produce hydrogen are around $56 per kilowatt — just a third of a coal-fired station.

It seems from every aspect that compared with electricity, a hydrogen fuel system would be cheaper; cheaper to tanker, to pipe, to make, to maintain and to store. Furthermore, there are no pollution products, oxygen would be produced as a by-product and the fuel is portable. There are no obvious barriers to storage. Suggestions are that the liquified state is not ideal and that it is better to use metal hydrides that release the hydrogen when heated.

Direct conversion from hydrogen to electricity is also straight-forward using the fuel-cell. Fuel-cells can provide electricity at a density rate exceeding any petroleum derived conversion technique. A Gemini H_2—O_2 fuel-cell is shown in Fig. 13. Oxygen and hydrogen are fed continuously into the cell wherein the electrochemical process produces

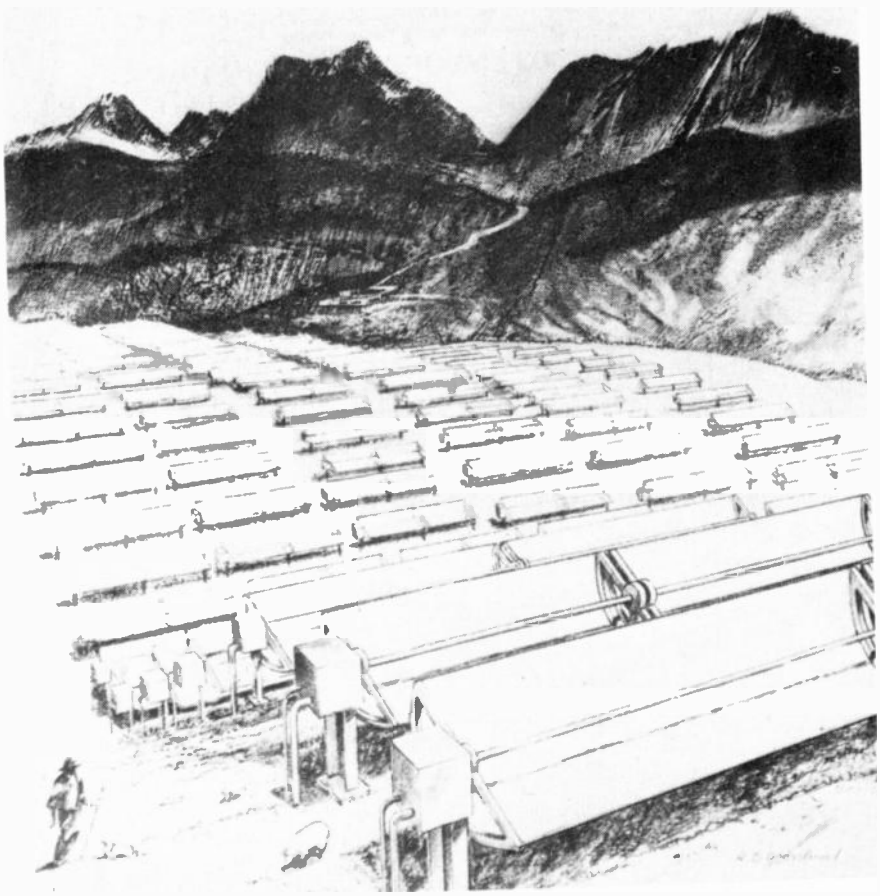


Fig.11. Solar energy 'harvested' by trough-shaped collectors, shown in this artist's drawing, may assist future power systems. Refer to Fig.12 for schematic drawing. (Drawing courtesy University of Minnesota/Honeywell Inc.).

Fig.12. This thermoelectric generator uses bottled gas.

SOLAR POWER

electricity and a waste product, water in this case. Another possible fuel is hydrazine (N_2H_4) which produces harmless nitrogen and water wastes. The cost to produce hydrazine must be reduced to make it economic. Increased production capacity would answer this problem.

It has been suggested that the electric car could well be driven by combining fuel-cells and secondary batteries — the former to provide the base load, the latter the peaks during acceleration. We will go no further with this aspect but the problem of electric versus conventional cars is closely tied with the energy problem.

It seems then that the hydrogen answer cannot be overlooked. How would it be produced? Many alternatives exist; nuclear power or coal could be used to produce electricity for the electrolysis of water. The report in Science did not, however, consider solar methods. By design, electrolysis plants can be made as low voltage, large current units thus directly suiting the low impedance thermoelectric and photovoltaic devices.

It would be hard to correctly predict which way the developments will go. No doubt we will see many schemes adopted. Perhaps we will see an immediate move to find and exploit more oil fields, then a decade later, hydrogen in use as a portable fuel. After two decades, perhaps solar energy will be made more use of and then on to clean nuclear plant and solar farms. There will certainly be a change of attitudes. Let us hope those moulding the decisions come up with the right answers — for theirs is a difficult task. ●

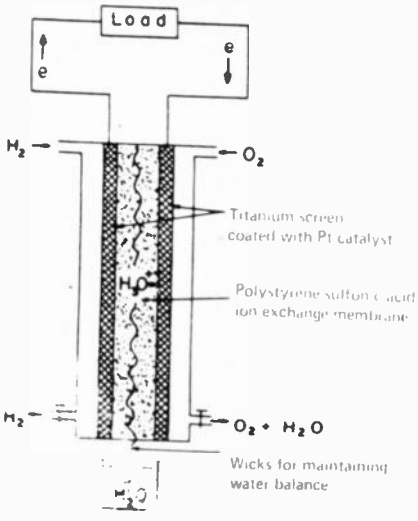


Fig.13. A Gemini hydrogen-oxygen fuel cell.

FURTHER READI

Report No. 17 research, 1973, Austr. Sciences, P.O. Box 21 Canberra.

"U.S. Energy Outlo Director of Information, 10300 Bells Mill Terrace, Maryland, U.S.A. 20854.

"A new Look at Solar Radiat an Energy Source" — C. Watson-Munro, Search, 1973, 4, 100-103.

"Solar Energy — a Reappraisal" — W. Szulmayer, Search, 1973, 4, 8, 319-321.

"Solar Power Supply Design" — Application Note. No. 2. Spectrolabs, Textron Inc., Maico Electronics, Heidelberg, Victoria, 3084.

"Hydrogen: Its future role in the Nation's Energy Economy" — W. E. Winsche, K. C. Hoffman and F. J. Salzano, Science, 1973, 180, 1325-1332.

"Here comes the Sun" — M. Kenward, New Scientist, 1973, 12 July.

"Electrochemical Transportation" — J. O'M Bockris, Search, 1973, 4, 5, 144-151.

STILL SEARCHING FOR HI-FI STEREO TREASURE?

YOU'LL DISCOVER IT WHEN YOU VISIT YOUR FRIENDLY BLEAKLEY GRAY DEALER.

Let's be brutally frank. Some hi-fi equipment offers more value than others. Your Bleakley Gray dealer carries a range of hi-fi products which are firmly established on the world markets, backed by effective guarantees and after-sales service. This is the range which offers more *audible value for your money.*

Your Bleakley Gray dealer sells Sansui equipment. *In his stock you will also find:—*

ALTEC LANSING — A superior range of wide range speaker systems from the U.S. *Particularly well suited to the demanding requirements of the discriminating audiophile.*

AMPEX — America's finest recording tape and cassettes. Ask about the brilliant new 20/20 tape — available in reels and cassettes.

ORTOFON — Danish made tone arms and stereo cartridges. The brand chosen by professional users. Listen to the new M15 Super stereo cartridge — which offers the *lowest distortion* ever!

SILCRON — Australian designed and made belt driven turntables. *Silent and reliable.* Available with arms, bases, covers, etc.

TANDBERG — Norwegian tape recorders and cassette decks. The recently released cassette deck, the TCD-300 is, without doubt, *the best cassette deck available in the world today.* Tandberg reel to reel machines also offer a standard of reproduction *audibly better* than any similarly priced deck.

THORENS — Swiss transcription turntables. The electronic TD-125 Mk II is the unit selected by many of the world's reviewers and electronic buffs. Demand for the less expensive TD-160 still exceeds supply in both European and overseas markets. Both models available with and without bases, arms, etc.

WATTS — Record cleaning and maintenance equipment. The "Dust-Bug", Disc Preener, Humid Mop and Manual Parastat. *Effectively maintains your records in as-new condition.*

WHARFEDALE — Probably Australia's most comprehensive range of fully compatible stereo equipment — amplifier, cassette deck, sound source (turntable, etc.), headphones and no less than eight speaker systems. Backed by over forty years manufacturing *"know-how"* by the most experienced audio engineers in the U.K.

Need more proof? Visit your Bleakley Gray dealer. *Soon.* See for yourself just how much more audible value you get from his comprehensive range. And sleep easily, knowing your equipment is *fully guaranteed, extremely reliable* . . . and *your money's been wisely invested.*

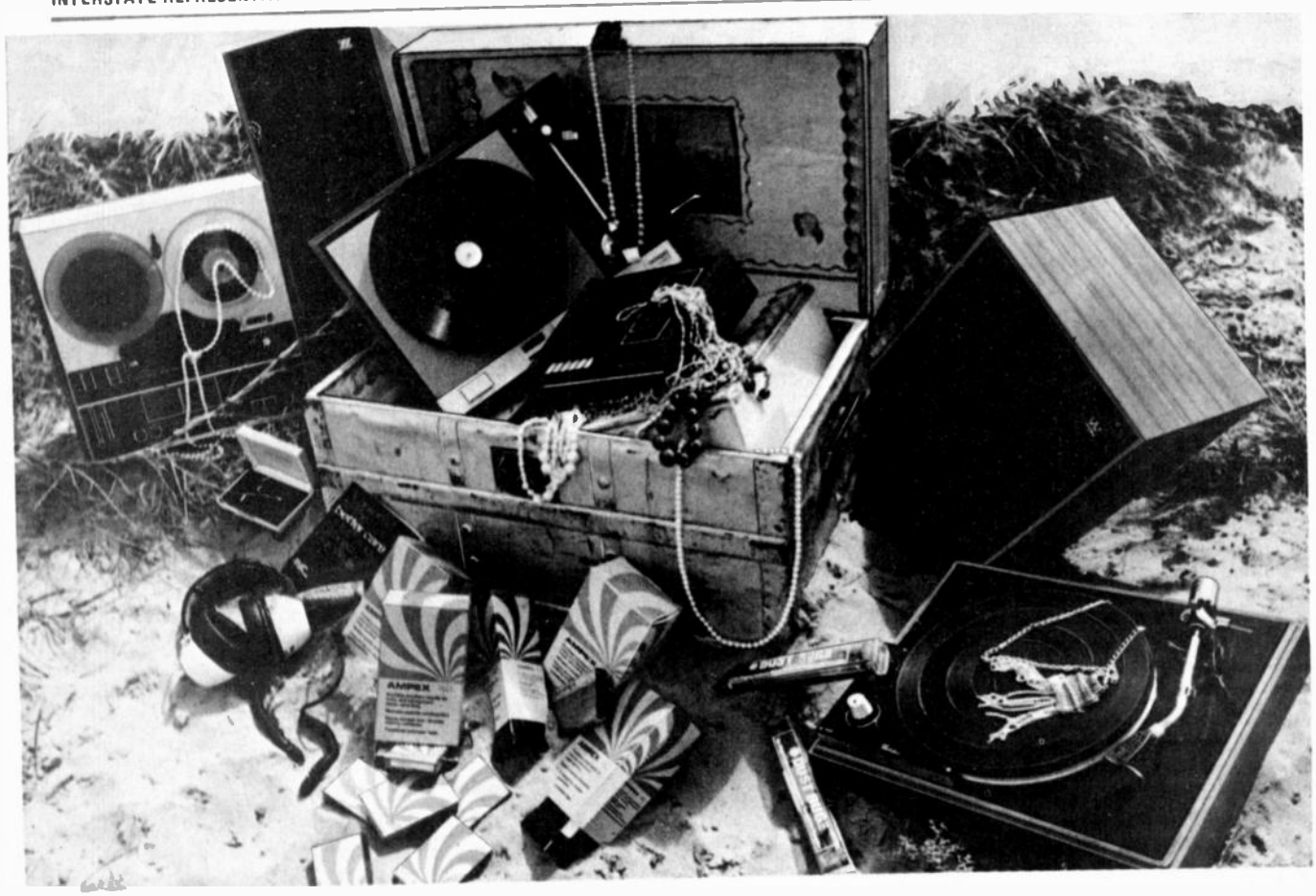
A Member Company of Rank Industries Australia

Bleakley Gray Corporation Pty. Limited.

Australian National Distributors:

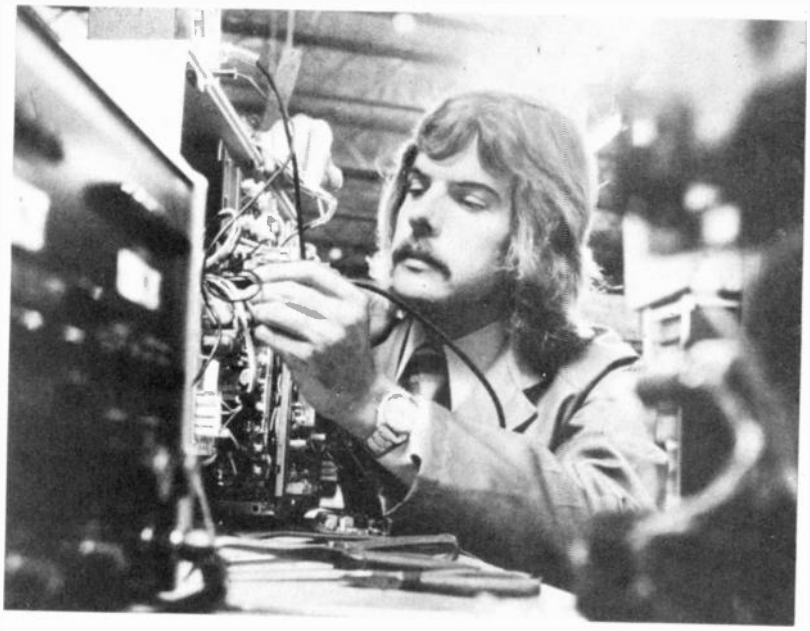
Melbourne Office: 58 Queensbridge St., South Melbourne, Vic. Tel. 61 6281. Telex 31904
Sydney Office: 177 Salisbury Rd., Camperdown, N.S.W. Tel. 519 5555*
Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 95 2144*
Adelaide Office: 3 Bowen St., Kensington. Tel. 32 4288
Brisbane Office: 14 Proe St., Fortitude Valley, Qld. Tel. 52 7333
Perth Office: 27 Oxford St., Leederville, W.A. Tel. 81 4988

INTERSTATE REPRESENTATIVES: N.T. Pfitzner's Music House, Smith Street, Darwin. Tel. 3801. Tas.: K.W. McCulloch Pty. Ltd., 57 George Street, Launceston, Tel. 2 5322.



Six top careers in electronics

A top salary, job security and positive success. That's what a career in the exciting and rapidly expanding electronics industry can give you—if you have the right qualifications. An ICS course can give you the training you need for the rewarding career you deserve. With ICS, you learn at home, at your own pace. There's no time lost travelling to classes; ICS provide you with everything you need by mail. You're ready for success in electronics now, so select your course, then fill in and post the coupon today.



INDUSTRIAL ELECTRONICS SPECIALIST
If you're interested in specialising in industrial electronics, this course offers technical-level training. It is an ICS Diploma Course, with a full list of subjects ranging from Circuits, Electronic Diagrams and AM/FM Radio Receiving Systems to Ultrasonics and Computer Principles. The full range from the most basic to the most sophisticated technology.

ELECTRONICS TECHNICIAN
This Diploma Course will give you a particularly thorough knowledge of Electronic Technology. You will learn the principles, applications and maintenance of electronic equipment in industrial and other fields, including instruction on radio principles. Major sections cover electrical and electronic measuring instruments, telemetering, facsimile and radio-electronic telemetery.

COMMUNICATIONS BROADCASTING SPECIALIST
This course prepares students wishing to sit for the P.M.G. examinations for the various proficiency certificates—Commercial Operator's Certificate of Proficiency (Aust.), Radio-Telegraph Operator's Certificate of New Zealand, Broadcast Station Operator's Certificate of Proficiency and Certificate in Radio Technology (New Zealand). Sections covered include: Electrical Theory, Radio Theory, Regulations, Telegraphy Tests, Practical and Oral Questions.

ELECTRONIC COMPUTER SERVICING SPECIALIST
A specialist course designed to provide a sound knowledge of the technical aspects of computers; how they function and their practical applications, including programming. The course covers Number Systems and Digital Components; Organisation and Maintenance of Computers; Servomechanisms and Fundamentals of Computer Programming.

COMPUTER TECHNICIAN
This compact Diploma course will be of special value to technical people who are likely to be concerned with the installation, maintenance and operation of digital computers. It provides a sound introduction to Electrotechnics, Electronic Theory, Electronic Computers and Digital Computer Programming. Practical applications are stressed throughout.

COLOUR TV
If you already have a knowledge of the principles and practice of TV, this course will prepare you for the introduction of colour TV. Subjects covered in detail include: Colour in TV, the Colour TV system, Picture Tubes and Receiver Circuits for Colour TV, Troubleshooting Colour TV, Alignment of Monochrome and Colour Receivers and the PAL System.

POST THIS COUPON TODAY TO

ICS

DEPT. 411,
400 PACIFIC HIGHWAY,
CROWS NEST, N.S.W. 2065
and 182 Wakefield Street,
Wellington, New Zealand.

Please provide me with information about the Career on_____

Mr/Mrs/Miss_____ Age____

Address_____

_____ Postcode_____

Occupation_____

LB3.4929

jensen

MODEL 6

A 'GIANT' AMONG SPEAKER SYSTEMS

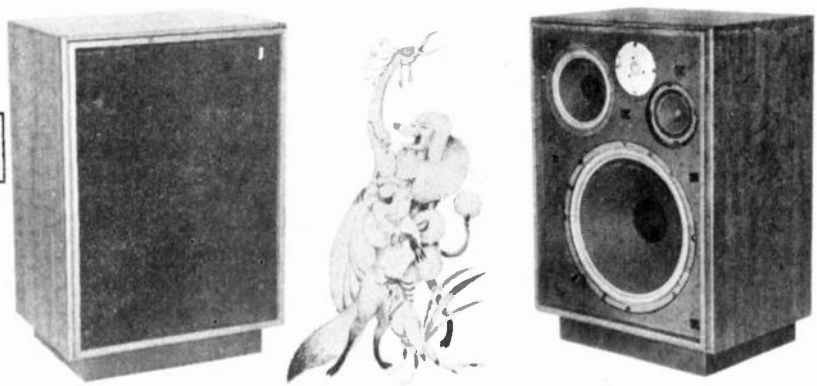
Great speakers make any system sound better, and the heart of a sound system are the speakers. That's why a pair of Jensen Model 6 should be part of any sophisticated system.

The Model 6 is a 4 way, 4 speaker design, built around Jensen's Total Energy Response concept.

"Down to 27 cycle" bass response comes from a massive 15" Woofer using "Flexair" suspension (for large cone excursions) crossing at 300 cycles to silky smooth midrange and high frequency assemblies.

With skilled craftsmen making the fine fumiture cabinets, you'll be proud to own a pair of Jensen model 6 system.

5 Year Warranty



$260.00 each R.R.P.

Aust. HI-FI magazine commented:– "Switching from other speakers showed that colouration was virtually non-existent, indicating careful integration of the four drivers and excellent basic design – The overall response was impressively smooth, giving a beautifully "detached" impression to stereo listening – treble was crisp and clinical, tackling strong transients exceptionally well – midrange was firm giving a lively, "present" quality to all material – bass could only be described as superb – (We) the Jensen Model 6 can be recommended without hesitation as unparalleled value for money, and *(one of the finest speakers at any price that we have heard)* -VOL 4 No. 3.

SPECIFICATIONS:

Freqency Range:– 27 – 30,000 Hz
Power Handling:– 75 Watts
Impedance:– 8 ohms.
Crossover frequencies:– 300/1000/4000Hz – 12 dB/octave.
Frequency Dispersion:– 170 degrees.
Balance Controls:– Two, for midrange and high frequencies.
Dimensions:– 29½" x 20½" x 15" deep.
Weight:– 74 lbs.

FOR THAT BIG SYSTEM YOU'RE BUILDING, ONLY MODEL 6 WILL DO.
IT MAKES YOUR OTHER COMPONENTS WORTHWHILE.

AVAILABLE FROM

QLD:
Reg. Mills Stereo – Buranda 911089.

NSW:
Allied Music Systems – Crows Nest 439-1072.
Audio Gallery – Warringah Mall 938-2205.
Dyna Stereo – St. Peters 51-7071.
Fidela Sound – Summer Hill 799-2618.
Insound – Crows Nest 929-2714.
Instrol – Sydney 29-4258.
Kent HIFI – Sydney 29-6973.
Magnetic Sound – Sydney 29-3371.
Wests – Burwood 747-4444.
Dynamic Sound – Newcastle 21-188.
Audio World – Wollongong 295-110.
HIFI House Wollongong 286-661.
Pee Jay Sound Centre – Broken Hill 7303.

ACT:
Plaza HIFI – Woden 821-499.

VIC:
Douglas Trading – Melbourne 639-321.
Instrol HIFI – Melbourne 675-831.
R & G Applicances – Geelong 915-24.
John Lewis – Ballarat 323-615.

TAS:
Teak House – Hobart 433-249.
Audio Service – Burnie 312-390.

WA:
Leslie Leonard – Perth 224-304.
Alberts TV & HIFI – Perth 215-004.

AUSTRALIAN DISTRIBUTORS:

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

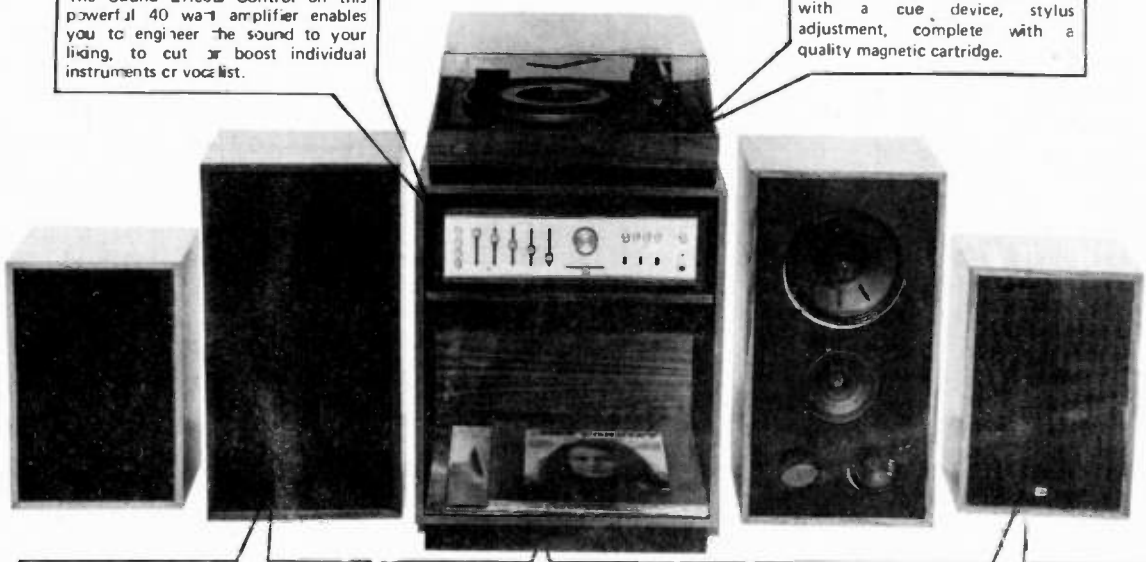
expo international

the sound of excitement

NOW IN 4-CHANNEL

The Sound Effects Control on this powerful 40 watt amplifier enables you to engineer the sound to your liking, to cut or boost individual instruments or vocalist.

The auto-changer turntable, fitted with a cue device, stylus adjustment, complete with a quality magnetic cartridge.



Up front: big booming 3 way speakers for wall-shaking sound.

And to top it all off, Expo includes free a handsome cabinet in matching woodgrain finish. The perfect way to house your new system and your records.

Crisp 2 way speakers in the rear give the life-like effect of the concert hall.

only Expo International offers superb 4-Channel sound for only

$399

SEE THEM AT YOUR EXPO DEALER!

HEAD OFFICE expo international
47-49 Buckley St., Marrickville 2204 NSW Ph. 519-4622

NSW
MAGNETIC SOUND
32 York Street,
Sydney.
Ph. 29-3371

VIC.
TOM'S HI FI
239 Elizabeth Street
Melbourne.
Ph. 67-3484

QLD.
CHANDLER'S
Cnr. Albert &
Charlotte Sts.,
Brisbane.
Ph. 31-0341

SA.
CHARLIE CARTER'S (WHYALLA) P/L
Westlands Shopping Centre,
Whyalla.
Ph. 45-9493

THE LIGHTWRITER

New aid for handicapped people displays up to 64 characters using typewriter-style keyboard.

FIVE years ago, at the age of 21, Toby Churchill, a mechanical engineer, contracted an unidentified viral disease which left him with a number of disabilities, including a paralysed right arm and complete loss of speech. Communication became frustrating and difficult for him, every word having to be slowly picked-out on a spelling card.

Toby was certain that his problem could be solved if he could operate some type of alphanumeric display.

He searched through the various application notes, and found several pieces of hardware which might be suitable. His acquaintances, who were finding the situation similarly frustrating, realised that between them they had the capability and facilities for tackling such a project. This was commenced with the help of D. Battison of Britain's Medical Research Council, and H. Lowe and T.Gossling of Cambridge University's Engineering Department.

Having short-listed a suitable read-out device, the team, under Toby's guidance, worked out a design.

Basic requirements were that the unit should be capable of displaying letters and numbers on some type of readily visible panel.

It would also be necessary for the unit to have some form of memory so that characters would *continue* to be displayed even though the appropriate input key were no longer pressed. By such means complete sentences could generated and displayed.

The unit also had to be light, portable, capable of battery operation, easily operated and easily read.

Two prototype 'lightwriters' quickly followed, and both have been in constant use for over eight months.

THE ELECTRONICS OF THE SYSTEM

The lightwriter makes full use of large scale integration, built around a self-scan 32-character 'Panaplex' panel display manufactured by the US Burroughs Corporation.

The display operates in a sequential mode, entering characters from the right side. Each character is retained in the memory and shifted one position to the left as the next character is generated at the right hand edge, and is lost again as it leaves the left hand side. A back-space function is included to shift the display to the right, losing the last character entered. This facility is useful for error correction. A blanking input is also provided to erase the display.

Each character is defined by a six-bit binary code, facilitating a 64-character complement (see Fig.1), each coded character being processed via an ASCII converter which defines the pattern in which each 5 x 7 dot matrix is illuminated.

Figure 2 illustrates the various functions carried out by the integral circuit of the display, Fig. 3 details circuitry responsible for shifting the logic voltages to levels suitable for operating the Panaplex gas-discharge tubes in the matrix. In the illustration the eight anode driver transistors are switched individually by constant currents set by the level shifter under the control of the driving logic. The cathode drivers, also constant current sources, switch the display cathodes under the control of the driving logic.

The display is programmed by a light-weight teletype keyboard, hooked into the system through a large scale integrated circuit from

BINARY INPUT	CHAR.	BINARY INPUT	CHAR.
0	@	32	(BLANK)
1	A	33	!
2	B	34	"
3	C	35	#
4	D	36	$
5	E	37	%
6	F	38	&
7	G	39	/
8	H	40	(
9	I	41	)
10	J	42	*
11	K	43	+
12	L	44	,
13	M	45	-
14	N	46	.
15	O	47	/
16	P	48	0
17	Q	49	1
18	R	50	2
19	S	51	3
20	T	52	4
21	U	53	5
22	V	54	6
23	W	55	7
24	X	56	8
25	Y	57	9
26	Z	58	:
27	[	59	;
28	\	60	<
29	]	61	=
30	↑	62	>
31	←	63	?

Fig. 1 TRUTH TABLE

Texas Instruments. This converts the key presses into binary coding compatible with the display's ASC II converter.

The display panel on the prototype is sloped and positioned where one would expect to find a typewriter carriage; this makes for easy reading by those facing the operator, but the operator sees the display upside-down.

FUTURE PLANS

As a result of pressure from friends and acquaintances, Toby Churchill recently set up a company to supervise the manufacture of the Lightwriter, and a factory, Industrial Sub-Assemblies Ltd., have accepted the contract for the production of the device.

The basic production model, in the relatively small quantities in which it will at first be produced, will cost around the £400(sterling) mark. It will consist of keyboard, associated electronic circuits and mains power supply in one case, with the display panel clipped on the back in a separate housing, allowing it to be placed in the most advantageous position for viewing.

One of their prototypes illustrates a variation on this basic theme, operating from 12 Vdc re-chargeable batteries using a dc to dc converter, (this was actually made so that Toby would be able to go on camping holidays).

They envisage another unit incorporating a serializer so that two Lightwriters may be linked and whatever is then typed on either keyboard will appear on both display panels. Thus disabled patients in hospital, even if in separate wards, would be able to converse.

Another device 'in the pipeline' is an acoustic coupler which will allow the system to be linked into a telephone line. However, in use it is likely that the individual will transcribe the message on to tape first, in order to carry out time compression by rapid replay, thus saving time and 'phone bills!

Yet a further design will be a single display worked from two keyboards, more economical than two complete units. The Lightwriter is even compatible with larger display units, giving a full page of typescript instead of a single line.

Surprisingly, no designs have been mooted for an accessory which will give a typewritten output, the reason being that the team were aware that many people without the capability of speech have a psychological barrier against putting their thoughts in such a tangible form.

The Lightwriter keyboard was the most useful entry system from Toby's point of view. However, the team also envisage different entry systems, i.e. by sucking and blowing, or by tiny movements of finger or toe. In these cases a chart would be provided, giving a coding for each character available, and a set of 12 lights to represent it. The code for say letter 'A' could be set up for verification, entered if correct, erased and repeated if not.

The Lightwriter team returned from the Eureka International Inventors Exhibition in Brussels while this feature was in preparation, with the news that the Lightwriter had gained a number of awards, including a gold medal, the first British invention to do so for 25 years. ●

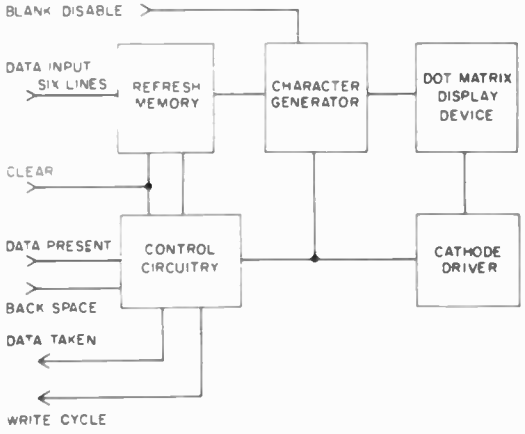
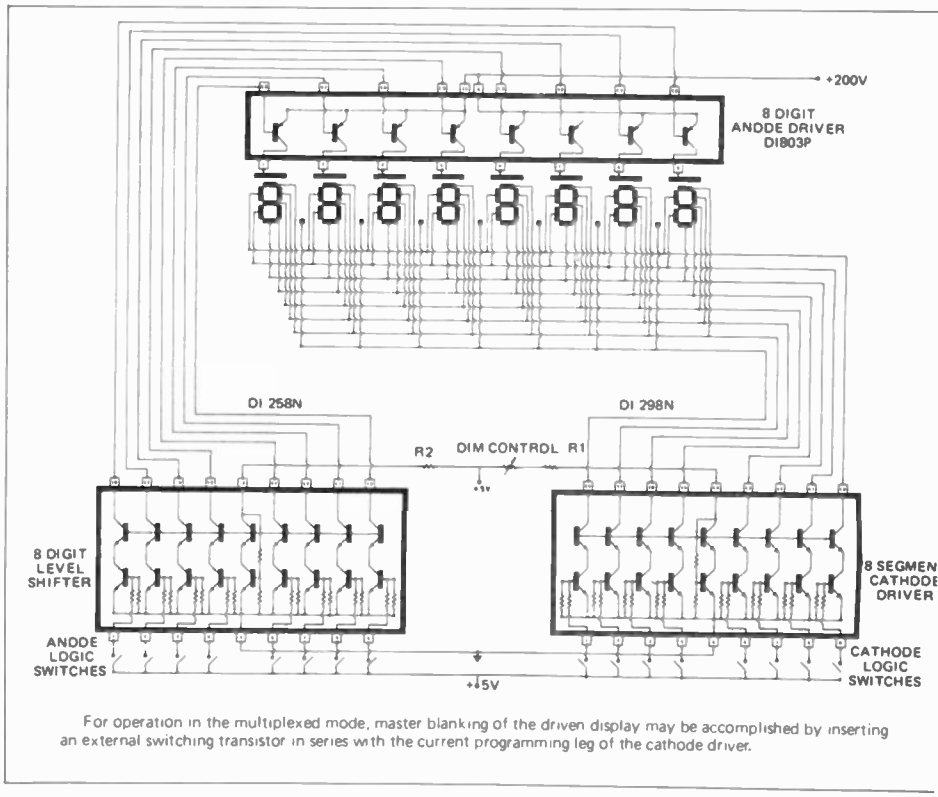


Fig. 2



For operation in the multiplexed mode, master blanking of the driven display may be accomplished by inserting an external switching transistor in series with the current programming leg of the cathode driver.

Fig. 3

YOU'RE LIVING IN THE HI-FI YEAR 20 A.S.

This is the Hi-Fi Year 20 A.S. *Twenty years AFTER SANSUI. Twenty years* after Sansui successfully introduced a hi-fi amplifier to the world markets. *Twenty years* of Sansui achievement. *Twenty years* of dramatic changes on the hi-fi scene. We've seen the introduction of the stereo recording . . . *and four channel equipment* . . . and Sansui has been there, pioneering research and development for the ever growing International audio market.

Today Sansui equipment leads the field, at home in Japan and overseas. Sansui's formidable reputation has been built around the performance and reliability of the Sansui product. With Japan's most dedicated electronic engineers at the drawing boards *and* supervising production, it's not surprising.

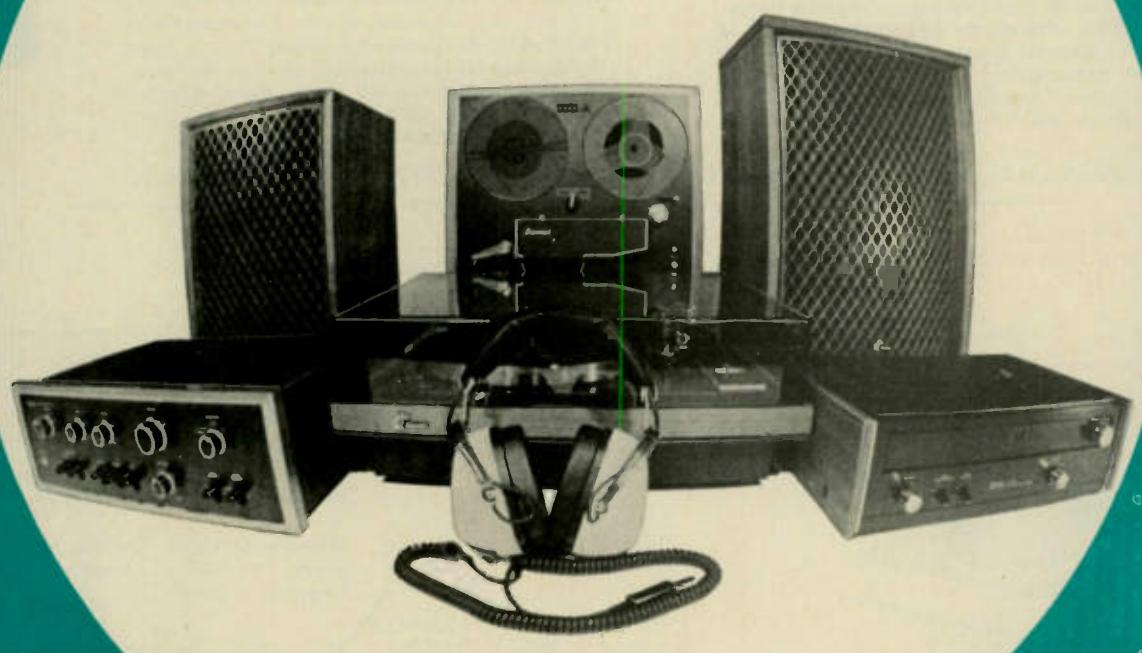
Sansui

Sansui sets world wide standards for audio equipment. You're always ahead technically when you buy Sansui. And you get extraordinary value for money. *See your Bleakley Gray dealer!*

What's in the Sansui range in the Hi-Fi Year 20 A.S.?

☐ STEREO AMPLIFIERS ☐ FOUR CHANNEL AMPLIFIERS AND RECEIVERS
☐ FOUR CHANNEL "ADD ON" UNITS
☐ STEREO TUNER/RECEIVERS
☐ SPEAKER SYSTEMS ☐ TUNERS
☐ HEADPHONES ☐ TWO AND FOUR CHANNEL TAPE DECKS
☐ STEREO CASSETTE DECKS
☐ TURNTABLES/SOUND SOURCES
☐ MANY AUDIO ACCESSORIES.

Sansui equipment is distributed throughout Australia by the Bleakley Gray Corporation Pty. Limited, a Division of Rank Industries Australia Pty. Limited. Sales and service facilities are nation wide . . . and Sansui performance is matched only by the enthusiasm of the specialist hi-fi stores . . . *the men who sell Sansui.*



Sansui equipment is manufactured by:— Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-Ku, Tokyo, Japan.

Bleakley Gray Corporation Pty. Limited.
A Member Company of Rank Industries Australia

Melbourne Office: 58 Queensbridge St., South Melbourne, Vic. Tel. 61 62 Telex 31904
Sydney Office: 177 Salisbury Rd., Camperdown, N.S.W. Tel. 519 5555*
Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 95 2144*
Adelaide Office: 3 Bowen St., Kensington. Tel. 32 4288
Brisbane Office: 14 Proe St., Fortitude Valley, Qld. Tel. 52 7333
Perth Office: 27 Oxford St., Leederville, W.A. Tel. 81 4988

INTERSTATE REPRESENTATIVES: N.T. Pfitzner's Music House, Smith Street, Darwin. Tel. 3801. Tas.: K.W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel. 2 5322.

INSTROL

NEW LOWER A.D.C PRICES

ADC STEREO CARTRIDGES — AMERICA'S QUALITY CARTRIDGE

ADC 220X . . . $15.00

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

ADC 10E mk4 . . . $45.00

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

ADC 220XE . . . $18.00

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

ADC 500XE . . . $27.00

ADC 550XE. Type: Induced Magnet; Output: 5 mV at 5.5 cms/sec. recorded velocity; Tracking Force: ¾ to 2 grams; Frequency Response: 10 Hz to 20 kHz ± 2 dB; Channel Separation: 20 dB from 50 Hz to 12 kHz; Compliance: 35 x 10^{-6} cms/dyne; Elliptical Stylus Tip Radii: Contact radius .0003". Lateral radius .0007"; Vertical Tracking Angle: 15°.

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

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

This outstanding turntable value consists of:–

(A) J.H. TURNTABLE	Belt drive, synchronous motor, unmeasurably small rumble, wow and flutter of better than 0.04%, negligible hum radiation, with 12" diameter of platten.
(B) EXCEL ES 801 ARM	Oil-damped cueing device; fully calibrated stylus pressure adjustments; adjustable bias compensation; universal headshell.
(C) A.D.C. 220X	Magnetic cartridge. Tracking force 1½ to 3 grams, extremely linear and smooth frequency response.
(D) INSTROL 44 STAND PLUS HINGED 'PERSPEX' COVER	This acoustically sprung player stand is available in either oiled teak or walnut, complete with moulded perspex cover and "stay-up" hinges.

ALL THE ABOVE FOR ONLY **$109.00**

(fully assembled & packaged)

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

Contains full specifications, gloss colour illustrations and special Instrol discount pricing on the following items—:
Turntables, cartridges and styli, Amplifiers, Amplifier kits and Dynakits, Speaker system, Speaker kits, Speaker enclosures, Tuners, Four channel equipment, Tape decks and recorders, Dolby cassette decks, Record Storage cabinets and kits, Equipment Cabinets (Built and Kits) for hi-fi, Hi-Fi accessories, Instrol products, etc.

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

NAME .....

ADDRESS .....

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

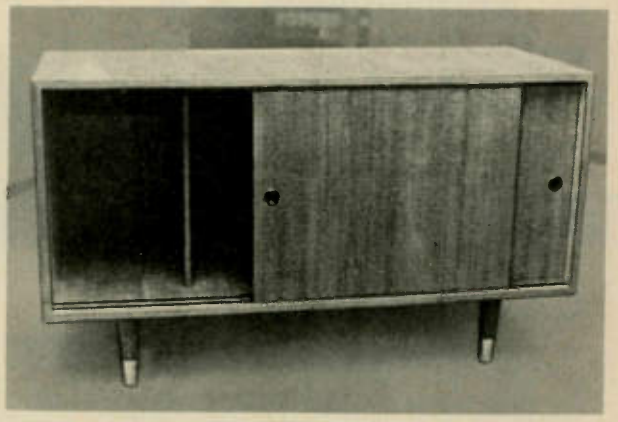
T402

INSTROL + RECORD STORAGE CABINETS

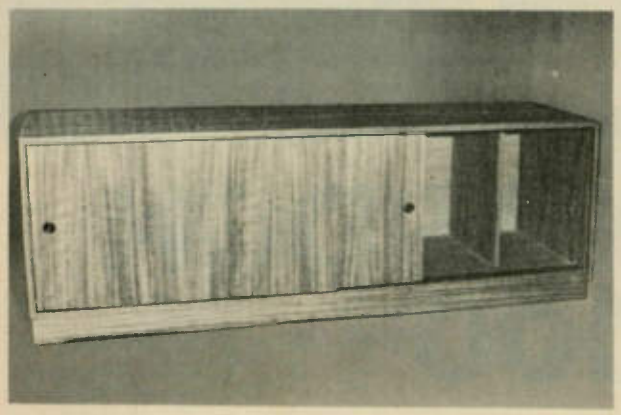
Now available in pre-cut kits

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

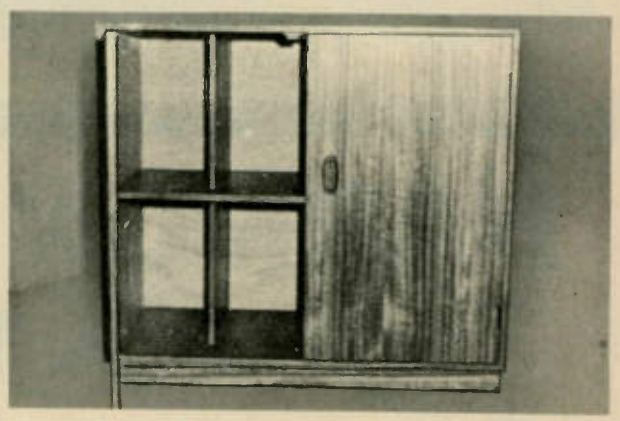
A neat general purpose unit, designed to carry between 80 anc 100 records, it measures 23¾" x 14" (high) x 14½" (deep). Kit price is $33.00 (teak or walnut veneer). Normally comes with base. but 4½" legs optional.



A larger unit measuring 35½" x 14" (high) x 15¾" (deep), the kit is priced at $49.50 (teak or walnut veneer). Normally comes with base, but 4½" legs optional.



This model measures 51¼" x 14" (high) x 15¾" (deep) and is priced at $57.00 (teak or walnut kits). Normally comes with base, but 4½" legs optional.



This attractive model is aesthetically styled with full height opening doors and recessed handles cut from solid teak. With two record storage shelves, one on top of the other, and ample vertical dividers, the unit measures 35¾" x 31½" (high) x 16" (deep). Kit price is $74.00 (teak or walnut veneer).

INSTROL HI-FI

TWO GREAT LOCATIONS

SYDNEY – 91a York Street, Sydney. Phone 29 4258

MELBOURNE – 375 Lonsdale Street, Melbourne. Phone 67 5831

ALL MAIL ORDER – 91a York Street, Sydney.

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

. . . . . at $ . . . . .

. . . . . at $ . . . . .

. . . . . at $ . . . . .

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

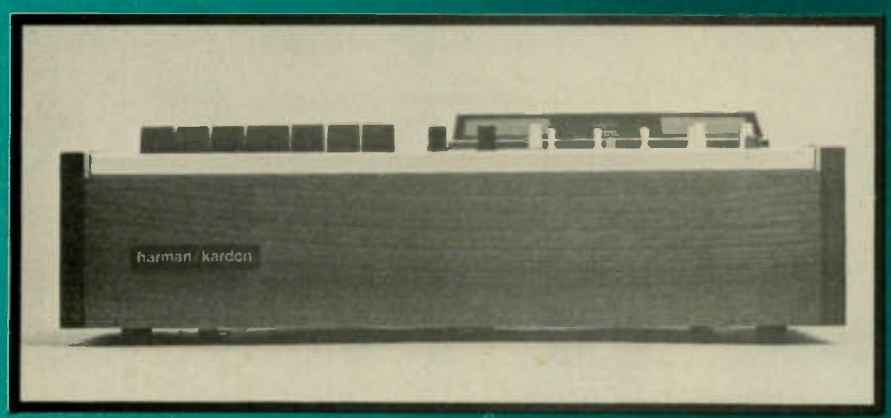
NAME . . . . . .

ADDRESS . . . . . .

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

T402

electronics TODAY INTERNATIONAL
product test



"Performance far better than practically every other machine on the market" — Louis Challis

Recommended retail price $430

HARMON KARDON HK 1000 Cassette Recorder

IN THE FIELD of hi-fi, equipment development is an ongoing process. For some devices, such as amplifiers, perfection is virtually within sight and a great deal of effort is now spent on improving facilities rather than performance. Record players too are now practically as good as they need to be and a machine bought today will not be technically obsolete in five years time.

But cassette recorders and tapes are very much in the throes of a development period and many a machine that was technically brilliant two years ago — or even one year ago — may now be well and truly surpassed by later products from its own and other manufacturers.

When for example, we reviewed Harmon Kardon's CAD5 recorder some two years ago, we found that it had the best technical performance of any cassette recorder reviewed up to that time. Its frequency response was virtually unchallenged by any other machine, and the facilities that it had to offer, together with its overall performance were extremely good. Yet now, a mere two years later, Harmon Kardon's new HK 1000 is a vastly different and generally much improved machine. Its performance is superior to the CAD5 in all respects except one.

The HK 1000 is a particularly

attractive machine. It features a wooden base with teak veneer and a deck section which is basically a black plastic moulding with inserts of satin brushed anodised aluminium with black engraving.

Overall frontal appearance of the deck is particularly neat. It is laid out in three distinct sections. At the top, above the cassette well, is a three digit counter with reset button. To the right of this is a raised and sloping panel. This contains two VU meters together with a red coloured bezel to indicate the record mode, and a yellow coloured bezel to indicate the operation of the Dolby noise reduction system. In the centre of the deck, on the left hand side, is the cassette well (with a mirror in the centre to clearly show the extent of tape usage). On the right hand side of this are two slider controls for record level together with a recessed left and right channel record calibrate screw potentiometer. In the middle, at the top, is a test button for the oscillator signal for testing the Dolby record level mode, and on the right hand side are two playback level slider controls. These are also flanked by a recessed playback calibration control potentiometers, of which we will have more to say later.

On the lowest and frontmost section of the deck are from left to right, seven lever switches for cassette eject, fast rewind, record mode, one and a half times normal width stop button, normal play mode switch, fast forward mode switch, and a pause switch which has a locking position.

In the middle of the deck are two tip and sleeve microphone sockets flanked above by their very small respective microphone level potentiometers.

On the right hand side of the deck is a stereo/mono switch, a standard tape, low noise tape, chromium dioxide tape selection switch, a memory on-off switch, a Dolby noise reduction on-off switch, a self illuminated bezel power switch, and below it, at the front in the right hand corner, a tip ring and sleeve headphone jack which allows monitoring of the recorded signal without a main amplifier.

At the rear of the unit, on the left hand side, there is a fuse receptacle, and the power output lead, which in the case of this unit is a two core flex and American style two pin plug. On the right hand side of the rear of the deck, inserted behind the actual cabinet, are the two RCA type co-axial output sockets, a slotted head for the motor speed adjustment potentiometer, and four input sockets for respectively, low impedance inputs of 50 mV, and two high impedance inputs for 200 mV input.

One of the features of the machine which warrants special comment, and possible criticism ergonomically, is the provision of the record and playback calibration potentiometers recessed behind the front panel and readily accessible. Harman/Kardon point out that this is a special facility and claim that there are definite advantages to be gained from having ready access to the Dolby set-level controls particularly if one purchases one of the "Dolby Reference Cassettes". Their philosophy is that the user has inbuilt facilities to optimize the Dolby system in the recording mode for every type of tape.

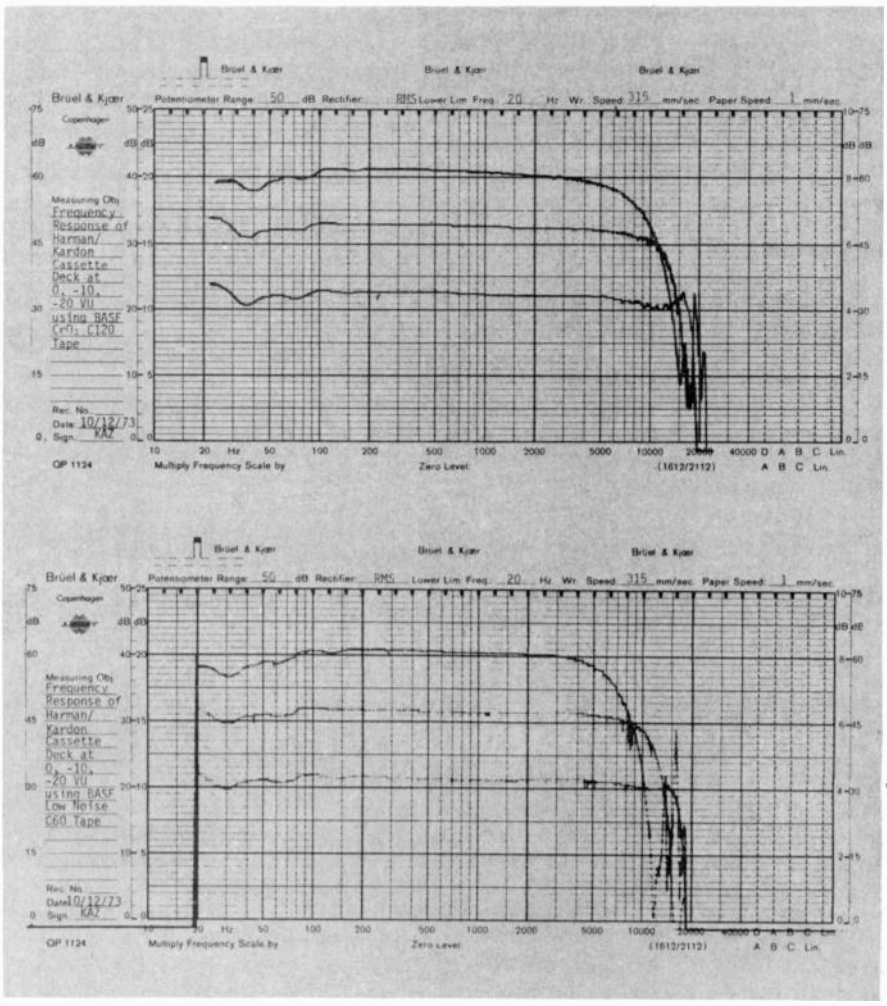
This adjustment is done using an internal calibration signal which is recorded on the tape. Any adjustment then required is made using the record calibration controls and the procedure repeated to check the new setting. Calibration is only required if a new type of tape is being used. As delivered, the machine is correctly adjusted for playback and the playback calibration controls (which are located on the front panel) should only be adjusted using the special calibration tape supplied by Harman/Kardon. This calibration is already performed in the factory and should not be necessary in normal use.

The HK 1000 is a particularly easy machine to use. It does not have any fickle or special controls over and above those provided by other medium priced machines – apart from the record and replay calibration controls – yet it can provide a very high level of performance.

The machine has obviously been designed for easy servicing and most of the printed circuit cards used are mounted with plug and socket connections to facilitate removal, checking, and if need be, replacement. The standard of the electronic wiring is particularly good. The nine printed circuit boards are clearly labelled on the component side with component numbers incorporated. The cards themselves are clearly designated with their purpose and operation.

An internal feature that we particularly liked was that the main transformer is well shielded. A mu-metal wrapping is used to reduce residual magnetic leakage.

The handbook was not up to the same standard as the machine itself, nor as good as those provided with other high fidelity equipment manufactured in Japan. It does provide operating details, but no circuit diagram is provided.



Our new 60-watt receiver. For people who want more power than a 100-watt receiver.

It isn't hard for some high fidelity companies to turn a 40-watt receiver into a 100-watt receiver. All they have to do is overestimate their own power.

Instead of testing their receivers at every audible frequency, for instance, they use one easy-to-reproduce frequency. Or they use "peak power" or "IHF" watts instead of true RMS watts. Or omit distortion figures.

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.

For that, you can buy a receiver with more watts than ours. But you can't buy one with more power.

For more information, write to
Jervis Australia, P.O. Box 6, Brookvale, NSW 2100
or phone 939-2922

harman/kardon
The Music Company

A good feature which is clearly noticeable when the unit is removed from its cabinet is the very effective automatic motor and mechanism shut off. This is operative in both the play, fast forward, and rewind modes.

MEASURED PERFORMANCE

Our first test was to measure the performance of the unit with chromium dioxide and standard gamma ferric oxide tape at 0 VU, -10 VU, and -20 VU.

The performance under these conditions was particularly creditable at -10 VU and -20 VU. In fact this was virtually the first machine, apart from the Nakamichi 1000, where the performance with gamma ferric oxide tape was of the same order as that obtainable from chromium dioxide. Without any special adjustment the machine turned out a very creditable 20 Hz to 16.5 kHz +3 dB at -20 VU.

Harman Kardon make a strong selling feature of this machine's ability to provide an almost flat frequency response between 20 Hz. and 100 Hz. This claim is justified and the low frequency performance is better than most reel to reel machines, let alone most other cassette recorders that we have measured.

Total harmonic distortion was quite acceptable at 1 kHz and 6.3 kHz, but was considerably higher than normal at 100 Hz.

On the machine tested it was 10% at 0 VU.

Intermodulation distortion was particularly low, and even at 0 VU was considerably better than obtained from other cassette recorders.

Signal to noise ratio was extremely commendable. At 0 VU with a 1 kHz signal (without Dolby) it was -52 dB. With Dolby it was -54 dB.

'A' weighted it was -56 dB (A) without Dolby and -58 dB(A) with Dolby. These figures are even better than those provided by the Nakamichi 1000, and are easily the best that we have yet seen with Dolby and DNL.

The erase ratio for a 1 kHz signal pre-recorded at 0 VU, was -70 dB. This is the best erase ratio that we have yet measured on a cassette recorder.

Cross talk figures are quite acceptable, being 40 dB at 100 Hz and 45 dB at 1 kHz.

Wow and flutter figures are reasonably good being 0.17% on the unit tested compared with the manufacturer's specification of 0.13% or less.

Line input sensitivities were respectively, 18 mV for the low signal low impedance input, and 150 mV for the high impedance high sensitivity input.

The microphone sensitivity was 0.2 mV for 0 VU whilst the line output sensitivity if 1.4 volts. This is a substantially higher output than stated in the handbook.

The most interesting feature of the HK1000 is one of the techniques used to obtain the extended frequency response. This is achieved, in part, through the use of a replay head which is not inserted as deeply into the cassette body as it is in other machines.

This modifies the angle of contact between the head and tape so that the extent of magnetic coupling at the fringe of the gap is reduced and thus the "effective gap width" is reduced.

The penalty that is paid for the reduction in effective gap width is a simultaneous reduction in the stability of the contact pressure between the tape and the head with certain brands and types of magnetic tape.

This can and does result in these tapes lifting slightly from the head and results in a loss of replay signal level. The problem can of course be obviated by suitably selecting tapes.

On a theoretical basis it can be shown that there is a 55 dB loss per wave length of spacing between the tape and head. At 7.5 kHz the recorded wave length is 0.25 mil, thus a tape head spacing of only 0.025 mil (which is not very much) will result in a drop of signal of 5.5 dB.

The performance of the HK 1000 is good — in fact with normal programme material it is particularly difficult to tell the difference between the original and the replayed material.

Frequency response is really excellent but, on the machine tested at least, this was achieved at the expense of tape/head contact. This failing — and this failing only — precluded our rating it as the second best recorder that we have ever reviewed.

Nevertheless it is a very good machine indeed and most of the performance parameters are far better than found in practically every other cassette machine on the market.

It is not as good as a Nakamichi — but comes much closer than its 60 to 70 per cent lower price would seem possible. ●

MEASURED PERFORMANCE OF HARMAN/KARDON HK1000 SERIAL NO. 30364034

Record to Replay Frequency Response
With BASF CrO_2 Tape at:

0 VU	20 Hz — 6 kHz ±3 dB
−10 VU	20 Hz — 12 kHz ±3 dB
−20 VU	20 Hz — 17 kHz ±3 dB

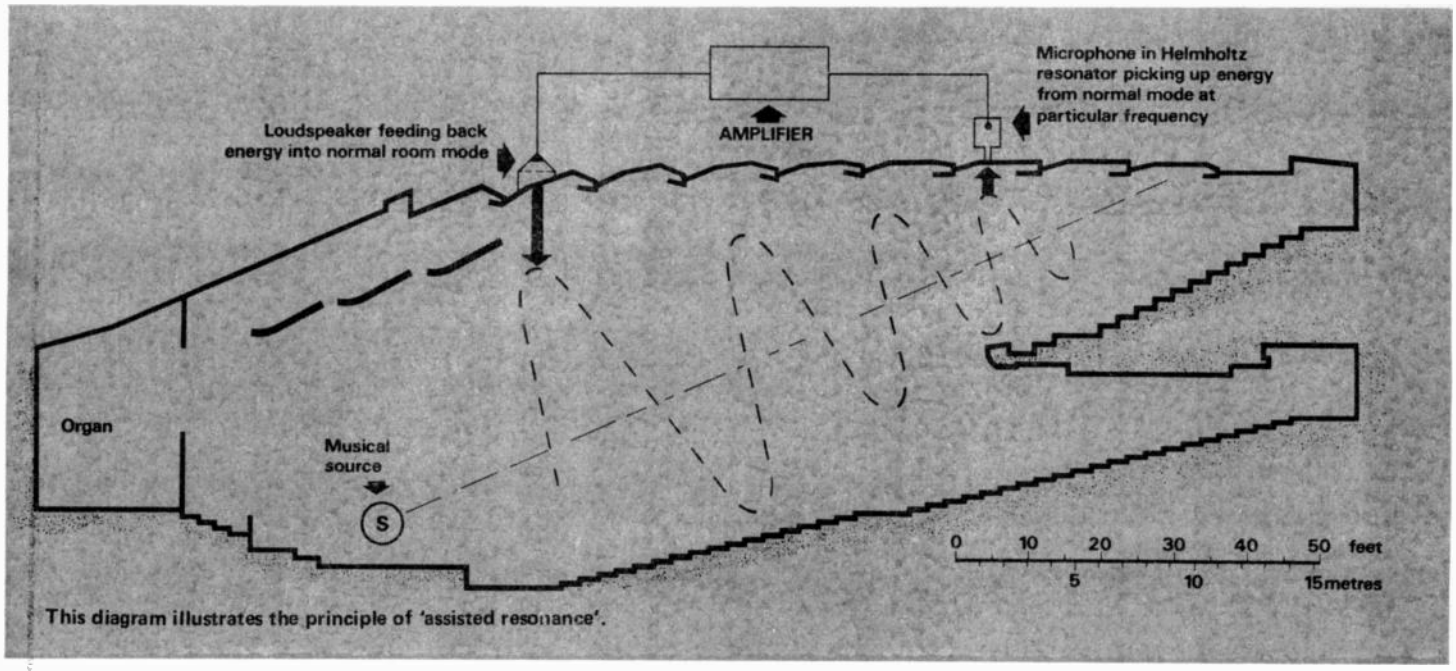
With BASF -C60 Tape at:

0 VU	20 Hz — 6 kHz ±3 dB
−10 VU	20 Hz — 10 kHz ±3 dB
−20 VU	20 Hz — 16.5 kHz ± 3 dB

Intermodulation Distortion (at 1kHz and 960 Hz):	0 VU	0.4%
	−10 VU	0.2%

Signal to Noise Ratio (CrO_2 tape + Dolby O VU re 1 kHz)	with Dolby	without Dolby
	54 dB (Lin)	52 dB (Lin)
	58 db (A)	56 dB (A)

Erase Ratio for 1 kHz Signal (Prerecorded at 0 VU)	−70 dB	
Cross Talk at 0 VU:	100 Hz	40 dB
	1 kHz	45 dB
Wow & Flutter % — Weighted:		0.17%
Line Input Sensitivity for 0 VU	(Low)	18 mV
	(High)	160 mV
Microphone Input Sensitivity for 0 VU		0.2 mV
Line Output Sensitivity for 0 VU		1.4 V



This diagram illustrates the principle of 'assisted resonance'.

Multi-channel sound optimizes concert-hall reverberation times.

'ASSISTED RESONANCE'

by P.H. Parkin, Building Research Station Watford, UK.

MANY factors control the acoustics of a concert hall or theatre but the most important influence, and the only one under any control, is what is known as the reverberation time.

This is defined as the time taken for the sound in a room to decay to one-millionth of its original intensity after the source of sound has stopped. Roughly speaking, it is the time it takes for a moderately loud sound to die away to inaudibility.

In a furnished living room this time will be about a half-second, in a theatre about one second, in a concert hall between one and a half and two seconds, and in a cathedral five seconds or more.

The reverberation time of a room is determined by two things: the size of the room, and the amount of sound-absorbing material it contains. The sound can be visualised as travelling round and round the room after it has left the source, and each time it strikes a reflecting surface some of it is absorbed. Therefore the more absorbent each surface the quicker the sound is absorbed and the shorter the reverberation time. Also, the larger the room the farther the sound has to travel between each reflection, making the reverberation time longer. Nearly always the reverberation time is different at different frequencies because the sound absorption of all room surfaces, and of people, varies with the sound frequency.

MOST IMPORTANT FACTOR

Why the reverberation time should be such an important factor is not clear. It is probably not so much the time itself that matters as the fact that it is a measure of the *amount* of reverberant sound in the room. That is to say, it is a measure of the ratio of the sound that reaches a listener directly from a speaker or an orchestra to that which reaches him after being reflected from the room surfaces. But whatever the reason for its importance, it is the one factor we can measure and probably the most important influence on producing – so far as music is concerned – that elusive, desirable quality for concert halls known variously as 'warmth', 'resonance', 'fullness of tone', and many other similar terms.

As already mentioned, a theatre, or any room designed primarily for speech, will have a reverberation time of about one second. Anything shorter than this will cause the sound to seem 'dead', even for speech, and anything much longer will make speech rather difficult to hear. For music, however, a reverberation time of one second means that the sound will be very lifeless, one and a half seconds is generally reckoned to be about the minimum and two seconds about the optimum.

One obvious consequence is that there is an acoustical conflict when – as often happens – a room is to be used for both speech and music. A reasonable compromise reverberation time is one and a half seconds, but the effect is not very good for music and a little too reverberant for rapid speech.

This conflict has been realised for many years and various attempts have been made to overcome it. For example, rooms have been built with variable surfaces such as rotatable panels, one side of which is covered with sound-absorbing material so that when that side is facing into the room the reverberation time is shortened. On their other side these panels have a hard surface which when exposed inwards makes the reverberation time longer. This arrangement can be made to work reasonably well in studios, but in auditoria a large amount of sound absorption is due to the seats and

audience. Therefore the change in reverberation due to the change in surfaces is limited. Further it is difficult to build reversible panels with different amounts of absorption on either side to deal with low sound-frequencies.

ELECTRONIC CONTROL

Because of the limitations of physical alterations, the idea of using some kind of electronic control in the auditorium has appealed to acousticians for many years. Several attempts have been made to devise an adequate electronic method of altering the reverberation time of an auditorium or, more precisely, to devise an electronic means of lengthening the reverberation time because no such method for shortening it has yet been evolved.

This article describes one of the more recent methods to be employed. It is known as 'assisted resonance' and was tried experimentally in the Royal Festival Hall in London in 1964 before being installed permanently. A simplified system has now been put into the Central Hall of York University in Northern England.

The simple picture of sound travelling round a room is one way of visualising what happens, but another, more accurate, way is to think of the room's acoustic behaviour as a large number of resonances. The air in an organ pipe will resonate at one fundamental frequency with harmonics depending mainly on the length of the pipe. Similarly, the air in a room will resonate at various frequencies. But because a room has breadth and height as well as length, the number of resonances is enormous – several million in a large concert hall – so that they cannot normally be distinguished by ear.

What assisted resonance does is to select a large – but, of course, finite – number of these resonances, and 'assist' them as illustrated in the diagram.

A microphone connected by an amplifier to a loudspeaker forms what is known as a 'channel' and for each channel the microphone and the loudspeaker are positioned in the auditorium so that they respond more to one of the room resonances than to any other. Each channel puts some acoustic energy into the room whenever it is excited by the original source of sound, and the amount of that energy depends on the gain of the amplifier.

Obviously, this power compensates to a controllable extent for the power being lost at the room surfaces, and thus the reverberation time can be increased by controlling the gain. However, each channel is 'assisting' only one frequency, so it is necessary to have a large number of channels to cover the frequency range.

In the Royal Festival Hall there are 172 channels covering the frequency range 58 to 700 Hz. Using these channels it has been possible to increase the reverberation time from, for example, about one and a half seconds at 125 Hz to about two and a half seconds, and this time could be increased still further by increasing the gain of the amplifiers if desired.

OVERCOMING A CONFLICT

As already suggested, a more widespread use of the system could be to overcome conflict between speech and music. A hall would be designed with a reverberation time of about one second for speech and assisted resonance would be switched on to bring the reverberation time up to the region of two seconds for music. The cost of such a system would depend on the number of channels used, and the installation at York University was a development of the Festival Hall system to see (a) how few channels were needed, and (b) how much increase could be obtained in a hall which started off with a short reverberation time.

The York installation in fact consists of 72 channels and at the time of writing, has increased the reverberation time at the lower frequencies from about one second up to about 2.2 seconds and at the medium frequencies from about one second to 1.4 seconds. The number of channels used, and their spacing along the frequency range, was the best guess that could be make at the time of the installation.

Experience so far suggests that either a few more channels, up to a total number of perhaps 100, will be needed to make the hall *really* satisfactory for music or that some of the channels used for the lower frequencies might be switched to the medium frequencies.

To sum up then, the indication is that a maximum of 100 channels will increase the reverberation time of an auditorium at the lower frequencies by at least 100 per cent and at the medium frequencies by at least 60 per cent. Thus, a multi-purpose auditorium could start with a reverberation time of about 1.2 or 1.3 seconds – which is a little longer than used to be recommended for speech but which is now accepted, and the channel system used to bring the reverberation time at lower frequencies to about two and a half seconds and at medium frequencies to about 1.8 or 1.9 seconds, which should be adequate for music. ●

AUSTRALIA'S LEADING ELECTRONICS
ELECTRONIC COMPONENTS—KITS

KIT-SETS AUSTRALIA

BRANCHES AT

SYDNEY
Kit-Sets Aust. (Sydney) Pty. Ltd.
400 Kent Street, Sydney
Phone 29-1005

DEE WHY
Head Office, sales centre and national mail order dept.
Kit-Sets Aust. Pty. Ltd.
1st floor, 21 Oaks Ave., Dee Why
Phone 98-7500

ADELAIDE
16A. Peel St., Adelaide
Phone 87-5505

BRISBANE
Kit-Sets Aust. (Qld.) Pty. Ltd.
293 St. Pauls Terrace,
Fortitude Valley
Phone 52-8391

MELBOURNE
Kit-Sets Aust. (Vic.) Pty. Ltd.,
271 Bridge Rd., Richmond
Phone 42-4651

PERTH
557 Wellington St., Perth
Phone 21-3047

We offer FAST, EFFICIENT and COURTEOUS Mail Order Service at guaranteed best prices.

We operate Australia's largest and most efficient Mail Order Service — our service for mail order clients is second to none. Guaranteed best prices for new components and equipment. Same day despatch.
SPECIAL 24-HOUR PHONE COD SERVICE.
This is the easy and sure way of ordering. Just phone us and state your requirements, and your order will be despatched COD within the hour. Phone 982-7500 (Area Code 02) anytime, anyday, for this service.

MORE NEW PRODUCTS FROM

NEW

SQ™

FABULOUS NEW INTERNATIONAL 420
FOUR-CHANNEL AMPLIFIER

At last! An attractive, top performing 4-channel amplifier which incorporates the latest in patented SQ plus ambiance decoding, which is simple to construct and produces 15 watts per channel! This brilliant performer which can be constructed at a fraction of normal cost incorporates the latest Motorola SQ decoder integrated circuit type MC1312P which is AVAILABLE EXCLUSIVELY FROM KIT-SETS AUSTRALIA who have been licenced by CBS to distribute them in kit-form in Australia! Because of this ONLY KIT-SETS AUSTRALIA CAN SUPPLY YOUR KIT BEARING THE REGISTERED CBS SQ TRADEMARK! Provides 15 watts per channel, 2 channel driven and 12.5 per channel, 4 channels driven with typically less than .2% distortion. SN ratio better than 70 dB. A fabulous amplifier for the do-it-yourself enthusiast!

AS THE DECODER IC IS IN SHORT SUPPLY, SEND FOR YOUR KIT COMPLETE WITH DECODER I.C. AND SQ TODAY TO AVOID DISAPPOINTMENT!

PRICE ONLY **$129.00** COMPLETE
P/Post $2.50

COMPLETE DECODER SECTION (less pots) WITH MC1312P . . . $17.00 (Sorry, licence prevents us selling MC1312P separately).

EXCITING

YOU HAVE TO SEE IT TO BELIEVE IT —

COLOR ORGAN MODEL V3050

A totally new concept! The display is complete including 3 channel driver unit with a Five colour Diamond patterned display made up of thirty lights mounted in a walnut finished cabinet faced by a shatterproof acrylic display screen.
Display colours: Red, Yellow, Green, Blue, Violet.
Dimensions: 11½" Wide x 18½" High x 7" Deep.
Operation: 240V 50 Hz Drive; Any amplifier output.
Seeing is believing!

ONLY $39.50 P/Post $1.50

NEW

Kit-Sets Australia are pleased to announce that they can now supply the range of high-quality wired and tested
AUDITEC MODULES.

This well-known and highly respected range of modules are designed for the engineer or enthusiast wanting a fully wired and tested unit having professional specifications and which can be incorporated in systems of the highest quality. All modules are fully guaranteed for 12 months and can be obtained from your nearest Kit-Sets Australia Store or by mail. Here are just a few of the modules available:

001 32 WATT HI-FI POWER AMP. 32 watts RMS into 8 ohms at less than 0.1$ THD. Response 20 Hz-80 kHz + 1 dB. Input 1 volt into 100K. Price $24.42. P/Post 50c.

001D 001 with Integral Power Supply Diodes. Price $25.44. P/Post 50c.

002 COMPREHENSIVE HIGH-QUALITY PREAMP. MODULE. Inputs: Magnetic, ceramic, tuner, aux, tape. Outputs tape recording 100 mV before tone controls. 1 volt main output. THD less than 0.1% response 14 Hz-100 kHz + 1 dB. Price $19.45. P/Post 50c.

009: 100 WATT POWER AMPLIFIER MODULE 125 watts RMS into 5 ohms, 110 watts into 4 ohms at less than 0.2% THD. Response 10 Hz-30 kHz ±1 dB. Input 500 mV, 100 K. Fully short-circuit and overload proof! Price $60.38 P/post 75c.

013, 014: SIREN MODULES. Conventional and European (Hee-Haw) with manual or automatic operation. Price $10.99. P/Post 30c.

015: MICROPHONE/GUITAR PICKUP PREAMPLIFIER. Complete with bass, treble, volume controls mounted on printed board, fits against front panel with absolute minimum of wiring. Inputs low Z MIC 0.5 mV, pickup 100 mV, guitar/high Z MIC 5 mV. Outputs 25 mV/10 K for mixing and 1 v/10 K for driving power amps directly. Price $14.84. P/post 75c.

018: 50 WATT POWER AMPLIFIER MODULE 60 watts RMS into 4 ohms, same performance characteristics as 009. Price $36.75. P/Post 50c.

025: STEREO MAGNETIC EQUALISING PREAMP RIAA ±1 dB. Outputs 1 v and 25 mV, adjustable. Inputs 25 mV/47 k. Max signal handling 270 mV ENI-125 dBm. Price $20.28. P/post 50c.

For further information on these and the complete range of auditec modules please phone your nearest branch or write to our mail order department.

ONLY NEW AND GUARANTEED
manufacturer's seconds

CENTRES AND MAIL SERVICE
–TEST EQUIPMENT–HI-FI

KIT-SETS AUSTRALIA!

THE GREATEST AMP OFFER EVER

SAVE PETROL!

C.D.I. ELECTRONIC IGNITION KIT

With this simple easy to construct Capacitor Discharge Ignition kit you will increase –

* Fuel economy * Spark-plug life * Points life * Easier starting * much improved overall performance. Is suitable for all 12V systems, positive or negative earth. Secondary winding of transformer is pre-wound. Sturdy diecast box supplied. All parts are new and guaranteed.

A MUST FOR EVERY MOTORIST AT ONLY $20.50! P/Post 75c.

PLAYMASTER 131 TUNER

Here's your opportunity to construct a simple, compact I.C. tuner for a mere $21.50! It can be built into the cabinet of your choice and is small enough to fit into many existing amplifier systems. Employs the reliable TAA840 I.C. and is our most popular Tuner Kit! (See E.A. Feb. 71)

PRICE $21.50 P/Post 75c

WHY NOT SHOP THE MODERN EASY WAY . . . USE OUR NO DELAY MAIL ORDER SERVICE.

It is so easy to use our highly organised mail order service. Just write or phone and the postman will be delivering your order quicker than you thought possible. See the panel alongside for details of our special COD phone service.

FOR THE BUDGET CONSCIOUS

LOW-COST FOUR CHANNEL DECODER

Here is a simple little decoder unit that will allow you to sample some of the pleasures of four channel sound without having to dig too deeply into your wallet! Is intended to operate with a second amplifier driving rear channel speakers. Simple construction on a P.C. Board allows the unit to go into any amplifier cabinet. Power supply is 18-20V at 5 mA. (See EA Nov. 72).

ADD A WHOLE NEW DIMENSION TO YOUR RECORD LIBRARY FOR JUST $6.25! P/Post 50c.

ACOS DUST JOCKEY

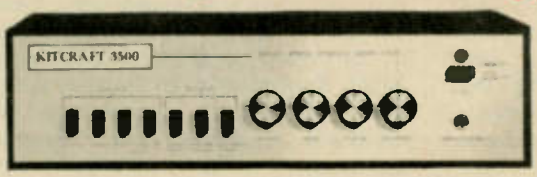
A HI-FI MUST!

EVERYONE WHO PLAYS RECORDS MUST HAVE A DUSTBUG!

Not only does it reduce static and increase pick-up performance, but because it dusts recordings ahead of the cartridge it will considerably lengthen the life of your records and stylus! Suits all types of turntables and is a must at a mere –

SPECIAL $4.75 P/Post 50c

SEND FOR YOURS TODAY!



KITCRAFT 3500

MODULAR STEREO AMPLIFIER KIT

35 WATTS RMS PER CHANNEL FOR ONLY $119.00!

Most modern quality speaker systems require at least 30 watts RMS to realise their full potential, but in the past, amplifiers in this class would cost you much more than $200. Now Kit-sets Aust. offer you the opportunity to obtain professional quality 35 watts RMS per channel integrated amplifier at a mere $119, if you are prepared to spend about 1 hour fitting pre-wired and tested modules into place, and in carrying out a minor amount of simple wiring and assembly! The amplifier is fully modularised and comes 95% pre-wired and tested.

Simple final assembly instructions are supplied. For a demonstration, visit your nearest Kit-sets Australia Centre today!

POWER OUTPUT: 35 watts R.M.S. per channel at 8 ohms (both channels driven). DISTORTION: Less than 0.05% total harmonic. Less than 0.05% I.M. FREQUENCY RESPONSE: 20 Hz to 20 kHz ±0.1 dB. Stable and ring free output into reactive loads up to 0.5μF. KITCRAFT 3500 – THE FINEST OF QUALITY. $110 for KIT; $140.00 COMPLETELY BUILT. PACK/POST $4.00.

SPECIAL ANNOUNCEMENT

NEW, MODIFIED PLAYMASTER 136!

Having trouble obtaining a complete kit of parts for the Playmaster 136? Or, would like to build it, but find the power amp section a bit too difficult? Well, here's the answer! Kit-Sets Australia can now supply a kit of parts for a –

Our kit retains the existing chassis and front panel and the pre-amplifier section but incorporates a newly designed power amp section which is far more compact and easy to construct. It also delivers A FULL 15 WATTS RMS PER CHANNEL AT LESS THAN .2% DISTORTION AND IS OVERLOAD PROTECTED FOR 20 SECONDS OF SHORT CIRCUIT! AND GUESS WHAT, YOU CAN STILL OBTAIN IT FOR THE REMARKABLE PRICE OF JUST $62.00 COMPLETE! SEND FOR YOURS TODAY! P/Post $2.00.

KIT-SETS AUSTRALIA – THE PARTS PLACE! AND HERE'S WHY –

One of our competitors suggested that ONLY two things are necessary to provide an efficient National parts service. A good catalogue and an efficient mail order service.

For small mail order firms this may be the case. However, not only do KIT-SETS AUSTRALIA – THE NATION'S LARGEST SUPPLIERS, provide the BIGGEST AND MOST COMPREHENSIVE PARTS CATALOGUE IN AUSTRALIA (40 pages more than our nearest competitor) and the SPEEDIEST AND MOST RELIABLE MAIL ORDER SERVICE AVAILABLE, we also provide:

* THE LARGEST AND MOST COMPREHENSIVE STOCKS OF PARTS FOR THE ENTHUSIAST! So important at the moment!
* THE LOWEST PRICES ON ONLY NEW AND GUARANTEED BEST QUALITY PARTS IN AUSTRALIA! Done any comparisons lately?
* STORES THROUGHOUT AUSTRALIA TO PROVIDE YOU WITH A MORE PERSONAL AND CONVENIENT SERVICE! You can see what's available, no need to wait up to 3 weeks to find out!

We have no choice of "fast" or "slow" mail order service, obviously, all our customers want a FAST SERVICE! So no convenient excuses for slow delivery, if it's at all available, EVERYONE GETS THEIR MAIL ORDER FAST FROM KIT-SETS AUSTRALIA!

So, if you had to wait up to 3 and 4 weeks for so-called 24 hour mail order service lately, and can't visit one of our branches, JOIN THE MANY THOUSANDS OF SATISFIED KIT-SETS AUSTRALIA CUSTOMERS AND TRY OUR MAIL ORDER SERVICE TODAY!

The recent move of our Mail Order Department to more spacious premises and an increase in mail order staff will improve our service even further!

IF YOU DON'T HAVE YOUR COPY OF THE KIT-SETS AUSTRALIA 1973-74 CATALOGUE AND ARE NOT PURCHASING YOUR KIT AND PARTS REQUIREMENTS FROM US – YOU ARE WASTING TIME AND LOSING MONEY! WHY NOT GO KSA – THE RIGHT WAY – TODAY!

IF YOU HAVEN'T BOUGHT THIS CATALOGUE YOU'RE LOSING MONEY

NEW 1973-74 CATALOGUE

BRAND NEW! AVAILABLE NOW

KIT-SETS 1973/74 Catalogue, containing over 100 pages with the very latest in electronic components projects, kits, test equipment, tools, servicing aids, accessories, diagrams, definitions, hints, etc. Also features new Hi-Fi section containing our selection of the best available.

WRITE FOR YOUR COPY NOW

together with your cheque or money order for 65c and 20c postage to:

KIT-SETS AUST. PTY. LTD.
P.O. Box 176, Dee Why, N.S.W. 2099.

A MUST FOR ALL ENTHUSIASTS, HOBBYISTS, SERVICEMEN, AND ANYONE REMOTELY INTERESTED IN ELECTRONICS!
No other publication in Australia offers so much.

PARTS SUPPLIED

Why take chances? KIT-SETS (AUST) does not deal in rejects or surplus, but we guarantee to match or better any genuine price obtainable elsewhere.

CREATIVE AUDIO

PART SIX

A practical guide to creating and producing your own sound
by Terry Mendoza B. Sc. (Hons).

THE very real attraction that electronic music offers to the composer/realiser is that it can produce results far exceeding the limitations of the human performer. For example, on a conventional instrument a musician may simultaneously instigate a dozen or so tones and their harmonics. This is meagre in comparison with a burst of pure white noise which will contain samples of *every* audible frequency. Another benefit offered by electronic music is that the performer will be freed from many limits imposed upon him by conventional instruments. Once a piano has been tuned to chromatic intervals, it is normally left this way, but a synthesizer keyboard may be played chromatically at one moment, then macro or micro-tonally at the next.

Composition of electronic music is in fact so free and loose that a composer has to impose his own limitations to give structure to his work. The most basic of the boundaries he will introduce will probably be that the frequency range of his music remains in the human 'audio' region — unless he wants to entertain the bats!

He will now have the choice between electronic music and music concrete, although there is no reason why these methods should be mutually exclusive. In its present sense, electronic music entails the derivation of material solely from wave-forms originating in electronic circuits. It further sub-divides into additive and subtractive tonal methods, additive techniques building complex timbres from pure tones, and subtractive methods utilising enharmonic (i.e. — a whole set of harmonics not related by any multiple of a semitone) and noise sources which are precisely filtered to the desired result. Both types of device are to be found in the majority of synthesizers and electronic music studios.

Music concrete, on the other hand, uses existing sounds for raw material, which can be quite literally anything from a pneumatic drill to a snatch of birdsong. It implies an input transducer of some kind, air-microphone or contact-microphone. Tape manipulation and electronic modification, are its prime tools.

Electronic music covers too wide an area to describe a typical approach to a creation, as there is no single 'correct' method. We will therefore survey in general terms the various devices that can be constructed or purchased for this activity.

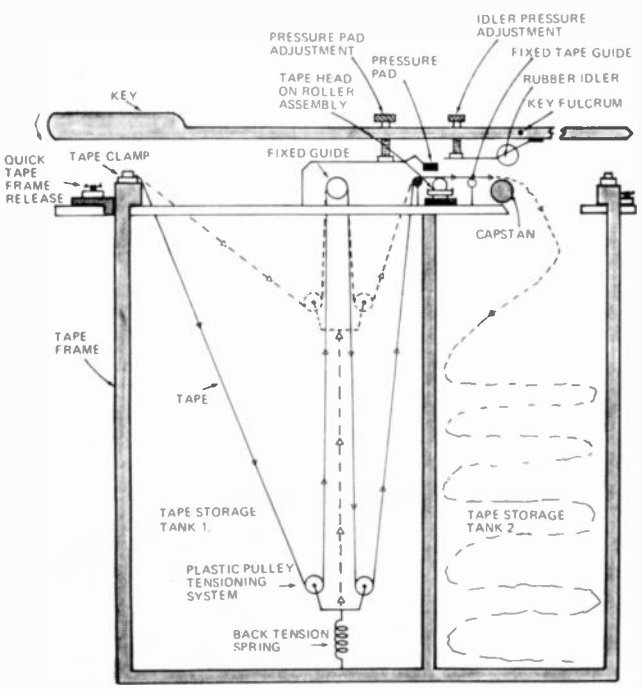


Fig. 1. Tape transport system of a Mellotron 400.

MELLOTRON

This device was introduced by a British firm in the mid-sixties. It took two forms, the first intended to be a complete sound effects library, and the second a kind of 'portable orchestra'. Ingenious though they were, they were also unwieldy, complicated and expensive, and so in 1970 gave way to a much simpler second generation based on the same principles, and known as the Mellotron 400 range.

The devices are equipped with an organ-type keyboard (the key-return achieved by a spring attached to the rear of the pivot-point) and owe their success in imitative 'synthesis' to the fact that their sounds are derived from tapes of actual musical instruments. For simplicity let us consider just one key mechanism (see Fig. 1). Previously a tape will have been made of the note relating to that key; it is cut to eight seconds, on the assumption that very few pieces will require a single note duration longer than this, at the same time ensuring that the 'attack' of the note is intact. This tape is kept in a storage tank under very light tension using spring-loaded pulley-guides. The tape is laid from the storage tank over various guides, a replay head, and thence over a capstan in the form of a finely-machined bar running behind the length of the keyboard, coupled to a servo controlled dc motor. From the capstan, the tape traverses another tank, being fixed on the far side of the tank. A small rubber pinch-wheel and a felt pressure-pad on a phosphor-bronze strip are attached to the underside of the key which is pivoted near the back.

The majority of the tape is held by the sprung pulleys in the first storage tank, with the 'attack' portion of the note adjacent to the replay head when the key is at rest. When the key is depressed, it can be likened to a tape recorder mechanism moving from 'pause' to 'run' — the pinch-wheel, tape and capstan are brought into contact, and simultaneously the pressure pad pushes the tape against the head. The tape plays for as long as pressure is maintained on the key; the instant it is released, the sprung guides

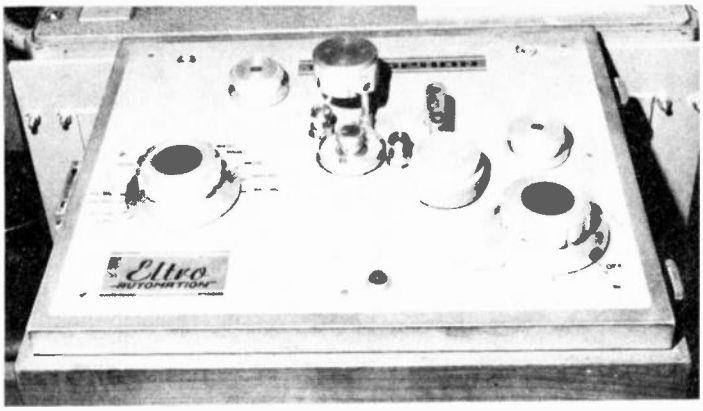


Fig. 2. Tempo-Regulator.

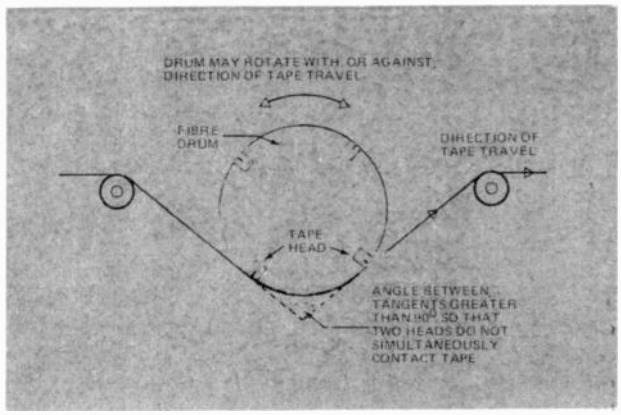


Fig. 3. Mechanical layout of tempo regulator.

from the first tank, which have been keeping the tape tensioned, return the tape to its start. This system is duplicated along the keyboard, with the multiple head block feeding its own amplifier.

The motor governing the capstan has its speed controlled by a servo-amplifier, which is in turn controlled by a single potentiometer. This permits the musician to tune the device, or introduce glissando effects which may be of large magnitude, if desired.

The tapes, which are of non-standard 3/8" width, each contain three tracks enabling the reproduction of three instruments (flute, violin and brass on the standard model) and utilise a purely mechanical track-change system – the tape guides are a fixture, and the complete head block is displaced to line the heads up with the required track. One advantage that this gives is the possibility for the musician to cross-fade between instruments, or even play combinations of instruments when the head gap is staggered across two tracks.

Simply by playing the relevant chords, whole violin sections may be effectively created. The one slight disadvantage of the Mellotron system is that, although the attacks are accurate, each note stops dead when the key is released, i.e. there is no true decay. However to an extent this is masked when chords are played, and may be further disguised by feeding the instrument through a reverberation unit.

The characteristic of this instrument that most lends itself to creative application is that the tapes, guides and storage tank can be lifted out as a self-contained unit, and another substituted to take the conventional ¼" tape width – the composer can then programme the Mellotron with any type of sound or instrument that he wishes.

THE MORPHOPHONE

Many years ago, a prototype Morphophone was developed for use in the Music Concrete Studio in France. The general principle was that a tape loop fixed to the circumference of a metal wheel was rotated, with between four and 10 heads around the loop to pick-off the signal. These could be moved within wide limits, and each had its own individually controllable filter, enabling not only prolongation of the signal, but also subtle variations of the reverberation response curve. However, its specialized nature precluded the possibility of its going into mass-production.

THE TEMPO-REGULATOR OR TEMPOPHON

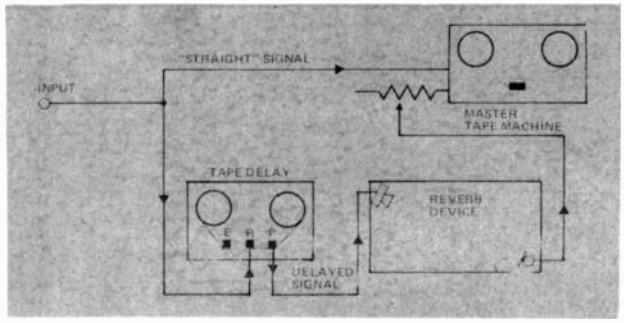
This device, in essence, performs a tape sampling operation, joining the sampled portion to compress the time scale or re-iterating the samples to expand the time scale (See Figs 2, 3).

It is used in conjunction with a variable speed tape deck, and is equally capable of converse operation which changes the pitch whilst leaving the time scale unaffected.

The device, developed by A. Springer, consists of a fibre drum with four integral magnetic heads. The magnetic tape wraps around the drum and is reproduced by the head nearest the tangential tape contact when the drum is static. If the drum is rotated in the same direction as the tape travel, then, although 60 seconds of tape will still take 60 seconds to travel from the feed spool to the take-up spool, the relative tape/head speed will have been decreased, causing a drop in the replay pitch. Increasing this tape speed in order to bring the pitch back to normal will result in the tempo being

Fig. 4. Lexicon Varispeech IA.

Fig. 5. Using a tape-delay in conjunction with a reverberation device.



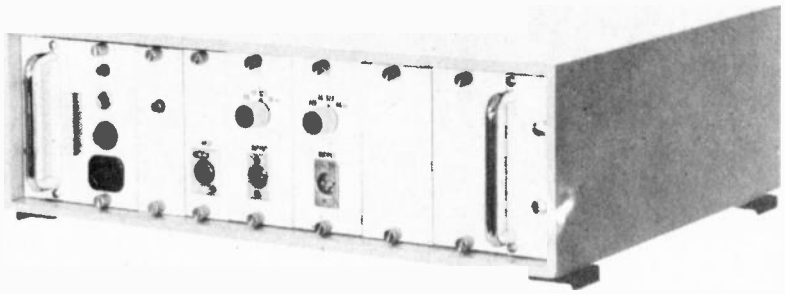


Fig. 6. Electronic Delay System EMT 440.

compressed. Rotating the drum in the opposite direction to that of the tape travel has the effect of independently expanding the duration or raising the pitch of the taped material.

This device is capable of ±30% pitch/tempo variation, but tends to be obvious in use as the transition between one head leaving the tape and the next coming into apposition, imparts an unwanted modulation to the signal.

The Lexicon Varispeech 1A (Fig.4), a relatively new piece of equipment, is worth noting although intended for a 'talking book for the blind' application rather than for electronic music. Operating on standard 1/8" cassettes, it uses digital sampling methods – the speech is transferred to a digital code. The velocity of the tape is then increased, at the same time dropping varying quantities of data before re-converting the signal into analogue form. The apparatus performs quite marked time-compression without detriment to the sense of the spoken word. However, it is unsuitable for music work, as the output has a warbling character.

DIGITAL DELAY LINES

The principal direct application of digital methods in conventional music recording is found in the 'digital delay line'.

It has long been known that a signal fed directly into a reverberation device becomes 'swimmy', the clarity of the source being muddled by its own decaying reverberation. Until recently it was standard studio practice to interpose a tape delay system between the signal and the reverberation device (See Fig.5) – the signal would be recorded by the first head of a tape recorder, and taken off via an adjacent replay head. Unfortunately the only way in which delay time could be varied was by altering the tape speed. (This governed the time taken for the taped signal at the first head to reach the second head). The most severe limitation was that short delay times required excessive tape speed on the delaying machines.

The E.M.T. 440 and its contemporaries solve this problem in the following way. The signal first undergoes 'tweaking' of the frequency response – the idea is similar to the frequency compensation applied when discs are cut, i.e. in order to optimise the signal-carrying capabilities of the medium.

This signal is then fed to a high resolution analogue-to-digital convertor and the encoded message clocked through a digital memory operating on a bucket-brigade principle at 30 kHz. The memory is in sections, so that varying lengths of delay line can be switched in as required. The signal emerging at the far end of the delay line is reconstituted in analogue form, and frequency correction applied to regain a signal of top quality suitable for feeding the reverberation unit.

Incidentally, the L.S.I's manufacturers are now developing a completely solid-state stereophonic reverberation synthesiser, using a similar delay line in which the output signal is routed back into the delay line at differing loci along the chain, the random repetition rate that results providing a realistic effect.

TAPE ECHO UNITS

Tape is a common denominator of all electronic music, whether used as a device for the transformation of material, or merely as its storage medium. Tape echo units, much beloved by rock groups, produce a flutter echo composed of a number of re-iterations rather than a cavern-type reverberation. The tape is in the form of a loop which passes an erase head, a record head, and a number of replay heads in succession, before returning to the erase head again. Combining the outputs from the replay heads and/or feeding their signal back to the record head at differing levels, gives a wide spectrum of echo effects. Further scope is possible if the output from each head can be tapped-off separately and appropriately treated via further sound modifying devices before undergoing re-combination. Drawbacks with this type system are that oxide can build up on the head, splice-noise may be a nuisance, and the transport mechanisms often leave something to be desired.

REVERBERATION DEVICES

The 'spring line' and the 'plate' are the two most common types of reverberation devices. The electro-mechanical principle is the same in both instances. The signal possibly after passing through a filter to counteract the colouration due to the mechanical elements, energises a fixed coil resembling a loudspeaker voice-coil. This encircles a ceramic magnet, free to move perpendicular to the coil windings, subject to its attachment to the metal spring or plate responsible for the mechanical transmission. A similar magnet attached at the remote end of the metal is also surrounded by a fixed coil (Fig. 7).

Signals energising the first coil, propel the encircled magnet by solenoid action, in this way causing vibrations in the metal medium. These are mechanically reflected back and forth in the metal, causing the second magnet to induce an emf, as it

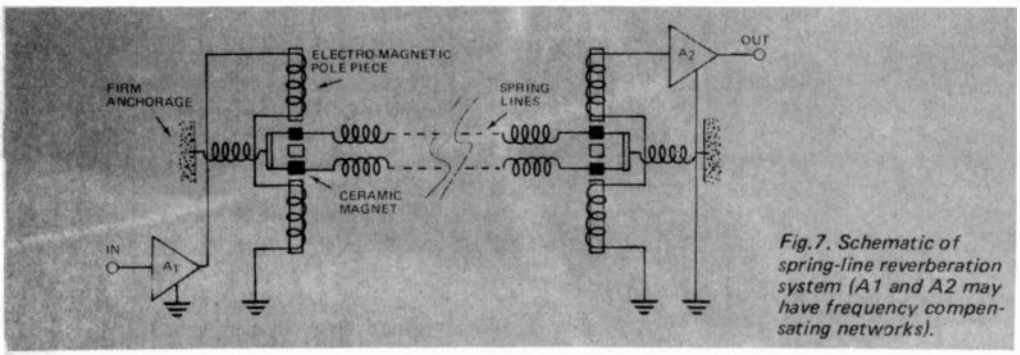


Fig.7. Schematic of spring-line reverberation system (A1 and A2 may have frequency compensating networks).

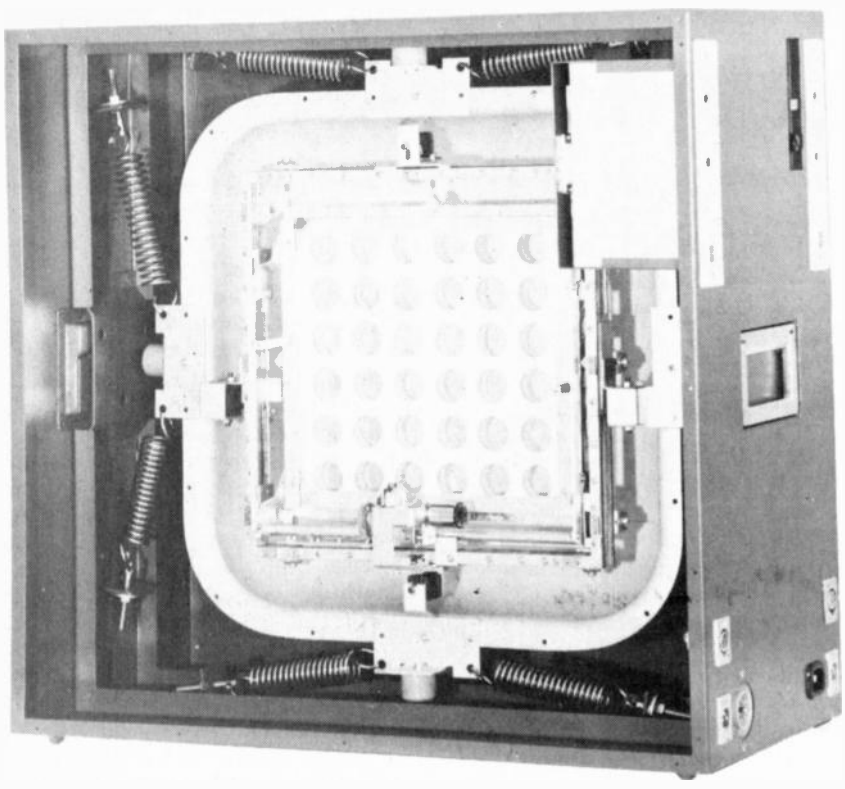


Fig. 8. EMT 240 – transportable reverberation plate.

oscillates in its fixed coil. This signal can then be amplified to feed the next item in the audio chain.

Commercial spring line units are constructed around a pair of springs of differing length, to simulate the reflections that would result from two sets of parallel walls, i.e. a rectangular room.

The standard E.M.T. reverberation plate measures around 2 metres by 1 metre, which means that once installed it is usually a fixture; its size offers the benefit of a very smooth colour-free reverberation. The decay time is controlled by a remote damper pad which is mechanically moved towards, or away from, the plate. Two years ago E.M.T. introduced a transportable version (Fig 8), using gold foil as the mechanical link between the two vibration transducers. The complete unit is acoustically isolated inside its carrying case by a webbing of springs, and produces results equal to those of its larger brother.

FREQUENCY SHIFTERS

If the tape speed of a replaying musical tone is doubled, its pitch will be raised one octave. Each of the harmonics of that tone will also be raised one octave i.e. doubled in frequency. However, if the frequency of the tone, say 440 Hz, is *electronically shifted,* by 440 Hz for simplicity, although the basic tone is raised one octave, each overtone is raised by only 440 Hz and not by an octave. The harmonic structure of the note will be completely changed.

Frequency shifters operating with shifts of around 5 Hz have been successfully used with public address systems to reduce howl, by eliminating a 'systemic resonant frequency'.

Another use of a limited-range shift device has been in electronic organs to simulate the choral tone effect.

Electronic music demands a very much higher shift than that needed for the aforementioned applications. This has been accomplished by two methods, the 'heterodyne' and the 'phase-shift' type frequency shifter.

1. THE 'KLANGUMWANDLER' OR HETERODYNING SHIFTER.

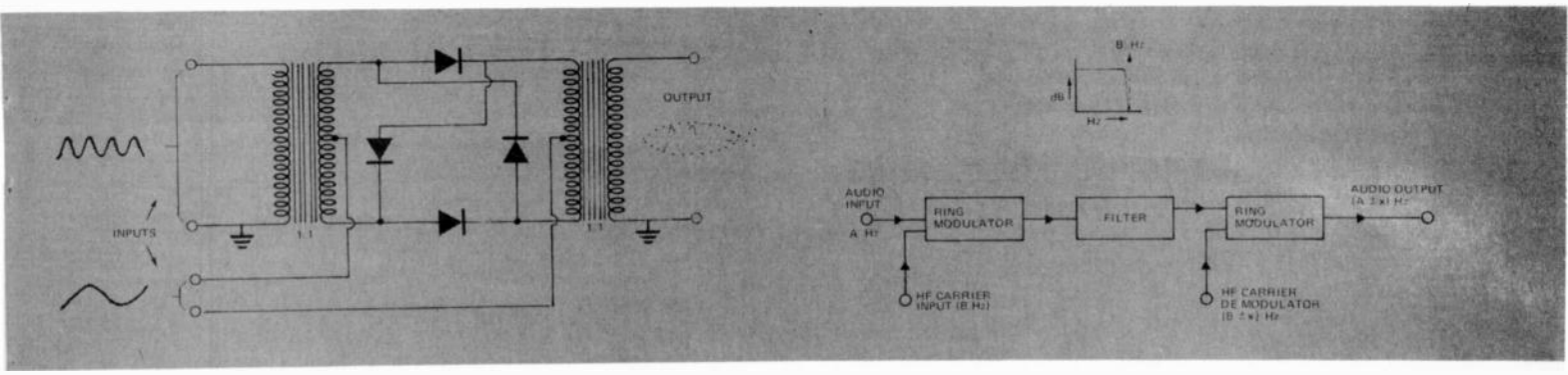
The signal is fed into one leg of a ring modulator (Figs. 9, 10) with an ultrasonic carrier, say 20 kHz fed into the other leg. The ring modulator, at its output, produces a sum signal and a difference signal of its two input frequencies. This composite signal is now passed through a filter with steep attenuation close to the carrier frequency and below, thus blocking the lower sideband from the output, which therefore consists of the upper sideband only. This is fed to a second ring modulator which has a similar ultrasonic carrier. The sum of the two ultrasonic frequencies will naturally be in the ultrasonic region, but if the ultrasonic carriers of both ring modulators are of identical frequency, the difference signal will be in the audio band, and will be a replica of the original audio signal which was fed to the first ring modulator. By this method of double heterodyning and single sideband filtering, the frequency of the audio signal is shifted by an amount equal to the difference between the two ultrasonic carriers.

If the first carrier is 20 kHz and the second 20.1 kHz, then the audio material will be shifted down by 100 Hz.

The limitation of the heterodyning-type is its useful operating range which lies between 200 Hz and 10 kHz. Interference from the suppressed sideband may be experienced below this range, and the upper frequency limit is dictated by the efficacy of the single sideband filter.

Fig. 9. Simple (transformer) ring modulator.

Fig. 10. Heterodyning-type frequency shifter.



CREATIVE AUDIO

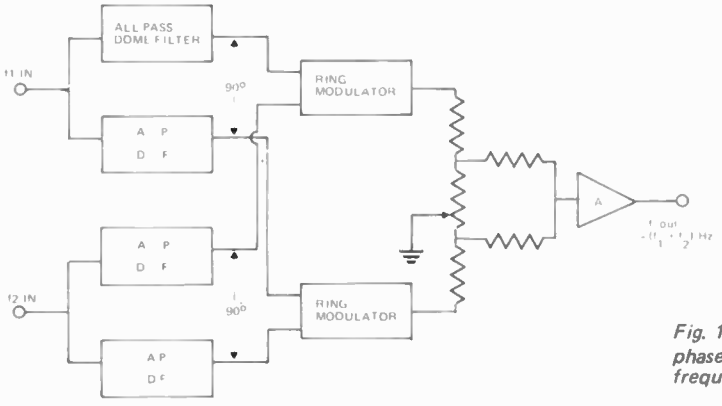


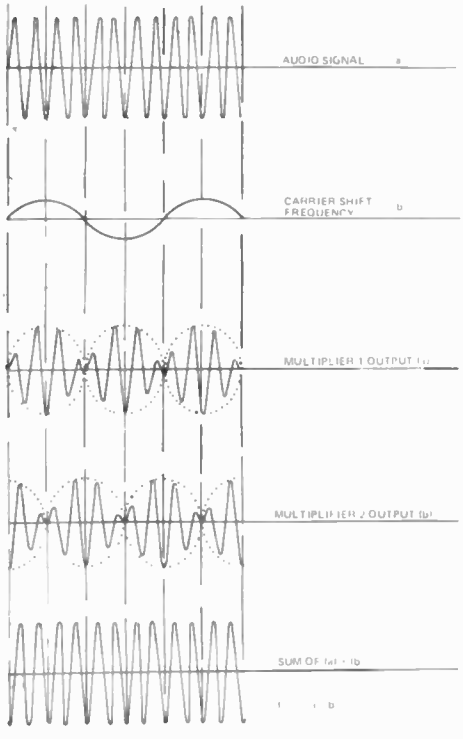
Fig. 11. Schematic of phase-shifting type frequency shifter.

2. PHASE-SHIFTING TYPE SHIFTERS.

The audio signal is split and routed to a pair of all-pass dome-filters which give two outputs, one shifted through 90° relative to the other throughout the audio range. The carrier frequency, which is the frequency by which the audio signal is to be shifted in this case, is similarly treated. The 'advanced' waveforms from audio and carrier signals are fed to one ring modulator, and both 'retarded' waveforms fed to a second.

Summing the outputs of the two ring modulators gives a waveform of a frequency equal to the arithmetic addition of the audio and carrier waves (Figs. 11, 12).

Fig. 12. Waveforms involved with phase-shifting type frequency shifter (after Bode and Moog).



A more complete mathematical analysis of the system, together with details of several other designs, can be found in the Bode and Moog paper "A High-Accuracy Frequency Shifter for Professional Audio Applications", Journal of the Audio Engineering Society, July/August 1970 Vol. 20 No.6.

One possible application of either device is found by mixing the output with the untreated signal. When no frequency shift is being caused, the mix will emerge 'straight'. An accurately controllable 'phasing' effect occurs as soon as any frequency shift is applied.

When inserted in the familiar tape-echo arrangement, in the feed-back line between the replay head and the record head, it gives the resulting tape-echo a glissando – each repeat being of a slightly higher pitch when the shifter is set to add a few cycles, and vice-versa when it is set to lower the output frequency.

MIXERS

When it comes to the task of controlling the amplitude of pure tones, the majority of commercially-available mixers are unsuitable, as sine waves highlight the slighest wiper crackle unmercifully, especially in the case of wire-wound or stepped potentiometers. Current thinking lies with indirect operation via a voltage-controlled amplifier, but long before the advent of widespread voltage-control, the B.B.C. Radiophonic Workshop had devised its own particular solution (Fig. 13), using a Wheatstone Bridge Null circuit in each channel.

One pair of opposing arms of the bridge each has a photocell placed in parallel with the arms resistance. The other two arms are trimmed for null output. The photocells are placed in a light-proof housing, together with a lamp fed from a separate dc potential divider circuit formed by the fader of that particular channel. Any wiper noise is smoothed over by the bulb's filament.

The lamp can, when required, be fed with ac, which will modulate the signal at twice the frequency of the alternating supply.

Electronic music need not be bound by the conventions which apply to orchestral works, hence stereo movement often plays a big part. The Workshop has a mixer designed with this in mind – each of the linear fader controls can also be operated in a rotary fashion to pan the relevant channel, in this way doubling the capabilities of one pair of hands!

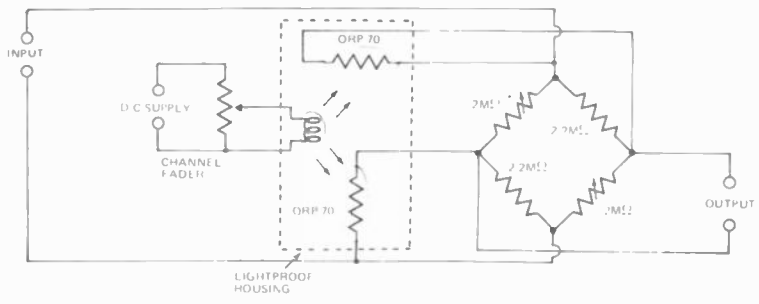
THE THEREMIN

This is the only musical instrument known to the writer that is played without being touched! The Theremin is named after Professor Theremin who, in 1928, amazed New York audiences when he demonstrated his ability "to obtain music from the ether".

The instrument has two rods protruding from its housing, each one forming one 'plate' of a capacitor. The performer's hands become the second 'plates' when held near the rods. The capacitive changes engendered in one rod controls the pitch of the tone, the other rod responding by varying the amplitude of the output.

A simple experimental circuit is

Fig. 13. Noiseless fader circuit devised by the BBC Radiophonic Workshop.



illustrated in Fig.14; the plate should be around 30 cm. square. It is placed next to a radio receiver tuned to a fairly strong station around 900 kHz. The slug of the coil is then adjusted to obtain the most pleasing tone. When the hand is moved near the plate, the pitch of the tone will change.

THE TRAUTONIUM.

In the same year that the Theremin was first shown, Professor Friederich Trautwien finalised his design for what has been claimed to be one of the first electronic synthesising devices incorporating voltage control.

The Trautonium consists of an oscillator, the grid bias of which is controlled by an ingenious variable resistor. This is in the form of an insulated drum with a winding of resistance wire, the whole suspended in a wire gauze cylinder. The inside 'ceiling' of the cylinder has a silver-plated bronze strip attached to it, which is brought into contact with the resistance wire when the gauge is depressed.

A dummy rubber keyboard mounted on top of the drum gives an approximate guide to chromatic interval, but the number of possible notes in an octave is limited by the windings on the drum under the keyboard, and is in the region of 1200 rather than 12! (Fig.15). ●

To be continued . . .

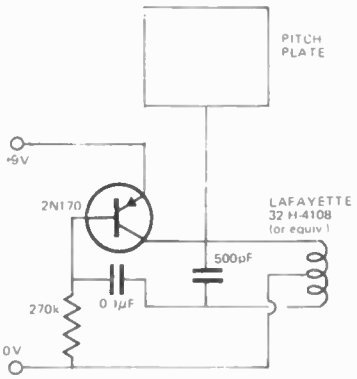


Fig. 14. Elementary Theremin Circuit.

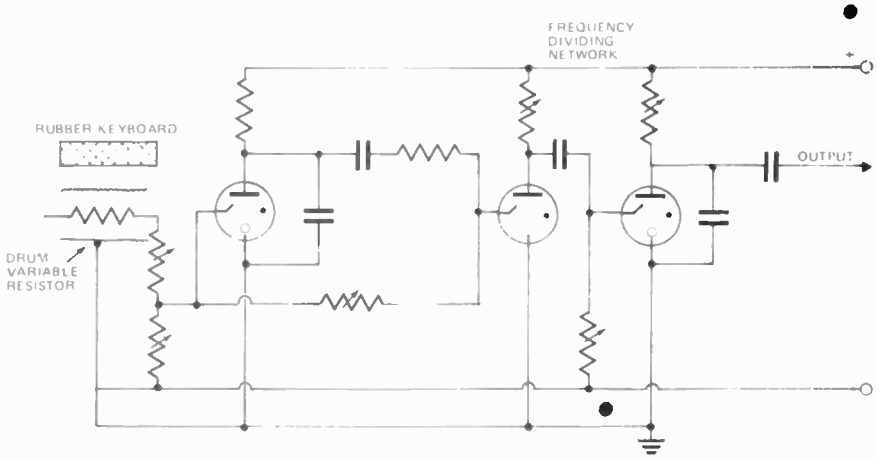


Fig. 15. Circuit of the 'Trautonium'.

THIS IS NO ORDINARY DISGUISED MAN,

IT'S THE SUPERMAN DIGIT.

The Data-Lit 707 second generation LED display has all the qualities you would like to see in a Superman digit. Low cost, low power, full solid segments with minimum gaps, low cost, availability, standard pins, high reliability, low cost.

It's Cheap. Everyone wanted us to say economical. But the DL-707 is cheap compared to what you've been used to for LED displays and tube displays. The total system cost of power supplies, drivers, digits and mounting hardware is now less in the 2 to 8 digit range using LED's *than any other* display technology.

ELD makes it all happen. Encapsulated Light Diffusion (ELD) was developed in our Krypton lab. We've produced a high quality diffusing light channel in a single encapsulating step. This allows us to use 85% less GaAsP material without sacrificing brightness. The only thing it cuts is cost.

Replaces everything else. The Data-Lit 707 is designed in the standard 14-pin dual in-line package. It's pin-for-pin identical with the MAN-1 and DL-10. The Data-Lit 704 is pin-for-pin identical to the MAN-4 and DL-4. And while it isn't pin-for-pin identical with tubes, the total system cost will beat them penny-for-penny.

the bright guys litronix

This looks like a job for Superman DL-707. If you're anywhere in the thriving metropolis of desk top calculators, POS equipment, digital panel meters, small instrumentation and so on, you have to see the Data-Lit 707 and get our volume prices.

Here's the first of our Superman Data-Lit 700 Series:

DL-707	Common anode, left decimal
DL-707R	Common anode, right decimal
DL-701	Common anode, polarity and overflow
DL-704	Common cathode, right decimal
DL-747	0-6" Light Pipe 7 seg. display A big job!

No surprises, the Bright Guys did it again.

CEMA DISTRIBUTORS

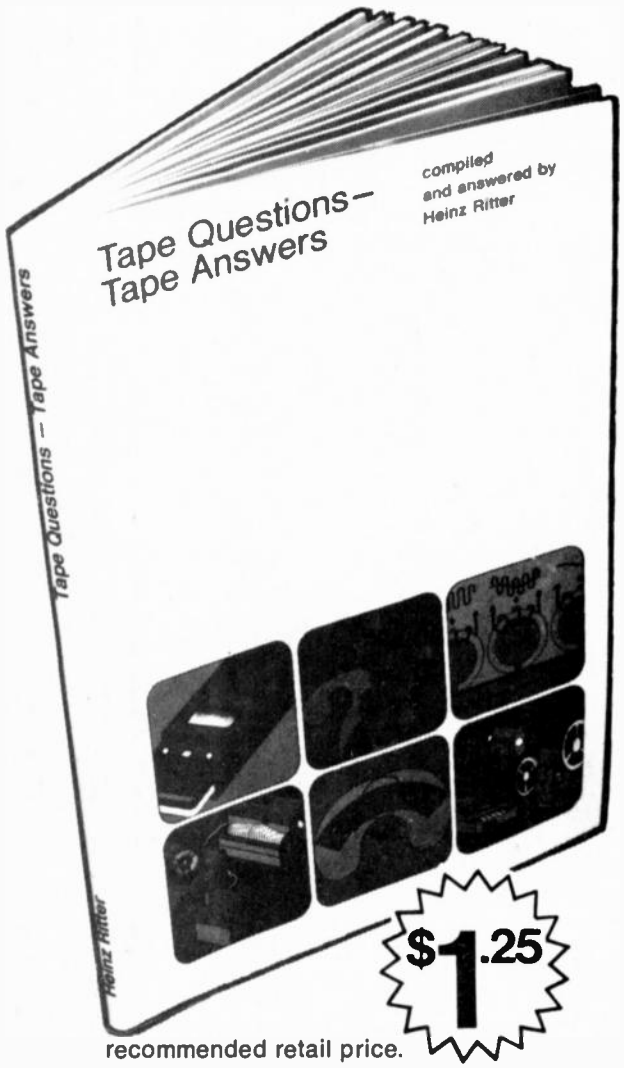
SUPER HUMAN RESOURCES EX STOCK

21 CHANDOS STREET, CROWS NEST N.S.W.
Ph. 439-4655
Telex 22846

543 KINGS STREET, MELBOURNE VIC. 3001
Ph. 329 7144
Telex 32295

2 WATSON AVE., ROSE PARK S.A. 5067
Ph. 32-4311

NOW Answers to all the questions you've ever asked about tape recorders - **in one book!**



recommended retail price.

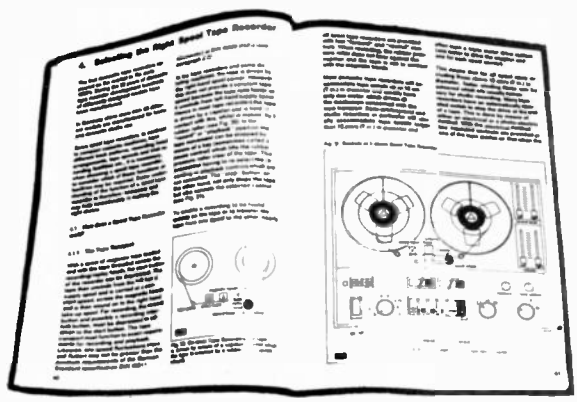
Whether you've just built your own hi fi system, or whether you're just thinking about your first cassette recorder, "Tape Questions—Tape Answers" will be a mine of valuable information. Written by noted German authority, Heinz Ritter and published in conjunction with BASF, world leader in tape, this book covers all aspects of recording on magnetic tape. Here's just a few examples taken from the 18 Chapter headings:— "Selecting the right tape"; "Which Sound Mixing for what Purpose?" "Which microphone for what purpose?" "Editing and splicing of Magnetic Tape." "Tape recorder maintenance." "Compact Cassettes or Spool Tape Recorders?" "How to add sound to 8mm Film."

All the technical data for experts, clear explanations and illustrations for the experts-to-be. Over 120 pages with 100 illustrations and diagrams.

Get more satisfaction by using your equipment more effectively. Save money by selecting the right gear. Maybe settle a few arguments!

At just $1.25 you can't afford to be without this valuable reference book.

Buy "Tape Questions—Tape Answers" at your BASF dealer NOW!



Buy "Tape Questions-Tape Answers" at your **BASF** dealer NOW! OR send this coupon

BASF

To: Maurice Chapman and Company Pty. Ltd., Box 882, G.P.O., Sydney 2001.
Please send me my copy of "Tape Questions, Tape Answers." Enclosed is my Cheque/Postal Order/Money Order for $1.45, which covers postage and handling.

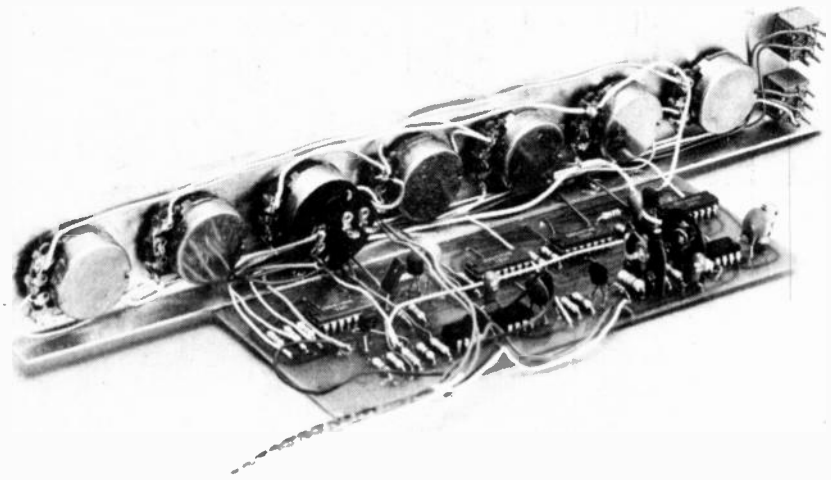
NAME

ADDRESS

POSTCODE

BA2408

3600/4600 INTERNATIONAL MUSIC SYNTHESIZERS



TRANSIENT Generator 2 module provides an almost infinite variety of output shapes.

It may for example be used to modify the keyboard output voltage. Such a keyboard output would, when applied to an oscillator for example, cause it to commence the note in tune, raise to say one octave higher, hold the note for a preset period and then drop the note to one octave lower than the basic frequency.

The number of semitones or octaves, shifted up or down, is uniform over the entire keyboard range. The maximum design range of control is of the order of plus or minus two octaves.

Usually this module will be used to control a Voltage Controlled Filter (VCF), in the bandpass mode, being fed from a complex waveform (considerable harmonic content). Upon pressing a keyboard key the Transient 2 waveform could for example, cause the filter to commence at the timbre as selected the VCF "TUNE" control, sweep up to the higher overtones and finish on the lower fundamentals.

CONSTRUCTION

With the aid of the component overlay (Fig. 2), assemble components to the printed circuit board paying particular attention to the orientation of integrated circuits, transistors, diodes and electrolytic capacitors.

It is recommended that sockets be used – for the CMOS ICs at least. These CMOS ICs should also be the last components to be fitted to the board.

The mechanical assembly is similar to

PARTS LIST

Transient Generator 2

R1, 19, 22	Resistor	100k	¼W	5%
R2, 13, 18	"	10k	"	"
R3	"	15k	"	"
R4	"	680 ohms		
R5	"	470 ohms		
R6	"	8.2k		
R7, 9, 11	"	1M		
R8, 12, 15, 16, 17	"	1.2k		
R10	"	1.8k		
R14	"	39k		
R20	"	3.3k		
R21	"	470k		
RV1, 2, 6		2M log rotary		
RV3, 4		22k trim potentiometer		
RV7, 8, 9		25k lin rotary		
RV5		2M log rotary switched		
C1,	Capacitor	4.7µF 25 V tag tantalum		
C2, 6,	"	33pF ceramic		
C3, 5	"	0.0033µF polyester		
C9, 10	"	10 µF 25 V tag tantalum		
C8	"	10pF ceramic		
C4, 7	"	2.2 µF tag tantalum		

IC1, 2, 3	Integrated circuit	LM301A
IC4, 5	" "	SCL4016AE*
IC6, 7	" "	SCL4011AE**

* the prefix and suffix of CMOS varies from manufacturer to manufacturer.
** should be Solid State Scientific only (CEMA)

Q1,	Transistor	PN3638 or similar
Q2, 3, 4	"	PN3643 or similar
D1, 2,	Diode	IN914 or similar
SW1, 3	Switch	SPDT minature toggle CNK7201 or similar
SW2	"	Part of RV5
PC Board	ETI 601g	

Metal bracket to Fig 4.

Recommended extras

8 pin socket Utilux type M2139-8 off
Utilux type M2138 pin 8 off
14 pin IC socket 4 off.

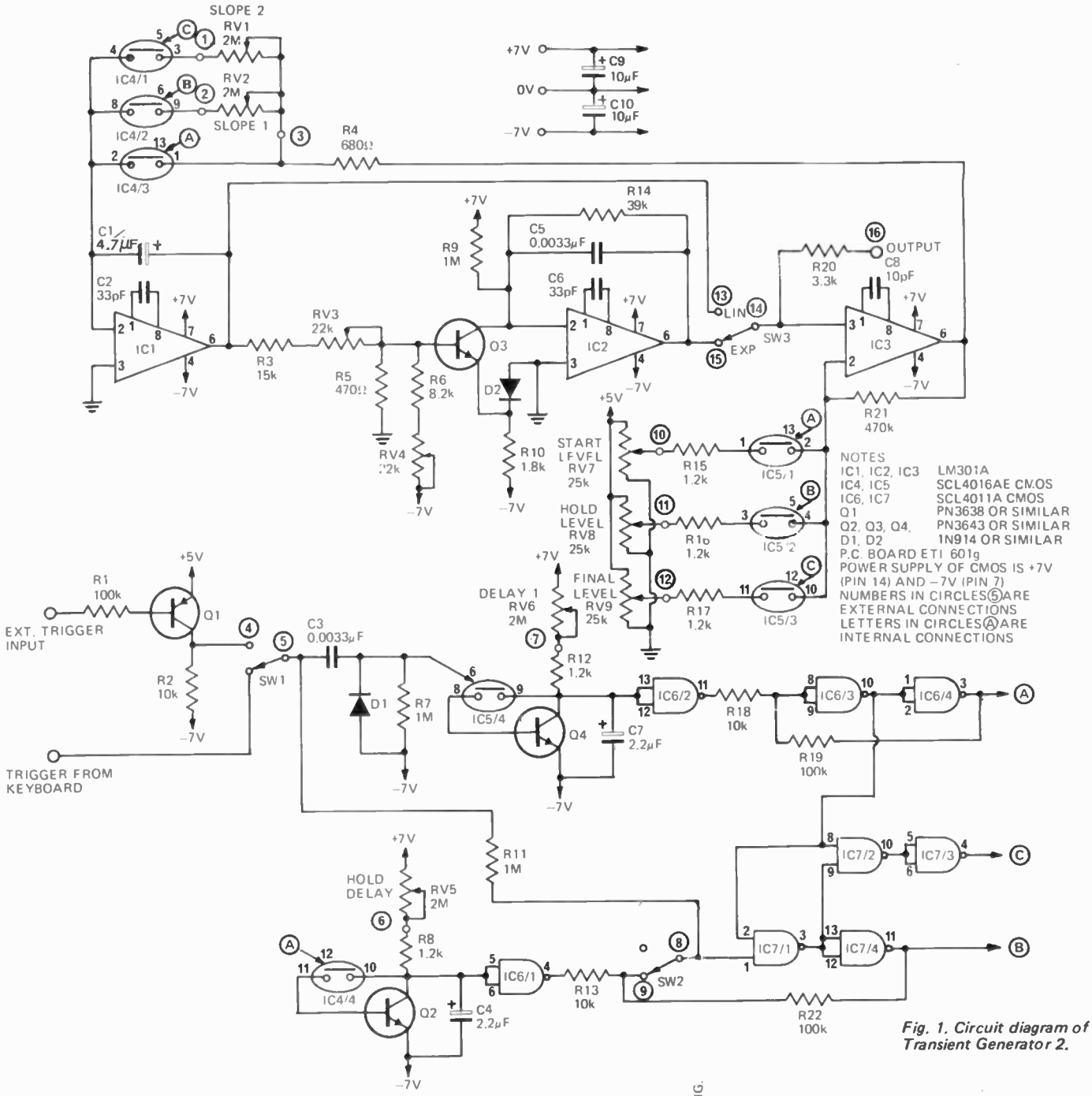


Fig. 1. Circuit diagram of Transient Generator 2.

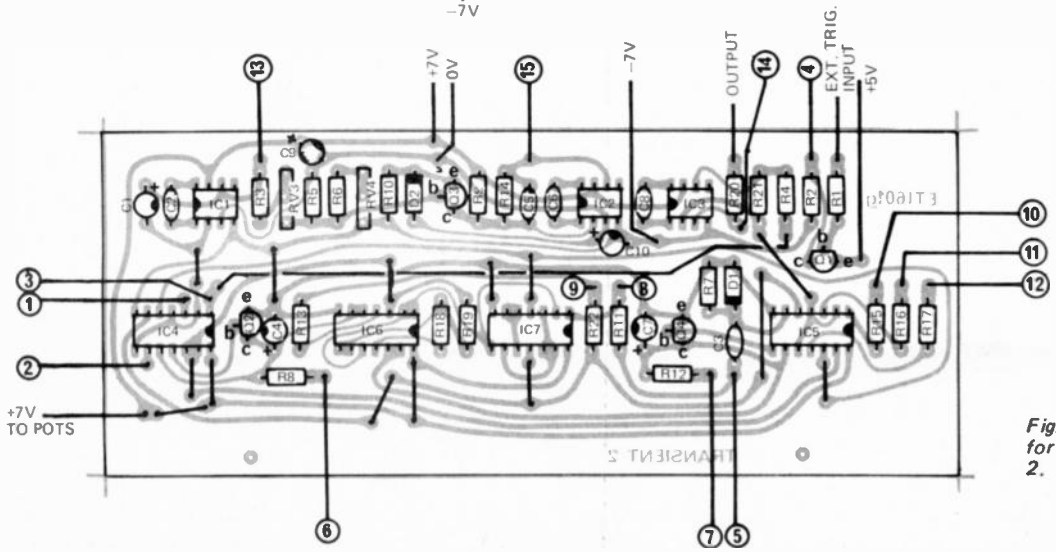


Fig. 2. Component overlay for the Transient Generator 2.

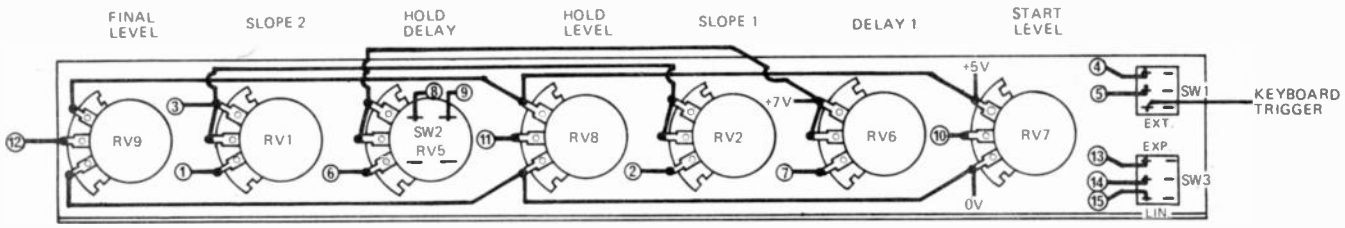


Fig. 3. Wiring diagram to switches and potentiometers on the mounting bracket.

INTERNATIONAL MUSIC SYNTHESIZERS

that for Transient 1 (described last month). All rotary potentiometers and switches are mounted onto the bracket, drilling details for which are shown in Fig. 4. The bracket, in turn, is mounted onto the component side of the printed circuit board.

Wiring between the potentiometers and switches, and the connection points to the printed board is illustrated in Fig. 3.

CALIBRATION

As with Transient Generator 1, the exponential converter section has to be calibrated. Begin by setting SW3 to the LINEAR position and SLOPE 2 to maximum rate.

Measure the output voltage and check that it is variable between '0' volts and +5 volts by means of the FINAL LEVEL control.

Adjust the output to '0' volts by means of the LEVEL CONTROL and adjust RV4 so that the output of IC2 is exactly zero.

Adjust the output to +5 volts with the level control and then adjust RV3 for +5 volts at the output of IC2.

Repeat the previous two adjustments until the settings remain correct when the level control is varied from one end to the other.

Switch to EXPONENTIAL and check that the output of IC1 does not go negative at any setting.

HOW IT WORKS

Transient Generator 2

This module is very similar to the Transient 1 generator described last month. It consists of two main sections.

1) The wave shaping circuitry (analogue).

2) The control circuitry (digital).

The analogue section is almost identical to that of Transient 1, described last month, and reference should be made to that article. The main exception is the omission of the reset-transistor across the integrator IC. Additionally the three inputs to the comparator are all adjustable, the 'ATTACK' potentiometer has been deleted and the 'attack time' is thus always at its maximum rate.

Last month's "How it works", in conjunction with both circuit diagrams should readily explain the operation of this section.

The digital section of the two modules is different. That for Transient 2 works as follows:–

When a trigger pulse is presented to gate IC5/4, it turns on for about 3 millisecs. This discharges C7 via Q4. The resulting low level at the input of IC6/2 gives 'high' output at (A) (IC6/4). Whilst (A) is high C4 will remain discharged.

The digital ICs used in this module are 2-input NAND gates (four per package), the truth table for which is shown below:–

INPUT 1	INPUT 2	OUTPUT
0	0	1
0	1	1
1	0	1
1	1	0

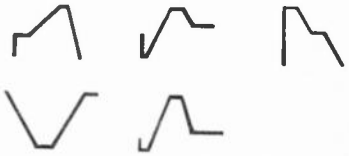
Note that for the ±7 volt supplies as used, '0' means less than –1 V and '1' means greater than +1 V at the inputs. In the case of outputs, '0' means close to –7 V and '1' means close to +7 V.

A high output at (A) will select the maximum slope rate and the START LEVEL potentiometer RV7. The output will go rapidly (within 5m-secs) to the level set by RV7.

After the initial 3 m-sec period C7 begins to charge at a rate selected by 'DELAY 1' control, RV6. When C7 charges to approximately 0V the output at (A) will go low allowing output (B) to go high selecting 'SLOPE 1' and the HOLD LEVEL as set by RV8. The output will now charge towards this new level at the SLOPE 1 selected rate. At the same time capacitor C4 is also released and begins to charge. When about half charged (around 0V) the output (B) will go low and output (C) high. Thus 'SLOPE 2' is selected and the 'FINAL LEVEL' set by RV9. The output cycle is thus complete and the final level will be maintained until the unit is retriggered.

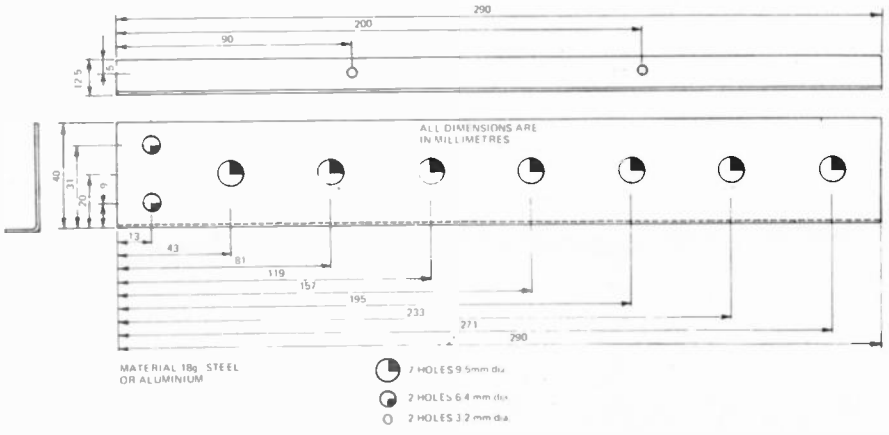
Note that the slopes can be in either direction depending only on the settings of the level potentiometers.

Below are examples of output waveforms available.



If the 'HOLD DELAY' potentiometer (RV5) is switched off, the key hold time replaces the hold delay, and, if the key hold time is less than DELAY 1, then at the completion of DELAY 1, SLOPE 2 and FINAL LEVEL will be selected – thus eliminating SLOPE 1 AND HOLD LEVEL.

Fig. 4. Mounting bracket for Transient Generator 2.



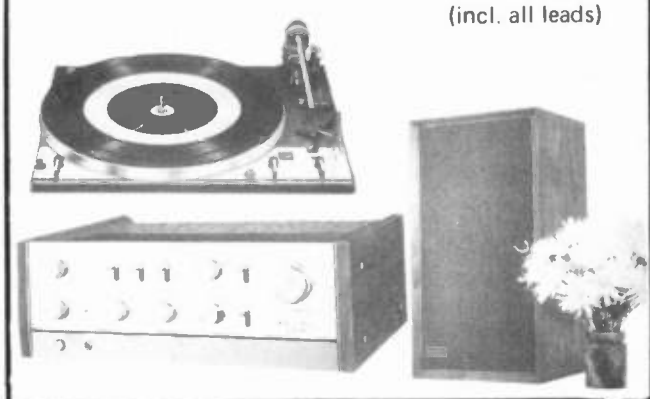
4 TOP QUALITY SYSTEMS TO CHOOSE FROM

Dual 1214 Turntable
Kenwood 4002A Amplifier
Wharfedale Meltons Speakers.

$445 (incl. all leads)

Dual 1216 turntable or belt drive
turntable (with Shure 75E cartridge)
Kenwood 4004 amplifier
Altec Lansing Coronas speakers

$599
(incl. all leads)



New Garrard S86 SB turntable belt/drive
(with Shure 91 ED cartridge)
Onkyo 733 amplifier
Transmission line speakers
(built from KEF B129, B110, T27)

$799 (incl. all leads)

Thorens TD 160 turntable (with Ortofon
MF 15E, or Shure V15 III cartridge)
Crown IC 150 preamplifier
Crown ID 150 amplifier
The new ESS AMT 1 loudspeaker

$1599
(incl. all leads)

FULL DETAILS OF THESE SYSTEMS, WRITE OR CALL AT:

KENT HI-FI

432 KENT STREET
SYDNEY ph: 29-2743

(WHERE THE BEST
EQUIPMENT COSTS LESS)

no gimmicky sales talk. just the facts.

- High-precision, polished uniform thickness POLYURETHANE BELT provides smooth revolution with minimized wow-flutter (less than 0.175) and high s/n ratio (better than 48dB).
- DIE-CAST ALUMINIUM ALLOY DOUBLE RIM PLATTER, driven by belt drive system assures precise and constant speed through optimum flywheel action.
- 4 POLE SYNCHRONOUS MOTOR assures smooth, and stable revolution.
- STATIC BALANCE TYPE S-SHAPED TONEARM with REVOLVING TYPE COUNTERWEIGHT eliminates lateral balancing weight and assures easy and stable operation.
- New ANTI-SKATING DEVICE, with self compensating CANCEL FORCE according to stylus pressures, eliminates the distortion caused by inside-force and protects stylus and record.
- REVOLVING type counter weight and PLUG-IN TYPE. New SLIM LINE and non-resonance HEAD SHELL made of special light aluminium alloy accepts cartridges of 4 to 9 grams.
- DIRECT READING SCALE RING coupled with counter weight permits easy and accurate adjustment of the stylus pressure from 0 to 3 grams.
- OIL DAMPED ARM LIFTER provides the up and down arm movement by feather-touch lever.
- "FEATHER-TOUCH" SPEED SELECTOR allows easy selection of 33.1/3 or 45 r.p.m. speed with BELT PROTECTION MECHANISM.
- CARTRIDGE, designed after severe hearing test, reproduces fresh dynamic sound realistically with fine tracing ability.
- SEMI-AUTO and MANUAL models also available.

RALMAR
agencies pty. ltd.
71 Chandos St., St. Leonards 2065 Tel.: 439 4352

AGENTS:
QLD: Tallerman & Co. Pty. Ltd., Robertson St., Valley, Brisbane
VIC: K.J. Kaires & Co. Pty. Ltd., 4 Hill Court, Macleod
S.A.: K.D. Fisher & Co., 72-74 McLaren St., Adelaide
N.Z.: Avalon Radio Corp. Ltd., 131-139 Hobson St., Auckland
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

EDITORIAL OPPORTUNITY

ELECTRONICS TODAY INTERNATIONAL is now thoroughly established in Australia, France and England. In the three years since its inception it has become the third largest electronics publication in the world.

We also publish a highly successful audio trade magazine and will shortly be expanding into further areas.

The ETI group of magazines is owned and published by Modern Magazines (Holdings) Ltd, a totally Australian owned and run organization.

Due to our continuing programme of expansion we need an Assistant Editor for ETI.

The successful applicant will, after a reasonable period of time, be expected to take prime responsibility for the production of the magazine – under the general direction of the Editor – and to take full responsibility during the Editor's absence.

It is our ultimate intention that the successful applicant will eventually take over the full Editorship.

The main requirements are:–

- Extensive knowledge of electronics and the electronics industry, preferably including hi-fi and television. Technical qualifications are desirable but by no means essential.
- Ability to work on a number of often-exacting tasks simultaneously, whilst still maintaining close attention to detail.
- The ability – or at least the desire – to write clearly and simply about complex matters. Here, clarity of expression is considered to be more important than totally impeccable grammer.

We have no rigid ideas about age – except that applicants under 26 or so are unlikely to have sufficient general experience. But if you think you are the person we seek – then apply anyway!

Applications are invited both from men and women, applicants for this, or any other position within the ETI group of magazines will be assessed solely on their potential ability to do the job.

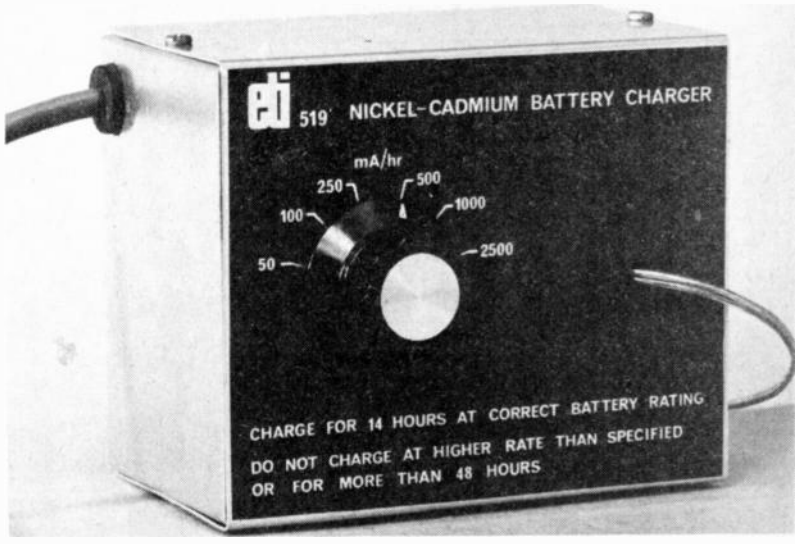
Salary will be by negotiation. This is a responsible and demanding position. The successful applicant will be paid accordingly.

Please apply in writing to our Editorial Director, Electronics Today International, Ryrie House, 15-19 Boundary St., Rushcutters Bay, NSW. 2011.

All replies will be treated in the strictest confidence.

NICKEL-CADMIUM BATTERY CHARGER

Universal unit will charge practically any nickel-cadmium battery currently in use.



PROJECT 519

THERE is an increasing proliferation of portable equipment, such as flash guns and calculators, which could, or already do, use rechargeable batteries of the nickel-cadmium type.

If the equipment was originally fitted with rechargeable batteries, a charger may well have been provided. But when replacing ordinary dry cells with rechargeable types a charger will be required. Unfortunately, nickel-cadmium battery packs come in a variety of voltages and ampere-hour ratings and a charger supplied for one piece of equipment (eg, an electronic flash) will seldom, if ever, be suitable for other equipment such as an electronic calculator.

The ETI 519 battery charger will charge almost any nickel-cadmium battery in use today. The charging rate is switch-selectable for batteries from 50 mA/h to 2500 mA/h capacity.

Any battery voltage up to 20 volts is *automatically* accommodated. No voltage selection is required.

Charging time is approximately 14 hours for a flat battery and proportionally less for one that is partially discharged.

Overcharging at the correct ampere/hour rate will not damage a nickel-cadmium battery. Thus an overnight charge for a partially discharged battery may be safely given. In fact, provided the correct ampere/hour charging rate has been selected no damage will occur if left on charge for 48 hours.

CONSTRUCTION

The circuit is a very simple one. Practically any method of construction may be used provided care is taken with the insulation of 240 Vac wiring.

In our prototype unit we assembled all components on tag strips, with the exception of the range resistors which were mounted directly on the range switch itself.

If only a single range is required, a

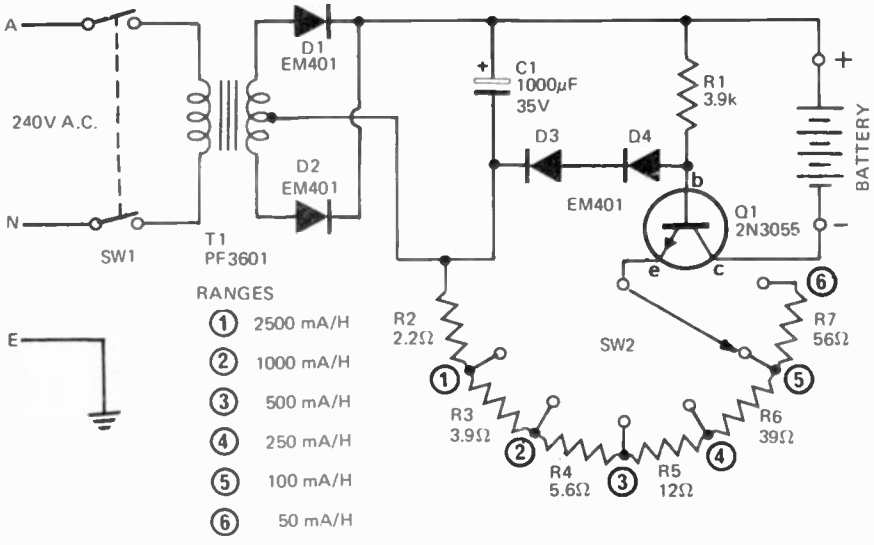


Fig. 1. Circuit diagram of the Nickel-Cadmium Battery Charger.

TABLE 1

BATTERY VOLTAGE	TRANSFORMER **	R1
1.25 – 3.75	12.6 V CT	1 k
5 – 10	24 V CT	2.2 k
11.25 – 20	40 V CT	3.9 k
21 – 30 *	60 V CT	5.6 k

* Capacitor C1 voltage rating should be 50 V.

** Current rating of the transformer, in mA, should be greater than the maximum mA/h battery rating divided by 10. A single winding transformer of half voltage may be used if a bridge rectifier is employed.

single resistor may be used. Its value in ohms should be 6000 divided by the mA/h rating of the battery. The nearest 5% nominal value to that calculated as above will be adequate.

By virtue of the nature of the constant current supply any battery, or bank of batteries up to 20 volts may be charged. If the 20 volt capability is not required a different transformer may be used as detailed in Table 1.

The transistor dissipates a fair amount of heat and hence should be mounted on a piece of aluminium to act as a heatsink. This piece of aluminium should be insulated from the case, or if not, the transistor should be mounted on the aluminium via a mica washer and insulating bushes. ●

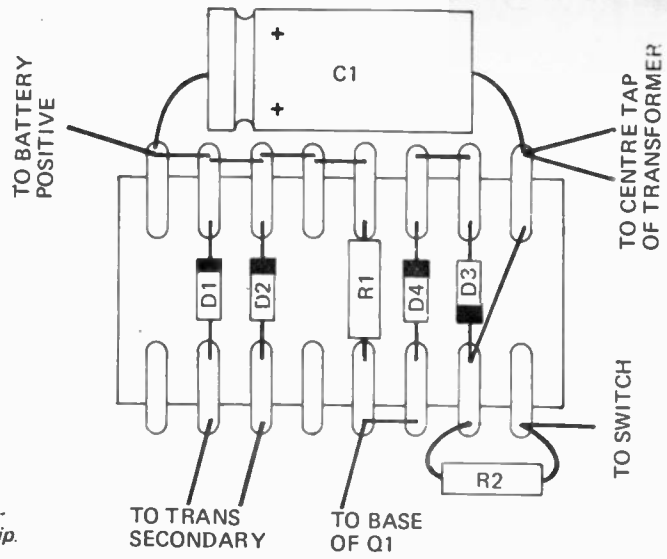


Fig. 2. Layout of components on the tag-strip.

HOW IT WORKS

Current regulators operate in opposite fashion to voltage regulators. In a current regulator, the current remains constant regardless of changes in load impedance – the output voltage varies to maintain constant load current.

In this circuit, the 240 Vac mains is reduced by T1 to 40 Vac. This is then rectified by D1, D2 and filtered by C1 to provide approximately 28 Vdc.

This dc supply is then regulated by Q1 and its associated components to produce a current level selected by SW2.

Transistor Q1 is biased by D3 and D4 such that there is about 1.2 V between the base of Q1 and the negative side of C1. As there is 0.6 V between base and emitter of Q1, there will be 0.6 V developed across the resistor network R2-R7. Therefore the emitter current of Q1 must be 0.6 V divided by the resistor value selected by SW2.

The emitter current generated as above will produce an approximately equal collector current which charges the battery and remains constant provided there is at least one volt between the collector and emitter of Q1.

PARTS LIST

ETI 519

R1	Resistor	3.9 kΩ	½ W	5%
R2	"	2.2 Ω	"	"
R3	"	3.9 Ω	"	"
R4	"	5.6 Ω	"	"
R5	"	12 Ω	"	"
R6	"	39 Ω	"	"
R7	"	56 Ω	"	"

D1-D4 Diodes EM401 or similar
C1 Capacitor 1000μF 35 V electrolytic
Q1 Transistor 2N3055
T1 Transformer PF3601 20 V-0-20 V
SW1 Two-pole on-off switch
SW2 Six-position single-pole rotary switch
Metal box, bracket for 2N3055, 3-core flex and plug.

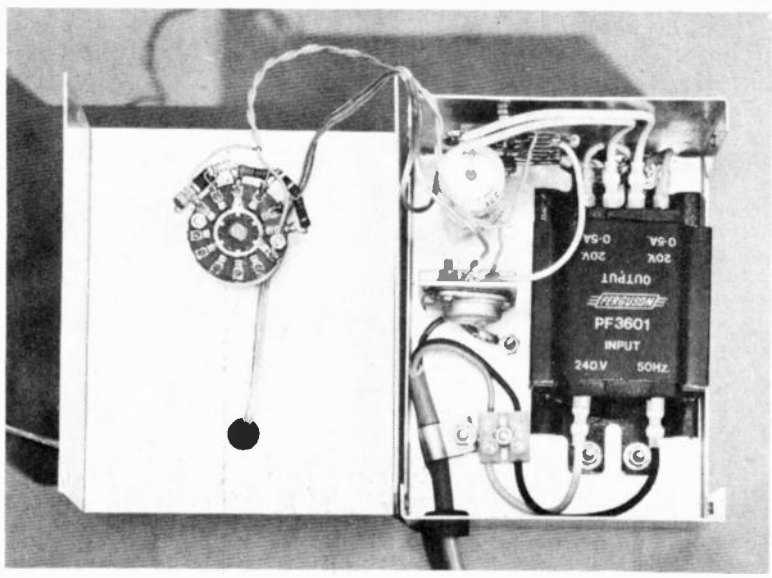
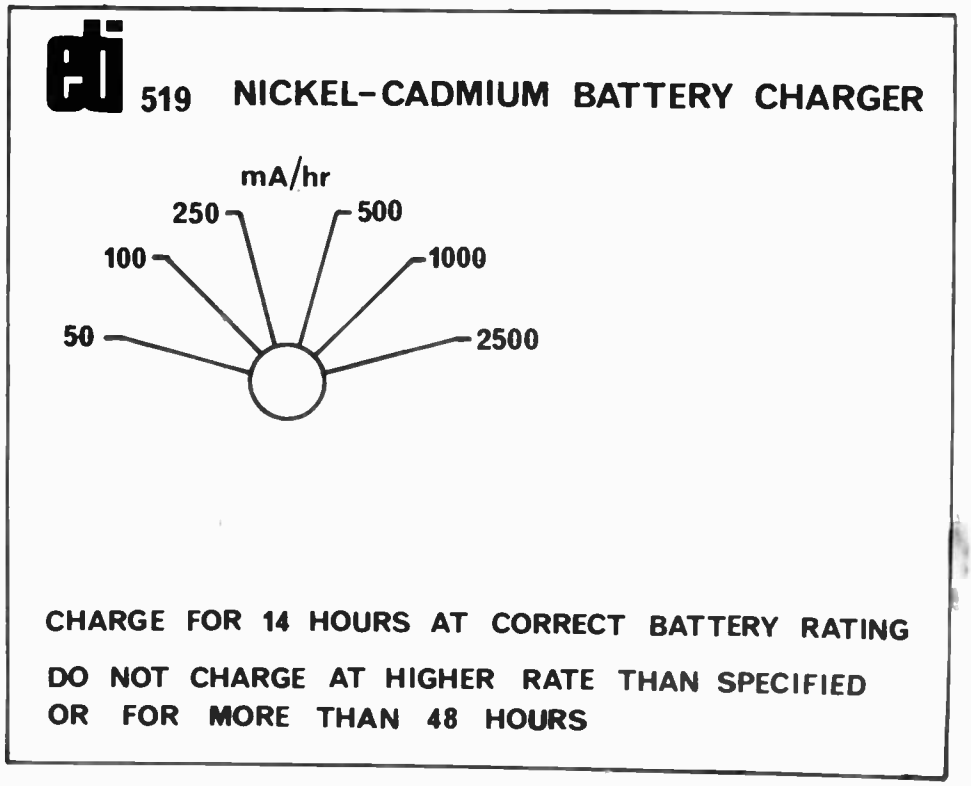
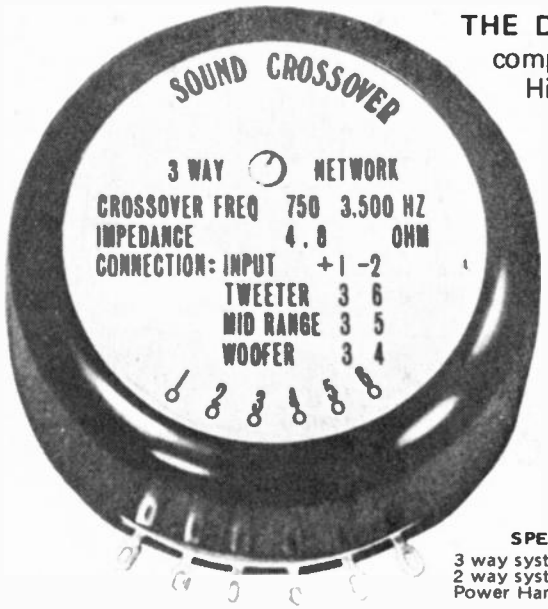


Fig. 4. Front panel artwork.



ACCEPT NOTHING LESS



THE DELTEK SOUND CROSSOVER is a precision audio component designed to improve the performance of your Hi Fi speakers. Distorted sound and incorrect frequency calibrations are the result of poor crossover designs, such as the condenser-type, and sometimes, even no crossover at all!

You must insist on the DELTEK SOUND CROSSOVER.

It will match your woofer, mid range and tweeter with the frequencies from your amplifier perfectly.

Improve your speakers' performance today.

for only **$8.00**

SPECIFICATIONS
3 way system. 750, 3500 Hz
2 way system. 3500 Hz
Power Handling 300 W

distributed by **DODWELL TRADING** 8 GLEN ST. MILSONS PT. NSW.

Designed to provide reliable, high-speed and long life operation, OKI series MRD and URD relays are employed in a wide variety of applications including transistor, integrated circuit, general purpose control, telephone and telegraph switching and data processing equipment circuitry.

OKI relays are extremely small and lightweight, highly sensitive and of magnetically shielded construction to enable close proximity mounting with each other without interaction.

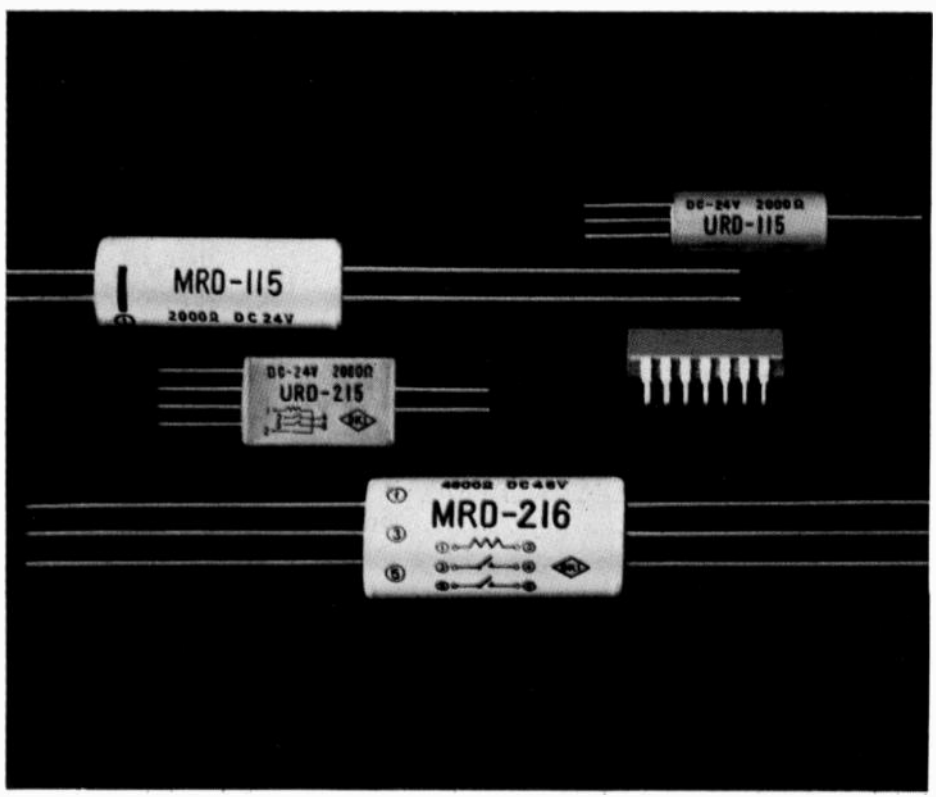
A wide range of packages are available: all are shock, vibration and humidity resistant. Series URD are miniaturised versions of the MRD and include a 14 pin DIL package. They are particularly suitable for switching circuits with high output/input ratios.

OKI relays incorporate miniature reed insert switches and coil assemblies. Switch contacts employed in the range are of rhodium or gold diffused material for maximum reliability and life.

Comprehensive literature is available on request to the Professional Components Division.

Plessey Oucon Pty. Limited
Box 2, P.O. Villawood, N.S.W. 2163
Telephone: 72 0133. Telex: 20384
Melb: Zephyr Products Pty. Ltd. 56 7231
Adel: K. D. Fisher & Co. 42 2920
Perth: H. J. McQuillan Pty. Ltd. 68 7111
Everett Agency Pty. Ltd. 81 5500
N.Z.: Henderson (N.Z.) 64 189

OKI MRD & URD DRY REED RELAYS



PLESSEY

AC98

KIT-SETS AUSTRALIA

AUSTRALIA'S LEADING
ELECTRONIC COMPONENTS–K

NOW! SPEAKER SYSTEMS THAT CANNOT B
AND PRICE!

Everyone knows that a speaker system is the most important part of
That is why KIT-SETS AUSTRALIA, the Nation's largest chain of ELE
HI-FI CENTRES, have decided to market an exclusive range of sele

Steintron

THEY MUST BE SEEN AND HEARD TO BE BELIEVED!

Kit-Sets Australia have imported a range of speaker systems direct from the manufacturers Never before have such high quality systems been offered at such a low price. The savings have been brought about by our policy of direct importing which bring you, the customer, systems at almost half the normal retail price.

MODEL V120 12" 4-WAY SPEAKER SYSTEM

Top of the range is the Model V120 which consists of a roll surround high compliance 12 inch woofer, a 6½ inch midrange (with a crispness which has to be heard to be believed) complemented by a highly efficient 1½" Dome tweeter with 120° Dispersion and the most incredible 2" Super tweeter. Comes in a beautiful walnut finish, sturdy cabinet with a wood slotted grille, rather than the normal grille cloth fitted to lesser quality units. The cabinet has a cubic capacity of 2.75 cu.ft. having sides 1" thick to stop any resonances that may occur. To top all this the crossover has roll-off of 12 dB per octave and includes a tone control to allow you to tailor the response to your room. Power handling capacity 50 watts RMS frequency response 20-22000 Hz.

Our special Direct Import price is only $198.00 per pair. Freight $10.00 per pair for mail order.

only $99 each

MODEL V100 10" 3-WAY SPEAKER SYSTEM

MUST BE HEARD TO BE BELIEVED

For the economy minded we have the Model V100 which has all the features of the V120 except has a 10" woofer plus 5" midrange and the same 1½" Dome Tweeter in a 1.75 cu.ft. enclosure, an incredible power handling capacity of 40 watts RMS and a Frequency response of 20-20 000 Hz.
$158.00 per pair. Freight $10.00 per pair for mail order.

only $79 each

INCREDIBLE

Have you ever tried to find extension speaker, small enou anywhere in your room or car power handling capacity of RMS, a frequency and bass res equal that of a 10 inch tw speaker, with an attractive finish.

Ideal for rear channel use!

GUESS WHAT? WE HAVE FOUND IT!

Our little Cube speaker took 3 develop and has all the features been looking for in a small spea is fitted with an 8 ohm 5" fu speaker with voice coil throw o bass response equal to that o speaker, a frequency response to 18 kHz, achieved with a 3" structure. All enclosed in a measuring only 6" x 6" x 6". in 3 decorator colours: black, ivory. This is the best small speak on the Market today at the in low price of $14.95 P/Post $1.5

PRICE SLASHED ON

FOR THE BUDGET CONSCIOUS

A beautifully presented So system featuring 5¼" woofer a 2½" tweeter. Is an ideal compa system and can be used to provi top quality rear channel soun Power handling 10 wat frequency range 95-1800Hz. steal at this never to be repeat price!

JUST $27.50 EACH

YOU OWE IT TO YOURSELF TO INSPECT R

DEE WHY	SYDNEY	BRISBANE	MEL
21 Oaks Ave.,	400 Kent St.,	293 St. Paul's Ter.	271
Dee Why	Sydney.	Fortitude Valley.	Rich
Ph: 982-7500	Ph: 29-1005	Ph: 52-8391	Ph:

*FOR MAIL ORDER PHONE YOUR NEAREST BRANCH.

ELECTRONICS AND HI-FI SPECIALISTS

TS–TEST EQUIPMENT—HI-FI EQUIPMENT

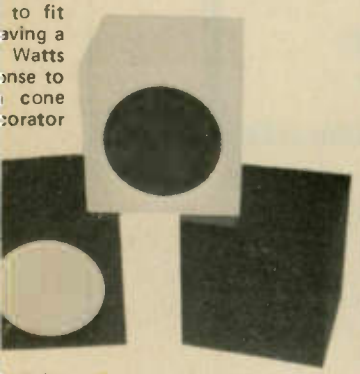
E BEATEN FOR QUALITY, PERFORMANCE

ıy hi-fi system! TRONICS AND ed top quality

imported and locally built speaker systems at their traditionally low prices! Only because we sell so many speaker systems can we import direct and cut out the middle man, to offer you top quality speaker systems at these incredible prices!

CUBE 55

small to fit aving a Watts nse to cone corator

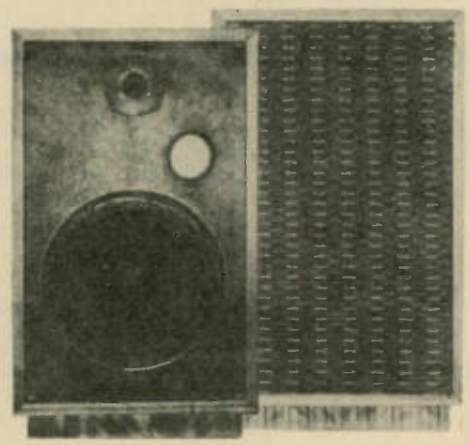


ears to u have er, yet range ½". A a 10" om 45 nagnet abinet ailable d and r value edibly

A MUST AT ONLY $14.95 EACH

DO-IT-YOURSELF IN ONE EVENING AND SAVE 30%

PLESSEY ASSEMBLE THIS 12" TWIN CONE/1" DOME TWEETER 2 WAY VENTED 1.6 CU FT. ENCLOSURE AND OBTAIN A SOUND THAT LEAVES MOST 8" AND 10" SYSTEMS FOR DEAD!



Housed in a specially designed and vented 1.6 cu.ft. enclosure, this remarkable system comprises the new Plessey CFL (controlled fibre-length) C12PX 12" twin-cone, wide-range speaker covering the bass and mid-range and the crystal-clear Plessey X30 tweeter covering the highs.

Frequency response is 30-20,000 Hz. Power Handling capacity is 30 watts RMS.

*OUR SPEAKER ENCLOSURE COMES PRE-ASSEMBLED AND VENEERED and requires only a small amount of final-assembly and strip veneering to complete!

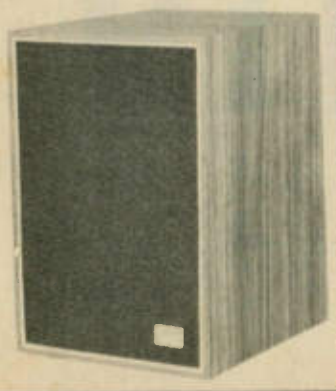
A 12" SYSTEM FOR ONLY $49.99

GIVES TOP PERFORMANCE AND REPRESENTS UNBEATABLE VALUE AT OUR SPECIAL LOW PRICE

ALSO AVAILABLE FULLY-ASSEMBLED FOR $70 EACH PACK/FREIGHT $5.00 EACH.

SONY SS-70

TWO WAY SPEAKER SYSTEM!



IS YOUR PRESENT SPEAKER SYSTEM LACKING BASS, MID-RANGE OR TREBLE? THEN IMPROVE IT BY SIMPLY ADDING ONE OR MORE OF THESE INEXPENSIVE BUT TOP QUALITY COMPONENT SPEAKERS! ANYONE CAN DO IT!

FOR IMPROVED BASS

WE RECOMMEND THE PLESSEY C12P 12" LOW FREQUENCY WOOFER! At Only $19.80, it represents unbeatable value and it more than holds its own with the best of them! Frequency response 25-11.000 Hz. Fundamental resonance 40 Hz. Power handling 30 watts RMS. P/Post $1.50.

NEW FROM PLESSEY! A SPECIALLY DESIGNED SEALED BACK 6" MID-RANGE SPEAKER. Is compatible with virtually any system and it will fill that all important mid-range! Ideal for Magnavox 8.30 systems! There is no need to construct a special inner enclosure because of its unique sealed back construction! Frequency response 450-6600 Hz 20watts RMS handling power.
PRICE ONLY $8.00 P/Post 75c.

TO FILL IN THE MIDDLE

FOR SPARKLING HIGHS

REPLACE THAT OLD FASHIONED CONE TWEETER WITH ONE OF THESE CRYSTAL CLEAR DOME OR HORN TWEENTERS!

PHILIPS 1" DOME TWEETER 40W RMS handling power. Frequency response beyond 20 kHz $17.00 per pair.

PLESSEY X30 DOME TWEETER 20W RMS handling power Extended frequency response. Special price $15.00 per pair.

THE BRAND NEW PLESSEY X20 HORN TWEETER! 20W RMS handling power Brilliant performance. Price only $14.00 per pair.

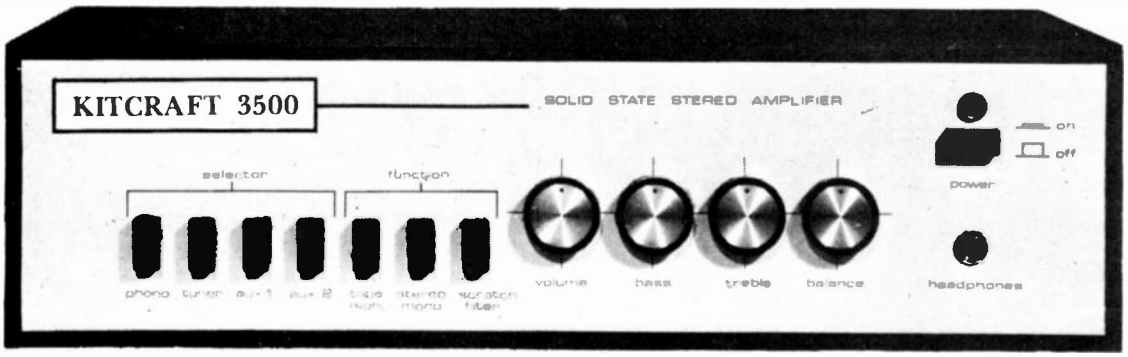
Pack/Post all tweeters $1.00 per pair.

GE AT ANY OF THESE BRANCHES.

URNE	ADELAIDE	PERTH
dge Rd., nd 4651	50 Grenfell St. Adelaide. Ph: 87-5505	557 Wellington St., Perth. Ph: 21-3047

WRITE TO KIT-SETS (AUST) PTY LTD.
P.O. Box 176
DEE WHY N.S.W. 2099.

KITCRAFT 3500



The makers of Lancodie have combined with Australias leading electronic component, kit and Hi-Fi specialists — Kitsets Aust. P/L to present a new concept with this remarkable amplifier.

KITCRAFT 3500 MODULAR

- All circuit blocks wired tested and guaranteed.
- Wiring loom pre-tested to couple easily with the circuit block using P.C.B. edge connectors
- No intricate wiring whatsoever
- Assembly time, one spare evening.

SPECIFICATIONS:

POWER: 35 watts RMS per channel
FREQUENCY RESPONSE: 20 Hz – 20 kHz ±0.5 dB
DISTORTION: .05% THD .05% IM
TONE CONTROLS: Base ±15dB
Treble ±15dB
HUM & NOISE: Phono 65dB Aux 80dB

$119

Take advantage of this truly splendid offer now available exclusive to Kitsets unquestionably the best value in Australia today.

SYDNEY	DEE WHY	BRISBANE	MELBOURNE	ADELAIDE	PERTH
400 Kent St.,	21 Oaks Ave.,	293 St. Paul's Ter.	271 Bridge Rd.,	16A Peel St.,	557 Wellington St.,
Sydney.	Dee Why.	Fortitude Valley.	Richmond.	Adelaide.	Perth.
Ph: 29-1005	Ph: 982-7500	Ph: 52-8391	Ph: 42-4651	Ph: 87-5505	Ph: 21-3047

ELECTRONICS -it's easy!

PART 4

This course, written in down-to-earth language, takes the mystery out of electronics — explaining it as the logical, fundamentally simple, yet far ranging subje :t it really is.

WE HAVE seen that a voltage source will provide the force needed to cause charges to circulate in an electronic circuit. Electrons, negatively charged, flow from negative to positive in an attempt to cancel out the charge imbalance created at the supply.

But not all voltage sources create a *static* charge imbalance. It is, in fact, quite possible to produce a condition in which the charge imbalance alternates from positive — negative and then negative — positive, repeating the cycle continuously, thus causing a corresponding alternating direction of current flow.

The principle of alternating current (ac) is simple, and as easy to grasp as that of direct current (dc). Its implications however, go much deeper, for our thinking must allow for the time element present in all ac excited systems.

FREQUENCY AND WAVELENGTH

In a dc circuit, the current always flows in the same direction. It does so with an amplitude that may vary from virtually zero through small to large.

This amplitude — either of voltage or current — may be measured, as we saw last month, by using an appropriate meter.

The result may be visually presented in the form of a graph with time on the horizontal axis, and meter reading on the vertical axis. A dc voltage level is shown graphically in Fig. 2a.

In an ac circuit, the current reverses periodically, and voltage sources that operate in this fashion are called alternating current generators.

As electrical energy flows at the speed of light it is possible to regard it as instantaneously following the charge imbalance created at the generator terminals. Note that it is not the electrons themselves that travel at such a speed.

Electrons start moving in a circuit virtually instantaneously when a potential difference is established. They cease moving equally fast when the potential difference is removed.

The effect is rather like turning on a tap.

Water flows immediately, because the pressure from the pump or reservoir is exerting a force on the water in the pipe.

But although *water* flows the moment the tap is opened, it may take hours or even days for any given drop of water in the reservoir to travel along the intervening pipes to the tap.

So with electrons. Although they start and stop moving virtually instantaneously — their actual rate of flow in a conductor is very slow, in fact individual electrons move at mere centimetres a minute.

At first sight it might seem pointless to have an electrical circuit in which electron flow continuously changes direction. The change flow averages out to precisely zero — so why bother!

Nevertheless, this form of current flow is absolutely essential for the operation of innumerable electronic devices. This will become clearer as the course proceeds. For the time being one can regard the effect of alternating currents (ac) as being similar to the action of a cross-cut saw or double acting steam engine — i.e. work is done during both half-cycles of movement.

In an ac circuit, the current reverses periodically, with a peak amplitude that is usually equal in both directions. As with a dc current, ac currents may vary from practically nothing (fractions of picoamps) to millions of amps. Not only are ac currents variable in amplitude. There are many other ways by which the current can rise, fall, and reverse, with time. Some of these are shown in Fig. 2b.

The behaviour with respect to time is called the waveform of an ac signal. In the case of Fig. 2b, where the reversal of current flow takes place instantaneously, a waveform is produced which, for obvious reasons, is called a square wave.

Waveforms are characterized by three attributes. Shape, amplitude, and cycle time.

If the waveform resembles a common geometric shape it is usually referred to accordingly — square, triangular, staircase — are three examples. If the waveform does not resemble a

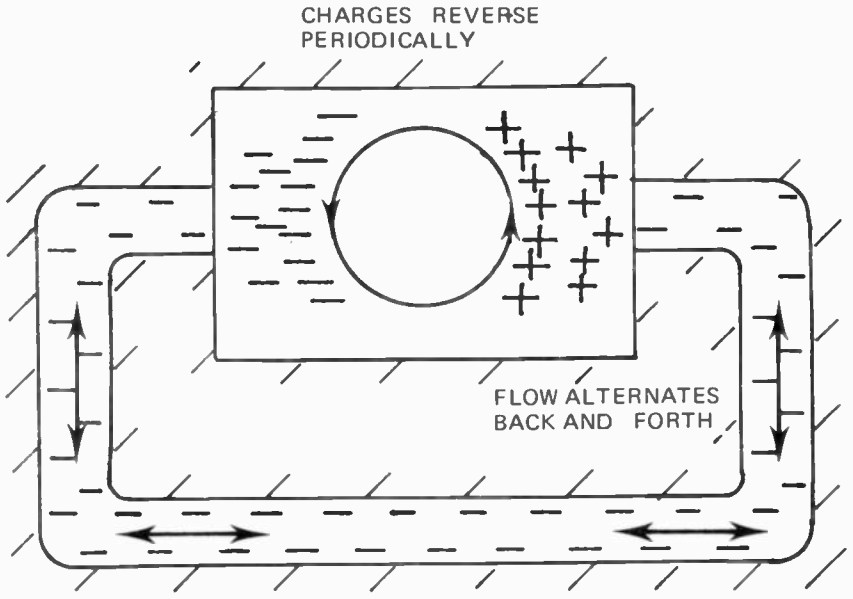


Fig.1. With alternating current, the charges periodically reverse direction.

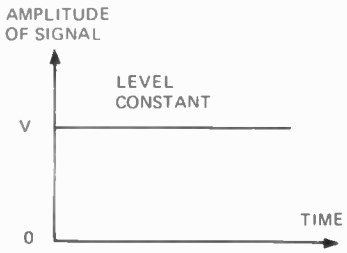


Fig.2a. This form of graph shows how signal amplitude varies with time – this is a dc signal.

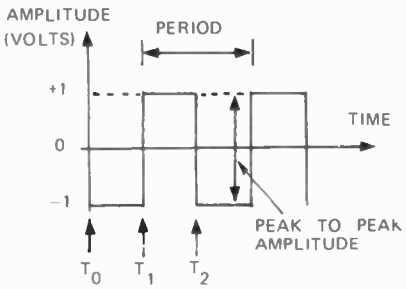


Fig.2b. Amplitude – time graph of squarewave ac signal.

common geometric shape then we define it in other ways appropriate to its characteristic.

Amplitude can be specified in several ways – the most obvious being its value from one peak, through zero, to the opposite peak. This is known as the peak-to-peak value (usually abbreviated to pp or p-p). The square wave shown in Fig. 2b has an amplitude of 2 volts peak to peak.

The cycle time of a waveform – usually known as its 'period' – is the time that a waveform takes to swing from any given point through one complete cycle and back to a similar starting point. It is usually denoted as T. In the case of Fig. 2b the period is from T_0 to T_2.

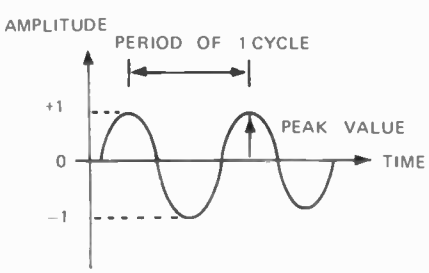


Fig.3. The most basic waveform is the sinusoid.

The period of electronic waveforms varies from one cycle every few thousand seconds to one cycle every fraction of a picosecond (one million-millionth of a second), or less.

The number of such periods occurring in a given time is known as the 'frequency' (usually denoted as f). Thus frequency and period are related – as $f = 1/t$, provided both are measured on the same units of time; seconds being generally used. The number of cycles occurring in one second used to be known (reasonably enough!) as 'cycles per second'. Nowadays the term Hertz is used for the same parameter. Hertz is generally abbreviated to Hz, often with a multiplier prefix such as kHz (one thousand Hertz) or MHz (one million Hertz).

To illustrate the inter-relationship between period and frequency, a 1 MHz squarewave has say, a cycle time (or period) of 10^{-6} seconds. Thus it repeats the waveform one million times a second. At the low end of the spectrum a 1 millihertz waveform takes 1000 seconds to pass through each complete cycle. (Note – although the abbreviation 'm' denotes milli – it is not generally so used as a prefix when denoting frequency. i.e. the abbreviation mHz is correct but millihertz will nevertheless normally be written. This is because frequencies of less than 1 Hz are not commonly encountered in electronics, and because of its rarity, 1 mHz may well be mistaken for 1 MHz – a unit one 1000 million times larger!).

INTRODUCING THE SINE-WAVE

Although the square wave is the easiest alternating waveform to comprehend – it may be produced simply by a battery and a continuously reversing switch – it is not the most basic waveform that exists.

Square waves, and in fact all other waveforms, are really composed of multiple waveforms called 'sinewaves'.

As the name implies, the amplitude/time graph of a sinewave is sinusoidal. It follows the trigonometric sine function as time proceeds. The shape of a sinewave is shown in Fig.3.

The instantaneous values for a sinewave of two 'units' peak to peak can be obtained from a set of natural sine tables by giving it the appropriate sign change during the cycle.

Unlike square waves, a sinewave current does not have rapid transitions (called 'transients') but varies smoothly from zero, rises to a positive maximum, falling through zero, to rise in amplitude in the opposite sense.

It is often necessary to be able to equate the mean energy value of sinewave current to that of dc current. Clearly the total charge moved (energy, therefore) in a given time by a sinewave differs from that moved by a dc current having the same *peak* value (the peak value of a dc current is of course the same as its mean, or average, value). The peak to peak value of a sinewave does not express the true mean energy flowing.

The equivalence occurs when we use a value less than the peak of a sinewave. This lower value is known as the rms value. The term rms is short for Root of the Mean of the sum of the Squares – of the instantaneous values and this turns out to be 0.707 of the zero to peak value.

In other words the rms current (or voltage) in an ac system fed with sinewave power has the same energy level as a dc system fed with dc power of the same numerical value.

Heating illustrates this well. Our household 240 volt 50 Hz ac supply is not 240 volts peak to peak, but 240 volts rms. An electric heater energized by the 240 volt mains ac supply would therefore produce the same amount of heat if fed from a 240 volt dc supply instead.

It is not generally appreciated that our 240 volts 50 Hz ac mains has a zero to peak value of 340 volts. Considerably higher than the value quoted!

In many designs the peak value of an ac waveform must be very carefully considered for it is this value that determines the insulation required. Because of this many components have their voltage ratings quoted in peak not rms value.

Sinewave power is sometimes quoted as an 'average' value. This is the average of the sum of instantaneous values). It works out at 0.637 of the zero to peak value. Average power is

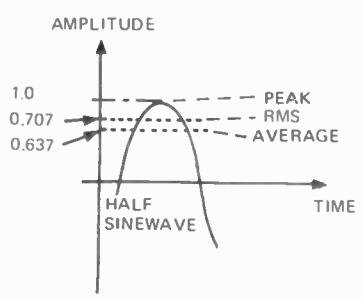


Fig.4. Relationship between average, peak, and rms. of a sinusoidal waveform.

rarely quoted as it has relevance in special applications only. Figure 4 shows the relationship of peak, rms and average values.

HOW SINEWAVES ARE GENERATED

Most of the world's electrical energy is generated as sinewaves.

The basic principle, used in everything from power stations to the alternator now fitted to modern cars, is very simple.

When a loop of wire is rotated in a magnetic field a current is caused to flow in the wire by the influence of the magnetic field.

The direction of current flow is determined by the direction of the magnetic field with respect to the direction of motion of the conductor. By examining Fig.5 it may be seen that each side of the loop will cut the magnetic field alternately downwards and upwards as it rotates. Thus the current must reverse in the loop of wire. The current is at maximum when cutting the field parallel to the North/South pole axis, and at minimum when perpendicular to it. Thus the current is *also proportional to the angle of the conductor in the field.* These two effects combined produce the waveshape output known as a sinewave. The law governing the direction of current flow in a conductor is known as Faraday's law and will be discussed in more detail later.

In practice, the rotating loops of alternating-current generators have many turns and, more often than not many pairs of magnetic poles.

The rotating alternator is an efficient way of generating electricity in large quantity, but only in large quantity — i.e. fifty watts upwards. Because of this and for reasons of practicality, the majority of sinewaves used in electronic equipment are in fact generated by special electronic circuitry powered from dc, that in turn, is either generated by batteries, or produced from the 240 volt ac mains. More about this later.

NOTHING IS PURER THAN A SINEWAVE

In the 1800's, when science was more devoted to thought than hardware, and electricity was still a 'magic' trick, mathematicians were laying the foundations of our present-day sophisticated theories.

One such mathematician was Jean Fourier, a Frenchman.

Fourier's thing was the solution of numerical equations. He eventually proved that all *periodic* functions (i.e. all functions that repeat periodically) could be broken down into a sum of sinewaves having different amplitudes and frequencies. As each individual sinewave cannot be broken down any further it seems that the sinewave is the purest of waveforms obtainable.

The method, now known universally as 'Fourier Analysis', involves relatively advanced mathematics. Nevertheless the concept can easily be demonstrated using our now familiar amplitude/time graphs.

Waveforms that are not strictly sinusoidal are known as 'complex'. Various complex waveforms are shown in Fig.6. As will be shown, our

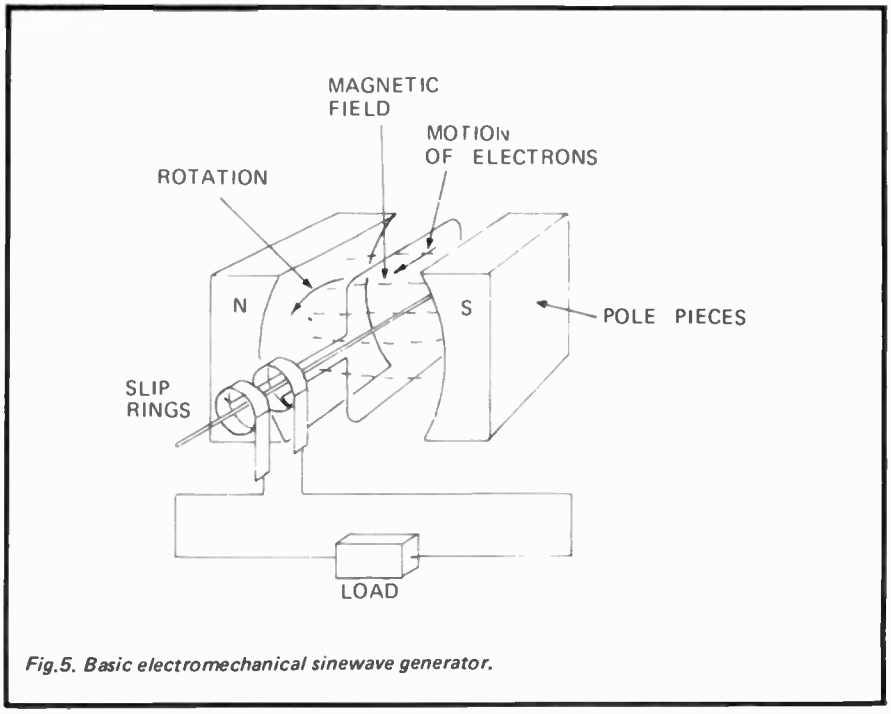
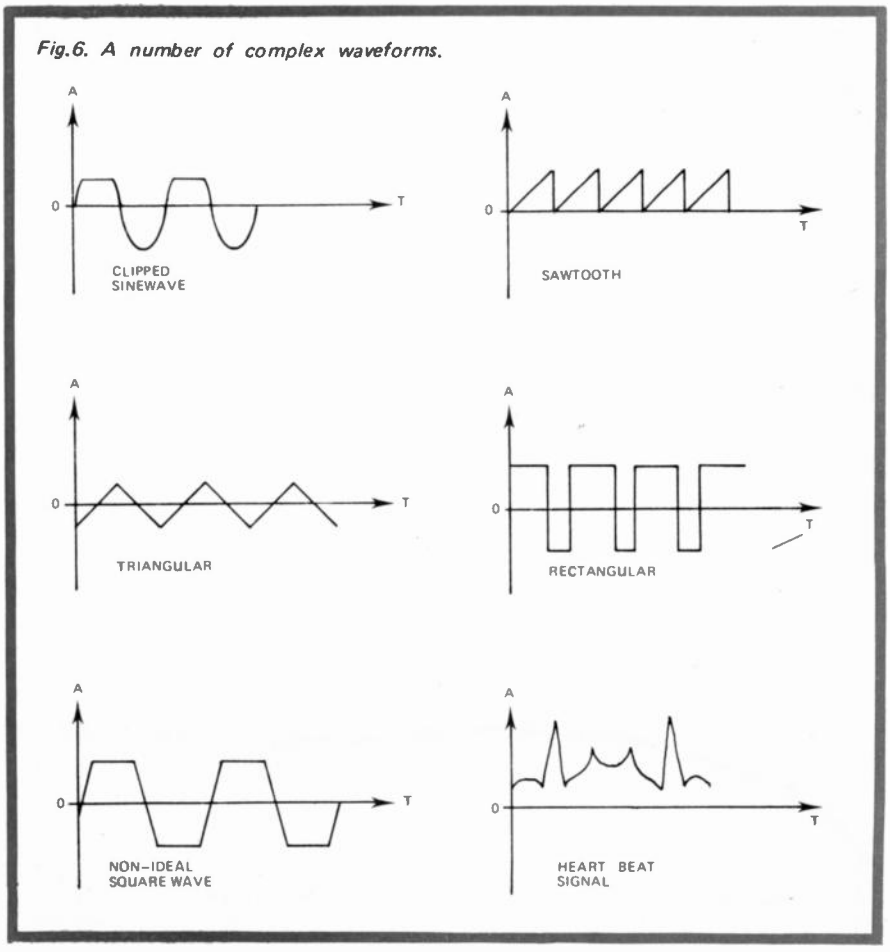


Fig.5. Basic electromechanical sinewave generator.

Fig.6. A number of complex waveforms.



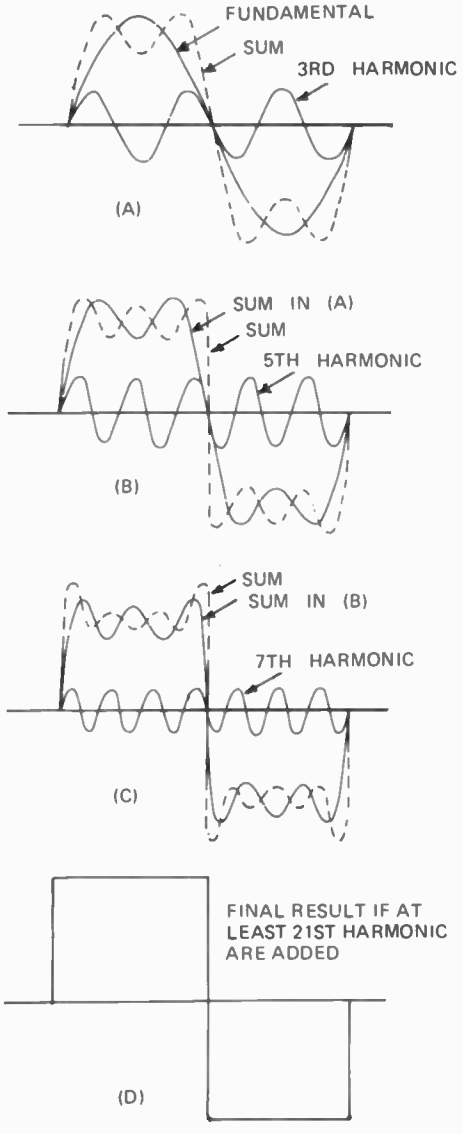


Fig.7. The apparently simple squarewave is really made up of the addition of numerous sinewaves of different frequency and amplitude.

apparently simple looking squarewave is in fact quite complex. It contains sinewave frequencies varying from one having a period identical to that of the squarewave, to one with (theoretically) infinite cycles per second.

Figure 7 shows how a squarewave is made up of a (theoretically) infinite number of sinewaves. In (a) a sinewave, with period equal to that of the squarewave (this one is called fundamental frequency) is added graphically to another sinewave of three times the frequency (known as the third harmonic) but only one third the amplitude. Already the addition of the third harmonic makes the waveform begin to look like a squarewave.

In Fig.7b we have added the fifth harmonic at an amplitude one fifth that of the fundamental – the waveform now looks even closer to a squarewave. In (c) we have added the seventh harmonic – at one seventh the amplitude.

By continually adding frequencies in this way we eventually obtain our final squarewave. In practice, up to the 21st harmonic will be required to obtain a reasonably shaped squarewave.

All complex waveforms can be broken down in this way, not only in theory but also in practice, in fact one way of generating sinewaves is to generate a basic squarewave – perhaps even by using a battery and an automatic polarity reversing switch – and then to use an electronic filter to extract the fundamental frequency.

The concept of Fourier analysis is another basic tool of the person trained in electronics – we will refer to it again throughout the course.

OUR LARGE RANGE OF FREQUENCIES

Electronics in essence may be seen as a vast, tremendously versatile service facility providing the means of transferring energy between input and output devices.

A TV set, as we showed in the first part of this series, receives its signals from the broadcasting station, processes them, and finally uses these signals to recreate the sound and picture of the original programme material. An alarm circuit uses some form of switch to operate a warning device. A computer accepts information – in the form of coded electrical impulses, or holes in paper tape or cards, and then processes this information to produce further holes in paper, tape or cards, printed output data, or whatever.

In radio broadcasting we use high frequency radio waves to carry the audio sound waves across vast distances. In contrast, the same high frequencies may be used for heating and welding plastics, and for deep-heating in medical therapy.

A microwave oven uses very high frequency energy to heat – a case where information transfer is not a factor.

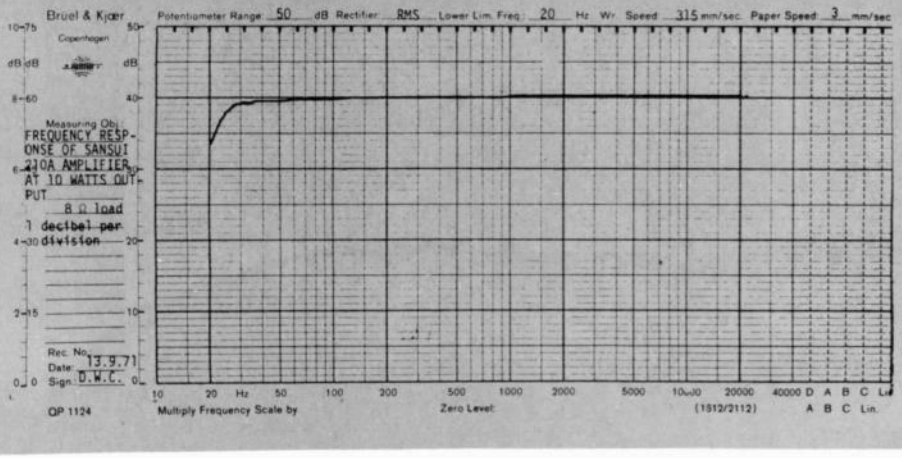
Examples such as these indicate why such a wide range of frequencies is needed to handle our diverse needs. The frequency that we need to use is often related to the speed with which we need to transfer or process information.

At the low end of the frequency spectrum is the simple alarm circuit where one piece of information needs to be transmitted only when needed. Is the alarm contact open? (If not, it must be closed).

There is little need for extremes of operating speeds as the relatively slow human senses are used to interpret and act on the data received.

Computers may need to process literally millions of pieces of information in as short as space of time as possible. Because of this their frequency of operation is for ever being increased and present day computers have switches capable of operating at speeds in excess of 1000 million cycles per second.

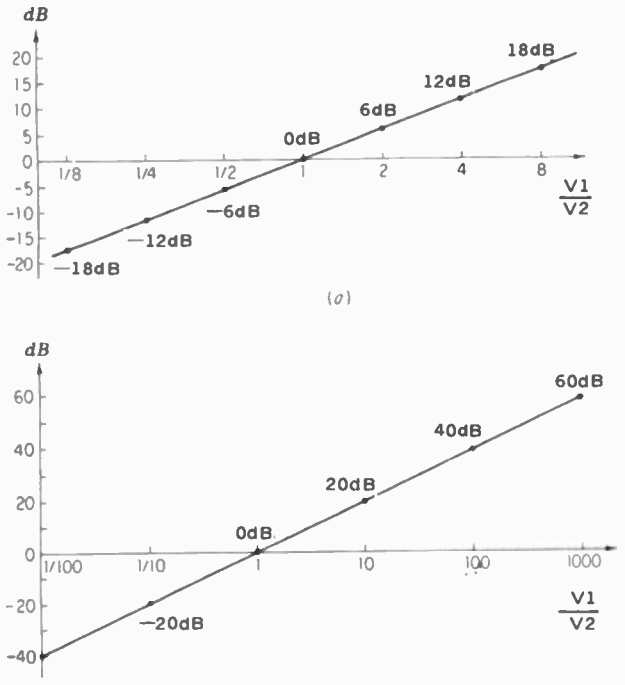
Fig.8. This frequency-response plot (of a hi-fi amplifier) was obtained using an automatic recording chart plotter.



GRAPHICAL REPRESENTATION

At the beginning of this part of the series we introduced amplitude/frequency graphs operational sequence in a system where things are happening faster than our senses can follow.

In many electronic systems, such as



Ratio $\frac{V1}{V2}$	in decibels
1/100	−40
1/10	−20
1/8	−18
1/4	−12
1/2	−6
1	0
2	6
4	12
8	18
10	20
100	40
1000	60

Fig.9. These charts and table give rapid conversion between voltage gain and the equivalent decibel value.

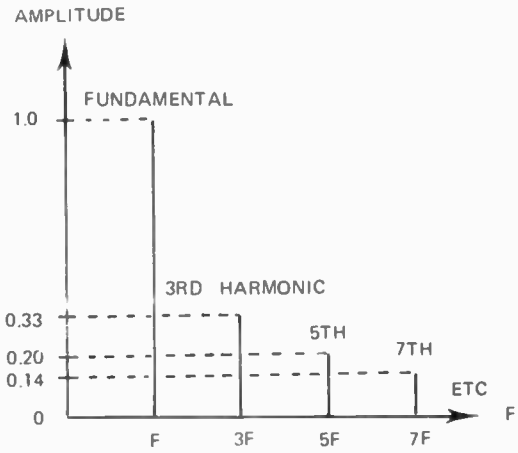


Fig.10. Frequency spectrum of squarewave signal.

hi-fi equipments, we often need to know the amplitude of a signal at a particular frequency or range of frequencies. To do this we can use a graph on which amplitude is plotted as before, but with time replaced by frequency on the horizontal axis.

Figure 8 shows the frequency response of a hi-fi amplifier; that is an indication of how output level varies with constant level input at various frequencies. Ideally an amplifier should have a 'flat response' — that is, it should amplify all signals within the audio range by an equal amount regardless of frequency.

The first thing to note about Fig.8 (and all similar graphs) is that frequency is not plotted on a linear scale. A logarithmic scale is used instead. The reason for this is that to cover the audio frequency range (that is from approx 20 Hz to 20 kHz) linearly would require several yards of paper. The use of a logarithmic scale compresses the information needed into a more satisfactorily handled format.

The graph shown in Fig.8 starts at 10 Hz and passes through 100, 1000, and 10 000 Hz decades. Paper ruled in this fashion is usually obtained ready printed, but it is worth remembering that a crude log plot may be made by ruling lines at equal intervals for each decade, then subdividing each decade by three equal intervals delineating the 2 and 5 unit positions.

Although it does not appear to be so at first sight, the vertical scale in Fig. 8 has also been compressed logarithmically. Here, although the actual markings are at linear intervals, the response has been plotted in units called decibels (dB) — units used to relate voltage or power levels on a logarithmic basis.

As with frequency, voltage and power levels used in electronics cover an enormously wide range. Several thousands of billions in fact. Thus to show a signal varying amplitude from say, 1 nanovolt (10^{-9}) to 10 volts, would require an enormously wide piece of paper to allow us any resolution at all. So again we need to compress the scale.

The decibel method compresses the values logarithmically *before* plotting and by so doing produces a linear scale — as Fig. 8 shows.

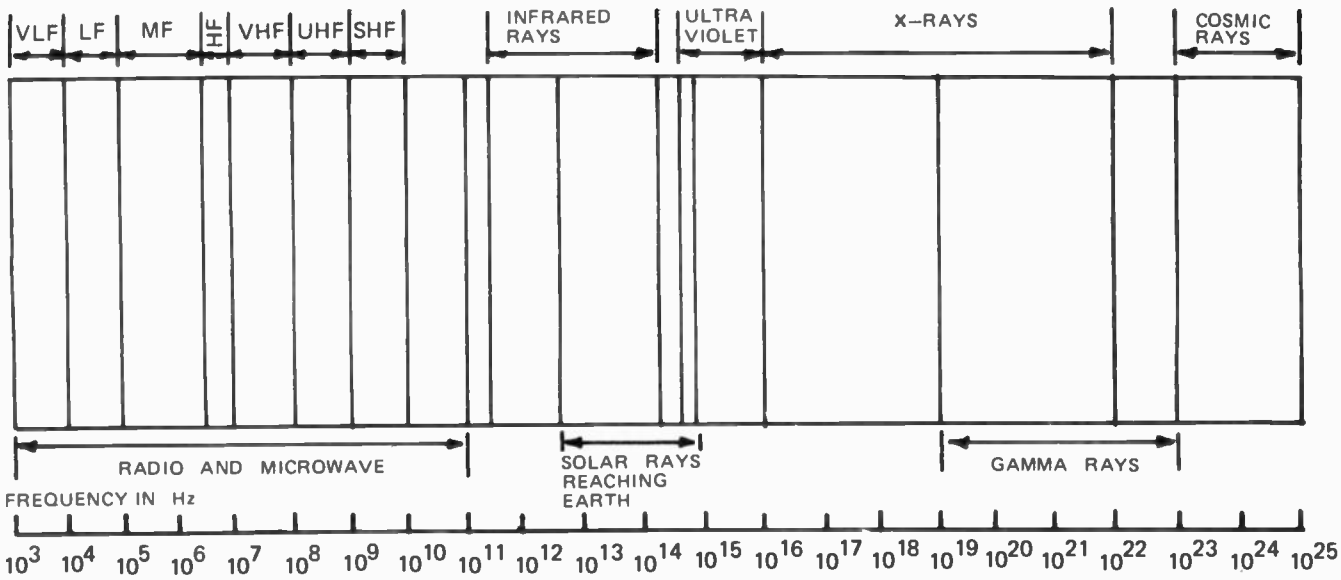


Fig.11. This chart shows the enormously wide frequency range of the electromagnetic spectrum.

As with many electronic circuits, the response of an amplifier is a matter of relative comparisons between two values, in this case a constant amplitude input signal and the resultant (amplified) output signal. For voltage levels the decibel value is obtained by the expression –

$$dB = 20 \text{ Log}_{10} \frac{V1}{V2}$$

Some useful values and charts are given in Fig. 9.

We should now be in a position to interpret Fig. 8. The graph shows us that the output of the amplifier falls off as the frequency falls below 30 Hz. Above this we say that its response is 'flat'. The curve terminates at each end, not because an amplifier cannot be made to work beyond these frequencies, but because it has no useful function beyond these limits.

THE FREQUENCY SPECTRUM

Another form of frequency plot is the so-called frequency spectrum. Previously we have discussed the response of a 'black box' to various input signals. A frequency spectrum on the other hand displays what frequencies are present in a signal and with what relative amplitudes. Figure 10 shows the amplitude/frequency spectrum of a square wave.

A spectrum of particular and general interest is that of electromagnetic radiation. It is the one that involves radiations of energy travelling at the speed of light.

The electromagnetic spectrum is shown in Fig. 11. It gives the names that have been adopted for the various ranges of frequencies that can be used. There is no concept of amplitude here – the graph merely illustrates the range. It is a very good example of the need for logarithmic scaling – for the known extent of the frequency spectrum ranges from zero frequency up to 10^{25} Hz.

PHASE

So far we have discussed relationships between amplitude and time or frequency. Phase is also important.

When two or more signals of the same frequency exist together, their relative timing can be important. If they pass through zero in the same direction at the same time we say they are in phase. If not, they are out of phase. The units used to express this relationship are degrees, fractional cycles or actual time periods. Phase/time and phase/frequency graphs can be drawn. In some applications these are vital, but generally to consider phase in this way is rather rare.

At this point it is appropriate to point out that the discussion above applies not just to electrical and electronic signals but to any periodic phenomena – for example, in mechanical, acoustical or even optical systems.

SEEING THE WAVEFORM

As an ac waveform varies in amplitude with time, a single instantaneous measurement does not necessarily provide the information sought.

If the waveshape is accurately known, as for instance the reasonably closely controlled 240 volt 50 Hz mains supply (sinewave), it is feasible to measure its effective value. This is done with some form of averaging device thus providing what appears to be a single measurement. The ac scale on a multimeter does this.

But if the waveshape and frequency are not known it is necessary to have some means that tells us what is happening.

For extremely slowly varying waveforms, such as squarewaves with periods of minutes, a meter, (reading zero in the centre of the scale) will enable us to observe the amplitude in each direction and the time taken to switch back and forth.

Unfortunately most signals vary faster than we can observe them. More sophisticated methods are necessary.

The most versatile instrument for this (and other) purposes is the cathode ray oscilloscope. Its operation is shown in Fig. 12. In its simplest form it displays what is happening to the signal amplitude as a vertical deflection of a spot of light on a display screen, whilst a signal proportional to time deflects the spot to and fro on the horizontal axis.

By triggering the horizontal sweep at precisely the same place on the repetitive waveform to be observed, the spot traces out a piece of signal wavetrain that persists on the screen long enough to be seen. When the sweep reaches the end it is again re-triggered thus overlaying a second swept pattern on top of the first – and so on.

Oscilloscopes enable us to see waveforms from periods of one cycle per thousand seconds to gigahertz frequencies. Even the cheapest of oscilloscopes will cover the audio spectrum and well beyond – but very wide range 'scopes are expensive devices.

Next to the multimeter, the oscilloscope is the most useful diagnostic tool available. Its price (from a couple of hundred dollars upwards) unfortunately rules it out for most amateur work, but any course given by an educational institute would use them. As we do not expect our readers to obtain one this course will not normally require its use in the practical exercises.

If the frequency of the signal to be measured lies in the region from dc to 10 kHz, it is usually possible to 'see' the waveform by using a suitable chart recorder.

These devices use some kind of electro-mechanically operated pen that follows the input signal producing a displacement corresponding to input signal. A mechanism similar to a moving coil meter is often used. The movement of the pen is then recorded

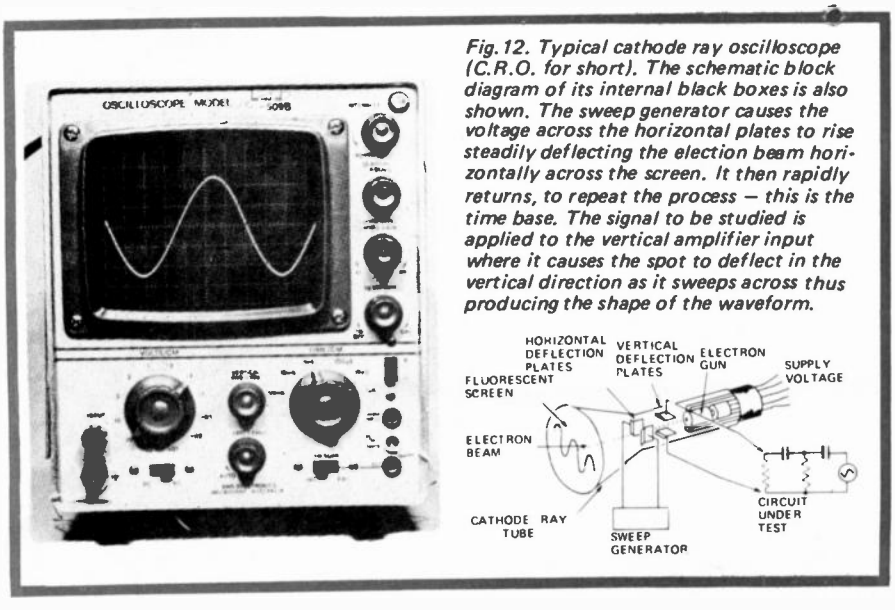


Fig. 12. Typical cathode ray oscilloscope (C.R.O. for short). The schematic block diagram of its internal black boxes is also shown. The sweep generator causes the voltage across the horizontal plates to rise steadily deflecting the election beam horizontally across the screen. It then rapidly returns, to repeat the process – this is the time base. The signal to be studied is applied to the vertical amplifier input where it causes the spot to deflect in the vertical direction as it sweeps across thus producing the shape of the waveform.

on paper which moves under it at a constant known speed.

Chart recorders come into their own when the signal is varying slowly – such as air temperature variations over a monthly period: they also provide a permanent record.

DC LEVEL OF AN AC SIGNAL

So far we have described ac signals in which the current alternates with equal amplitude in both directions.

It is however possible to have an ac waveform that is *not* symmetrical about zero. An ac signal can be produced, or adjusted, to produce this lopsided situation.

In Fig. 13, the sinusoid is symmetrical about zero in (a) but is biased to progressively greater extents in (b) and (c), in fact the waveform shown in (c) never swings negative at all. Some would argue that waveform (c) is not an ac signal but merely a varying dc signal. But nevertheless it would normally be regarded as an ac signal superimposed on a dc level.

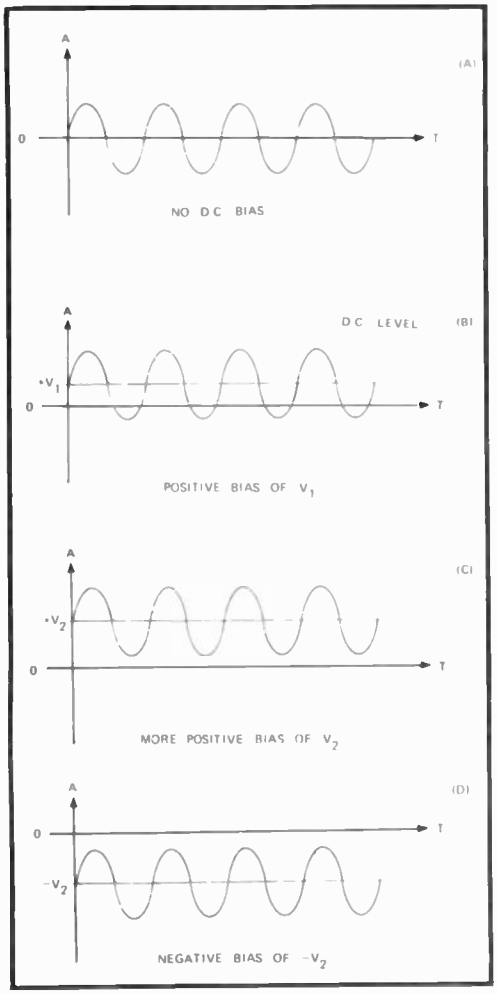


Fig.13. These graphs show how dc and ac can exist together in a circuit, the dc level providing 'bias' to the ac signal.

It is possible to separate the ac and dc components of such waveforms very simply – more of this later.

MEASUREMENT OF AC VOLTAGE AND CURRENT

Just as with dc signals, it is very necessary to be able to measure ac signals, such as voltage and current, in order to be able to check circuit operation.

If the signals are sinusoidal (as many are) we can measure the various values, such as rms, peak and average, with a meter made for ac measurements such as the moving iron repulsion type shown in Fig. 14. In this type of meter, the coil is fed with the ac signal, thus producing an electromagnetic field (rather like the relay described in the second article in this series). The electromagnetic field repels a moving iron vane. The greater the amplitude of the signal, the stronger the magnetic field and hence the greater the movement of the vane.

Although cheap and robust, moving iron meters are not very sensitive. Apart from this they have non-uniform deflection characteristics (i.e. vane movement is not linearly related to signal strength). Ac moving coil meters (described in this series last month) are more sensitive than their moving iron equivalents.

If ac current is fed directly to the meter movement, the needle will attempt to follow the positive and negative excursions of the current. It will vibrate about the zero point indicating little except that the signal is ac not dc.

RECTIFYING AC TO PRODUCE DC

Each ac cycle of an unbiased waveform has a positive half cycle and a negative half cycle. If a 'switch' is used to let the positive half cycles through but to block the negative half cycles the resultant waveform will appear as shown in Fig. 15a (centre).

If the positive half cycles passed by the switch are now passed into an 'energy store', the fluctuating ac signal will be smoothed out and dc obtained.

This process is called half-wave rectification and the switch used is called a rectifier.

An ac signal rectified in this way can be measured by a conventional moving-coil meter calibrated in rms ac signals. In meters of this kind, the mechanical inertia of the meter movement acts as the averaging energy store (much in the same way as a flywheel smooths out the individual firing impulses of a car engine). In other circuits a capacitor is used instead.

Although simple, half wave rectification is inefficient. Half the available energy is blocked by the rectifier and cannot be used. Also the discontinuity of the waveform adds to the difficulty of adequate smoothing.

A better method of rectification is to use a switch that reverses the polarity of the negative half cycles – thus making them positive. This is illustrated in Fig. 15b (centre).

This process is called full-wave rectification and is the most usual method of converting ac signals or power to dc.

This has taken us back to where we came in – measuring ac on a multimeter. We have seen that when an ac range is selected, the range switch inserts a rectifier between the input terminals and the meter movement, and if need be, adjusts the various shunts and multipliers to obtain the correct rms readings.

Later in this course we will return to look at the various kinds of rectifiers and their use. Their design and

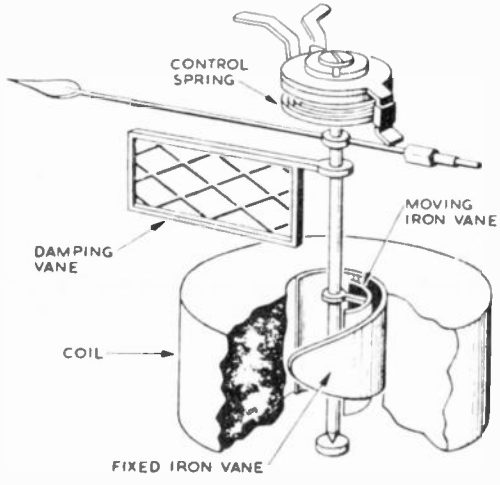


Fig.14. How the moving-iron meter works – illustrating the principle of attraction. This type of meter will also work on dc signals. The scale, shown right, is non-linear.

ELECTRONICS - it's easy!

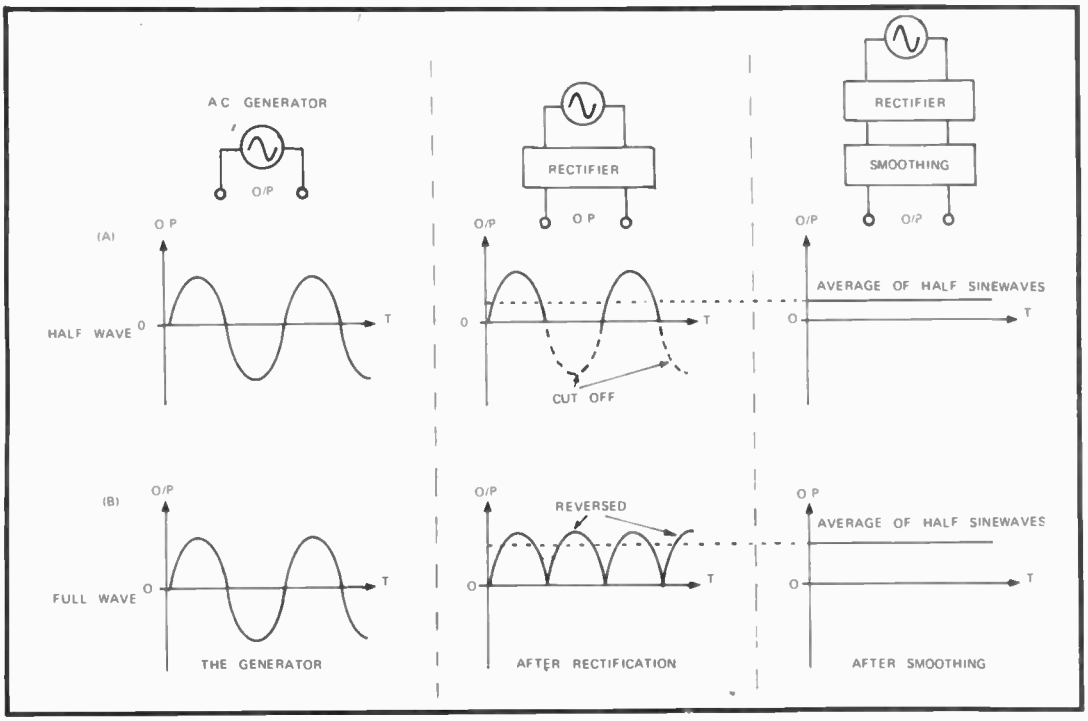


Fig. 15. Halfwave and fullwave rectification — and the black-box representation of the process used. Note the higher output level obtained from the fullwave process.

operation is relevant when building power supplies to operate electronic equipment powered by the ac mains supply.

A BASIC ELECTRONICS LIBRARY

It is impossible to remember all the facts of electronics. So as the course progresses we will recommend various inexpensive books or data sheets that are worth collecting.

A good start is to obtain an electronics dictionary of terms such as the paper-back —

S. Handel 'A Dictionary of Electronics' 3rd. Ed. 1971, Penguin Reference Books, $1.55.

(Continued on page 104)

Why we decided not to advertise S.A.E.

Every amplifier manufacturer and his agent claims all sorts of perfection for his amplifier so what good is one more claim? Even though the claims are true this time?

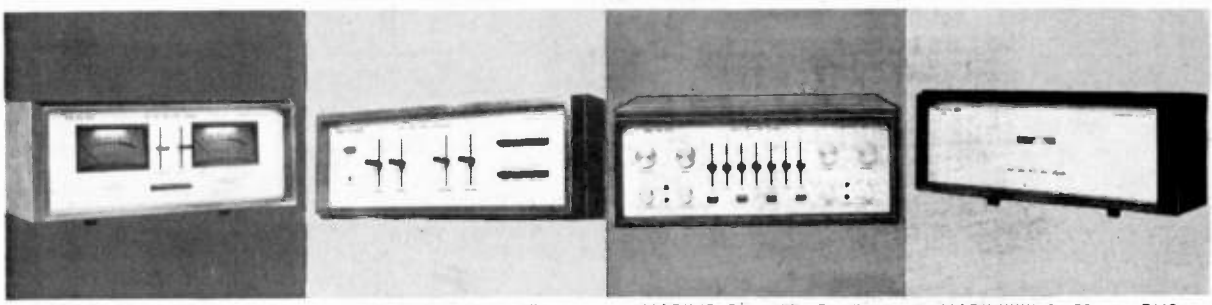
With all the exclusive break-throughs in circuitry, even the worst amplifiers must sound better than the real thing by now.

And we thought "S.A.E. never seem to advertise in the U.S.A., and yet they're accepted as America's best amplifiers and loudspeakers. All the pro's rave about them. So why should we advertise them? Anyway, with its performance, looks, price and warranty, S.A.E. gear should just walk off the dealers shelves.

Anyway our problem is not to sell S.A.E., but to get it. Our next two shipments are just about sold out, so what's the point in advertising? It'll only make the supply position worse."

That's why we decided not to advertise S.A.E.

Still, we ought to use the photos they sent us.



MARK IVCM, 2 x 100 Watts RMS | MARK XXX, Preamplifier | MARK IB, Preamplifier Equalizer | MARK XXXI, 2 x 50 watts RMS

Sole Australian Distributors

Leroya Industries PTY. LTD.

266 Hay St., Subiaco, Western Australia 6008.

N.S.W.: Autel Systems Pty. Ltd., 639 Pacific Hwy., Chatswood, 2067.

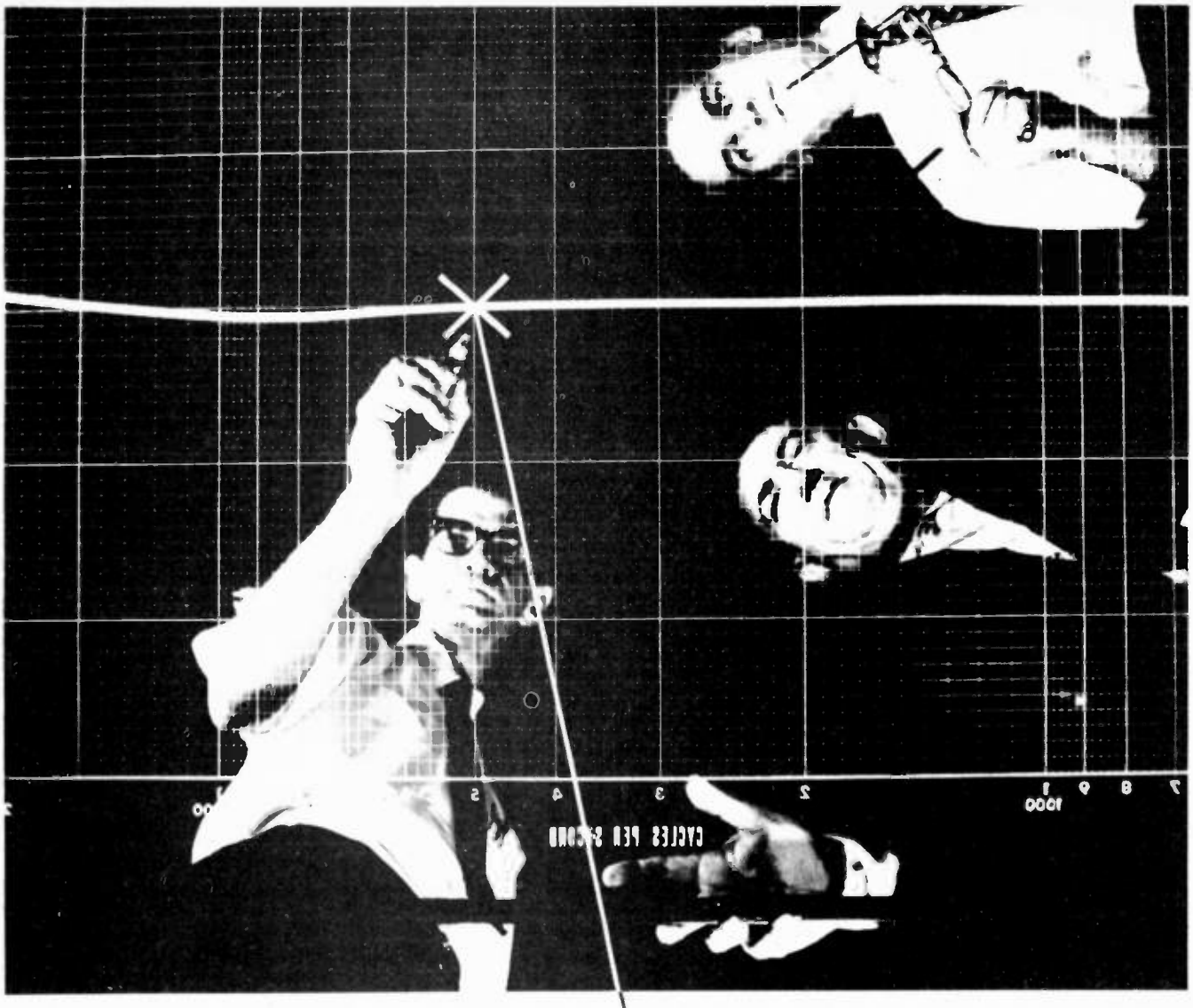
VIC.: Douglas Trading Co., 191 Bourke St., Melbourne, 3000.

S.A.: Sound Spectrum, 33 Regents Arcade, Adelaide, 5000.

QLD.: Brisbane Agencies 72 Wickham St., Fortitude Valley 4006.

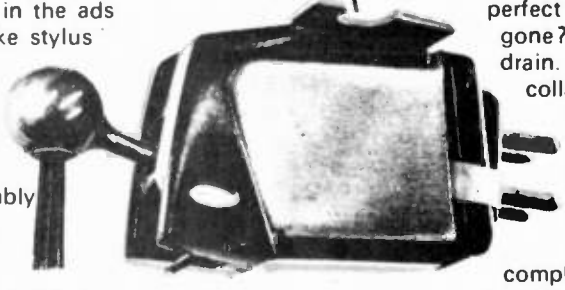
A.C.T.: Ouratone Hi-Fi, Cnr Botany St & Altree Court, Phillip, 2606

LER 053



Stanton solves the X Factor

X IS THE UNKNOWN QUANTITY



It's what they don't tell you in the ads and specifications. Things like stylus life, distortion, resistance to hum, kindness to records, consistency.

Ever noticed how two identical cartridges sound completely different? Probably not, because few people have the chance to compare identical cartridges. But we do, and one thing we're proud of is a Stanton . . . is a Stanton . . . is a Stanton.

Ever paid out a small fortune for a pricey cartridge and had the stylus collapse after a few months? Diamond perfect but cantilever suspension gone? Forty odd dollars down the drain. Stanton stylii just don't collapse. If you happen to get one that does, we'll swop you a new one. So we can frame yours.

Then think how much longer your records will last with Stanton (remember static compliance doesn't mean a thing, but it's the only figure you're likely to get), think how clean your records will sound because you're not amplifying hum, and think of the distortion that's probably less than your amplifier. Think, and you'll agree—the X factor is the deciding one.

SOLE AUSTRALIAN DISTRIBUTORS

Leroya Industries PTY. LTD.

266 Hay St., Subiaco, Western Australia. 6008

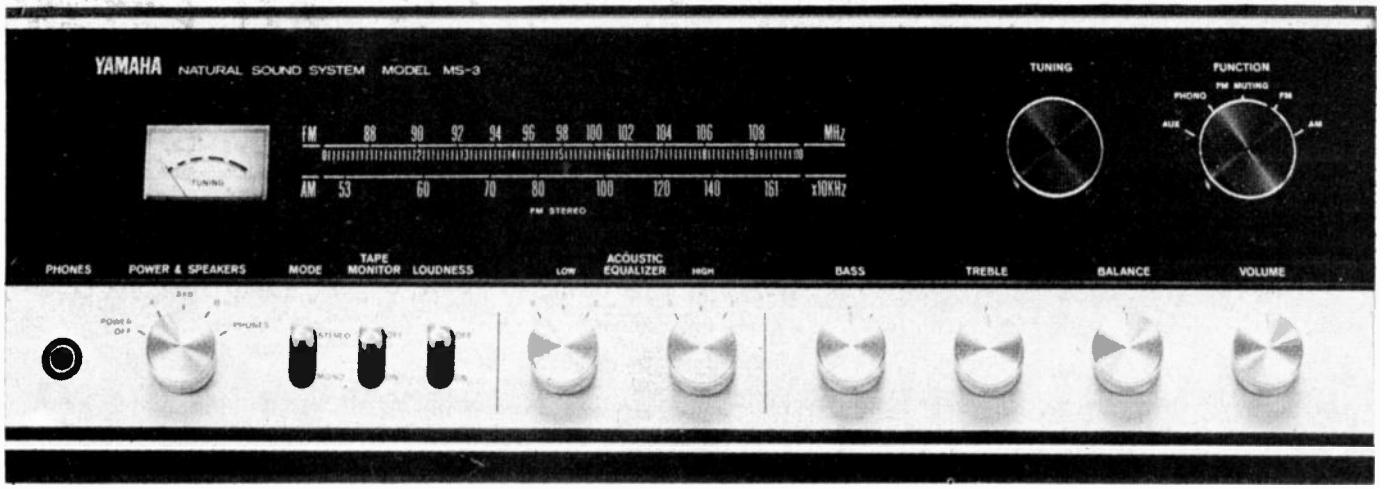
VIC. BJD Electronics P/L, 191 Bourke Street, Melbourne. 3000

QLD. Brisbane Agencies, 72 Wickham Street, Fortitude Valley, Qld. 4006

N.S.W.W.C. Wedderspoon P/L. 193 Clarence Street, Sydney, N.S.W. 2000

S.A.Sound Spectrum, 33 Regents Arcade, Adelaide, S.A. 5000

LERO26



FM RADIO - a new commission

by T.D. Jarvis and G.L. Wilson of the Music Broadcasting Society of NSW.

Once again, FM is news. Forty years after its invention, and 26 years since Australia's first experimental broadcasts, an independent inquiry is to report on the "technical, social and economic implications of establishing frequency modulation broadcasting in Australia."

THE advantages of FM are well known. Free from the problems associated with long-range sky wave reception (because of the line-of-sight characteristic of transmissions above 30 MHz), FM broadcasting systems can make much greater use of channel sharing than MF AM systems. Many more radio stations result, typically as many as 25 in any one area. The flexibility of FM systems is consequently much greater than MF AM systems. This, together with their inherent high fidelity, their freedom from electrical and co-channel interference, and their potential for additional sub-channel transmissions (facilitating stereo), has commended FM to almost every ountry in the world.

In Australia until recently – and still in New Zealand – politicians and administrators have held that there was no demand, and therefore no need, for the kinds of advantages FM offers. This has ceased to be the case. The Australian Broadcasting Control Board strongly favoured the introduction of FM in the report of its 1971 inquiry:

"It is clear to the Board that the introduction of FM broadcasting should enable most, but not necessarily all, of the deficiencies of the present Australian broadcasting system to be overcome. If provision is to be made for programme material of greater bandwidth than provided for at present, and/or for stereophonic transmissions, the Board considers that a wide bandwidth system, such as FM operating in the VHF or UHF band, is essential. Based on the evidence submitted, the Board is satisfied that a sufficient number of minority groups demonstrated a requirement for specialised broadcasting services of various kinds to warrant the establishment of stations for the purpose."

OBSTACLES TO FM IN AUSTRALIA

Unfortunately, despite the Government's determination to have FM at the earliest opportunity, unique technical obstacles remain. Most may be traced back to the deliberations of the Radio Frequency Allocations Review Committee (the Huxley Committee) in 1960. The Huxley Committee was required to find 13 television channels in the VHF band, thought to be necessary for adequate television coverage of Australia by the Broadcasting Control Board of the day. This the committee was able to do, but at the expense of the band (88-108 MHz) internationally used for FM broadcasting (Table 1) overleaf.

Apart from utilising 88-108 MHz for television – it will be seen from Table 1 that channels 3, 4 and 5 partly or wholly occupy this band – the Huxley Committee recommendations are problematical in other respects. Its reservation for channel 5A conflicts with international agreements allocating part of this channel to space research and communications, and its recommendation that 92-94 MHz be used for fixed/mobile services has proved unworkable, despite continued heavy demand for such services, because of interference to adjacent television services (a difficulty which might have been foreseen).

Under the circumstances there are two alternatives open for the creation of an FM service in Australia – neither without difficulties. Established television stations must either be moved to other channels in those areas where they constitute an obstacle to the FM service (most notably the Newcastle-Sydney-Wollongong area in NSW), or the FM service itself must be located in an entirely different part of the radio-frequency spectrum. The Broadcasting Control Board in 1971 chose the latter course, commenting,

"Although some FM service could be provided in the VHF band . . . the long term needs of an FM broadcasting service would be better catered for by using a band which is allocated solely for the purpose, and is capable of future development. The Board is satisfied that the UHF band is the only frequency band available in which there is potential for such development.

Accordingly, the Board recommended, on the advice of the Postmaster-General's Department and A.W.A., that 40 MHz should be reserved in the UHF band (in the region of 470-540 MHz), sufficient for 20 channels with 2 MHz separation.

This would appear to be a logical solution, with the advantage that a technically superior system could be developed for Australia free from the limitations experienced overseas, particularly in respect of the degradation in programme quality that is typically experienced due to stereo multiplexing and the use of FM sub-channels. The Board's engineers have, for example, been researching five methods of stereo encoding in addition to the familiar "pilot tone" system.

The case for UHF is, however, by no means conclusive. Indeed, the Senate Standing Committee on Education, Science and the Arts – currently conducting what is undoubtedly the most comprehensive inquiry ever to be held into Australian radio and television – has some trenchant criticism to offer on the Board's recommendations:

"We believe the adoption of an FM system is long overdue, but we do question the recommendation to develop a UHF FM system . . . The technical evidence we have had leads us to believe that there are technically feasible alternatives open to enable the service to be accommodated in the international (VHF) band, where every other FM service is located, and that the Board has not adequately considered these alternatives from both the technical point of view, and from the economic and social point of view."

The Senate Committee goes on its its Second Progress Report to urge that

To use radio waves as a transmission medium, we must somehow impress the information we wish to transmit onto the radio wave. The process of impressing information onto the radio wave is called modulation, and the radio wave so modulated is called the carrier.

The carrier wave (assuming it is a pure sine wave) has two basic characteristics. They are:–

(1) Amplitude; In Fig. 1a, the waves represented by the dotted and solid lines are the same in every respect except amplitude.

(2) Frequency; In Fig. 1b, the wave has the same frequency as A in 1a but twice as many complete cycles occur in a given time.

To modulate the radio wave, we may modify either of these two characteristics.

Only two methods of continuous modulation are in general use for radio broadcasting These are amplitude modulation (AM), and frequency modulation (FM).

Amplitude modulation is depicted in Fig. 2 Here, an audio waveform causes corresponding changes in amplitude of the sine-wave carrier.

When the audio waveform swings positive, the carrier amplitude is increased, and when the audio waveform swings negative the carrier amplitude is decreased. The amount of increase or decrease depends on the amplitude of the audio tone.

Frequency modulation is shown in Fig. 3 In this case when the audio tone swings positive – the carrier *increases* frequency, and when the audio tone swings negative – the carrier frequency *decreases*. The carrier amplitude always remains the same. So in effect, the carrier fluctuates in frequency around its nominal value at a rate determined by the modulating audio tone.

It should be particularly noted that frequency swing of the carrier is related to the amplitude of the modulation signal, not its frequency. In AM transmission, noise disturbances are superimposed upon the carrier wave in the form of sharp spikes.

These spikes have exactly the same format as the AM modulation and are hence amplified and detected in the normal manner thus giving rise to very unpleasant static and noise which is reproduced through the loudspeaker. Widening the AM bandwidth, to obtain better fidelity, increases the susceptability to noise.

Now let us consider FM. Here, noise again produces amplitude variations in the carrier, but in this case the information is not carried by amplitude variations, but by frequency variations and hence is of an entirely different form.

If now we pass the signal through a clipping stage the signal will have the noise components clipped off but will still retain the full modulation information.

FM offers the capability of transmitting the entire audio spectra of a programme with much better noise performance and unwanted signal rejection than AM.

A further advantage of FM is the possibility of transmitting stereo music on the one carrier, and this process known as stereo multiplexing is a well established practice overseas.

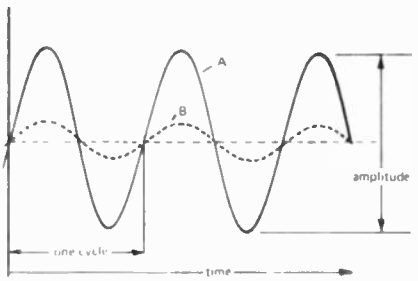


Fig. 1a. Two sine waves of same frequency but different amplitude.

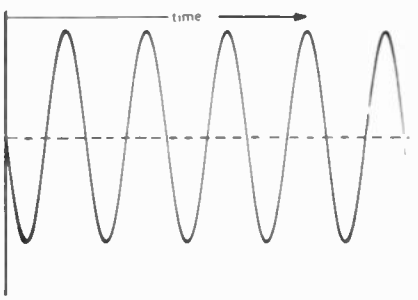


Fig. 1b. Sine wave having same amplitude as A in 1a but at twice the frequency.

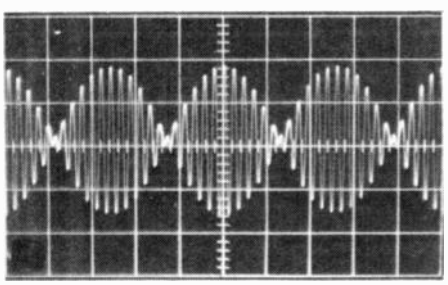


Fig. 2. Amplitude modulation – audio waveform causes corresponding changes in amplitude of sine-wave carrier.

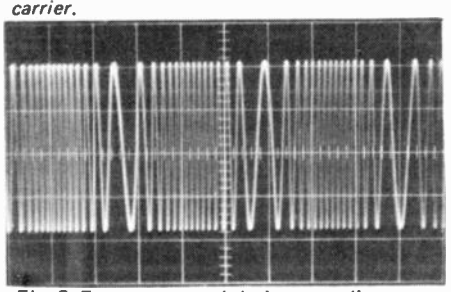
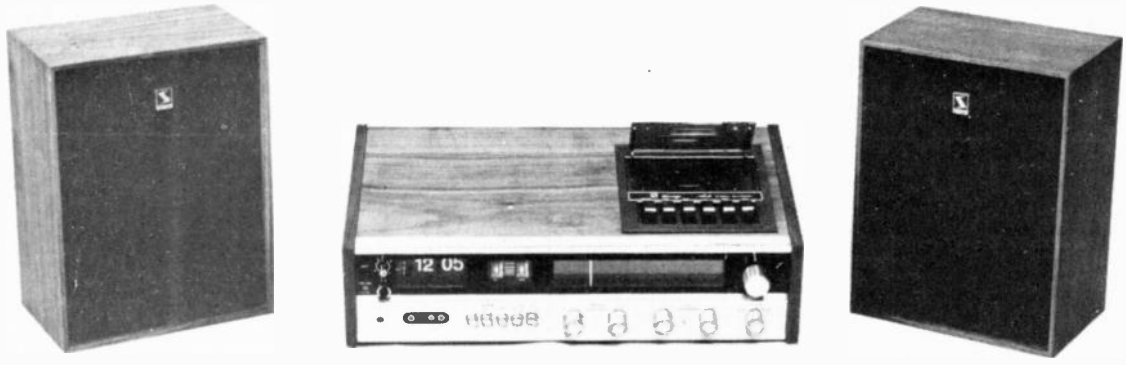


Fig. 3. Frequency modulation – audio waveform causes changes in frequency of carrier.

SURUGA CASSETTE RECORDER
STEREO AMPLIFIER SYSTEM

WITH AM RADIO AND BUILT-IN DIGITAL CLOCK WITH TIMER



Model SE4308

The system is a combination high quality deluxe AM receiver; a Stereo amplifier for record reproduction, a precision stereo cassette recorder with a digital clock and a timer, and a matched pair of dynamic microphones. It is designed for optimum re-production of program material from Radio Braodcasts, Cassette Phonographs and any other Audio Source. Full facilities are provided for recording directly from radio receiver, live program from microphones. New reduced prices made possible with the lower import duty.

AUTOMATIC RECORDINGS, WAKE UP and GOOD NIGHT SLEEP services can be made.

● Total Power Output:	15W(1HF) 10W (RMS @ 8 ohm .8% distortion)
● Frequency Range Tuner:	AM 535-1605 Hz
● Frequency Response:	20-20,000 Hz at -3dB or less
● Stereo Separation:	30 dB
● Stereo Cassette Deck:	4 Track 2 Channel
● Clock and Timer. Clock:	Made by Copal, Auto. off/on w/Sleep Switch.
Time:	Up to 3 hour time set.
Auto Recording:	Up to 1 hour with C120 Cassette
● Voltage:	AC 240V, 50 Hz
● Dimensions: Main Unit:	17" (W) x 4-3/8" (H) x 9-7/8" (D)
Speaker Enclosures:	8-1/8" (W) x 9-7/8" (H) x 5¾" (D) (with 6½" speakers)

1. SURUGA MODEL SE4308

with speaker system ✻ **$209-10** *tax included*
less speaker system ✻ **$196-35** *tax included*

2. SURUGA MODEL SE4308A/MAG CT
with pre-amp for magnetic gramo cartridge

with speaker system ✻ **$221-85** *tax included*
less speaker system ✻ **$209-10** *tax included*

Sole Australian Agents:

radioparts GROUP

562 Spencer St., West Melbourne, Vic 3003
Phone 329-7888. Orders 30-2224
OPEN SATURDAY MORNINGS

Telex 32980

City Depot: 157 Elizabeth Street,
Melbourne, Vic. 3000 Phone 67-2699
Southern Depot: 1103 Dandenong Road,
East Malvern, Vic. 3145. Phone 211-8122

FM RADIO - a new commission

Channel	1956 allocation (MHz)	1961 allocation (MHz)
0	–	45–52
1	49–56	56–63
2	63–70	
3	85–92	
4	132–146	94–101
5	132–139	101–108
5A	–	137–144
6	174–181	
7	181–188	
8	188–195	
9	195–202	
10	209–216	208–215
11	–	215–222

Australian television channel allocations

TABLE I

an independent assessment of the relative merits of the VHF and the UHF be undertaken. This has resulted in the inquiry now being conducted by Sir Francis McLean, Chairman of the Telecommunications Industry Standards Committee of the British Standards Institution and former Director of Engineering for the BBC, and Professor Renwick, Director of Research for the Hunter Valley Research Foundation.

THE BROADCASTING CONTROL BOARD'S CASE

The Board's decision in favour of UHF rests largely on the particular difficulties it foresees by incorporating the FM service into the VHF band without dislocation of or interference to established TV stations. In a recent technical report (No. 34) it concludes that, without changing existing TV allocations, only 10% of the population of Australia would be able to have more than 10 high power FM channels, with 43% having fewer than six. Sydney under these circumstances (because of the presence in Newcastle and Wollongong of stations in channels 3, 4 and 5) could only have two high power FM stations.

The situation is improved if at least one television station may be moved, preferably to another VHF channel. The most natural candidate for such treatment is channel 5, since there are only three high power stations operating in this channel, none of them commercial (Table 2). If ABHN-5 in Newcastle were moved, say, to channel 1, Sydney would then have a possible nine high power (approx. 100 kW) FM stations, together with eight low power stations (1 kW max.). According to the Board, a total of 26% of the population could then be served by more than 10 high power FM channels, and 71% with between six and 10 channels.

The Board bases its calculations on an examination of the different types of interference which it considers may arise between VHF FM and the television service. These may be summarised as follows:

TABLE 2: ASSIGNMENTS OF TELEVISION CHANNELS 3, 4 AND 5

STATE	CHANNEL 3	CHANNEL 4	CHANNEL 5
ACT	ABC-3 Canberra	–	–
NSW	NBN-3 Newcastle	WIN-4 – Wollongong	ABHN-5 Newcastle ABQN-5-Central West Slopes
VIC	ABGV-3 Goulburn Valley ABRV-3 Ballarat	AMV-4- Upper Murray ABLV-4 – Latrobe Valley ABMV-4 – Mildura	–
Q	ABDQ-3 – Darling Downs ABRQ-3 – Rockhampton ABTQ-3 – Townsville	SDQ-4 Southern Downs ABMQ-4 – Mackay	–
SA	BARS-3 Central East	GTS-4 – Spencer Gulf North ABCW-4 Central Agricultural	–
WA	BTW-3 Bunbury	–	ABSW-5 Bunbury
TAS	ABNT-3 N.E, Tasmania	–	–
TOTALS	2 Commerical 8 ABC 10	3 Commercial 5 ABC 8	3 ABC

(In addition to these there are low power translator stations operating in channels 3, 4 & 5: Channel 3, 4 Commercial and 3 National; Channel 4, 6 National, Channel 5, Commercial, and 6 National).

1. Interference caused by the second harmonic FM transmissions generated in the tuners of TV receivers tuned to channels 6-11 (cross-modulation interference).
2. Interference between FM receiver local oscillator radiation and television channels 4 or 5.
3. Interference between TV receiver local oscillator radiation (transmitted via the power reticulation network) and FM receivers (applicable to channels 1 and 2).
4. Adjacent channel interference (caused by strong signals swamping weak ones at closely adjacent frequencies).
5. Interference caused by the second harmonic of TV transmissions generated in the TV receiver tuner and beating with FM signals (unique to Channel 0).

No interference problems occur with channel 5A.

The expected interference in items 1 and 5 is due to non-linearities in TV tuners and results directly from the lack of standards and effective controls on TV front-end design in this country. Until tighter standards are observed by industry, this problem may be overcome in most cases by the insertion of a harmonic trap filter in the aerial feeder of affected receivers at minimal cost. However, it is to be hoped that, with the introduction of colour television, a much higher standard of tuner manufacture will be insisted upon, both for local and imported receivers, so that over a period of years receivers will cease to present this kind of problem.

Similar remarks apply to local oscillator interference in both television and FM receivers (items 2 and 3). Good design practice effectively eliminates this problem, but until stricter controls are enforceable it may be dealt with by filtering out the interfering signal.

Adjacent channel interference (apply to channels 3, 4 and 5) may be dealt with by paying careful attention to the siting of FM transmitters in critical areas, and does not constitute limitation to the service.

A CASE FOR THE VHF?

Even if the Broadcasting Control Board's view of the magnitude of the interference problem were to be accepted, there is further reason to suppose that twice the number of FM channels envisaged by the Board may actually be realised in practice. The Board's figures are derived from the assumption that the customary minimum channel spacing of 0.8 MHz is necessary between stations operating in close proximity. There is now substantial evidence (deriving from the C.C.I.R. among others) that an entirely satisfactory service can be achieved with as little as 0.4 MHz channel spacing.

If channel 5 is vacated where necessary and the remainder of the 88-108 MHz band shared with the television service wherever this is possible without objectionable mutual interference, and if closely adjacent FM channels are spaced down to 0.4 MHz, an effective FM radio system could be established, in every respect comparable with the best systems overseas, and with a capacity to meet whatever demands may be placed on it by broadcasters and the public far into the future.

COSTS, AND THE TIME FACTOR

The solution here proposed can not, of course, be achieved without some cost, since at least one television station and perhaps five translators would need to be shifted in frequency, with the need in some cases for viewers to buy new aerials. In this connection, it may minimise both cost and bother if channel 5 were shifted in frequency to channel 6 or 11 rather than channel 1 as considered by the Board (which would seem to necessitate the relocation of ABTN-1 in Taree). This procedure would interfere with the so-called "tertiary" reception of Sydney television stations by Newcastle viewers; however the introduction of colour television itself will further degrade this "service", and it may be questioned whether this in itself is sufficient reason to avoid such a solution.

Objections on the basis of cost need to be balanced against the cost of developing for Australia a radio system unique in the world (and with the prospect of remaining so), and against the difficulties potential broadcasters faced with an initial dearth of UHF FM receivers are likely to suffer. There are estimated to be in excess of one million VHF FM-capable imported receivers already in the country, representing more than 10% of the total receiver population. Beginning FM broadcasters, then, have a ready market for their product if VHF is chosen. In addition, VHF FM transmitters and ancillary equipment are available virtually "off the shelf" on world markets with a wide range of capabilities to suit all possible applications, whereas UHF FM transmission facilities would undoubtedly be for many years custom-built by local manufacturers — clearly the more costly alternative. The economic implications of these and similar considerations will be among the more important aspects of the FM question to be examined by the Independent FM Inquiry.

One other factor that has both economic and social bearing on the choice of frequency band is the time-scale involved. In a Position Paper prepared in May 1973, the Broadcasting Control Board estimates that the fundamental planning and determination of technical standards for a UHF FM system will take three years to complete. It envisages that the first commercial and "public" (i.e. independent educational, cultural and community-based) FM stations might commence operation by the end of 1977, and that the ABC should begin to establish a network of national FM stations beginning in 1978.

With the delays that have already occurred, it is likely that these estimates are conservative. The Board's statements concerning a similar timetable for the introduction of a VHF FM service have been very detailed, but there seems no doubt that such a service could be introduced much sooner than a UHF service, standards having already been determined, and the technology known.

THE FUTURE

The Broadcasting Control Board has strongly resisted any suggestion aimed at solving the problem of Australia's television allocations by moving one or more TV channels to UHF. However, it is clear that if in the future the television service needs to be expanded substantially (for example, to allow networks of educational TV stations to be established), UHF television will have to be considered. Indeed, there is evidence that such a development may be required within 10 years. Although recognition has been given to this by the Board in its reports, it appears not to have considered how this might relate to the proposed FM service.

Another factor which will have a profound effect on all the mass media in this country will be the introduction of cable services. Cable TV is the subject of a joint study being conducted by the Broadcasting Control Board and the PMG: whatever specific recommendations emerge from this study, it is safe to say that the Cable Revolution when it finally arrives will cause the problem of competing broadcast services to be seen in an entirely new light. It is surely time that the responsible authorities undertook a comprehensive study of the communications media with a view to making the best possible future use of all available resources. Such a study might well evolve a means of restoring, over a period of years, the whole of the 88-108 MHz band to radio in Australia. ●

Akai make more than just the world's most sophisticated tape recorders.

We also make amplifiers, cassette decks, cassette recorders, tape decks, turntables, speakers, and video tape equipment.
Now we all know how Hi Fi manufacturers tend to describe their sound equipment as the ultimate in faithful reproduction, but rarely, do they explain why.
Rather than attempt the impossible task of *writing* about *sound*, we make just one request and one statement:
OUR REQUEST: Listen to AKAI. You'll hear the difference.
AND OUR STATEMENT: Most—not all, but most—professional recording studios recognise AKAI equipment as being able to provide the most faithful sound reproduction.
We've got the good things others boast about, but also good things no one boasts about.
Because they are unique to AKAI. For instance: GX Heads that carry a *lifetime guarantee*. Self-lubricating motors capable of 10,000 hours operation without oiling. Automatic Distortion Reducing Systems (too technical to explain properly here). Stereo cassette decks with built-in amplifiers. And more. Which is why, should you know us only for our tape recorders, we suggest you get to know us for our other equipment as well.
All superb, most of it unique.

Distributed by AKAI Australia Pty. Ltd. Telephone: Sydney 61 9881, Melbourne 81 0574, Brisbane 44 0171, Adelaide 74 1162, Perth 65 5833.

AKAI

THE VERY REAL SOUND EXPERIENCE

AK.91

SCOPE

SOLDERING IRONS

Buy a SCOPE and join the club of satisfied users—you need not keep it a secret, others don't. That's why SCOPE is known at all the best places—in the tool kit, on the bench, in the boot, on the kitchen table, in the garage, on the service truck, in the engine room, even on the roof . . . Wherever SCOPE goes it gives you the best service—and a host of satisfied users will agree *it is the FASTEST, the EASIEST, the SAFEST . . . THE BEST.*

ECONOMICAL
Consumes current only whilst in use. Scope performs all the functions of other irons from 40 to 150 Watts. (Miniscope—up to 75 Watts).

FAST
Fast heating due to the unique replaceable carbon element. Only 5 to 6 seconds' initial heating up time from cold, then practically instantaneous.

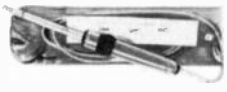
VERSATILE
Copes with all soldering jobs—from miniature components to large solder lugs. Temperature control at your finger tips. Heat only when, where and as much as needed.

SAFE
Low voltage operation. Scope irons operate from 2.5V to 6V.
For your complete protection and the satisfactory operation of your Scope iron, demand and use THE ***natronic*** TRANSFORMER which incorporates a specially designed ELECTROSTATIC SHIELD.
It is the only transformer approved by SCOPE Laboratories.

MINISCOPE SCOPE

SPARE PARTS
No expensive resistance wire heating elements to replace. Maintenance without special tools. Spare tips, carbon elements and other parts readily available from your Scope Distributor.
Scope products are available from all major electrical wholesalers and Hardware Stores throughout Australia and from H. W. Clarke, Wellington and Auckland, New Zealand.

The Scope is yours to have and to maintain easily. It's an Australian made.

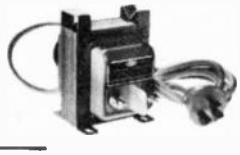


CONVENIENT
Ideal for those almost inaccessible spots. No burning of adjacent insulation.

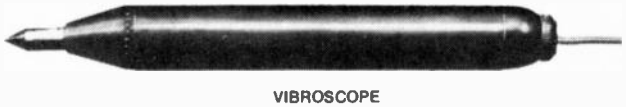
LIGHT WEIGHT
Scope weighs only 3½ oz.
Miniscope 1¾ oz.

All irons are supplied complete with a spare tip and two elements.
Modern two-tone styling, together with a strong stainless steel barrel is a feature of the De-Luxe Iron, which comes in a handy re-usable plastic pouch. The Standard economy version, with black handle and mild steel barrel, is supplied in a cardboard fibre pack.

natronic transformer
*Approved by electricity authorities
APP. No. N/360/6894-5



ETCHING TOOL



VIBROSCOPE

**Prevent theft,
etch your name or symbol
on personal possessions**

Distinct, permanent identification can be made in moments with the **VIBROSCOPE** on any metal, ferrous or non ferrous, hardened or annealed, dull or polished.
Not just a surface marker, the etching action of the Vibroscope produces good penetration with lasting results. Simply attach to a 4V accumulator, or 6V car battery, or Scope iron mains transformer and the Vibroscope electric etching tool is ready for action.
Anyone who can write can use Vibroscope—make "your" mark for security.
Maintenance is ridiculously simple. When the long wearing tungsten tip or core of the vibrating steel plunger wears out, it is very easily replaced and spares are readily available from all suppliers of Scope products.

NATRONICS PTY. LIMITED
IRH COMPONENTS DIVISION
THE CRESCENT, KINGSGROVE, N.S.W. 2208. PHONE: 50-0111
74 RAGLAN ST., PRESTON, VIC. 3072. PHONE: 44-5021

Interstate Agents
HOB. TAS. 34 2811
LAUN. TAS. 31 5545
PERTH W.A. 81 4155
ADEL. S.A. 23 1971
BRIS. QLD. 21 1933
New Zealand
H. W. CLARKE (N.Z.) LTD.

IRH

Please Post free SCOPE literature

NAME

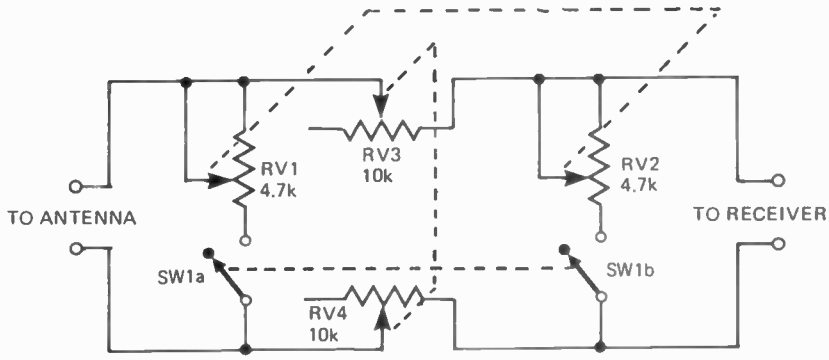
ADDRESS

CITY POSTCODE

Simple project may well restore a previously unwatchable TV channel.

KILL THAT GHOST!

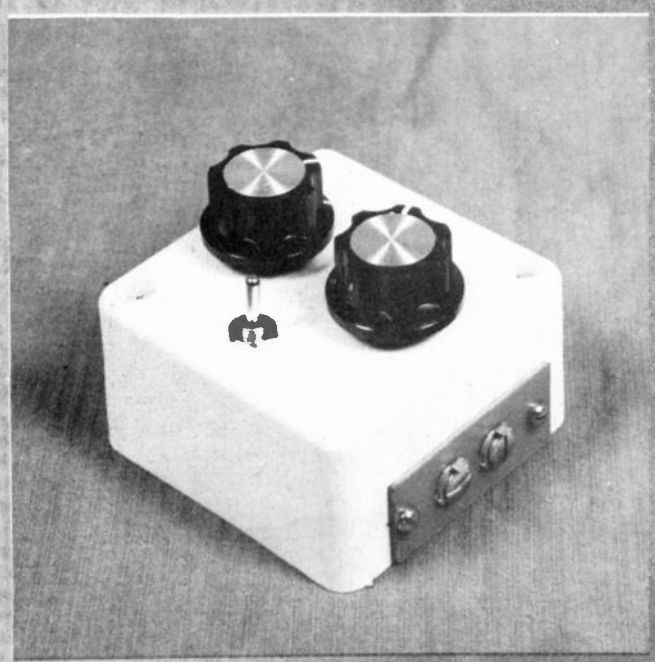
Fig. 1. Circuit diagram of the ghost eliminator.



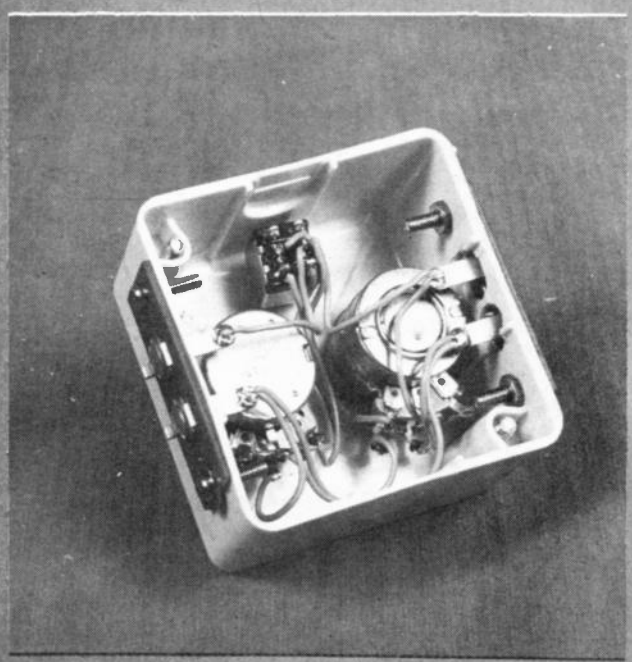
IF YOU live on a hill and have a direct line of sight to all TV transmitting antennas in your area you are fortunate indeed — for you will have an excellent, ghost-free picture on every channel.

Most of us are not so lucky. We may have good pictures on some channels, but another channel may be almost unwatchable due to 'ghosting' caused by multiple reflections.

The ghost eliminator may be built into any small plastic or metal box. This is how our prototype was built.



Internal positioning of the components may be seen from this photograph.



PARTS LIST

RV1/2 potentiometer dual-gang 4.7k
RV3/4 potentiometer dual-gang 10k
SW1 switch double pole single throw, connecting lugs, wire, plastic box.

PROJECT 216

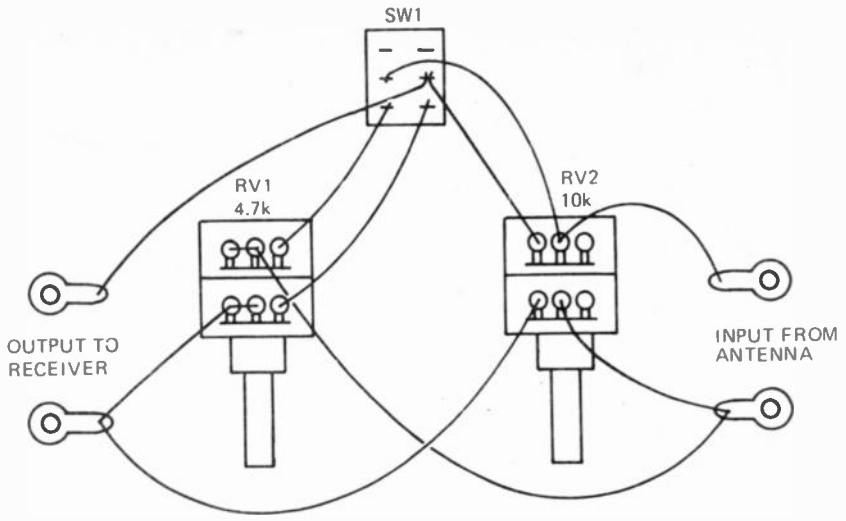


Fig.2. Point-to-point wiring diagram.

Providing that the signal strength on the offending channel is reasonable, this little project will attenuate the ghost and considerably improve the picture quality.

CONSTRUCTION

Construction of the ghost eliminator is quite straightforward. We constructed ours in a plastic junction box such as used by electrical contractors, but any small plastic or metal (mini box etc) will be suitable.

The circuit diagram is shown in Fig. 1 and Fig. 2 provides a point to point wiring diagram. Keep the internal wiring as short as possible.

Make sure you use the twin screw connectors as specified and keep the stripped portion of the antenna ribbon short so that an impedance mismatch is not created.

USING THE ELIMINATOR

Switch SW1 to the 'OFF' position and adjust the dual gang potentiometer RV3/RV4 until the ghost is just eliminated.

Now switch SW1 back on and adjust dual gang potentiometer RV1/RV2 for the best picture.

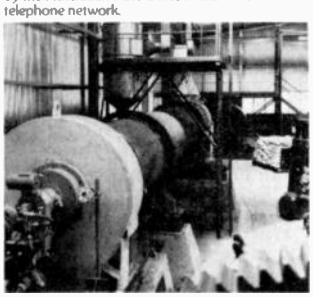
The eliminator may be connected to the antenna terminals of the TV set by a short length of aerial ribbon and just left hanging at the rear of the set. ●

Australia

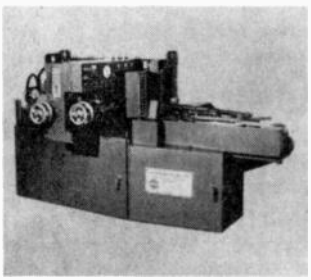
'PABX'—manufactured by Plessey Tele communication Systems, this private automatic branch exchange system employs crossbar switching and componentry similar to that used by the Australian Post Office in the national telephone network.

Plessey Rodan indicator lamps designed for compatibility with and to enhance the presentation of electronic, electrical and industrial equipment. These indicator lamps are just some of the vast range available from Plessey Ducon

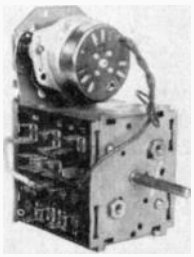
The 'do it yourself' stereo amplifier kit from Plessey Ducon. This simple and easy to assemble kit will provide truly first class reproduction at a cost far below that of equivalent powered units



Plessey Rola is Australia's largest manufacturer of magnetic materials. Under agreement with B.H.P., Plessey have exclusive marketing rights for hematite and ferrite powders produced from Yampi Sound

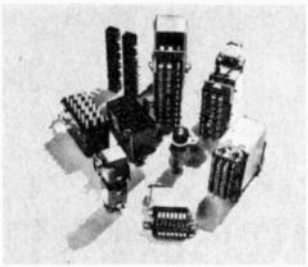


Designed and produced in Australia by Plessey Telecommunications, the 'Computermatic' timber grader completely eliminates the guesswork from visual timber grading. Electronic grading ensures that timber is accurately classified by strength and stability before use.

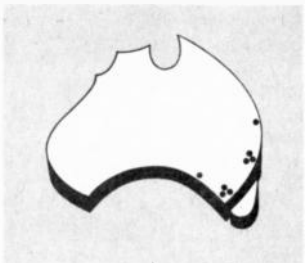


Plessey Mallory interval timer switch — commonly used in automatic washing machines and electric ranges are supplied by Plessey Ducon located at Villawood, N.S.W.

This direct reading digital clock is one of a wide range of models supplied by Plessey in Australia. Extremely accurate, the clocks are built for indoor use or weatherproofed and illuminated for outdoors



Some of the wide range of multi circuit connectors marketed by Plessey Ducon, all of which are reliability and quality proven



Number of plants 8
Factory capacity 1 million sq ft
Employees 4 000

Plessey

APP69

Amcron

BY CROWN INTERNATIONAL

"A NEW STANDARD"

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

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

Power You Can Count On

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

Two Amplifiers in One

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

Superior Output Protection

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

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

Lowest Distortion and Noise

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

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

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

PRICE $795.00 less than the DC300 sold for.
WARRANTY – three years, covering all costs of parts labor and round-trip shipping.
COOLING – excellent heat dissipation provided by massive cooling fins and the entire chassis itself.
DEPENDABILITY – stringent pre- and post inspection and testing proves every electronic component, every circuit module and every finished unit, to bring you one step closer to install-and-forget field dependability.
PEOPLE – the same innovative design team and careful craftsmen who made the DC300 such a sound success. And the same knowledgeable customer-service men ready to discuss your special application and send you detailed technical data.

AVAILABLE FROM:

QLD:
Stereo Supplies – Brisbane 213-623.
Brisbane Agencies Audio Centre – Valley 219-139.

NSW:
Instrol – Sydney 29-4258.
Kent HIFI – Sydney 296-973.
Arrow Electronics – Sydney 29-8580.
Miranda HIFI – Miranda Fair 525-6745.
Audio Gallery – Warringah Mall 938-2205.
Audico Sound Systems – Nth. Lambton 570-501.
Audio World – Wollongong 295-110.

ACT:
Duratone – Phillip 821-333.

VIC:
Douglas Trading – Melbourne 639-321.
Instrol HIFI – Melbounre 675-831.

TAS:
Quantum Electronics – Hobart 281-337.
Audio Services – Burnie 312-390.

SA:
Sound Spectrum – Adelaide 223-2181.

WA:
Alberts TV and HIFI – Perth 215-004.
Perth HIFI – Perth.

AUSTRALIAN DISTRIBUTORS:

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

POCKET PROGRAMMABLE CALCULATOR

Under $700 pocket calculator rivals full-scale desk-top machines.

HEWLETT-PACKARD'S handheld programmable calculator has now been released.

This, the first-ever pocket-sized unit to give users full programming capability, enables users to write and edit their own programs, to use pre-recorded programs (developed by H-P), which solve many frequently encountered problems in a variety of disciplines, and to operate the 51 keyboard functions pre-programmed into the machine.

Hewlett-Packards new calculator is a significantly more powerful version of current HP pocket-sized calculators, more than 250 000 of which are now in use throughout the world. The new model is for use in science, engineering, medicine, surveying, statistics and mathematics. Because users can write their own programs easily, the HP-65 can also be used in areas such as business, education and navigation.

PROGRAMMING

With the HP-65, no previous programming experience is required. The calculator has five master keys (A-E) for storing and recalling programs written by the user. These programs can be called up at the touch of the appropriate key.

Editing is done with a few simple keystrokes. When a recorded program is no longer needed, the magnetic card can be erased on the same machine and reused to record another program. Accidental erasures can be prevented by clipping a corner of the magnetic card.

The user simply enters the program using the HP-65's keyboard. The program can be changed or edited at any time. It is not necessary to rewrite the entire program when an error is made.

The program cards are easily entered into the calculator. One program containing up to 100 steps, or many programs totalling 100 steps, can be recorded on a single card.

The HP-65 allows the user to perform branches, logic comparisons and conditional skips in his programs as an aid to more efficient programming.

PRE-RECORDED PROGRAMS

In addition to doing his own programming, the user can expand the capability of the machine with a series of pre-recorded programs (available from H-P). Initially, a total of six pre-recorded "Application Pacs" is available for statistical, mathematical, engineering, medical and surveying applications. Additional sets of pre-recorded programs will be offered as they are developed.

BUILT-IN CAPABILITIES

The HP-65's keyboard has 51 calculating functions and data manipulation operations. Many of the keys can each perform four functions.

Included among the pre-programmed functions are the standard arithmetic operations, logarithms — both natural and common — square and square root, exponential, factorial, reciprocal and trigonometric functions. When used in a program, each of these built-in functions occupies only one or two program steps.

The HP-65 can add and subtract in degrees, minutes and seconds format, allowing it to also perform calculations involving hours, minutes and seconds. It also will operate in any of three trigonometric modes — degrees, grads and radians — and will convert octal-based integer numbers to decimal-based integer numbers and back.

The unit has nine addressable memory registers. This extended memory, plus the calculator's ability to perform 51 built-in functions, enable the user to solve complex, multi-step problems with greater ease and in less time than possible with comparable desktop machines.

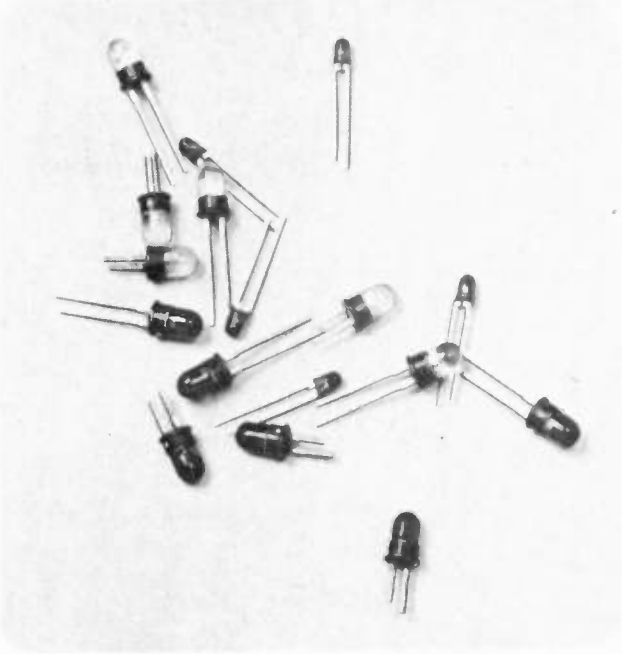
The nine memory locations permit register arithmetic. The user may specify which of the registers he wants to store a number in, recall it quickly, or combine it with other stored numbers.

Like other H-P pocket-sized calculators, the HP-65 has a four-register operational stack which stores intermediate answers and automatically brings them back when needed in a calculation.

The LED display can be set to show results in either fixed or scientific notation. Up to 10 digits are displayed, plus exponent and appropriate signs.

Rechargeable batteries operate the calculator for approximately three hours. It will also run on A.C.

A standard "Application Pac" accompanying each machine includes pre-recorded programs, diagnostic program cards, a magnetic head cleaning card and 20 blank magnetic programs cards. Users also receive a one year subscription to the HP-65 User Library Catalogs. The library provides users with a low-cost way to get program documentation for a large number of user-contributed and individual HP Application Pac programs. ●



see the light?

Let HP show you their complete range of LED lamps.

Whatever your field; Electronic Engineering, Radio Technology, Instrumentation, or even in your hobby Hewlett-Packard has the range. Let us show you our bright lights, or see them at any of HP's distributors listed below. Get in touch today for the light that's right for you.

HP *DISTRIBUTORS*

N.S.W.
RADIO DESPATCH SERVICE
869 George Street
Sydney, 2000
Phone 211 0816

QLD.
M. O. WALTON (ELECTRONICS) PTY LTD
3 Moore Street
Enoggera, 4051

W.A.
EVERETT AGENCY PTY LTD
17 Northwood Street
West Leederville
Western Australia, 6007
Phone 81 5500

S.A.
GERARD & GOODMAN PTY LTD
192 Rundle Street
Adelaide, 5000
Phone 23 2222

VIC.
RADIO PARTS GROUP
562 Spencer Street
West Melbourne, 3003
Phone 329 7888, 30 1251

HEWLETT hp PACKARD

Sales and service from 172 offices in 65 countries.
Australia, 31-51 Joseph Street, Blackburn, 3130, Victoria. Telephone 89 6351. Other Offices: Adelaide, Brisbane, Canberra, Perth and Sydney. Also Auckland and Wellington, New Zealand

90416/30144

TWO-FOUR RECEIVER

For audiophiles who feel this is the 2-channel stereo receiver era—but want to be ready for 4-channel—we recommend our latest two-four receivers.
They are the KR-5340 and KR-6340. They offer the most superb 2-channel reproduction characteristics with no loss of rear speaker amplifier power. Each has a BTL system that is compatible for two-four channel use. To enjoy SQ or RM merely turn the appropriate switch, and for total CD-4 sound reproduction plug in our KCD-2 demodulator (except on the KR-5340). These are stereo receivers that are ideal for the present or the future. For 2-channel or 4-channel stereo remember Kenwood's "two-four" and you will be prepared for either.

the sound approach to quality

KENWOOD

Distributed by: Jacoby, Mitchell Ltd. • Sydney 630 7400 • Adelaide 93 8117 • Perth 81 4144 • Canberra 95 9138 • Melbourne 41 7551 • Brisbane 52 8266 • Hobart 34 2666 • Launceston 31 5688 • Fairymeadow 84 8022 • Newcastle 81 4991. Ring for location of your nearest Kenwood Sound Centre.

SHORT WAVE FACSIMILE BROADCASTING

Photo courtesy of Paul Kassay

◀ *Fig. 1. A modular short wave facsimile receiving system using a conventional, unmodified communications receiver and types of components generally available.*

by C.M. Stanbury

This article is published as a matter of general interest. In some countries, any attempt to receive communications from military transmitters is a very serious offence.

Is this a viable alternative to slow-scan TV?

IT is hard to imagine a TV viewer who, at one time or another, has not dreamed of direct, global visual reception. Yet with the current anti-international trend in communications (eg. McLuhanism, non-standard UHF FM, the threat of jammer satellites etc.), direct broadcast TV satellites seem hopelessly snarled in technological and political power struggle. Meanwhile shortwave facsimile broadcasting (SW FAX) is at least distantly on the horizon as an international mass media. Balanced against this are limitations on SW FAX content imposed by relatively narrow bandwidths and an unstable ionosphere. At very best, short wave facsimile could be to television what animated cartoons are to cinema.

Of course as most parts of the world now have both aural and visual broadcast services, for any new and relatively expensive broadcast mode to become a mass media it must make substantial use of equipment already available to the general public. This is primarily a matter of simple economics. On the basis of novelty appeal, the electronic consumer will buy one piece of equipment to add to his receiving system (eg. a UHF converter and simple UHF antenna to augment a VHF TV receiver) but he will not buy a whole new system. Thus the American direct broadcast ATS-F satellite with its frequency modulated video on the 2570-2670 MHZ range cannot be considered as a serious attempt to establish a new international mass media. Further, in some nations on both the left and right, there are at least covert sanctions against international reception. Citizens of such states might be willing to add a clandestine converter to an otherwise "respectable" receiver but would not be willing to set up a wholly illegal system. Thus SW FAX, whatever its content, must broadcast to the same receivers used for short wave sound reception with only the addition of an *external* converter.

BASIC RECEIVING COMPONENTS

A practical SW FAX receiving system is shown in Fig. 1. It utilizes components available to the general public in most technologically advanced countries and requires no internal alterations of these components. Specifically the author's system includes a communications receiver in the medium price range (Hammarlund HQ-200) and a small speaker (plugged into the HQ-200's phone jack) which feeds the facsimile signal in the form of sound into the receiver (earpiece) receptacle of a XEROX 400 telecopier.

The XEROX 400 is intended for transmission and reception of facsimile material via conventional telephone circuits — without tampering internally with the telephone equipment, (in countries where relevant telephone authority regulations permit). To

accomplish that, the 400 converts the FAX scans into sound which is picked up by a telephone mouthpiece and then carried to an earpiece at the other end of the phone circuit, where a second 400 converts the sound back into FAX signal then prints it with an electric stylus (although scanning is mechanical).

It is this singular ability to convert FAX from audio that makes it a practical means of SW facsimile broadcast reception. Further the 400 receives at a scan rate of 120 per minute which is that used by most high frequency weather and hydrographic transmissions therefore providing ample signals for experimenters (as listed in Fig 2). The only major problem is that some of the charts, when printed, simply are not recognizable as coherent patterns to the layman. In Fig 3a, b, c we have displayed some that are recognizable — made up of distinctively curving millibar lines, latitude markers and (3c) a set of horizontal bars broadcast at the time of the October Israeli/Arab crisis which probably convey some sort of operational information to vessels of the U.S. Navy.

But whatever the content of the print received, the 400 must be activated by its manual start procedure, and the 400's mouthpiece receptable covered (with a book, piece of sponge rubber etc.) to prevent possible feedback.

A third minor compatability problem is that the extreme left hand side of the transmission is printed by the 400 at the right. This can be remedied with scissors and Scotch tape.

Within the limitations of the present system, the choice of a speaker is not particularly critical. Even though the audio frequencies involved are comparatively low, the author has obtained his cleanest prints with a tweeter which, because of its size, can be conveniently used with the 400.

Although some of the most stable FAX signals are within the conventional 60 and 90 metre SW broadcast bands, Hammarland's HQ-200 is a general coverage receiver providing access to all those frequencies listed in Fig 2. Its combination of excellent selectivity, ease of fine tuning (which makes it possible to tune out some image-produced heterodynes) and fair image rejection, through careful use of the antenna tuner usually is sufficient to provide at least one interference-free visual signal anytime of the day or night. Given the nature of this system, even a relatively low level of extraneous audio will ruin the print.

COPING WITH THE IONOSPHERE

All those examples of short wave facsimile reception accompanying this article were achieved on interference free channels. Nevertheless the prints are still partly obscured by constant fluctuations in signal strength. This is inherent in reception via the inonosphere which is comparatively unstable even under the best of conditions. Ships of the U.S. Navy would receive these transmissions on two or three different channels simultaneously, the output from all the channels would then be combined, and many of the random fluctuations cancelled out.

Multi-channel reception is also useful when one frequency is momentarily rendered useless by ionospherically induced phase shifts between carrier and sideband. Further, the U.S. military at such facilities as the Air Force's Cambridge Research Laboratories have developed various computor techniques for removal of "picture noise." One such technique involves enhancing only those patterns which conform to a loosely prescribed geometry, or by distorting contrasts. We have accomplished something of the latter in Figs. 3b and c by reducing the audio gain so that only highlights of the pattern are printed. In Fig. 3c especially, we have been able to eliminate almost entirely the half tones leaving only the pure black on white millibar design. But beyond experimenting with the audio level, neither picture enhancement nor multi-channel reception would seem to be economically feasible in the context of SW FAX as a mass media.

The HQ-200's automatic gain control which is applied at both the RF stage and the first IF, has a diode controlled time delay. Any further reduction in this delay would result in imperfect filtering out of modulation and an unacceptable loss in audio level. It is clear that any further substantial smoothing of the signal requires a more complex system of modulation.

One answer might be a frequency modulated subcarrier similar to that

FIG. 2. MILITARY SW FACSIMILE TRANSMISSIONS

kHz	STATION	LOCATION	OPERATED BY	TIME (GMT)
2122	NPM	Pearl Harbor, Hawaii	U.S. Navy	Continuous
3357	NSS	Annapolis, MD, U.S.A.	U.S. Navy	Continuous
4271	CFH	Halifax, N.S., Canada	Dept. of National Defense	2100
4346	NMC	San Francisco, CA, U.S.A.	U.S. Coast Guard	0945
4782	GFE	Bracknell, England	Royal Air Force	1400
4802.5	NPM	Pearl Harbor, Hawaii	U.S. Navy	0600-1800
4975	NPN	Guam, Marianas Islands	U.S. Navy	Continuous
	NSS	Annapolis, MD, U.S.A.	U.S. Navy	Continuous
7645	NPN	Guam, Marianas Islands	U.S. Navy	Continuous
8080	NSS	Annapolis, MD, U.S.A.	U.S. Navy	Continuous
8502	NMF	Boston, MA, U.S.A.	U.S. Coast Guard	1730
8682	NMC	San Francisco, CA, U.S.A.	U.S. Coast Guard	0945 G
9203	GFE	Bracknell, England	Royal Air Force	1400
9440	NPM	Pearl Harbor, Hawaii	U.S. Navy	Continuous
9890	CFH	Halifax, N.S., Canada	Dept. of National Defense	2100
10255	NPN	Guam, Marianas Islands	U.S. Navy	Continuous
10565	NSS	Annapolis, MD U.S.A.	U.S. Navy	Continuous
12750	NMF	Boston, MA. U.S.A.	U.S. Coast Guard	1730
12788	NMC	San Francisco, CA. U.S.A.	U.S. Coast Guard	0945 & 2145

SHORT WAVE FACSIMILE BROADCASTING

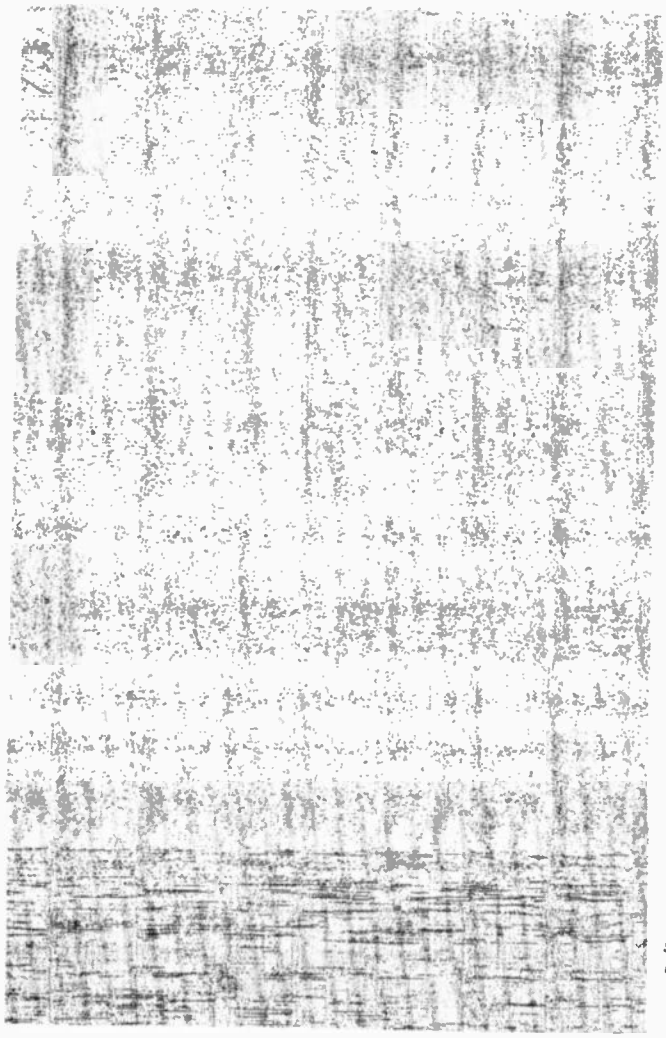


Fig. 3a.

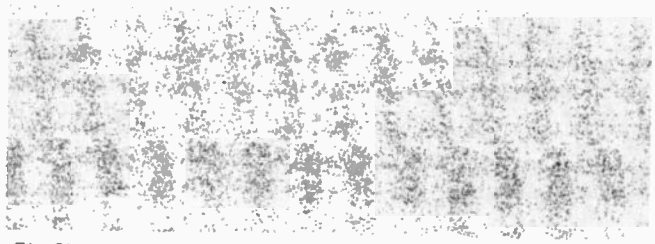


Fig. 3b.

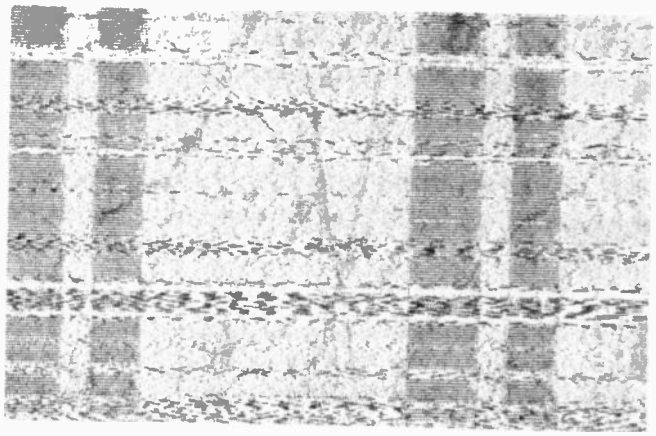


Fig. 3c.

Fig. 3. (a-c) Various weather and operations charts (or portions thereof) received on 4975 kHz in Canada from U.S. Navy facsimile broadcast station NSS Annapolis, Maryland.

presently used by experimental short wave Slow Scan TV and a printer which responds not to changes in audio amplitude but to variations in audio frequency (eg 2200 Hz would barely print while 1500 Hz produces the blackest black). Provided this frequency range was transmitted in standard AM form, the signal could be received on any conventional receiver. Slow scan TV uses single side-band with carrier removed but the complicated tuning procedure required would be impractical for a mass media. Radio Nederland Worldwide's director of technical development, J.J. Geluk has noted (in the June 1971 "E.B.U. Review") that even for SW sound broadcasting, general SSB reception (i.e. without carrier) would require complex and expensive receiver modifications.

A glance at Fig 2 reveals that most short wave facsimile broadcasting is carried on by the military – and at present is devoted entirely to utilitarian purposes, i.e. the dissemination of meteorogical, hydrographic or (on occasions) operational information. However as noted by the author in vol. 15 of the American cinema and literary annual "December", the U.S. military, especially from the Bay of Pigs on, has become ever increasingly involved in international broadcasting to the general public. While the military is not noted for its appreciation of radically new concepts, the Pentagon does have both the financial and scientific resources to carry out any long range exploration it chooses – including the hybrid AM/FM/FAX system suggested above. And in fact it has experimented, at least on a limited basis, with the related SSTV mode. This possible source of FAX/development probably comes down to a question of contingency planning: will the Pentagon decide that a viable SW FAX media, given the deficiencies of ionospheric propagation, would be a useful alternative to satellite broadcast capabilities? If they decide it wouldn't then it is up to the individual experimenter to at least begin the job.

OTHER RECEIVER CONSIDERATIONS

Even with the removal of one sideband (which already has been done by some FAX broadcasters) a hybrid AM/FM facsimile system would require greater bandwidth, less selectivity and therefore increase the chance of interference – especially the heterodyne variety. This would be partly compensated for by greater print speed: about eight seconds as compared with the present six minutes for 200 mm x 250 mm of copy. It would certainly be easier to obtain clear copy for eight seconds than six minutes. Although synchronization control becomes much more of a problem with an eight second picture, use of the established FAX system, as represented by the 400, is virtually ruled out for amateurs on the crowded short wave frequencies to which they are assigned. And for the experimenter working with equipment available at reasonable prices, it is this uselessness of the amateur bands which in turn limits him to weather and hydrographic charts (unless of course he is willing to set up an illegal transmitter).

As we are for the time being limited to the simpler FAX system and the abstract-like patterns transmitted by

SHORT WAVE FACSIMILE BROADCASTING

military stations, experimenters should consider the use of variable audio clipping circuits (inserted externally into the system between phone jack and speaker) to at least partially eliminate those extraneous horizontal lines caused on the print by sudden bursts of signal strength with which the AGC cannot cope. Most communications receivers, including the HQ-200, have a built in "noise limiter" circuit but as this can only be adjusted by pushing up the general audio level (thus removing much of the experimenter's "contrast" flexibility) it is not entirely satisfactory for facsimile.

Turning again to the interference problem, a further refinement lies in a frequency selective audio filter which, like the amplitude limiting clipper circuit, could be inserted into the system between phone jack and speaker: a tunable filter with very sharp rejection characteristics (eg. 25-35 dB) at any single audio frequency upon which it is set. With the hybrid system, if a heterodyne fell within the 1500-2300 Hz range, this type of filter would remove part of the print but save the rest. Such an audio filter would be even more useful for reception of the present short wave facsimile system. It is true of course that similar results can be obtained from a received which already has tuneable crystal selectivity built in to its IF. But that heterodyne rejection procedure requires considerable operating skill, thus eliminating it as a technique for future mass media use.

FAX SSTV

Facsimile and Slow Scan Television are closely related systems and in fact for space work (weather, earth resources and intelligence satellites as well as deep space probes) the two merge into one. But as modes of short wave transmission they can be considered as two potentially competing media. Receiving equipment for the present FAX system is somewhat cheaper than that for SSTV. Using prices in North America (where the author has carried out his research) as examples, a XEROX 400 rents in the U.S. at US$59.50 a month while equipment for slow scan reception (again excluding the short wave receiver itself) sells at a flat rate from $600 to $1000. A switch from amplitude to frequency modulated printer (and the replacement of mechanical with electronic scanning) would put FAX and SSTV in about the same price range — a price range which should drop considerably if demand and therefore production were increased. Incidentally, the experimenter should take note that at present there are no regularly scheduled short wave SSTV broadcasts; it is used entirely for amateur and experimental point-to-point transmissions.

The major difference however between SW SSTV and facsimile is that the latter *automatically* provides a permanent product. In this very important respect, FAX is unique from all other broadcast media. Sound broadcasts can be taped, TV can be photographed or preserved on video tape recorders but only FAX inherently involves a permanent product — and one which, after reception, can readily be passed on from hand to hand. Considering the quantity of printed material (everything from abstract and map-style QSL cards to pictures of Chairman Mao) presently distributed by SW sound broadcast stations, this aspect of FAX alone should make the mode of interest. ●

Facsimile transceivers enable typed, handwritten, drawn or photographic data to be transmitted over any distances via public telephones networks — or private wire circuits.

The machines generally use a photo-resistor technique in which the original data is scanned line by line by photo-electric cell, determining at which point the paper is white, black or one of several shades of grey.

A corresponding electronic signal is sent to the receiving machine, which is scanning a sheet of electro-resistive paper. Current proportional to the density of the area being scanned flows through the stylus to etch the image of the transmitted document onto the special electro-resistive paper.

The normal scanning rate of these machines varies from 100 to 600 lines a minute.

Whether working on private lines within a company or over international public telephone networks, applications of facsimile transceivers are endless. Orders and specifications can be transmitted between company branches or received from customers; urgent letters can be sent across the world in any language or alphabet in a matter of minutes. Drawings, diagrams or photographs can also be transmitted by facsimile.

Dollar Stretchers Sale!

SATISFACTION GUARANTEED!
or your money cheerfully refunded!

INTRODUCTORY SPECIALS

1. 25 yards Hook up-wire — 10/010 in 5 colours — $1.00
2. 50 ft Speaker wire — fig. 8 colour coded — $1.00
3. 4 Philips VDR's — experimenters pak — $1.00
4. 25 ft single shielded cable — hi-quality grey — $1.00
5. 15 ft twin shielded cable — fig. 8 grey — $1.00
6. 4 — Alignment tools — useful radio/TV types — $1.00
7. 8 — Assorted Slide Switches — SPST, SPDT, DPDT — $1.00
8. 200 — Assorted screws/nuts — suit electronics assembly — $1.00
9. 50 ft plastic spaghetti tubing — asst. sizes/colours — $1.00
10. 10-mini-globes & sockets — 6V 50 MA screw-in — $1.00
11. 25 ft nylon dial cord — c/with 5 dial springs — $1.00
12. 5 — NE 2 neon bulbs — 60V operation, 100's uses — $1.00
13. 10 volume controls — some w/switch, ganged — $1.00
14. 10 preset pots — tab mtg, TV types — $1.00
15. 5 — transistor sockets — 3 pin suit T05, T018 etc — $1.00
16. 4 — transistor sockets — T03 power transistor — $1.00
17. 2 — 2 pin din plug/sockets — best quality — $1.00
18. 3 — 4X1015 penlight battery holders — black plastic — $1.00
19. 15 — NO.216 battery clips — high-grade types — $1.00
20. Tuning Dial Kit — incl tuning spindle, 3x3/8" pulleys drum and dial cord etc. and inst — $1.00
21. 3 — magnetic 8 ohm ear pieces — c/w 3.5mm plug — $1.00
22. 2 — crystal earpieces — c.w 3.5mm plug — $1.00
23. 15 — fuses std 3AG — your choice ½A, 1A, 2A, 3A, 5A, 10A — $1.00
24. 3 panel fuse holders — std 3AG screw in — $1.00
25. 8 — chassis fuse holders — std 3AG clip in — $1.00
26. 50 — rubber grommets — asst. useful sizes — $1.00
27. 4 — 2 pin spkr plug/socket sets — polarised type — $1.00
28. 3 — push-button switches — 1P push to make — $1.00
29. 2 — neon screwdrivers — tests 180-500V AC or DC — $1.00
30. 25 rubber feet — asst. sizes, black — $1.00
31. 25 ft — 5 core solder — 16G 60/40 multicore — $1.00
32. 25 brass spacers — 4BA clearance hole, asst. sizes — $1.00
33. 2 — IC test prods — mini hooks, 1 red, 1 black — $1.00
34. 1 — transistor tuning gang — std type 1" x 1" — $1.00
35. Bonanza Jackpot — a wealth of all types of electronic parts for the hobbyist/experimenter. $25 value for only — $5.00
36. 2-way Intercom — master/slave with 50' cord — $9.50
37. Crystal microphone — hi imp, 200-6000Hz — $1.50
38. 27 MHz CB crystals — miniature type, 3/8" pin spac matched transmit/receive, PAIR for only — $5.00
39. P.C.B. etching kit — all the requirements incl P.C.B. to make professional P.C. Boards — $2.50
40. 2 — 5 pin din plug/sockets — cheapest and best — $1.20
41. 10 — jumper leads — asst. colours, alllg clips each end — $2.00
42. Chassis punch set — 5 punches, T-bar and reamer — $7.90
43. 2 — pair multimeter test leads — 3MM prods each end — $1.50
44. 1 — strobe tube + trigger transformer — matched set, Joule output — $5.95

Lowest Price Cassette Tape

BRAND NEW — FRESH AND FULLY SEALED PACKS
ALL TAPES 100% GUARANTEED.

TYPE	BRAND	1-9	10 +
C-60	Robins G-Tape LN	99c	90c
C-60	Concorde LN	$1.10	$1.00
C-60	TDK LN	$1.80	$1.65
C-60	TDK SD	$2.50	$2.30
C-60	TDK ED	$3.50	$3.30
C-90	Memorex Chrome	$3.50	$3.20
C-90	Concorde	$1.60	$1.40
C-90	TDK LN	$2.50	$2.30
C-90	TDK SD	$3.50	$3.30
C-90	TDK ED	$4.50	$4.20
C-120	Economy	$1.50	$1.30
C-120	Concorde	$1.90	$1.70
C-120	TDK N	$3.20	$2.90
C-120	TDK SD	$4.70	$4.20
90 sec	TDK endless cassette	$4.10	$3.80
3 min	TDK endless cassette	$4.20	$3.90
6 min	TDK endless cassette	$4.50	$4.15
8 Track Cartridge Blank 64 min.		$2.25	$2.00
8 Track Cartridge Blank 80 min.		$2.50	$2.20
Cassette Head Cleaner		99c	90c

CHROME — Chromium Dioxide.
LN — Low Noise
SD — Super-Dynamic
ED — Extra-Dynamic

Note: BUY NOW! Stocks are definitely limited

electronic agencies

THE MAIL ORDER DISCOUNT HOUSE,
P.O. BOX E5,
CONCORD EAST. NSW 2137.

NOTE: Add postage, rated 5% of order value. Minimum order value = $2.00. C.O.D.'s send $2.00. prepayment. Guaranteed 24 hrs despatch or money refunded. Please use this easy order form.

- Fairchild
- Motorola
- National
- Philips
- Texas

Largest Selection TTL IC's

Lowest Prices — Brand New — "D.I.L." Packages
Buy any five (5) I.C.'s take 10% discount. Order by type number!

SN7400	70c	SN7408	70c	SN7441	$2.00	SN7475	$1.50
SN7401	70c	Sn7409	70c	SN7442	$1.75	SN7476	$1.15
SN7402	70c	SN7410	70c	SN7446	$3.00	SN7490	$1.50
SN7403	70c	SN7413	$1.00	SN7447	$2.75	SN7493	$1.50
SN7404	70c	SN7420	70c	SN7472	$1.10	SN7496	$1.75
SN7405	70c	SN7430	70c	SN7473	$1.15	SN74121	$1.15
SN7406	$1.20	SN7440	70c	SN7474	$1.15	SN74192	$4.25

4 TRANSISTOR 500 mW AMPLIFIER CHASSIS

Only $2.95 ☐

A miniature OTL Amplifier ready-wired on PCB for hobbyist, experimenter, GP use. Operates from 9V battery with 4-8 ohm speaker. Uses silicon transistors with complementary push-pull output. Size only 470mm x 120mm x 100mm high. Cat. No. "A" $2.95.

Big Discounts on NATIONAL 309 VOLTAGE REGULATOR.

$3.99 ea. ☐ 2 for $7.50 ☐

LM309K, 5 Volts, 1.5 amps, T03 Case. Internally set. Overload and short circuit proof. No external components. With spec sheet.

FREE FLYER!

Send S.A.E. (size about 10" x 6") with two 7 cent postage stamps for our fantastic Summer Catalogue of stock lines, specials and bargain — priced components. You won't be sorry!

'PIC-A-PAC' TRANSISTORS

NPN 10 for $1.50 ☐
Similar to BC107-8-9. Guaranteed new but unmarked, for hobbyists and experimenters.

PNP 10 for $1.50 ☐
Similar to BC177-8-9. Guaranteed new but unmarked, limited quantity available.

BRAND NEW LOWEST PRICE
POWER IC CHIP!

☐ $2.95 2 for $5.50

NATIONAL 2 Watt Audio Amp.

The fantastic LM380 2 Watt I.C. chip in 14 pin DIL package has short circuit current limiting and thermal shutdown protection. Requires only 4 ext. components. With spec. sheet and circuit data.

LED LIGHT EMITTING DIODE

Type 5023.

A general purpose red LED, size T0-18 with bezel assembly for panel mounting use as indicator bezel. Typical forward voltage 1.75V, normal operating current 20mA. Maximum dissipation 140mW, P.I.V. 3V, maximum forward current 70mA.

RED HOT SPECIAL 60c ☐ 5 for $2.50

LINEAR

Op Amps

- FACTORY GUARANTEED
- FACTORY MARKED.
- FACTORY TESTED.

Buy any five (5) I.C.'s, take 10% discount.

LM301	$1.30	NE55	$2.50
LM304	$6.05	NE561	$9.50
LM305	$4.20	NE565	$6.25
LM308	$3.30	UA709	89c
LM309	$3.99	UA710	$1.80
LM370	$4.90	UA723	$1.60
LM371	$3.90	UA741	$1.20
LM372	$3.75	UA747	$2.90
LM380	$2.95	UA748	$1.75
LM381	$4.90	LM3900	$2.00

NIXIE TUBE SALE

$2.50 ea. 4 for $9.00
Mullard ZM1080.

0 to 9, characters 13mm high, 170V operation, 2mA anode current, includes red filter, fitted with 14 pin base, vertical mounting.

Mullard ZM1000
0 to 9, characters 14mm, 170V operation, 2.5mA anode current, decimal point left side, fitted with 14 long wire leads, vertical mounting.
$3.25 4 for $12.00 ☐

Mullard ZM1174
0 to 9, characters 15.5mm, 170V operation, 2.5mA anode current, includes red filter and decimal point, fitted with 14 pin base, vertical mounting.
Price $3.25 4 for $12.00

MAGNETIC CARTRIDGES FOR CONNOISSEURS.

Supplied with full spec. sheets.
TYPE MC-1
Economy Model, 15 Hz to 25 kHz, 5mV output, tracking 1-2.5 grams, conical diamond stylus. Channel separation 20dB. SPECIAL PRICE $5.99. ☐
TYPE MC-2
De-Luxe Model with elliptical diamond stylus, 10Hz — 30 kHz, 4mV output, tracking 0.7-2 grams, channel separation 25dB. SPECIAL PRICE $17.50. ☐
TYPE MC-3
Super De-Luxe Model with elliptical diamond stylus 10 Hz — 35 kHz, 3mV output, tracking 0.7-2 grams, channel separation 30 dB (1 kHz). Superb tracking ability, low distortion and excellent transient characteristics. SPECIAL PRICE $35.00. ☐

SHURE M44 G Spherical	☐	$12.00
SHURE M55 E Elliptical	☐	$18.00
SHURE M75 E Elliptical	☐	$22.50

VHF TRANSISTOR T.V. TUNER

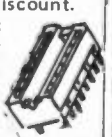
$7.50 12 Channels

A high sensitivity transistorized T.V. tuner suit Australian Stations. Operates from 12 V D.C. and output goes to IF section. Suit hobbyists, amateurs, T.V. servicemen etc. $7.50 ea. ☐

INTEGRATED CIRCUIT SOCKETS

Buy any five (5), take 10% discount.

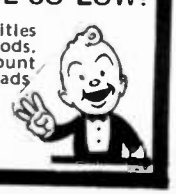
8 pin DIL	50c
14 pin DIL	60c
16 pin DIL	60c
T0-5, 8 pin	70c
10 Pin T0-5	90c
24 Pin DIL	$1.00



Best Quality, Gold Plated

3 BIG REASONS WHY OUR PRICES ARE SO LOW!

(1) We buy large quantities of specially-selected goods.
(2) We operate on discount principles-low overheads low margins.
(3) We are efficient — all orders are despatched within 24 hours.



ELECTRONICS–in practice

THIS month the intention is to provide experience with ac signals and the use of ac ranges on the multimeter.

One way to obtain this, that is both useful and instructive, is to build a small dc power supply operated from the ac mains. This will provide familiarity with ac components and connecting equipment to the mains.

A MAINS OPERATED SUPPLY

This unit, to which we will later add a circuit that controls its (adjustable) output voltage regardless of changes in supply voltage, provides dc current at a voltage ranging from 18 volts maximum off-load to 10 volts minimum on full load.

The completed unit may be used to replace your 12 volt battery supply in simple electronic applications, such as the relay circuit described in Part 2. It may also be used to power any other normal low current 12 volt devices such as model trains, portable cassette recorders etc.

HOW IT WORKS

The household mains supply delivers power at 240 volts rms 50 Hz.

To obtain the required 12 volt output it is necessary to reduce this voltage. This is done with the transformer shown in Fig. 16.

Inside the transformer are two separate, insulated windings, enclosed by a magnetic iron loop. By appropriate choice of the number of turns in each winding, it is possible to reduce (or increase) the voltage of an ac supply to the level needed.

Transformers will be discussed later in this course, but for now it is only necessary to recognise that in the transformer used for our simple project there are only four leads. Two of these go to the mains, two to the 12 volt circuit. Most transformers have these leads clearly marked. If not it is essential for you to ask a knowledgable person – such as your science teacher, if you are at school.

The reduced voltage ac has to be rectified. This is achieved using diodes arranged in what is called a fullwave bridge.

These diodes are solid-state switches. They allow current to flow only in one direction – as shown in Fig. 17. As an exercise trace out the conducting paths through the rectifier bridge remembering that the transformer provides opposite polarities alternately to the input to the bridge. You will see that the output from the bridge is always of the same polarity.

Although you will not be able to see the waveform without an oscilloscope it will look like Fig. 15b.

Our next and final stage is to arrange to average out the non-smooth waveform. This is done by the capacitor.

It is vital that the leads of this capacitor be connected the right way round as reverse polarity will not provide correct operation and will almost certainly ruin the capacitor – sometimes explosively!

The positive connection is usually marked on the case, either by a red mark or by a positive sign (i.e. +). If not it is again advisable to obtain assistance.

PARTS LIST ET217

Transformer 240 volt primary: 12-15 volt secondary (approx 1-1½ amps).
4 – diodes EM401, IN4001 or equivalents.
1 – capacitor 220 μF, 25 volt working electrolytic
2 – terminals 1 red, 1 black
6ft three-core mains cable.
1 – three-pin plug.
1 – rubber grommet for power cable.
3ft 23/0076 connecting wire
Tag strips, screws, etc.

USING THE MAINS SUPPLY

We cannot stress too strongly that the mains supply can be lethal if mishandled.

There is only one safe way in which to work. This is to make all connections and circuit changes with the power plug pulled out. NEVER TRUST THE SWITCH IN THE POWER POINT, for such switches often break just one of the two wires connected to the outlet. If incorrectly wired, as they frequently are, full mains voltage will still be applied to one terminal of the power point even though the switch is off.

This warning should not be taken as a discouragement to use the mains supply. Correct practice will safeguard you at all times.

The power supply unit should be earthed. That is, the earth wire from

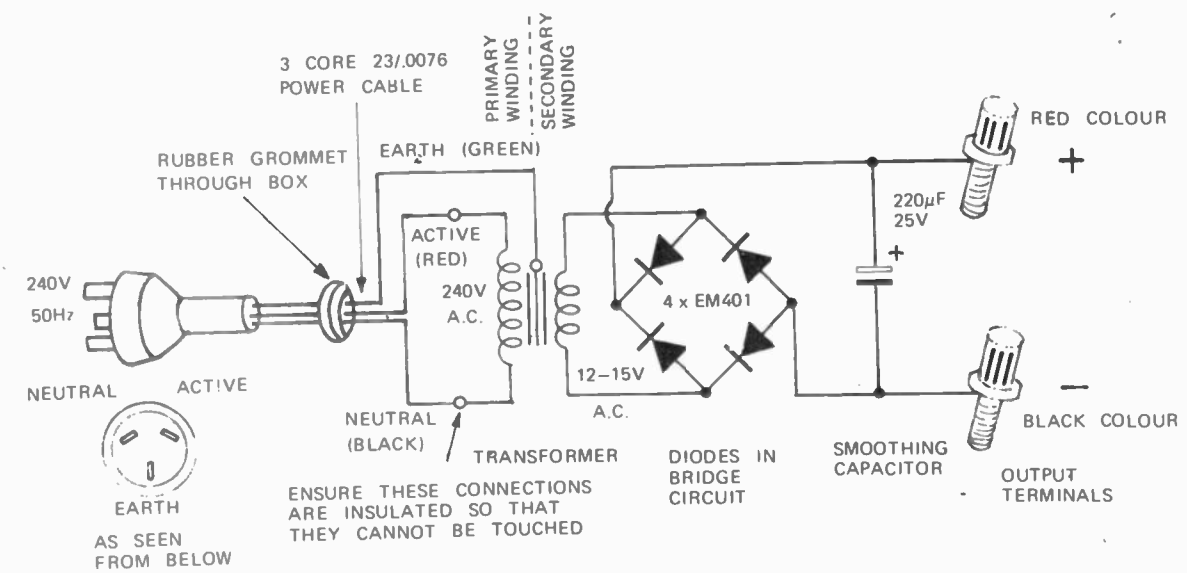


Fig.16. Circuit/pictorial drawing of mains-operated, unregulated, dc supply.

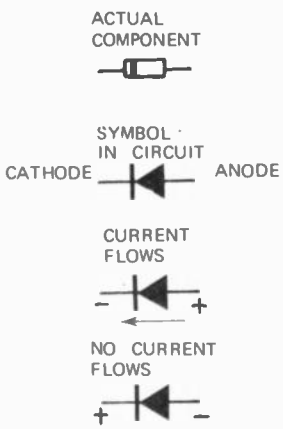


Fig.17. Corrections for the rectifier diodes used in the project shown in Fig.16.

the three pin plug and cord must be connected to all the metal parts associated with ac. In our case the earth wire must be connected to the transformer case, and to the power supply case – if it is made of metal.

Modern plugs have the pin connections clearly marked.

Once the input (or primary winding, as it is called) is correctly connected there is little danger, for the 18 volt (approx.) secondary winding is insulated from the mains and produces a voltage too low to be dangerous.

Even so, it is good practice never to make or alter the circuit in any way unless the power plug is pulled out of the mains socket.

USING THE AC RANGES ON THE MULTIMETER

Having built the power unit you will need to know if it works correctly.

Plug it in and turn on the mains. Then, using the ac volts range set to read 12 volts around mid-scale, measure the voltage across the secondary winding.

It is wise at this stage, not to measure the primary voltage, for a slip of the finger could give you quite a fright. If there is secondary voltage available, then the primary must be operating.

Now switch to a dc volts range and measure the voltage across the output terminals. This should be about 16 volts depending on the transformer used. This is the peak value of the half sinewaves (the capacitor charges up to the maximum peak value with no load applied).

Finally carry out a load test. This is done by progressively adding loads until the minimum allowed measuring voltage is obtained when the load is added.

The results are then plotted on linear graph paper with voltage on the vertical axis and load current on the horizontal axis. This is called a regulation curve – it shows what happens to our 'black box' as load is increased.

Depending on the multimeter used, you can also measure currents in the various wires. Remember that current is measured by placing the meter in series with the lead of interest. (Not all multimeters have ac current scales). ●

ERRATA

FOUR CHANNEL AMPLIFIER

ETI, JANUARY 1974

Page 66, Fig. 3. Under 'notes', bottom left of circuit diagram, Q1 should be TT 800 not TT 801.

Fig. 4, The printed circuit board is incorrectly designated. The correct nomenclature is ETI 420c not ETI 420a.

Preamplifier parts list, page 68. In list of resistors line commencing R5, R6, delete R26. Add R28.

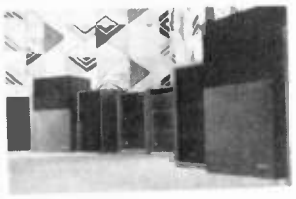
In list of capacitors commencing C1, C2, add C31 and C32.

Page 70. Paragraph 12b – should read cable is 6" i.e. 15cm. Paragraph 12c – should read cable is 8" i.e. 20cm.

Dick Smith Electronics Centre

New Hi Fi Section Opens

In charge of the new Hi Fi Demonstration Room is David Smith. David has a technical background and has been with two of the top Discounters. "Look at the gear in your local store," says



David, "but do yourself the favour of checking our price. I had a call from a chap in Orange who had spoken to 6 dealers and then saw an advert of ours in Open Road. We had to repeat the price four times—he couldn't believe it was so good." Here are some of the terrific deals David has put together for you. Call in and hear them if you can.

Pioneer Prelude 500

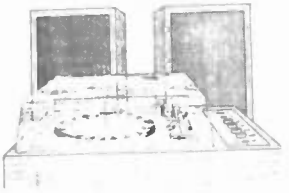
easily the best seller and no wonder — 13W RMS per channel: Heavy duty wide range 6" diameter speakers: Belt drive turntable. $299 WE ALSO INCLUDE FREE — stereo headphones for private listening AND choose your first record FREE.

DSHF1 System

comprises an Expo 24W peak amplifier plus high quality auto turntable with auto cuing device and a pair of 2-way, 2 speaker systems. This system normally sells at around $246. Our price is knocked down to a giveaway $199.

DSHF2 System

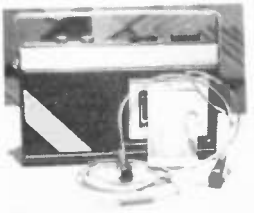
must be the lowest priced stereo 3-piece — come and hear the superb reproduction from solid state amp and twin cone speakers. Only $185 and we give FREE headphones plus choose your first record FREE.



NEW NEW

Sanyo 3-way cassette recorder

is a fantastic machine — records and plays in mono BUT will play stereo cassettes in STEREO through the FREE headphones we give you (ain't that a beaut idea?) It's tremendous value at only $79.95. And in addition to the FREE headphones we also let you choose a stereo cassette to show the Sanyo off to your friends!

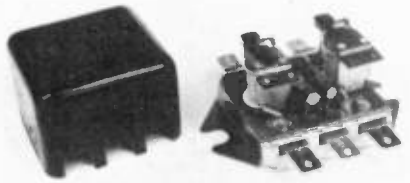


Call in and see the systems working. Discuss your requirements in a friendly atmosphere. No hard selling, we know the prices and gear are right. Browse through our huge selection of tapes and discs — LP's from $1.99, Cassettes from $3.99 and 8 track cartridges from $3.99. Just ask for David Smith and get the advice you'll appreciate — and so will your Bank Manager!

12V Relays

Type H2

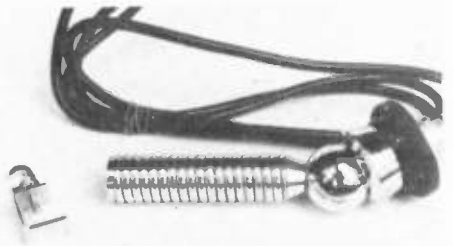
is a heavy duty job for car horn and general auto use. Contacts rated at 20A. Called the Elephant — imagine what it takes to switch them on!! Single on-off contact with screw or push-on connections $1.50.



Light Relay

is a super-dooper relay for auto use with numerous applications. Features twin coils for reliability or can be used as two separate relays in single (metal) case. Each make / break contact is independently fused at 30A so wire in parallel and switch 60A. Only $3.95.

Fibreglass Car Aerial Bargain



Imagine a 75 inch flexible fibreglass aerial for only $8.95. It's ridiculous isn't it? But ours has a chrome plated spring and swivel ball base. Plus 1.2 metres of connecting lead with plug. And a gutter clip. Yes it's a complete do-it-yourself installation for only $8.95. Don't tell your friends how cheap it was, they'll only want one and we're bound to sell out fast.

Ultrasonic transducers

Imported from USA. You've seen them in Wireless World, PW etc. Range up to 80 feet and no licence required. Ideal for burglar alarms, remote control etc. Type 105 has a ceramic phono-type socket for easy connection. Operates at 40kHz (circuits available if required with your order). Trial shipment of 50 only so hurry $5.95 each.

Stop / Go LEDs

Here's one for the model railway nuts. Build a LED signal with our $2 package of one red and one GREEN LED. Both top manufacturer and available separately RED CEMA RL209 at 60 cents and Green Plessey QLD 329 at $1.40. Or $2.00 a pair.

Rainbow cable

You've been asking us for this professional FLAT multicore cable. Well it's arrived. 12 colour coded multistrand wires bonded together into a flat cable. Ideal for looms, edge connectors etc 55c per yard with normal hook-up wire ratings.

Expo drill kit

made in England by a top specialist in this field. As used by dentists and jewellers. Will drill, saw, grind, burr, brush or polish. Drills holes up to 3mm. Kit contains 20 assorted tools and 9,000 rpm minimotor and chuck. Operates from 12V DC. We've already sold one to a chiropodist so what are you going to do with yours. $22.95.

E-Craft Baluns

It isn't too early to get ready for Colour. Start by updating your TV aerial installation. Baluns improve the match between antenna, feeder and set and are easily installed at the antenna. Ideal where ghosting is a problem due to mismatches and we have heard of people in fringe areas dramatically improving reception. Waterproof and easily fitted matches 300 ohm to 75 ohm $3.10. Don't spoil the installation use our low noise 75 ohm coax 20 cents per yard.

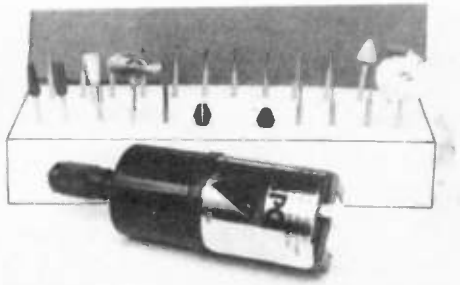
STOP PRESS
NEW LOW PRICES

REALISTIC RECEIVER
was $225 now $185
(see December 1973)

TRIO 9R 59DS
Receiver was $180
NOW ONLY $149
(see January 1974 ETI)

Spray Galvanise gives 3 years' protection

LPS instant galvanise comes in a 16 oz spray pack. It operates by electromechanical action which fuses 95% pure zinc onto any metal. DO NOT CONFUSE WITH PAINTS. Will withstand 3000hr saltwater spray tests, boiling water and heat to 1000°. Ideal finish or repair to outdoor gear. Can be welded without flash fire. Meets various US MIL specs including MIL-T-26433 for arctic zone towers! Get results comparable with hot dip galvanising with LPS for only $5.50. Remember it isn't a paint, LPS gives rustproofing for 3 years or more.



DICK SMITH WHOLESALE PTY LTD
P & P 50c. Hi-Fi road freight extra.
160-162 Pacific Highway, Gore Hill NSW 2065.
Tel 439 5311 or 02 4395344 (24 hour order answer phone).

BOOK REVIEWS

REVIEWER: Brian Chapman

RTTY HANDBOOK by Wayne Green. Published by TAB books 1972. Soft covers, 320 pages 135 x 215 mm. Recommended Australian price $7.40.

No doubt most electronics people have read at some time or another about teletype and telex communication systems. These systems may use a line or radio link and usually use the ubiquitous ASR33 teletype machine.

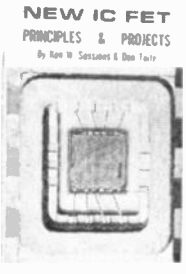
A less known facet of radio teletype communications, generally known as RTTY, is the amateur activity in this field. One may ask why amateurs would be interested in this field when CW, AM and SSB facilities are all readily available for them to communicate to other amateurs around the world.

The answer lies in the fact that a true amateur is an inveterate experimenter who will explore every possible means of communications. Amateurs are at present doing much research in the field of long distance, slow-scan television, and have contributed greatly in the past to knowledge in many diverse fields, a particular example being radio astronomy, which really commenced as an amateur activity only.

In the United States, and to a lesser extent in other countries, various types of encoding machines are becoming available through disposal sources at reasonable prices, and thus, world wide amateur activity in this field is increasing rapidly.

That's what this book is all about, the equipment and the methods for the transmission and reception of RTTY.

The subject is exhaustively treated and the book would be excellent value for anyone interested in this field. – B.C.



NEW IC FET PRINCIPLES AND PROJECTS by Ken W. Sessions and Don Tuite, Published by TAB Books 1972. Soft covers, 160 pages 135 x 215 mm. Recommended Australian price $4.95.

There is no doubt that the Field Effect Transistor (FET) has emerged from the realm of 'little understood curiosities' and has now become an extremely important part of semiconductor, and especially integrated circuit technology.

Nevertheless, many technicians, although familiar with conventional bipolar transistors, seem to believe that FET stands for 'Fearsome Electronic Thing', to be avoided like the plague.

It is true to say however that a knowledge of FET construction, theory of operation and useage is rapidly becoming essential.

FETs offer high input impedance, operation at UHF frequencies, and, very importantly, considerably increased packing density of gates in an IC package. They are even moving into the power field with 1 watt FETs now becoming regularly available.

In this book the principles, construction and theory of FETs is explained in a down-to-earth easy-to-understand manner. All the relevant circuit variations are given together with design examples and review questions at the end of each chapter.

Twelve constructional projects are given with the aim of providing practical experience in the use of FETs both individually, and in conjunction with bipolar transistors and integrated circuits.

The techniques of integrating circuitry with FETs, in particular logic gates, are discussed and examples of more sophisticated circuitry are given.

In all this is quite a good treatment of the field of FETs and is excellent value for money. – B.C.

TROUBLE SHOOTING SOLID-STATE ELECTRONIC POWER SUPPLIES by Ben Gaddis. Published by TAB books 1972. Soft covers, 208 pages 135 x 215 mm. Australian recommended price $6.15.

This book is the first of three covering general solid-state servicing techniques. This one in particular is devoted entirely to power supply circuitry.

Coverage is fairly extensive, progressing from various forms of rectifier and voltage multiplier circuitry through regulators, dc to dc supplies, SCR controlled, electromechanical and three phase supplies and finishing with a section on filters.

Operation of the circuitry is fairly well explained in completely non-mathematical terms and thus a raw beginner could learn the rudiments of power supply operation with little outside help.

Many useful servicing hints are provided which should point the way to solving typical service problems, for even the most inexperienced technician.

The complete lack of mathematics and numerical examples, however, puts the beginner at a disadvantage – he just would not know what to expect. For example, it is stated that a choke input filter provides better regulation, but lower output voltage than a capacitor input filter. Very true, but – how much lower and what percentage regulation can be expected is not given in any way.

Hence this is not a bad book for raw beginners, but does not arm them with all the information required for greater proficiency in servicing. – B.C.

4 CHANNEL DECODER

with integrated power amplifiers

This add-on unit will convert any existing stereo system into a full Quadraphonic system for the reproduction of currently available matrixed Quadraphonic records.

Incorporated within this unit is a decoder section with a level control at its front end, thereby allowing its use with all stereo amplifiers of different impedances and power capabilities.

This unit is used by connecting its inputs to the speaker output terminals of the existing stereo amplifier.

The output signals from the stereo amplifier are decoded, then amplified in a power output stage to drive two additional speakers for full Quadraphonic reproduction.

The output power of this unit is 5W R.M.S. per channel into 8 ohm load.

T.V. TUNER SERVICE PTY LTD.

Victoria
T. V. Tuner Service Pty. Ltd., 469 Georges Rd, Thornbury. 44-6179.
N.S.W.
Vic. Furnari 73 Milner Crescent, Wollstonecraft. 439-1782.

A.C.T.
Electronic Components Pty. Ltd., 3 Pirie St, Fyshwick. 95-6811.
Queensland
E. A. Pearce & Co. Pty. Ltd., 74 Bowen St, Brisbane. 21-4944.

Tasmania
W. & G. Genders Pty. Ltd.,
Hobart 34-4311
Launceston 31-2511
Devonport 24-4844
Burnie 31-2344

THE rustrak PRIVATE EYE

Rustrak Miniature Recorders chart voltage, current, power, temperature, pressure, strain, events; or virtually any parameter that can be converted into an electrical signal.
Inkless, drywriting, rectilinear recording with wide range of sensitivities, writing and chart speeds.
Quick, easy chart review and re-wind. Sliding access window.
Rugged die-cast aluminium case in epoxy suede-like charcoal gray finish.
63' chart roll — one month's supply at 1" per hour.
Portable or for panel mounting as a system component.
Accuracy ±2% of full scale.
Only $5\frac{5}{8}$" high, $3\frac{5}{8}$" wide, $4\frac{1}{8}$" deep. Weighs $3\frac{1}{2}$ lbs.
Combine any two functions on one chart in our new Dual 300 Series.

Model 288

TECNICO ELECTRONICS

Premier Street, Marrickville, N.S.W. 2204. Tel. 55 0411
2 High Street, Northcote, Vic. 3070. Tel. 489 9322
Adelaide: 267 2246. Perth: 25 5722.

MO8759/1173

CONVOY FOR RELIABLE SERVICE ON QUALITY HI-FI EQUIPMENT

The white building facing the end of Plunkett Street, Woolloomooloo.
Open all day Saturday and late Thursday. Ample parking.

Convoy Technocentre
Tel 357 2444

PRE~PAK electronics and agencies

HEAD OFFICE and mail order dept
718 Parramatta Rd., Croydon, N.S.W. 2132. Ph: 797-6144

WOLLONGONG, NSW Agent,
HI-Tec Electronics 265
Princes H'way, Corimal, N.S.W. 2518. PH: 84-9034.

NEWCASTLE, NSW AGENT
Digitronics Aust. Pty. Ltd.,
12 William Street,
Maryville, NSW. 2293.
Phone 69-2040

SOUTH AUSTRALIAN AGENT
Revolver Electronics
(mail order only) 20 Essex St., Goodwood S.A. 5034.

NTH QUEENSLAND AGENT
Philtronics Cnr. Grendon and Palmer Sts., Nth Mackay, Qld. 4740. Ph: 78855

DUBBO, NSW AGENT
A & R Olsen 34 Church St., Dubbo 2830. Ph: 82-2300.

WEST AUSTRALIAN AGENT
B.P. Electronics, 192-196 Stirling Terr., Albany, W.A. 6330. Ph: 41-3427

HUNTER VALLEY N.S.W. AGENT.
Hunter Valley Electronics and Hi-Fi., 478 High St., MAITLAND. N.S.W. 2320
Phone: 33-6664

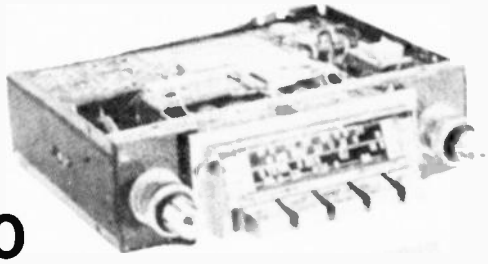
QUEENSLAND AGENT
Proportional Systems Aust.
4 Gaythorne Rd., Gaythorne, Brisbane, Qld. 4053.

CAR RADIO KIT

Exclusive to Pre-Pak Electronics!

Features:—

- 10 Transistors.
- 2 Watt Output.
- R.F. Amplifier.
- Tone Control.
- 12 V — Ve ground.
- Push-Button or Manual Tuning.



$33.50

A new 10 transistor push-button car radio kit is now available using a Philips UF415 pre-aligned and assembled tuner module. Reception is extremely good even in country districts due to RF amplifier and power output of 2 watts is more than ample. The push button or manual tuner makes for easy selection of stations and the overall appearance would complement the interior of any car. A speaker and car aerial are included. Price (complete kit) $37.50., post $1.50. Price (complete Kit) without aerial or speaker $33.50., post $1.50.

DYNAMIC NOISE FILTER AND VOLUME COMPRESSOR KIT

This remarkable unit (see E.A. Sept '73) gives excellent noise reduction with tapes and eliminates most surface noise from records, yet it is quite simple to build for yourself. Input voltage required is about 300mV while overall gain is unity. Operates from 12V D.C. Kit includes P.C. Board and all parts listed except panel meter (use multimeter instead). Price: Mono $19.00. Stereo $35.00. post 50c each. Data sheet available on request.

ELECTRONIC CALCULATOR

WITH MEMORY! 12 MONTHS GUARANTEE

FULL PRICE ONLY **$99.50** post $1.50

- **Rechargeable battery.**
- **Charger included**
- **8 digits — 16 digit recall.**
- **Leather Carry Case**

The MARK 9 Digital Calculator has all the usual features you expect e.g. Addition, Subtraction, Multiplication, Division, Chain or Mixed Calculations, Automatic Squaring, Cubeing etc., Floating Decimal Point, Constant Function, Over-range Indicator plus a few you won't find in other calculators under $100.00. Such as: a built-in memory for storing information while doing other calculations, 8 digit capacity with 16 digit decimal point recall, negative number operations and rechargeable batteries with charger included in the price. The large green 7 segment display with ¼" high characters is easy to read from all angles and the compact size (5½" L x 3¼" W x 1.5/8" H) and light weight (only 13 ozs) allows you to take it anywhere. And the guarantee is for a full 12 months.
We have secured only a limited number at this price — don't delay!
A full descriptive brochure is available on request.

Manufactured in USA by Radiant Energy Systems

CALCULATOR MODEL 600

Features:—

- 6 Digit Capability.
- Addition or Subtraction.
- Multiplication or Division.
- Chain or Mixed Calculations.
- Automatic Squaring and Summing.
- Compact Size — only 5" x 2½" x 7/8".

Place your order NOW while stocks last!

PRICE $29.95 Post and packing $1.00

ETONE GUITAR /PA/HI-FI LOUDSPEAKERS

- **Fully cast housings**
- **Large voice coils**
- **Extremely efficient with powerful magnets.**

These trade line speakers are now available for sale direct to the public. All are Australian made and are fully guaranteed by the manufacturer. They feature aluminium coil formers bonded with high temperature epoxy and heavy duty cone assemblies for years of lasting service.

MODEL 12PH:
12 inch 30W speaker for general purpose audio, guitar, vocal etc. Frequency Response 40Hz — 6kHz, flux density 11,500 gauss, total flux 120,000 maxwells. 8 or 15 ohms. PRICE $25.00., plus freight.
MODEL 12HA:
12 inch 40W speaker, heavy duty version of 12PH above. Frequency response 40Hz — 7kHz, flux density 13,500 gauss, total flux 180,000 maxwells. 8 or 15 ohms. Price $35.00., plus freight.
MODEL 12HZ:
12 inch 50W Speaker, suit guitar or vocal (PA) use, ideal for small cabinets or horn loading. Frequency response 70Hz — 7kHz, flux density 11,500 gauss, total flux 180,000 maxwells, 8 or 15 ohms. Price $38.00., plus freight.
MODEL 12W:
12 inch, 35W, hi-fi woofer with neoprene rubber surround. Suit sealed enclosures of 2-3 cub. ft. Frequency response 20Hz — 3kHz, flux density 11,000 gauss total flux 130,000 maxwells, excellent transient response. 8 or 15 ohms. Price $35.00., plus freight.
MODEL 15B:
15", 100W bass speaker for guitar amp, organs, high-powered audio. Frequency response 20Hz — 4kHz, flux density 11,500 gauss, total flux 260,000 maxwells, 8 or 15 ohms. Price $125.00., plus freight.
MODEL 15BH:
15", 50W (steel-framed) bass speaker for bass guitar, organ or audio applications. Frequency response 40Hz — 6kHz, flux density 14,000 gauss, total flux 19,000 maxwells, 8 or 15 ohms. Price $55.00., plus freight.
MODEL 15XA:
15" (steel-framed) 60W heavy-duty version of 15BH. Specification as above except total flux 210,000 maxwells. Price $75.00., plus freight.

DESCRIPTIVE BROCHURE AVAILABLE ON REQUEST

NEW 35W POWER AMP KIT

A compact (only 3" x 2-3/8") Power Amplifier Kit using a Signetics NE540 Power Driver Integrated Circuit driving a pair of complementary, output transistors, up to 35 Watts RMS into an 8 Ohm load, with a positive and negative 25V Power Supply. Kit includes P.C. Board, I.C. Output Transistors, Resistors and Capacitors. (Two required for Stereo) . . . PRICE $9.95. each, Post 25c.

LM380 2W AMPLIFIER KIT

Using the NATIONAL LM380 I.C. Chip, this handy little amplifier is useful for Intercom, Record Player, Signal Tracer and a host of other applications. Features output and temperature overload protection and requires 12-18V D.C. supply at 200mA maximum. Maximum distortion 0.5% at 2.2W. Includes P.C. Board and external components. SPECIAL PRICE $4.50. Post 25c.

DIGITAL CLOCK KIT $59.50

THE NATIONAL/SPERRY SP-151 evaluation kit consists of the NATIONAL MM5314 Clock Chip, Sperry 4 digit 7 segment display, 13 driver transistors, I.C. and display connecting pins and 2 P.C. Boards. Special package price, just $39.50, plus 50c post. A complete Kit, including those parts described above plus case, transformers, resistors, capacitors, diodes and hardware etc., is available at the special package price of $59.50, plus 50c post.

"No-Bull" Catalogue FREE!

Our 24 page catalogue is a handy source of "what's new" in electronics for servicemen, amateurs and hobbyists alike. All products carry a technical description and illustrations where possible and a large range of kits and hi-fi gear is in there too! Our prices include only a small profit margin and in many cases are less than trade. And, of course, we send it to you free on request.

FERRIS TRANIMATE $8.95

- **RF Booster for transistor radios.**
- **Pulls in stations 100's miles away.**

The fantastic new Ferris Tranimate is a 2 transistor tuned RF amplifier (patented design) for use in car or in country areas to allow portable transistor radios to pick-up distant or weak stations. Connects easily to any transistor radio, operates on 9V No. 216 battery (not included). Normally priced at $15.95. SPECIAL PRICE $8.95. Post 50c.

J.H. SYNCHRONOUS TURNTABLE

A revolutionary turntable with 12-pole synchronous motor, belt-drive operation, unmeasurably low rumble, wow less than 0.05% and fully balanced platter. Normally $45.00. SPECIAL at $37.95. Post $1.00. High quality precision LUSTRE Tone Arm with hydraulic cueing device. $27.50. Post 75c. J.H. Turntable, Lustre Arm, Base, Cover and Magnetic Cartridge, only $89.00. Post $2.50.

ELECTRONIC SIREN KIT.

- **Rising and Falling Pitch**

Just add 8 ohm speaker 6-9V battery for attention — getting electronic siren with rising and falling pitch. As used by Police, Fire Department etc. Useful for party novelty, toy siren, warning device, burglar alarm for home, car or factory etc. Price $5.50. Post 35c.

COMPONENTS

BEEP GENERATOR

An electric multi-signal acoustic warning device has been developed by A. P. Besson Limited of the U.K.

The device, named 'cybertone', is intended to satisfy requirements where a range of audible warnings of different and easily distinguishable types are required.

It is based on Besson's earlier Bleeptone signaller, but allows a choice of nine completely different signals from the same unit. The sounds are all highly penetrating audio signals, each one differing in frequency modulation.

The standard signals will penetrate even very high ambient conditions, although quieter versions can be specified, if required.

The unit weighs less than 2 oz.

Further details: Total Electronics, 239 Bay Street, North Brighton, Vic. 3186.

GAS SENSORS

Tecnico Electronics have been appointed exclusive Australian Distributors for the Figaro TGS range of gas sensors.

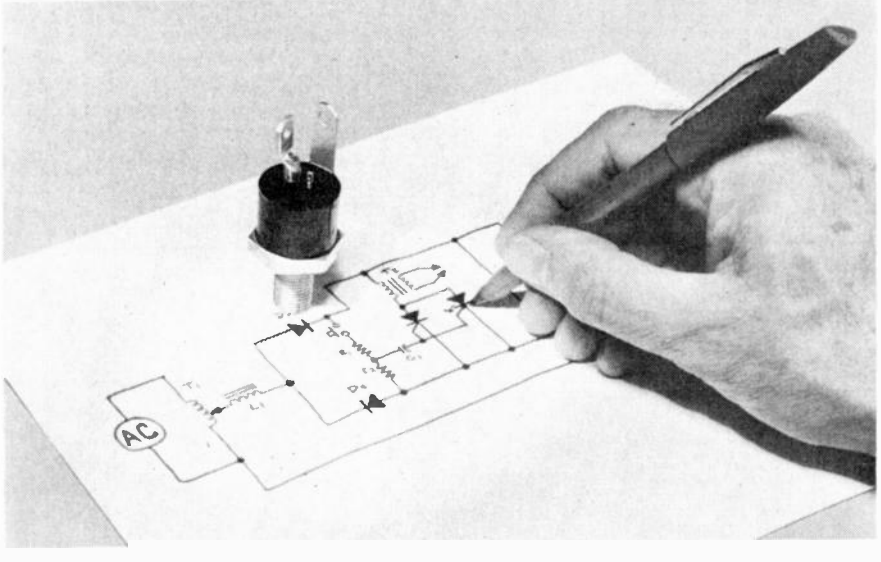
TGS is a sintered n-type semi-conductor bulk device mainly composed of Sn02 (tin dioxide) whose conductivity increases in the presence of combustible gases such as hydrogen, carbon monoxide, methane, ethane, propane or organic solvent vapors belonging to the alcohol, ketone, ester and benzol families etc.

The increased conductivity of the TGS when exposed to even a low concentration of gas can be as high as twenty times that of its conductivity in air. Such a change can be brought about by the presence of 0.1% propane by volume which represents only 1/20th of the lower explosive limit for propane. This large change enables a buzzer or relay to be directly actuated by the TGS. When used with a simple amplifier several hundred ppm of carbon monoxide can be readily detected.

Apart from the applications, the TGS has found wide acceptance for use in gas-leak detectors, alcohol detectors, automatic ventilation and fire alarms. Its advantages are high sensitivity, compact size, ease of installation, long life, reliability and low cost.

Further details: Tecnico Electronics, Premier Street, Marrickville, N.S.W.

ISOLATED STUD THYRISTORS



A new line of 80 ampere rms isolated stud thyristors has been introduced by Motorola Semiconductor Products Division. The new device series, designated MCR82, is designed for high power industrial and consumer applications including welders, furnaces, motors, speed controls, space heaters and other equipment.

Nine, repetitive peak reverse blocking voltage ratings are available from 50 to 800 volts. Peak non-repetitive surge current for all ratings is 1000 amperes. These units use glass passivated junctions with centre gate firing for greater parameter uniformity and stability.

Further details: Motorola Semiconductor Products, Suite 204, Regent House, 37-43 Alexander Street, Crows Nest 2065.

CALCULATOR CHIPS

Three new calculator chips have recently been announced by Mostek.

The MK5022A requires 20 keys to operate and features automatic constant, floating decimal, floating negative sign, algebraic entry, display blanking and internal debouncing and decoding of keyboard inputs.

Mostek's other circuits include the MK5020A, an 8-digit, six-function programmable circuit and the MK5021C, a 10-digit, six-function circuit. The six functions on these circuits include add, subtract, multiply, divide, per cent and square root.

Both circuits feature automatic constant, floating or selectable decimal point, floating negative sign, algebraic or business entry, display blanking during calculations, internal encoding and debouncing of keyboard inputs and seven-segment display outputs. Both are suitable for battery-operated hand-held calculator applications.

The three calculator circuits are available in single, 28-pin dual in-line packages.

PROXIMITY SWITCH

The RSM02 series of well-proven magnetically-actuated proximity switches from FR Electronics is now capable of switching loads of up to 1A at 250 VA.

In many applications, intermediate relays between proximity switch and load may now be dispensed with, or conventional contact proximity devices immediately replaced by these inherently more reliable units.

In carefully designed systems more than 10^8 switching operations may easily and consistently be achieved with negligible mechanical movement of operating point.

Further details: NS Electronics Pty. Ltd., Cnr. Stud Road & Mountain Highway, Bayswater, Vic. 3153.

QUAD COMPARATOR USES SINGLE VOLTAGE SUPPLY

For industrial and consumer applications requiring a number of differential voltage comparators, Motorola's new quad comparator presents a practical solution. The new IC, type MC3302, packs four independent voltage comparators into a single plastic DIP package. These comparators can operate from a single power supply ranging anywhere from 2 to 28 Vdc. Power drain is only 1.5 mA max. at V_{CC} = +5.0 to +28 Vdc – that's the total of the four comparators.

Specifically these devices feature a

voltage gain of 30 000, an input bias current of only about 30 nA, and an input offset voltage of 3 mV. The outputs are MTTL compatible and can sink 2 mA min. at V_{OL} = 0.8 V (T_A = −40 to +85°C).

The unique design of these comparators allows them to compare voltages very near ground potential (even when operating from a single supply voltage) and makes it possible to combine the outputs of several individual comparators to produce an implied AND output function.

Further details: Motorola Semiconductor Products, Suite 204, Regent House, 37-43 Alexander Street, Crows Nest, 2065.

COLOUR CHANGE

Adhesive backed temperature recorders for 100°F to 350°F are described in a new 4-page technical bulletin now available from Telatemp Corporation.

Each Telatemp contains calibrated temperature sensitive increments which turn from silver color to black after exposure to their rated value. Four standard models are described with up to six increments. Special designs, specifications, incremental values available and numerous applications photos are included.

Further details: NS Electronics Pty. Ltd., cnr Stud Road & Mountain Highway, Bayswater, Vic. 3153.

36-LEAD SOCKET WITH RETAINING COVER

A new socket distributed by McMurdo is intended for test applications where rapid insertion and withdrawal of the integrated circuit is necessary.

With the hinged cover open the contacts are relaxed providing a very low insertion force.

Closure of the cover applies pressure to the contacts forcing them against the integrated circuit legs.

Contact resistance is less than 10 milliohms.

The body and cover are moulded in glass filled polycarbonate. Contacts are gold plated phosphor bronze.

Further details: McMurdo (Australia) Pty. Ltd., P.O. Box 321, Clayton, Vic. 3168.

POWER DARLINGTONS FOR AUTOMOTIVE ELECTRONICS

Six power Darlington transistors, designed primarily for automotive electronics, have been introduced by Fairchild Camera and Instrument Corporation.

Darlington amplifiers are particularly useful in systems calling for high-gain characteristics.

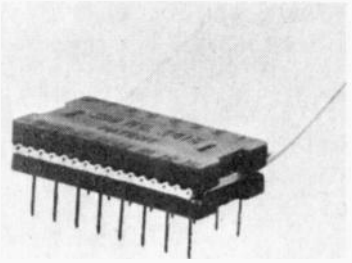
Designed primarily for applications such as seat-belt interlocks, ignition, fuel metering and fuel injection, the new Darlington power devices can also be applied to computer power supplies and driver elements, in industrial power supplies, motor and valve controls and in consumer audio amplifiers, regulators and motor controls.

The six devices consist of three transistor types packaged in TO-3 metal cans and three electrically equivalent devices in TO-220 plastic power packages. The metal can units can dissipate up to 100 watts. These are designated the SE 9300, SE 9301 and SE 9302.

The equivalent plastic packaged types are rated at 70 watts. These are types SE 9303, SE 9304 and SE 9305.

All six devices are NPN types that can safely handle up to 10 amps collector current and have high current gain characteristics (beta is 1000 at 4 amps).

DIP SOCKET CONNECTORS WITH RECTANGULAR CONTACT LEGS



A change from round to rectangular contact legs on Scotch-flex 14– and 16–pin dip socket interface connectors has been announced.

The design revision will expand the connectors' applications into a large number of integrated circuit sockets. The change to rectangular pins will also provide increased strength and retention force in the sockets, it is claimed.

The two connectors (Scotchflex number 3406, 15 pin, and Scotchflex number 3416, 16 pin) mate with Scotchflex flat cables on .50 inch (.127 cm) conductor spacing or with individual round wire 28–26 AWG conductors made by other manufacturers.

The connectors are used for interfacing in computers and test equipment and for other electronic applications using dual-in-line packaging.

Further details, Tecnico Electronic, Premier St, Marrickville, NSW 2204.

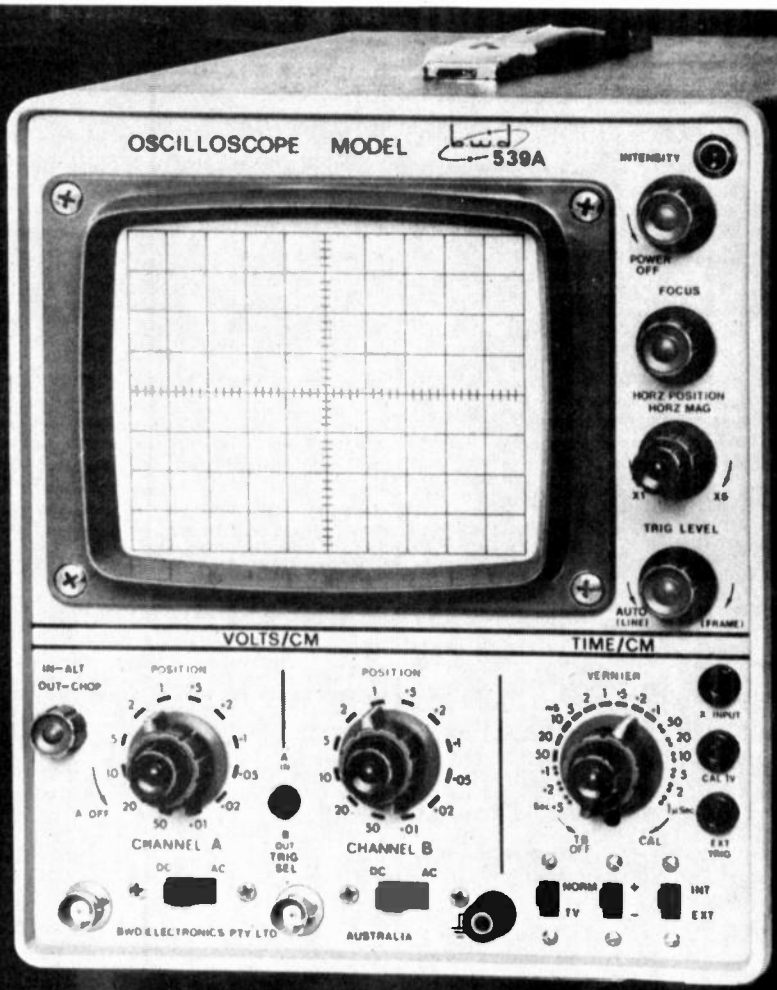
b.w.d

539A
DUAL TRACE OSCILLOSCOPE

NOW!
DC TO 12MHZ-3db

AND
FLAT WITHIN 5% OVER THE ENTIRE VIDEO BAND WIDTH

*Instant selection of line or frame trigger from any video signal even when it's buried in noise or varying in amplitude.



CHECK THE SPECIFICATIONS AND SEE WHY IN INDUSTRY EDUCATION AND SERVICE THE bwd539A IS SO WIDELY ACCLAIMED..

VERT. AMPLIFIERS
DC-12MHz-3db
10mV-50V/cm Both Channels
Ampl. usable to >20MHz

DISPLAY
Chan. A & B or
Chan. B only

TIME BASE
200n Sec. to 2.5 Sec./cm
Including X5 magnification
and 5-1 Vernier

TRIGGER
Chan. A or B or EXT.
+ or —. Norm. or TV
Auto. or Level Select

TRIGGER RANGE
5Hz to >15MHz 1 cm defl.
2 cm composite video

GENERAL
8 x 10 cm CRT, 3KV EHT
Z Mod. 20V P-P, 1MΩ input
Horz. Input DC-1MHz, 0.6-6V/cm

PRICE
For this
Superbly Stable 100% Solid State
Oscilloscope

$375
(12 months' warranty)
Plus tax if applicable
FIS Australian Capital Cities

b.w.d. 539A.
Federal Stock No.
6625-66-046-6608.
AN AUSTRALIAN OSCILLOSCOPE IN SERVICE AROUND THE WORLD.

WINNER OF AWARD FOR OUTSTANDING EXPORT ACHIEVEMENT

GL&C1257BW

b.w.d

B.W.D. ELECTRONICS PTY. LTD. Designers and Manufacturers of the Finest Electronic Instrumentation
329-333 Burke Road, Gardiner, Vic. 3146. Ph. 25 4425. 127 Blues Point Road, North Sydney, N.S.W. 2060. Ph. 929 7452.
S.A.: A. J. Ferguson Pty. Ltd. Ph. 51 6895. **W.A.:** Cairns Instrument Services. Ph. 23 3871.
QLD.: Warburton Franki (Brisbane) Pty. Ltd. Ph. 52 7255 **A.C.T.:** Associated Scientific Sales Pty. Ltd. Ph. 95 9138.
and from B.W.D. Agents around the world.

HAM RADIO SUPPLIES

MAIL ORDER SPECIALISTS

67-7329 323 Elizabeth Street, Melbourne (2 doors from Little Lonsdale Street) 67-4286

MIDLAND

MODEL 13-700 TRANSISTOR 2-CHANNEL CALL SIGNAL TRANSCEIVER

CIRCUIT: 1 Watt, 2-Channel Solid State Transceiver, 12 Transistors, 1-Diode, 1-Thermistor.
RECEIVING FREQUENCY: 2-Channels available, Channel 11 (27.240 MHz) Crystals Factory Installed In Number One Position.
RECEIVING SYSTEM: Crystal Controlled, super-hetrodyne System with Tuned RF Stage.
INTERMEDIATE FREQ: 455 kHz.
TRANSMIT SECTION: Crystal Controlled Oscillator foloowed by RF Amplifier
MODULATION SYSTEM: Push-Pull High Level Class "B".
RF INPUT POWER: 1 Watt.
FREQUENCY TOLERANCE: ±0.005%.
RECEIVER SENSITIVITY: 1uV or better at 10 dB S/N.
SPEAKER/MICrophone: 2¼" PM Dynamic, 8-ohm.
ACCESSORY JACKS: AC, Earphone and charge.
POWER SOURCE: 12V DC (8 x 1.5V "AA" cells) $39.95 each P.P. ($1.00 or $79.00 a Pair BE EARLY.

NEW RELEASE

MODEL NC-310
DE-LUXE 1 WATT 3 CHANNEL C.B. TRANSCEIVER
- WITH CALL SYSTEM
- EXTERNAL AERIAL CONNECTION

SPECIFICATIONS, NC-310

Transistors: 13
Channel Number: 3, 27.24 OMHz Citz. Band
Transmitter Frequency Tolerance: ±0.005%
RF Input Power: 1 Watt
Tone Call Frequency: 2000Hz
Receiver Type: Superheterodyne
Receiver Sensitivity: 0.7μV at 10dB S/N
Selectivity: 45dB at ±10KHz
IF Frequency: 455KHz
Audio Output: 500mW to External Speaker Jack
Power Supply: 8 UM-3 (penlite battery)
Current Drain: Transmitter: 120-220mA
Receiver: 20-130mA.

Price $50 per unit or $99.00 pair.

BARLOW-WADLEY XCR-30

a truly portable communications receiver, based on the WADLEY LOOP principle, the same principle as applied in the DELTAHET and RACAL receivers. A truly crystal-controlled highly sensitive multiple-heterodyne portable receiver of exceptional stability with continuous, uninterrupted coverage from 500kHz to 31MHz.

BARLOW-WADLEY XCR-30 features include: Selectable USB/LSB, CW & AM reception, frequency read-out 10kHz throughout the entire range, calibration accuracy within 5kHz, antenna resonator, tuning signal-strength meter, zero-set control, clarifier-vernier tuning, MHz & kHz tuning controls, telescopic antenna. Power source: 6 type D dry cells; provision for external DC power supply. Weight 9 lbs; size 11½ x 7½ x 4in.

All for $225.00

When not in use or for carrying, the top meter/megahertz scale flips down flush with the case and clear of the handle.

ELECTRONIC KITS FOR BEGINNERS

Mykit Series 150 in 1

Mykit Series 10 in 1

Popular imported electronic kits, no soldering, easy to assemble, battery operated, safe, suit all ages — children and adults, board type construction with easy to follow instructions that make them ideal gifts.

CRYSTAL RADIO KIT No. 28207, tunes AM broadcast band, simple 1 hour construction, no batteries, ideal for beginner, post and pack. $4.95 30c p.p.
AM TUNER AMPLIFIER KIT No. 28241, build your own 3 transistor tuner and amplifier, all parts transistors, tuning gang, transformers, speaker etc. $13.50 p.p. 75c.
10 PROJECT ELECTRONIC KIT, No. 28202, 10 working projects, SOLAR BATTERY, builds radios, oscillators, signal generators, all solid state. $8.95 75c p.p.
15 PROJECT ELECTRONIC KIT No. 1544, learn electronics with each project. Build these, morse code oscillator, radios, alarms, sirens etc. $11.25 p.p. 50c.
IC-20 20 PROJECT ELECTRONIC KIT, learn about intergrated circuits with this educational kit, 20 working projects including intergrated circuit. $13.25 p.p.75c.
50 PROJECT KIT No.28201 DELUXE MODEL, 50 working projects, educational entertaining, all solid state, includes everything, nothing to buy, constructed in hardwood case, panel meter, radios, amplifiers, burglar alarms, tachometer, test equipment, good value — $21.50 p.p. $1.00.
DELUXE 150 ELECTRONIC PROJECT KIT using intergrated circuits. Contains all parts for 150 different working projects including I.C. diode and transistor radio, electronic switches, relays, alarms, test equipment, etc, etc. Very good value, Prices $34.95 p.p. $2.00.
80/ Project kit build 80 different and sophisticated circuits. Includes mike, speaker etc. $24.50 p.p. $2.00.

REALISTIC with separate speaker

a Realistic value . . . a Realistic performer

The popular REALISTIC DX150B which has gone from strength, to strength with amateurs, shortwave and broadcast listeners alike now has a further improvement. A SEPARATE MACHINE SPEAKER included.
The DX150B gives long range worldwide realistic reception on four bands, including broadcast. Fully transistorised — all solid state — no warm up delays; the DX150B will run on dry cells if current fails or is not available; will operate from a car's cigarette lighter or any 12V DC service. A 240V AC power supply is also built in. Over 30 semi-conductors — product detector for SSB/CW, plus fast and slow AVC — variable pitch BFO — unlimited electrical band spread, fully calibrated for amateur bands — cascade RF stage — ANL for RF and AF-zener stabilised — OTL audio illuminated "S" meter.

SW/CW SSB/AM
TRANSISTORISED all solid state
4 BANDS 535 to 30 MHz
(Includes Broadcast)
240V AC or 12V DC operation

REALISTIC REDUCED PRICE
$189.00

MODEL OL-64D/P MULTIMETER

20,000 ohms per volt. DC volts: 0.025, 1, 10, 50, 250, 500, 1000 (at 20K o.p.v.), 5000 (at 10K o.p.v.). AV volts: 0-10, 50, 250, 1000 (at 8K o.p.v.). DC current: 50uA, 1mA, 50 mA, 500 mA, 10 amps. Resistance: 0-4K, 400K, 4M, 40 megohms. DB scale — 20 to plus 36 dB. Capacitance: 250pF to 0.02uF. Inductance: 0-5000 H. Size: 5¼ x 4-1/6 x 1¾ in. **Price $19.75 p.p. 50c.**

CT-500/). $16.75

Popular, medium-size, mirror scale. Overload-Protected.
AC/V: 10V, 50V, 250V, 500V, 1000 (10,000Ω/V)
DC/V: 2.5V, 10V, 50V, 250V, 500V, 5000V (20,000Ω/V)
DC/A: 50μA, 5mA, 50mA, 500mA.
OHM: 12kΩ, 120kΩ, 1.2MΩ, 12MΩ
dbi — 20db to +62db.
Approx. size: 5½" x 3-5/8" x 1¾". p.p. 50c.

RF SIGNAL GENERATOR Model TE-20D

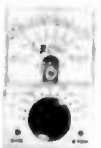
SPECIFICATIONS

Dial has 7 separate band TE-20D covers 120 kHz — 500 MHz (6 Fundamental Bands & 1 Harmonic Band). Freq. Accuracy: + or —2%. Audio Output: to 8 volt. Internal Modulate: 400 Hz approx. Tube: 12BH7A, 6AR5. Power Source: 105-125V, 220-240V AC 50/60 Hz. 12 watts TE-20D employs a Xtal socket and can be used as below. a. — Self-Calibration. b. — Marker Generator. Small size-Space Saving. Printed Circuit for a uniform characteristic. Dimensions 140 x 215 x 170 mm. Weight: 2.8 kg.
Price $47.00. P & P $2.00

H10K1 MODEL L-55 FET MULTITESTER

This amazing instrument features a 20 Meg ohm input impedance, 36 ranges from 300 mV full scale to 1200 volts and can measure as low as .2 ohm! Comes complete with probes and carry case. $42.95 p.p. 75c.

MODEL C1000 $6.95 P.P. 50c



Is the ideal low cost pocket meter.
AC volts: 10V, 50V, 250V, 1000V (1000Ω/V).
DC volts: 10V, 50V, 250V, 1000V, (1000Ω/V)
DC current: 1mA, 100mA
OHMS: 150kΩ
Decibels: -10db to +22dB.
Dimensions: 4¾" x 3-1/8" x 1-1/8" 4¾" x 3-1/8" x 1-1/8"

200-H. $12.50 P.P. 75c

90° quadrant meter. Pocket size.
AC/V: 10V, 50V, 100V, 500V, 1000V (10,000Ω/V).
DC/V: 5V, 25V, 50V, 250V, 500V, 2500V (20,000Ω/V).
DC/A: 50μA, 2.5mA, 250mA
OHM: 60kΩ, 6MΩ
Capacitance: 100pF to .01-μF, .001μF to .1μF.
dbi: -20db to + 22dB.
Audio Output: 10V, 50V, 120V, 1000V Ac.
Approx. size: 4½" x 3¼" x 1-1/8"

EQUIPMENT NEWS

DESK TOP DICTATING MACHINES

Plessey Communication Systems, recently appointed dictaphone distributor for Australia, now have available the 'U400 series' in the dictaphone 'Desk Top' range. This series combines the best features of belt dictation systems in its unique and patented magnetic sound sheet.

The dictaphone 'Sound Sheet' can be erased and re-used thousands of times. It can be written on, punched, folded or clipped to documents, or folded and sent through the mail in a standard envelope.

An index system allows immediate priority selection of any part of the 'Sound Sheet'. It is also possible to record supplementary information to speed up work flow and to pinpoint any editing problems or corrections to text.

A special dynamic microphone with 'Dictate' or 'Conference' positions is standard with the U400 series. A further advantage is that only one simple control is required for all functions: push up and down for record or playback (including backspacing) and right and left for start and stop.

Initially two models of the dictaphone U400 series will be available in Australia: the U401 and the U404.

The U401 is the standard work horse, desk top model of the dictaphone range and uses the 'Sound Sheet' as the recording medium.

The dictaphone U404 is basically similar to the U401 except that it can also transcribe from the mini-cassettes used in miniature portable note taking systems.

Further details: Plessey Communication Systems Pty Ltd., Racecourse Road, North Melbourne, Vic. 3051.

NEW PULSE GENERATOR

Low-cost instrument has high voltage output for testing newer MOS circuitry as well as linear circuits.

With pulse amplitude variable from 250 millivolts to 16 volts, a new Hewlett-Packard Model 8011A Pulse Generator can test the most commonly used logic families. Source impedance on the lower ranges is 50 ohms, while in the four volt to 16 volt range, either 50 ohms or high impedance can be selected.

Pulse polarity can be positive, negative or symmetrical. The pulse complement can be selected positive or negative, and duty cycle can be up to 100%.

Repetition rate is variable from 0.1 Hz to 20 MHz so that circuits can be driven at their clock rate, or slower for easy analysis. Repetition rates slower than 0.1 Hz are obtained by externally triggering the Model 8011A, or by switching the instrument to the square wave mode where the repetition rate can be 0.05 Hz to 10 MHz. Pulse width can be varied from 25 nanoseconds to 100 milliseconds. Transition times are fixed at less than 10 nanoseconds.

A counted pulse burst option is available. With this option the user preselects the number of pulses (between one and 999) to be generated. Rate, width, amplitude, polarity and format are selected, and the burst started with an external or manual trigger. Circuits can be clocked to a particular state at their operational clock rate, then analysed under static conditions. In addition, at the end of a burst, pulses can be added one at a time by using the single pulse pushbutton.

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

SIGNAL AVERAGING

Laborious manual calculations of periodic averages from strip charts are eliminated by the Monitor Labs. Inc. Signal Averager Model 8640.

The Model 8640 signal averager accepts analogue signals from most analysers and outputs a signal voltage proportional to the average value of the input over a selected time period.

Averaging periods from one minute to 99 minutes may be selected by front panel switches.

An optional output programmer provides time shared operation of a single strip chart recorder so that it records the instantaneous value of an analogue signal except when an average has been determined at which time it is automatically switched to record zero, thence to record the average value and finally back to continuous recording of the instantaneous signal.

A typical application is the determination of average pollutant levels but the 8640 also finds wide general application in electrical, chemical and mechanical averaging measurements.

Further details: Arlunya Pty Ltd., P.O. Box 113, Balwyn, Vic. 3103.

LOW VOLUME LEAD PROCESSING

The TJR lead processing machine manufactured by Heller Industries has been specifically designed for the smaller production line, where sophisticated, high-volume automatic equipment cannot be justified.

The electrically operated, bench mounted machine will process the leads of transistors, radio capacitors, DIP's and TO-5 IC's. Lead forming tooling is available to provide snap-in, stand-off, or spread forms, as well as straight cut-off. As an example of its versatility, it will process all radial capacitors – regardless of body style, with lead centres from 3.175 mm to 15.875 mm without changing dies. Production rates in excess of 600 pieces per hour are claimed. Dies have an inherent capability to support the component during forming, to avoid damage to seals or internal construction.

The low cost and small size of the unit makes it suitable for use by a number of operators, directly on the production line.

Further details: Royston Electronics Pty Ltd., 22 Firth Street, Doncaster, Vic. 3108.

MINIATURE TEMPERATURE RECORDERS

Tecnico Electronics announce the introduction of a new miniature temperature recorder from Grant Instruments (Development) Ltd., of U.K.

The Model D clock-governed recorder has been developed specially for mapping general trends of temperature over long periods of time without requiring any attention and with the utmost economy in battery power and chart paper. It is widely used in all branches of micro-meteorology, monitoring of crop temperature, and many similar applications.

It is basically a battery-powered-multi-point (up to 28 points) recorder with a built-in precision battery-wound clock movement. This initiates a quick cycle covering all points at ¼, ½ or one hourly intervals. The advantage of this system is a vast increase in battery and chart life since the recording is switched off between cycles and the only drain on the battery is the minute power required by the clock. Consequently the instrument may be left unattended in the field for up to sixty days at hourly operation (for the nine-point model).

The Model D recorder can also be used as a continuous recorder at the throw of a switch. The cycle time is, however, fixed at ½ or one minute and the chart speed at 30"/hour. Slower gear trains (inexpensive and easily interchangeable) can be supplied for use if much continuous recording is envisaged (for single point operation).

Instruments are normally arranged to switch on at either ¼, ½ or one hourly intervals. At extra cost they can be made to switch on at two or all three of these intervals at will.

Further details: Tecnico Electronics, Premier Street, Marrickville, N.S.W.

Tecnico Electronics, 2 High Street, Northcote, Vic.

DUAL TEMPERATURE SOLDERING TOOLS

Soldering tools which idle at the ideal soldering temperature, and feature a 'power boost' for high speed or heavy duty work, are included in an extensively updated range of soldering equipment released by Adcola Products Pty Limited.

Called the 'Duotemp', the new tool series is claimed to eliminate the drawbacks of conventional single-temperature tools, including the compromise necessary between idling and operating temperatures.

Long, fast soldering sequences or heavy chassis joints demand a high thermal capacity. This is generally achieved in single-temperature tools by running them at elevated temperatures to compensate for the heat absorbed by the terminations. Even by pushing these temperatures beyond advisable limits, however, the capacity is frequently still inadequate: yet the resultant excessive idling temperature shortens element and tip life, destroys tip tinning, and contributes to uncomfortably hot handles.

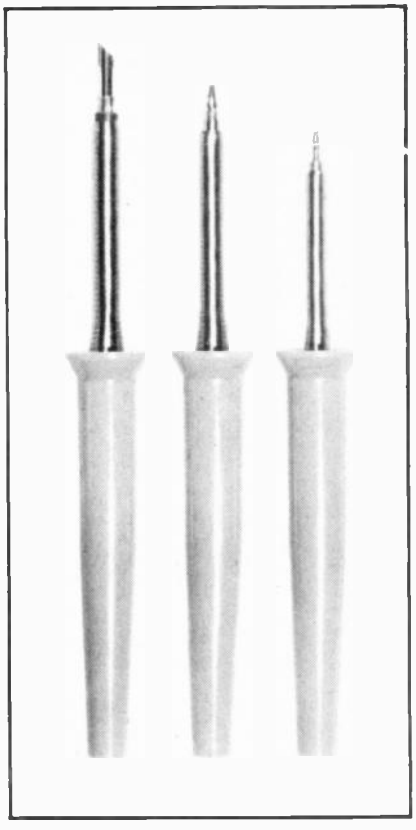
The Duotemp idles on half wave current. Idling temperature is retained at what the manufacturers state is the ideal level for modern printed circuitry, ready for instant use. When soldering, the power can be switched to full wave, boosting the thermal capacity to replace heat absorbed by the terminations.

Switching is achieved by a sensitive button on the handle. This is operated effortlessly (or avoided easily) when the tool is held in the normal manner. Full wave operation when the tool is first switched on also provides a greatly accelerated heat up from cold.

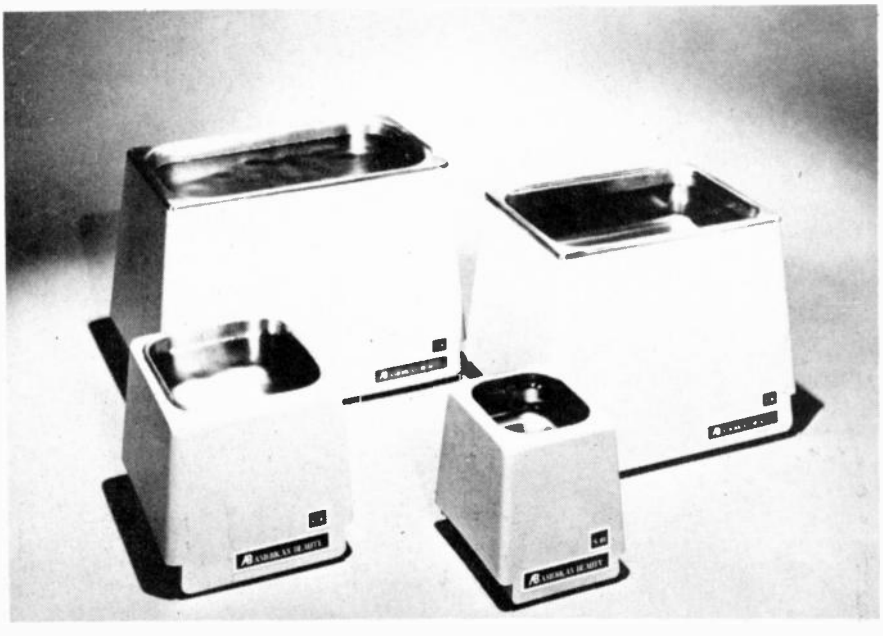
The Duotemp design allows the elements to be made from wire of a heavier gauge. This, combined with the lower idling temperature and resultant lower oxidation, is claimed greatly to extend element life. Tip life is also extended, and top tinning readily preserved.

Tip face size and profile can be selected from the range of twelve standard tips, in either the Tricald or the long life Armclad series. All tips are fitted with anti-seize ferrules to avoid scratching the plating on the sealed shanks.

Further details: Adcola Products Pty Ltd. 22 Firth St, Doncaster, Vic. 3108.



SELF-TUNING ULTRASONIC CLEANERS



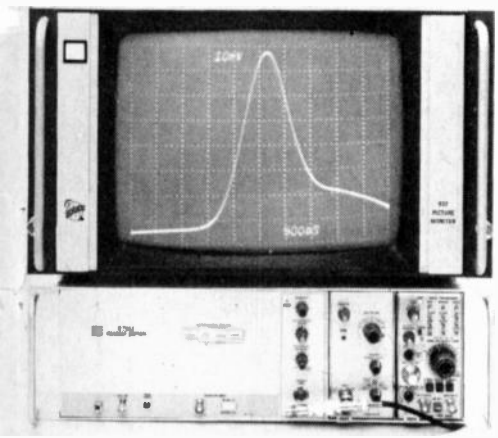
A range of single-unit ultrasonic cleaners now available are both self-contained and self-tuning, so no skill or experience are required to operate them.

The tanks are made from 300 series stainless steel, with rounded corners. Circuitry is all solid state. The virtually indestructible transducer is lead zirconate titanate, and the generator is right in the base of the unit. Internal temperatures are held down by designed-in heat sinking and aeration – no fan is required.

Cleaning power ranges from 25 W to 200 W: tank sizes from 30 to over 650 cu.ins. Modern production methods, claim the manufacturers, have provided an attractive unit that combines a long service life with a moderate price, and the ability to stand up to production duty cycles.

Further details: Royston Electronics Pty Ltd, 22 Firth Street, Doncaster, Vic. 3108.

TRANSIENT DIGITIZER



The Tektronix R7912 Transient Digitizer can acquire fast single-shot or repetitive signals and convert them to digital data or to a TV-compatible format. Key component in the instrument is a Tektronix-developed scan-converter tube.

The R7912 operates in two modes: digital and TV. In the digital mode, it operates as a fast analogue to-digital converter taking 512 samples of a waveform in a time window as short as 5 ns. This digital information can be stored in an optional self-contained memory or sent to a computer or other peripheral such as a digital-to-analogue converter for display on an X-Y monitor.

Software available from Tektronix will permit measurements and analysis. In the TV mode, the R7912 processes waveforms into a TV compatible format (525 lines, 60 Hz field, 2:1 interlace) for bright, large-screen displays on conventional TV monitors such as the Tektronix 630 Series Picture Monitor.

Signals are acquired with standard 7000-Series plug-ins. This provides a very flexible and versatile signal acquisition system, allowing selection from over 25 plug-ins, as well as compatibility with the many other instruments in the 7000-Series family.

Several options are available to expand the measurement performance of the R7912. The optional memory allows the acquired waveform to be stored in the R7912 for later sequence into a computer or into permanent memory storage such as a digital tape system. An electronic graticule option allows an electronically generated dot-pattern graticule to be stored or displayed along with the signal.

The R7912 is designed to be mounted in a rack with the computer, monitor, or other equipment.

Further details: Tektronix Australia Pty Limited, 80 Waterloo Road, North Ryde, NSW 2113.

M.S COMPONENTS
EVERYTHING IN ELECTRONICS

95-97 REGENT STREET, REDFERN,
N.S.W. 2016. PHONE 69-5922
HEAD OFFICE: & M.O. DEPT.,
P.O. BOX 156 REDFERN, N.S.W. 2016

Due to high cost of invoicing no ORDERS under $2 can be accepted. No C.O.D.'s.

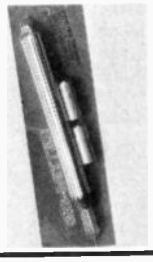
*FRUSTRATED WITH THE COMPONENT SHORTAGE? THEN CALL OR WRITE TO US TODAY. WE STILL HOLD THE LARGEST STOCKS IN THE COUNTRY... MILLIONS OF RESISTORS, THOUSANDS OF CAPACITORS OF ALL TYPES... THOUSANDS OF TRANSISTORS, DIODES, RECTIFIERS ETC. GOOD STOCKS OF I.C's, SPEAKERS, CONNECTORS, PLUGS & SOCKETS... YOU NAME IT... ALSO OF COURSE TRANSFORMERS ****

THE LATEST & BEST FROM THE STATES...
...'CERTRON' CASSETTE TAPES

Special introductory offer of these exclusive and ultra efficient high density—low noise tapes.
Just compare OUR Prices... Tapes are fully guaranteed and have been tested and certified by Louis A. Challis & Associates Pty. Ltd.

GAMMA C60	$1.55
CROLYN C60	$2.45
PRO C60	$1.25
STANDARD C60	$1.20
GAMMA C90	$2.25
CROLYN C90	$3.50
PRO C90	$1.55
STANDARD C90	$1.45

4 PRO-PAK Four PRO-C 60's in re-useable, versatile storage case. ONLY $4.50. P&P 30c. All other tapes 20c.



UNIVERSAL SIGNAL INJECTOR

Model SE-260 (New powerful type). Employs a blocking circuit. Its oscillation waves contain higher harmonics and its output voltage is as high as 50V, so a signal is injectable into the circuit to be measured without prod or circuit contact. Ideal for trouble of Antenna and RF Circuit of Radios, Transceivers and Car radios. $7.95 each plus P&P 30c.

'GALAXY' CAR RADIO

Universal Manual Tuned 6 Transistor 12 volt (— Earth) Radio. Designed for Universal under-dash or in-dash installation and can be used on any 12 volt electrical system. Complete with in-built Speaker, connectors, fixing hardware and extra external leads for an additional speaker. Supplied complete with Antenna and fully guaranteed for 90 days. Very powerful and selective. ONLY $35.00 plus P&P $1.25.

PHILLIPS HIGH FIDELITY SPEAKERS

One of the World's Best and most reliable in Speaker technology.
Type AD8065/W8. 8" High Fidelity WOOFER. Power Handling Capacity: 20W rms. Impedence 8 ohms. Resonance Frequency: 28 Hz. Frequency Range: 35 Hz — 1.8 kHz. $14.50 p & p. $1.00.

Type AD7065/W8. 7" High Fidelity WOOFER. Power Handling Capacity: 20W rms. Impedance 8 ohms. Resonance Frequency: 28 Hz. Frequency Range: 50 Hz — 2 kHz. $12.50 p & p $1.00

Type AD0160/T8. 1" High Fidelity DOME TWEETER. The Best you can buy in TWEETERS. Power Handling Capacity: 20W rms. Impedance 8 ohms. Resonance Frequency: 1 kHz. Frequency Range: 1 kHz — 20 kHz. $10.90 each or in Stereo Kit Form viz: 2 TWEETERS in presentation Pack, complete with Cross-over Capacitor and Full Data. $20.50. p & p 65c & $1.00.

Type KAD2WX. Two way CROSS-OVER NETWORK System. Comes in Kit form with all necessary components & Instructions. STILL only $5.50 P & P 50c.

Type KAD3WX. Three way System as above, but ready wired and assembled. $11.50 P & P 50c.

ALL THE ABOVE ARE HARD TO OBTAIN ITEMS... OUR STOCKS ARE LIMITED SO RUSH YOUR ORDERS NOW...

FIRST TIME HERE... Exclusive to us
HEADPHONE RADIO

Looks like a normal Headset, but has in-built miniature transistor Radio, that simply drags the stations in. Fully adjustable and finished in Ivory Bakelite. A special connector adaptor is also supplied that converts the Unit into an ordinary High class stereo Headphone. Definately NOT A GIMMICK and is fully warranted. Must be heard to be believed. ONLY $26.00 each plus 75c P&P.

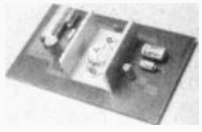
I.T.T. 20 WATT HYBRID AMPLIFIERS

Still a few left of these very versatile and efficient Amplifiers. Outstanding features are: Single-ended push-pull circuit... Can withstand a 5 second short-circuit across the output terminals... No external components required. full protection and temperature compensation... Harmonic distortion less than 0.5% at full power... Frequency range 20 Hz to 100 kHz at 1 watt output, 20 Hz to 20 kHz at full power output.

TA 20 42volt/55 volt $6.50. TA 20C 22 volt/29 volt $12.00. P&P each unit 30c. DATA SHEETS SUPPLIED FOR EACH AMPLIFIER.

3 WATT AMPLIFIER KIT

Consists of the M5102AY Power I.C. which is a 10 lead I.C. in a modified JEDEC T03 Case. Supplied in a ready drilled and prepared P.C. Board, Heat-Sink, all necessary external components and full wiring instructions. A 'beaut' Kit at a modest price. ONLY from M.S.C. $6.95 plus 50c P&P.



'HIPOWER'

DC-DC Car Converter 6 & 9V

Only $4.95 P.P 30c

M.S.C's SPECIAL 1974 OFFER of I.C's TRANSISTORS & DIODES.

Never again at these Inflation destroying prices...

SN 7473 14 pin DIL Dual JK Flip-Flop	$1.30
SN 7440 14pin DIL Dual input Nand Gate	$0.80
SN 7472 14pin DIL Single JK Master Slave Flip Flop	$1.20
LM 709 T05 Case G.P. Operational Amplifier	$0.85
LM 741 T05 Case G.P. Operational Amplifier	$1.25
BC 107 NPN GP Transistor — 5 for	$1.30
BC 108 NPN GP Transistor — 5 for	$1.30
BC 109 NPN Audio Transistor — 5 for	$1.30
BC 177 PNP Audio Transistor — 5 for	$1.60
BC 179 PNP Audio Transistor — 5 for	$1.60
2N 3055 NPN Power Transistor — 2 for	$2.75
2N 3054 NPN Power Transistor — 2 for	$1.75
2N 1554 PNP Power Transistor — 2 for	$2.50
2N 3642 NPN GP Transistor — 2 for	$0.75
OA 95 Germanium Small signal Diode — 5 for	$1.80
OA 202 Silicon Small signal Diode — 5 for	$1.80
BA 102 Variable Capacitance Diode — 2 for	$0.95
BZY88/C4V7 to C13 Zener Diodes, each all at	$0.45
AC 128 PNP Audio Output Transistor — 2 for	$2.00

ALL ITEMS ABOVE Plus 12c P & P.

RECORDINGS classical

REVIEWER: Tanya Buchdahl

WALTON: Facade – an Entertainment. Poems by Edith Sitwell. Fenella Fielding, Michael Flanders (speakers); members of the Academy of St-Martin-in-the-Fields/Marriner. HMV ASD2786 $6.20.

And an entertainment it is indeed. Delightful not only for adults but for intelligent children as well; and it should be played for every poetry appreciation course to show that sound can be just as important as meaning for giving pleasure.

'Facade' is made up of 21 of Edith Sitwell's nonsense poems set to music which matches the character of each one. I don't say "reflects" because these are not poems just recited to a background of music, or even interwoven with it, but the voice is just an ordinary ensemble instrument. Probably the closest approach to this elsewhere is the Gliere concerto for (soprano) voice and orchestra, but all aaaa. . . and no words at all. The fact that in 'Facade' the voice happens to be producing recognizable English lexicon and syntax is quite incidental. So it is really a vast onomatopoeic exercise, but it is the sentences and even the whole poem which is onomatopoeic, not just the individual words.

So you can see why one needs to have actors such as Fielding and Flanders as speakers – actors who have voices of extraordinary range and colour, that can wind sensuously around the words, or deliver with such machine-gun rapidity that the words are quite indistinguishable (hear Michael Flanders spit out "Thetis wrote a treatise noting wheat is silver like the sea; the lovely cheat is sweet as foam; . . ." in No.6!)

Many people will know this work in its purely orchestral arrangement in suites, particularly the Tangopasodoble, No.6. Now that I have heard the original I cannot ever understand why it was ever arranged without the voices. My only gripe with this record, however, is that the voices are a little too forward, giving them too much of a solo function and forcing one to listen to the words (as having meaning), which is especially unnecessary here as they are printed in entirety on a leaflet which comes with the record (the Philips version with Cleo Laine, Annie Ross and the Johnny Dankworth Ensemble is better in this regard, though I cannot understand the substitution of Annie Ross for a male voice). Otherwise, the Academy is thoroughly delightful all the way through – everywhere suitably dry and ironical – as you would expect when players such as John Wilgraham (trumpet) and Jack Brymer (clarinet) are featured. Technically this is some of the best directional sound I have heard in stereo, with the instrument coming from so many different places, speakers excluded (what would quad do for this work?).

Just as this work should be given to music lovers to show them the potential of the spoken word, so should it be given to anyone who loves poetry to show just how much effect a piece of verso can have if its sound qualities are considered as well as its meaning and its scansion. It is also educational for this reason if given to an intelligent child, and a good replacement for the old (1958) Saint Saens 'Carnival of the Animals' by the Andre Kostelanetz Orchestra, with added verses by Ogden Nash (read by Noel Coward), the disappearance of which was the Deletion Disaster of the Decade. 'Facade', in short, is highly original, and an entertainment for everyone with a sense of humour. – T.R.B.

PAGANINI: Violin Concerto No.1 in D (transcribed from E flat), SARASATE: 'Carmen' Fantasy. Itzhak Perlman (violin); London Symphony Orchestra/Foster. HMV OASD 2782 ($6.20).

Let me say now that I think Itzhak Perlman will be the new Heifetz. Note that I say "will be" – he isn't yet; but there is plenty of time, for he is still under 30. At present he is a highly sensitive artist with a simply amazing and seemingly effortless technique, and this is how all his recordings that I have heard sound, including this Paganini release. But with a greater maturity to his interpretation it is then that he could lay claim to the title of Violinist of the Century.

The Paganini No.1 itself was of course written primarily as a showpiece to advertise the composer's virtuosic abilities, which seem to have been considerable. One story has it that disaster struck three times during one performance, causing a string to break each time, and thereby causing Paganini the necessity of having to continue on three, then two, and finally one string, to the delight and amazement of the audience. Subsequent examination of the violin showed all three broken strings to have been partially sawn through! So the technical tangles invented by such a composer would and do form ideal material for a violinist such as Perlman. The sounds he draws from his instrument are quite astounding, the more so in combination with his complete but unaffected self-confidence.

This all applies to the Sarasate Fantasy too, no technical chicken-feed. It is, however, a rather mean fill-up for a full-price record, when it is possible to put on one record both Paganini Concertos 1 and 2, for example. Further, this record is also a re-issue from last year's two-record set (SLS832), the other record bearing the complete (24) Caprices Op.1. While this separate issue is a good idea for those who already have the Caprices, it seems senseless to pay $6.20 for it when one can have the whole excellent set for the recently *reduced* price of $8.00 (highest praise to EMI who have reduced prices on many of their SLS series sets).

I do urge you to lay hands on as many of Perlman's issues as you can: the Wieniawski Concerti Nos.1 and 2 (HMV ASD-2870), the Tchaikowsky concerto with the Boston S.O. under Leinsdorf which I have seen in a record shop dealing in out-of-the-way issues in Melbourne, (Discurio, 294 Little Collins St.) but is normally available (coupled with the Sibelius) only overseas (RCA LSB4066). If I seem to be opening my mouth rather wide about Perlman's ability, I am basing my opinion not only on his records but on a concert he gave in Canberra with Romola Costantino (ABC Series 1) in June 1973. This concert was undoubtedly the best I have ever attended, out of some hundreds. Beethoven's 'Spring' Sonato was a revelation – it was as if I had never really heard it properly before. It was followed by Bach's Suite No.2 in A minor for unaccompanied violin, a performance so moving that I wept right through it and through the interval as well; as a consequence of which I remember of the second half only that I was as hugely delighted with Perlman's playing as he was with what he was playing. So please forgive me if I seem over-laudatory; but I do think he is worth every word of it. – T.R.B.

BACH: Cantatas: BMV 202 "Weochet nur, betruebte Schatten", BWV 209 "Non sa che sia dolore". Elly Ameling (soprano); Academy of St-Martin-in-the-Fields/Marriner. HMV ASD-2876 ($6.20),

Undoubtedly one of the very best records issued this year, from all points of view except the cover, which wins the prize for the Year's Most Unflattering Photo. Though we are at least seven years away from the Telefunken version of these cantatas, the directors must already be quaking at the thought of competing with this version. With every reecord Elly Ameling produces I become more amazed at the pure and rich tone of her voice – ravishing is more like it – and no-one else I know can produce

high notes which seem to be echoing within a cathedral. The poignancy of her first movement in No. 202 brings tears to my eyes each time I hear it.

As for the Academy, I usually find their playing just a fraction smug, but here they have surpassed themselves. The opening number of No.202 is followed by an aria accompanied by continuo only – harpsichord and bassoon, minus cello. Though it may cause a musicological apoplexy in some, I think no-one can deny that the sprightly rhythm (honours to Roger Birnstingl's bassoon-playing) produced without the slightly lumbering tone of the cello makes this aria utterly delightful (in any case, if we were being strict about it, we should replace Miss Ameling with a boy soprano, as no doubt Telefunken will do). It is most probable that this cantata, one of six secular, so-called "wedding" cantatas, was sung at the reception rather than the service itself; and so Marriner ingeniously treats the third aria (with Niel Balck's oboe) as a peasant's dance, with "bounces" on the first beats of the bars and slight *rallentandos* which suggest a new dance sequence just about to lead off, rather than just another *vivace* 3/8 piece.

BWV 209 is less interesting from the view of instrumentation. Here the solo instrument is the flute throughout and an entire cantata's worth of that one instrument comes a little close to tedious, despite William Bennett's colourful playing. I see on the cover notes (which oddly enough do not even give movements titles – surely an insert with words and translations could have been provided, especially as it is a full-price record) that this, and the bass cantata BWV 203 ("Amore traditore") have been doubted as authentic Bach. This claim is as fantastic to me as is the same claim tilted at the Harpsichord Concerto No. 1 in D. minor. Doubters seem to pick the least likely candidates to be fakes. In any case, the music of this cantata is quite beautiful, as is its performance. The sound is English HMV at its best, with Elly Ameling's voice finely captured, and balance and separation is first-rate, particularly in the recording of the bassoon in No.202. I must confess to returning time and time again to that aria – in less crusty terms, it tickles me pick. – T.R.B.

BACH: Complete Cantatas Volume 6: BWV 21 "Ich hatte viel Bekuemmernis"; BMV 22 "Jesus nahm zu sich die Zwoelfe"; BMV 23 "Du wahrer Gott und Davids Sohn". Soloists of the Vienna and Toelzer Boys' Choirs (sopranos); Paul Esswood (alto); Kurt Equiluz, Marius van Altena (tenors); Walker Wyatt, Max van Egmond (basses). Vienna Boys Choir, Toelzer Boys Choir, Kings College Choir, Cambridge; Concentus Musicus Wien/Harnoncourt and Leonhardt Consort/Leonhardt. Telefunken Das Alte Werk SKW 6/1-2)2-record boxed set with notes on works and performances and full scores $12.40.

It seems to me that with every issue this group of performers improves. I recall being quite stunned with their St John Passion (SKH 19/1-3) a couple of years ago, but this latest issue on the mammoth project of recording the complete cantatas seems now so much more polished and crystalline (also not entirely without aid from the engineers). BWV 21 is a wonderful cantata (a very early one – Weimar 1714), and the performance given here is quite remarkable – really outstanding. The honours, however, go to the boy soprano from the Vienna Boys Choir, studiously left unnamed. Particularly when one considers the necessarily limited amount of training he could have had, his precision and self-assurance are not only amazing, but the sheer joyous excellence of it really does the heart good. And for those who claim that all-male voices makes Bach too dry (I now find 'ordinary' or mixed performances very strange and generally too heavy) – I suggest listening to the alto and soprano duet section of the chorus "Was betruebst du dich, meine Seele", which is some of the most sensuous Bach I have ever heard – in any case, I don't think it is possible to make Bach too dry at all, and quite a lot of Bach performances would be vastly improved for some dryness.

The other two cantatas here are not exactly Bach at his most inspired, though they were written in 1723 when much of the great chamber music was composed; they are not recorded elsewhere, unlike No. 21 which is one of three currently available. Again the performances are first-rate, and couldn't fill the gap in the catalogue better. My one rather feeble complaint is the none-too-generous timing – 73 minutes over four sides (No.22 could easily have gone on the first record along with No.21), although there is much to be said for not breaking cantatas in the middle. But they do include the full miniature scores which in the cheapest edition, bought separately, are $1.95, and so I suppose I shouldn't complain about meanness. In short, these cantatas (in fact, all the sets so far) are first-rate performances and well worth having. – T.R.B. ●

The above review was originally published in our November '73 issue. Due to an oversight the final 24 lines were inadvertantly omitted. Because of this we have re-published the review – this time in its entirety. Our apologies to Tanya Buchdahl. – Ed.

easy money, that's

ife with SANYO

Selling Sanyo is easy . . .
with a super salesgirl like "Kerrie Biddell",
Australia's singing sensation.
Backed by big media money spending, she'll sell
Sanyo for you, on T.V., Radio and in Press across
the country.
Easy . . . that's life with SANYO.
Ask Kerrie! Or see your local dealer.

SANYO
thats life

SAN 3952

INPUT GATE

LETTERS FROM OUR READERS

4-CHANNEL SOUND

Yours seems to be one of the few magazines in your field whose editorial copy is not dictated by advertisers.

This being so what about telling us whether *you* Mr. Editor like four-channel sound or not.

C.H. Port Morseby, P.N.G.

We just don't feel strongly about four-channel one way or the other.

Of the systems we have heard so far we prefer CD-4 but would probably buy SQ simply because it's cheaper.

If our budget were very restricted we would go for a good two-channel system rather than a mediocre four-channel system every time.

To some extent our lack of enthusiasm is due to the poor production of currently available four-channel recordings. Most of these have been produced to show off the four channel effect rather than to enhance the musical experience.

If your thing is listening to Wagner from inside the bass drum you'll enjoy four-channel sound. Otherwise . . .

Incidentally C.H., there's an awful lot of nonsense talked about advertisers leaning on magazines.

Naturally every manufacturer tries to obtain publicity for his products, but very few ever try to dictate editorial policy.

If you read a magazine in which the editorial appears to have been written by the advertisers – it probably was – or at least with their help, but almost invariably at the instigation of the magazine rather than the advertisers. Magazines such as this exist – and are quite clearly identifiable.

RADIO PIRATES

Australia's radio pirates seem to be working on a very small scale indeed. I vaguely remember reading about a giant pirate radio setup run by the British Government during the war. Do you know anything about it?

– G.D. Perth W.A.

There have been a number of these. The most famous is probably GS-1. Gustav Siegfried Eins – to give it its name in full – was run from a small house in Aspley Guise (Bedfordshire, UK) by the British Government from May 1941 until October 1943.

Brainchild of Sefton Delmer, then head of British secret broadcasting, the station broadcast what purported to be traffic of a clandestine military organisation sending coded messages to secret conclaves in a occupied Europe. Between coded messages, an extreme right-wing type (even by Nazi standards!) would tell the supposed conclaves his views on the group that had seized control in Germany.

These views purported to fool the enemy into believing that there was a growing ideological split in German military and political ranks.

The unusual format chosen was intended to fool German listeners into thinking that they had accidentally tuned into radio messages not intended for their ears.

The scheme worked extraordinarily well. The station acquired a vast 'clandestine' following. Inside Germany speculation grew as to the origin of the broadcasts – many suspected it was the work of Goering, then Nazi Air Force chief. Surprisingly, very few suspected the British.

Knowledge of the station's true purpose was accidentally revealed in Washington in 1943, and the station was hurriedly shut down – fortunately before the leaked information became common knowledge in Germany.

Final broadcast from GS-1 was appropriately dramatic – with a staged 'discovery' of the chief by the Gestapo – the station left the air for the last time to a dubbed-in background of machine-gun fire!

Another, and quite extraordinary station was the 'Voice of the Patriotic Militiaman's Front' broadcasting on 9433 and 7216 kHz (in south east Asia) until quite recently.

This station, with call sign 'Day la Tieng Noi cua Mat Tran Dan Quan Ai Quec' denounced the US position in south east Asia – but apparently solely to gain credibility for its true purpose which was to foster nationalistic fervour amongst the North Vietnamese in an attempt to turn them against their communist Government.

The station is believed to have been located somewhere in South Vietnam but in its broadcasts gave its location as Hanoi!

In some ways similar to the legendary GS-1, its broadcasts ended with an hour-long segment of 'coded orders for agents operating in South Vietnam'.

ELAC PUZZLE COMPETITION

SOLUTION TO PUZZLE NO.9

With 3 red, white, or green lamps, we can make 15 variations each (45) with 1 red and 2 white we can make the same 15 and each way will admit of 3 variations of colour order, 45 in all.

The same with 1 red and 2 green, 1 white and 2 red, 1 white and 2 green, 1 green and 2 white, 1 green and 2 red (270).

With 1 red, 1 white, 1 green we get 6 x 15 variations (90).

With 2 red, or, 2 white, or 2 green, we can get 7 patterns (21).

With 1 red and 1 white, or, 1 red and 1 green, or, 1 white and 1 green, we get 14 variations each (42). With 1 lamp only, we can get only 1 signal each (3).

Add together the numbers in parentheses (45, 270, 90, 21, 42 and 3) and we get the answer – 471 ways.

The first correct entry opened was sent in by Mr. M. Coleman of 33 Wallis Parade North Bondi., N.S.W.

Permit No. T/C 4108

1973's TOP POP

CREAM OF THE CROP
REST OF THE BEST

An essential break down of the 1973 'Must Haves'

Three basic sections ('Male', 'Female' and 'Group') are used simply for convenience and clarity. Records listed under each section and section sub-heading are *not* placed in any order so as to avoid unnecessary comparisons.

Each section consists of the following sub-headings:

'Male' and *'Female' Singer/songwriter – Album(s) of the year:* The very finest in self-composed material, overall performance and recording quality released by a solo artist. The absolute cream of the crop.

'Assorted Group Mind Rorts' – 'Album(s) of the year':
Same as above – on a collective band basis.

'Other Outstanding Releases':
This refers directly to all three primary

FEMALE SINGER/SONGWRITER ALBUM OF THE YEAR

"HEART FOOD"
Judee Sill.
E.M.I./Asylum.
Stereo. SYL.9006.

OTHER OUTSTANDING RELEASES

"FOR THE ROSES"
Joni Mitchell.
E.M.I./Asylum.
Stereo. SYLA.8753.

"WHATEVER'S FOR US"
Joan Armatrading.
Phonogram/Cube.
Stereo. 2326.023.

OUTSTANDING FEMALE PERFORMANCES

"DON'T CRY NOW"
Linda Ronstadt.
W.E.A./Asylum.
Stereo. SD.5064.

"THE POINTER SISTERS"
The Pointer Sisters.
Festival/Blue Thumb.
Stereo. L.34965.

"THE DIVINE MISS M"
Bette Midler.
W.E.A./Atlantic.
Stereo. SD.7238.

"AMAZING GRACE"
Aretha Franklin.
W.E.A./Atlantic.
Stereo. SD.2906.

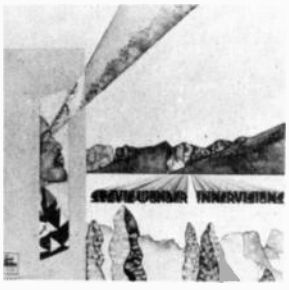
"I AM A SONG"
Cleo Laine.
R.C.A. Victor.
Stereo. MSL.102306.

SPECIAL MERIT RELEASE

"THE BILLIE HOLIDAY STORY"
Three Volume Set/Original Recordings.
"Volume One"
C.B.S./Mono. S2BP.220128.
"Volume Two"
C.B.S./Mono. S2BP.220129.
"Volume Three"
C.B.S./Mono. S2BP.220132

MALE SINGER/SONGWRITER ALBUMS OF THE YEAR

"LOGGINS & MESSINA"
Loggins & Messina.
C.B.S./Stereo. SBP.234253.



"INNER VISIONS"
Stevie Wonder.
E.M.I./Tamla Motown.
Stereo. STMA.7004.

"RIVER"
Terry Reid.
W.E.A./Atlantic.
Stereo. SD.7259.

"JACKSON BROWNE"
Jackson Browne.
E.M.I./Asylum.
Stereo. SYL.9002.

"LIVING IN THE MATERIAL WORLD"
George Harrison.
E.M.I./Apple.
Stereo. SMAS.3410.

OTHER OUTSTANDING RELEASES

"TRANSFORMER"
Lou Reed.
R.C.A. Victor.
Stereo. LSP.4807.

"G.P."
Gram Parsons.
W.E.A./Reprise.
Stereo. MS.2123.

"ST. DOMINIC'S PREVIEW"
Van Morrison.
W.E.A./Warner Bros.
Stereo. BS.2633.

"ROGER McGUINN"
Roger McGuinn.
C.B.S./Stereo. SBP.234331.

OUTSTANDING MALE PERFORMANCE

"THE SMOKER YOU DRINK – THE PLAYER YOU GET"

sub-headings. Records listed here are once again the very finest – largely or wholly self-composed, superlative performances, excellent recording quality.

'Outstanding Male/Female Performances'

Albums which consist of eclectic material, occasionally self-composed, largely diverse in style(s). Essentially, for interpretive character artists (usually vocalists).

Special Merit.

As with Billie Holiday and the timely C.B.S. triple legacy – an incisive, definitive, wholly revealing portrait of the songstress who instilled the art of conversation into popular music. In the 'Male' section, Mike Oldfield's innovative "Tubular Bells", an instrumental suite of amazing impact, sensitivity and originality, is quite purely unique and deserves to be lauded as such. As well, Roy Wood, long-time leader of the now defunct Move, appeared on three stylistically unrelated releases in each case as the pivotal musician – "The Electric Light Orchestra", "Wizzard" and his completely self-produced solo set "Boulders". An amazing gent whose productivity alone marks him as something very special.

'Outstanding Debut Recordings'

Covers all major sections – albums by artists previously unrecorded, unestablished. A run down of the dark horses.

Joe Walsh.
E.M.I./Probe.
Stereo. SPBA.3059.

"STILL ALIVE AND WELL"
Johnny Winter.
C.B.S./Stereo. SBP.234318.

"A WIZARD – A TRUE STAR"
Todd Rundgren.
W.E.A./Bearsville.
Stereo. BR.2133.

"A LITTLE TOUCH OF SCHMILSSON IN THE NIGHT"
Harry Nilsson.
R.C.A. Victor.
Stereo. APL1-0097-G.

SPECIAL MERIT RELEASE

"TUBULAR BELLS"
Mike Oldfield.
W.E.A./Virgin.
Stereo. VR.13-105.

ASSORTED GROUP MIND RORTS ALBUMS OF THE YEAR

"FRESH"
Sly & The Family Stone.
C.B.S./Epic.
Stereo. KE.32134.

"FOR YOUR PLEASURE"
Roxy Music.
Festival/Island.
Stereo. IL.2696.

"STRIKING IT RICH"
Dan Hicks & His Hot Licks.
Festival/Blue Thumb.
Stereo. SBTL.934.608.

"HEARTBREAKER"
Free.
Festival/Island.
Stereo. IL.9324.

"DOWN THE ROAD"
Stephen Stills/Manassas.
W.E.A./Atlantic.
Stereo. SD.7250.

"BYRDS"
The Byrds.
E.M.I./Asylum.
Stereo. SYL.0598.

"BAND ON THE RUN"
Paul McCartney & Wings.
E.M.I./Apple.
Stereo. PASA.10007.

"ALL I WANNA DO IS ROCK"
Mighty Kong.
W.E.A./Wizard.
Stereo. ZL.204.

"THE CAPTAIN & ME"
The Dobbie Brothers.
W.E.A./Warner Bros.
Stereo. BS.2694.

"WAKE OF THE FLOOD"
The Grateful Dead.
W.E.A./Grateful Dead Records.
Stereo GD.01.

"CAN'T BUY A THRILL"
Steely Dan.
E.M.I./Probe.
Stereo. SPBA.3057.

"DESPERADO"
The Eagles.
E.M.I./Asylum.
Stereo. SYL.5068.

"BIRDS OF FIRE"
Mahavishnu Orchestra.
C.B.S./Stereo. SBP.234298.

"SHOOT OUT AT THE FANTASY FACTORY"
Traffic.
Festival/Island.
Stereo. IL.34.841.

"THE ELECTRIC LIGHT ORCHESTRA"
E.L.O.
E.M.I./Harvest.
Stereo. SHVL.797.

"THE DARK SIDE OF THE MOON"
Pink Floyd.
E.M.I./Harvest.
Stereo. SHLVA.804.

"THE BEATLES – 1962/1966"
The Beatles.
E.M.I./Apple.
Stereo. PCSO.7171/2.

"THE BEATLES – 1967/1970"
The Beatles.
E.M.I./Apple.
Stereo. PCSO.7181/2.

"CARAVANSERAI"
Santana.
C.B.S./SBP.234240.

"GOAT'S HEAD SOUP"
The Rolling Stones.
W.E.A./Rolling Stones.
Stereo. COC.59101.

OTHER OUTSTANDING RELEASES

"BROTHERS AND SISTERS"
The Allman Bros. Band.
Stereo. CP.0111.

"THEY ONLY COME OUT AT NIGHT"
Edgar Winter Group.
C.B.S./Epic.
Stereo. ELPS.3659.

"HOT LICKS, COLD STEEL & TRUCKERS FAVOURITES"
Commander Cody & His Lost Planet Airmen.
Festival/Paramount.
Stereo. PML.34679.

"THIRTY SECONDS OVER WINTERLAND"
Jefferson Airplane.
R.C.A. Victor/Grunt.
Stereo. MBFL1.0147.

"GYPSY COWBOY"
New Riders Of The Purple Sage.
C.B.S./Stereo. SBP.234273.

"IT'S ONLY A MOVIE"
Family.
W.E.A./Raft.
Stereo. RA.58501.

OUTSTANDING DEBUT RECORDINGS

"A STRANGE FANTASTIC DREAM"
Ariel.
E.M.I./Stereo. EMC.2508.

"THE MARSHALL TUCKER BAND"
Marshall Tucker Band.
W.E.A./Capricorn.
Stereo. CP.0112.

"SMOKE DREAMS"
Captain Matchbox Whoopee Band.
Tempo/Image.
Stereo. ILP.724.

"STILL POINT"
Madder Lake.
Festival/Mushroom.
Stereo. MRL.34965.

"RUBBER BULLETS"
10CC.
E.M.I./Decca.
Stereo. SKLA.7703.

"KINDLING"
Gene Parsons.
W.E.A./Warner Bros.
Stereo. BS.2687.

"DOUG SAHM AND BAND"
Doug Sahm.
W.E.A./Atlantic.
Stereo. SD.7254.

"IN SEARCH OF AMELIA EARHART"
Plainsong.
W.E.A./Elektra.
Stereo. EKS.75044.

SPECIAL MERIT

ROY WOOD
"Wizzard's Brew"/Wizzard.
E.M.I./Harvest.
Stereo. SHSP.4025.

"The Electric Light Orchestra"./ELO.
E.M.I./Harvest.
Stereo. SHVL.797.

BOULDERS

ROY WOOD

"Boulders"/Roy Wood.
E.M.I./Harvest.
Stereo. SHVL.803.

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

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

DATA SHEETS ARE PROVIDED FOR EACH ITEM PURCHASED

7400 SERIES TTL

		DIP
7400	Quad 2-input NAND gate	$ .20
7401	Quad 2-input NAND gate	.20
7402	Quad 2-input NOR gate	.22
7404	Hex inverter	.22
7405	Hex inverter*	.20
7406	Hex inverter buffer/driver*	.35
7408	Quad 2-input AND gate	.22
7410	Triple 3-input NAND gate	.20
7420	Dual 4-input NAND gate	.20
7430	8-Input NAND gate	.20
7440	Dual 4-input NAND buffer	.20
7441	BCD-to-decimal decoder/driver	.80
7442	BCD-to-decimal decoder	.80
7447	BCD-to-7 segment decoder/driver	1.00
7448	BCD-to-7 segment decoder/driver	.80
7450	Expandable dual 2-wide 2-input AND-OR-invert gate	.20
7451	Expandable dual 2-wide 2-input AND-OR-invert gate	.20
7472	J-K master-slave flip-flop	.30
7473	Dual J-K master-slave flip-flop	.40
7474	Dual D-type edge-triggered flip-flop	.40
7475	Quadruple bistable latch	.75
7476	Dual J-K master-slave flip-flop with preset and clear	.40
74L78	Dual J-K master-slave flip-flop	.40
7483	4-Bit binary full adder (look ahead carry)	.80
7489	64-Bit read-write memory (RAM)	3.00
7490	Decade counter	.90
7492	Divide-by-12 counter (divide by 2 and divide by 6)	.60
7493	4-Bit binary counter	1.15
7495	4-Bit right-shift left-shift register	.75
74121	Monostable multivibrator	.60
74123	Dual retriggerable monostable multivibrators with clear	1.50
74193	Synchronous 4-bit binary up/down counter with preset inputs	1.00

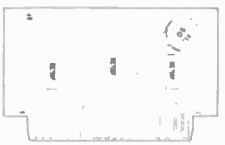
*With open collector output

LINEARS

NE540	70-Watt power driver amp	$1.00
NE555	Precision timer	1.00
NE560	Phase lock loop DIP	2.00
NE561	Phase lock loop DIP	2.00
NE565	Phase lock loop TO-5	2.00
NE566	Function generator TO-5	2.00
NE567	Tone decoder	2.50
NE5558	Dual 741 op amp MINI DIP	.90
710	Voltage comparator DIP	.60
711	Dual comparator DIP	.25
723	Precision voltage regulator DIP.	1.00
741	Op amp TO-5/MINI DIP	.55
747	Dual 741 op amp DIP	1.00
748	Op amp TO-5	1.00
CA3018	2 Isolated transistors and a Darlington-connected transistor pair	.75
CA3045	5 NPN transistor array	.75
CA3026	Dual differential amp	.75
LM100	Positive DC regulator TO-5	.50
LM105	Voltage regulator	1.00
LM302	Op amp voltage follower TO-5	1.25
LM311	Comparator DIP	1.00
LM370	AGC amplifier	1.00
LM703	RF-IF amp epoxy TO-5	.25
LM3900	Quad op amp	2.00
LM1595	4-Quadrant multiplier	1.00

8093-8094	Tri-state quad buffer DIP	$1.00
8850-9601	One-shot multivibrator DIP	1.50
8811	Quad 2-input MOS interface gate 15V open collector DIP	.30

RTL EXPERIMENTER PACKAGE



We purchased a computer using RTL logic. All the ICs are Motorola plastic DIP 700 series. Each board contains 3 or 5 ICs and a gold-plated standard 42-pin finger connector. VCC and ground are connected to all ICs, and a .05 bypass is provided. Each active pin of all ICs on the board go to a pin on the connector.

BOARDS AVAILABLE:

#1	3 MC724P Quad 2-input gate	$1.25
#2	3 MC789P Hex inverter	1.25
#3	3 MC790P Dual J-K flip-flops	1.25
#4	3 MC792P Triple 3-input gate	1.25
#5	5 MC799P Dual buffer	1.25

SOCKETS FOR BOARDS:

Bank of 5 bussed together to take 5 boards - gold-plated wire.....$2.50

Ten bussed together.....$4.50

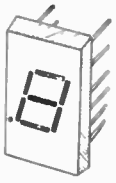
Set of 5 boards and sockets with data and applications.....$7.95

LSI CALCULATOR ON A CHIP

This 40-pin DIP device contains a complete 12-digit calculator. Adds, subtracts, multiplies, and divides. 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 $7.00
Data only $1.00

SLA-1 OPCOA



Pin compatible with MAN-1.

Large .334" character.

Mounts on .4" centers.

Left-hand decimal point.

$2.00 Each; 10 For $16.00

FAIRCHILD "TRIMPOTS"

Brand new 20 turn precision trimmers. These are prime parts, mostly individually packed in sealed envelopes.

FOLLOWING VALUES IN STOCK:

10 Ohm	1K	50K
20 Ohm	2K	100K
50 Ohm	5K	200K
100 Ohm	10K	250K
200 Ohm	20K	500K
500 Ohm	25K	1 Meg

Each Only 89¢

Ten for $7.50

Please specify P or L (PCB or wire leads). Order NOW, these won't last!

COUNTER DISPLAY KIT—CD-2

This kit provides a highly sophisticated display seotion 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).

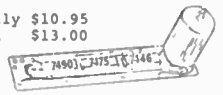
A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven-segment decoder driver. The 7447 accomplishes blanking 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 4 3/8" long. A single 5-volt power source powers both the IC's and the display tube.

CD-2 Kit Complete Only $10.95
Assembled and Tested $13.00

Board Only $2.50



RCA DR2010 NUMITRON

RCA DR2010 Numitron digital display tube. This incandescent five-volt seven-segment device provides a .6" high numeral which can be seenat a distance of 30 feet. The tube has a standard nine-pin base (solderable) and a left-hand decimal point.

Each $4.00
SPECIAL 4 for $17.50

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 $9.25

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 worse case TTL requirement) at current of up to one ampere.

Each $1.50 5 for $7.00

Babylon Electronics Inc.

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

WHAT'S ON IN '74

A calendar of the year's main conferences and exhibitions.

FEBRUARY

Feb. 25 – Mar 1. Seminex '74 Semiconductor Seminar & Exhibition, Bloomsbury Centre Hotel, London, England.
Feb. 26-28. ALTEX – Automatic Laboratory Technique Exhibition, West Centre Hotel, London, England.
Feb. 26-28. Compcon '74 International Computer Conference (IEEE), San Francisco, USA.

MARCH

March 10-11. Leipzig Spring Fair, Leipzig, Germany.
March 11-17. Festival International du Son, Paris, France.
March 12-14. Sound '74 International Public Address Equipment Exhibition, Bloomsbury Centre Hotel, London, England.
March 12-24. 21st International Exhibition on Electronics, Nuclear Energy and Aerospace Technology, Rome, Italy.
March 17-20. National Association of Broadcasters Convention and Exhibition, Houston, Texas, USA.
March 19-21. Electro-optics International Exhibition, Metropolitan Convention Centre, Brighton, England.
March 20-27. Electrex – International Electrical Engineers (ASEE) Exhibition, Earls Court, London, England.
March 26-28. TEMPCON Temperature Control and Measurement Conference and Exhibition, Metropole Convention Centre, Brighton, England.
March 26-29. IEEE Intercon Exhibition and Conference, New York, USA.
March 29-31. SONEX 74. Hi-Fi Exhibition, Post House Hotel, London Airport, England. Trade visitors – March 27 and 28.

APRIL

April 1-6. 17th International Electronics Components Exhibition, Paris, France.
April 2-5. Second European Electro-optics Conference, Montreaux, Switzerland.
April 8-11. CADEX 74 Conference and Exhibition on Computer-aided Design (IEE/EEA), Southampton University, England.
April 21-24. National Cable Television Association Conference and Exhibition, Chicago, USA.
April 22-26. IFSEC International Fire and Security Exhibition and Conference, Royal Lancaster Hotel, London, England.
April 22-26. HEVAC 74 International Heating, Ventilating and Air-conditioning Exhibition, Olympia, London, England.
April 22-26. EUROCON 74 European Conference on Electrotechnics (IEEE), Amsterdam, Holland.
April 25-May 3. Hanover Fair, Hanover, Germany.

MAY

May 6-10. National Computer Conference and Exposition (AFIPS), Chicago, USA.
May 13-17. IEA 74 – International Instruments, Electronics and Automation Exhibition, Olympia, London, England.
May 13-17. Eurocomp – European Computing Congress, Brunel University, Uxbridge, England.
May 14-16. Electro-optical Design Conference and Exhibition, Anaheim, California, USA.
May 14-17. Intertraffic 1974 – International Exhibition for Traffic Engineering, Amsterdam, Holland.
May 14-17. Intermag International Magnetics Conference (IEEE), Toronto, Canada.
May 18-26. International Spring Trade Fair, Budapest, Hungary.
May 21-23. SEMICON/West 74, San Mateo, California, USA.
May 21-24. Security 74 – Exhibition and Conference on Business Security, Grosvenor House Hotel, London, England.
May 29-31. 28th Annual Frequency Control Symposium, Atlantic City, USA.

JUNE

June 4-7. Communications 74 – International Conference and Exhibition of Radio and Data Communications, Metropole Convention Centre, Brighton, England.
June 9-12. Consumer Electronics Show, Chicago, USA.
June 9-18. International Fair, Poznan, Poland.
June 18-20. Computer Systems Design Conference and Exhibition, New York, USA.
June 18-21. Microforum 74 Exhibition and Conference, West Centre Hotel, London, England.
June 20-21. Association of Professional Recording Studios Exhibition, Connaught Rooms, London, England.

JULY

July 1-5. Electra 74 Electrical Engineering Exhibition, Johannesburg, South Africa.
July 8-12. Micro 74 – Royal Microscopical Society Exhibition, West Centre Hotel, London, England.
July 12-21. Electro-Electronic Trade Fair, Sao Paulo, Brazil.
July 16-19. Inter-Navex 74 Audio Visual Aids Exhibition, Olympia, London, England.

AUGUST

Aug. 5-10. IFIP 74 International Federation for Information Processing Exhibition, Stockholm, Sweden.
Aug. 23-25. Australian Hi-Fi Magazine Audio Show, Hilton Hotel, Sydney, Australia.
Aug. 24-Sept. 1. Sun-News Pictorial Homes Show, Exhibition Buildings, Melbourne, Australia.
Aug. 26-30. NELCON 74 – 11th New Zealand National Electronics and Geophysics Convention, Auckland, New Zealand.
Aug. 27-31. '75 Sounds Fantastic, Hi-Fi Industry Association Exhibition, Centrepoint, Sydney, Australia.
Aug. 29-Sept. 8. FIRATO International Exhibition of Electronics, Amsterdam, Holland.
Aug. 30 – Sept. 1. Australian Hi-Fi magazine Audio Show, Hilton Hotel, Melbourne, Australia.

SEPTEMBER

Sept. 1-8. Autumn Fair, Leipzig, Germany.
Sept. 2-8. Farnborough International 74 – SBAC Flying Display and Exhibition, Farnborough, England.
Sept. 3-5. Bio-medical Engineering Exhibition and Symposium, Imperial College, London, England.
Sept. 3-10. International Trade Fair, Plovddiv, Bulgaria.
Sept. 10-13. Fourth European Microwave Conference and Microwave 74, Montreaux, Switzerland.
Sept. 10-13. WESCON – Western Electronic Show and Convention, Los Angeles, USA.
Sept. 10-13. Compcon Fall Computer Conference (IEEE), Washington, DC, USA.
Sept. 10-14. ILMAC 74 – Sixth International Exhibition of Laboratory and Chemical Engineering, Basle, Switzerland.
Sept. 16-21. VIDCA International Market for Video-cassette and Videodisc Programmes and Equipments, Cannes, France.
Sept. 16-21. MICAB – International Cable Television Market, Cannes, France.
Sept. 18-24. Japan Electronics Show, Tokyo, Japan.
Sept. 23-27. International Broadcasting Convention and Exhibition, Grosvenor House, London, England.
Sept. 24-28. Home Electrics Exhibition, (includes 1974 Colour TV, Radio and Hi-Fi Show) Exhibition Buildings, Melbourne, Australia.

OCTOBER

Oct. 7-11. CETIA – Control, Electronics, Telecommunications, Instruments and Automation Exhibition, Melbourne, Australia.
Oct. 10-16. Interkama – International Exhibition for Instrumentation and Automation, Dusseldorf, Germany.
Oct. 15-17. Internepcon/UK – Electronic Packaging and Production Equipment Conference and Exhibition, Metropole Convention Centre, Brighton, England.
Oct. 28-31. Instrument Automation Conference and Exhibition (ISA), New York, USA.
Oct. 28 to Nov. 1. FIAREX – International Industrial Electronics Trade Fair, Amsterdam, Holland.
Oct. 28 to Nov. 3. International Audio Festival and Fair, Olympia, London, England.

NOVEMBER

Nov. 5-8. Automatic Testing 74 Exhibition and Conference, Metropole Convention Centre, Brighton, England.
Nov. 21-27. Electronica 74 International Exhibition for Production in Electronics Industry, Munich, Germany.
Nov. 26-28. COMPEC 74 Exhibition and Conference of Computer Peripherals, Small Computers and Systems, West Centre Hotel, London, England.

DECEMBER

Dec. 3-5. Conference on Power Electronics – Power Semiconductors and their Applications (IEE), Savoy Place, London, England.
Dec. 4-10. International Electronic Industry Exhibition, Budapest, Hungary. ●

READER INFORMATION SERVICE AND ADVERTISERS' INDEX

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:—

ELECTRONICS TODAY INTERNATIONAL, RYRIE HOUSE, 15 BOUNDARY STREET, RUSHCUTTERS BAY, SYDNEY, 2011.

ADVERTISERS' INDEX

Four reply coupons are provided here for your convenience. Please list only ONE advertiser and ONE product on each coupon. If you require information on more than four individual products, make as many copies of the coupons as you like (preferably typed) — again using one coupon form for each product.

Send to: ELECTRONICS TODAY INTERNATIONAL, Ryrie House, 15 Boundary Street, Rushcutters Bay, Sydney, 2011.

ADVERTISER ....
PRODUCT ....
NAME ....
ADDRESS ....
....
POSTCODE ....
COMPANY ....
POSITION ....

2:74

Send to: ELECTRONICS TODAY INTERNATIONAL, Ryrie House, 15 Boundary Street, Rushcutters Bay, Sydney, 2011.

ADVERTISER ....
PRODUCT ....
NAME ....
ADDRESS ....
....
POSTCODE ....
COMPANY ....
POSITION ....

2:74

Send to: ELECTRONICS TODAY INTERNATIONAL, Ryrie House, 15 Boundary Street, Rushcutters Bay, Sydney, 2011.

ADVERTISER ....
PRODUCT ....
NAME ....
ADDRESS ....
....
POSTCODE ....
COMPANY ....
POSITION ....

2:74

Send to: ELECTRONICS TODAY INTERNATIONAL, Ryrie House, 15 Boundary Street, Rushcutters Bay, Sydney, 2011.

ADVERTISER ....
PRODUCT ....
NAME ....
ADDRESS ....
....
POSTCODE ....
COMPANY ....
POSITION ....

2:74

BETTER THAN BOSE!

That's right. Even though Bose are the most highly reviewed speakers in the industry; even though critics proclaim "Bose is best, big or small, high or low"—now there are two speaker systems better than Bose 901 and Bose 501!

BOSE 901 SERIES TWO

Introducing the Bose 901 Series Two—it's everything that the original 901 was, and more: • Multiplicity of acoustically-coupled full-range drivers • Flat power radiation • Completely new Active Equalizer design, suited to program source variations never available before, and adapted to a much wider range of room environments (even drapes) • and SYNCOM™ II Speaker Computer quality control testing.

BOSE 501 SERIES TWO

Also introducing the new Bose 501 Series Two — the other speaker with direct and reflected sound, and flat power radiation, at a price far lower than you'd expect to pay.

The new 501 Series Two features: • A new tweeter with double the magnet size of the original 501 and four additional components in the crossover network, for improved high frequency response and power handling capability • and 100% selection and matching of the woofers and tweeters with the SYNCOM™ II Computer—the unique computer designed by Bose and put into operation in August 1973 to achieve a new level of speaker performance.

We invite you to challenge us! Compare the Bose 901 Series Two to any other speaker, regardless of size or price; and compare the Bose 501 Series Two to any speaker up to the price of the 901 Series Two. You be the judge. If we have done our homework correctly, the comparison will be interesting and short!

AUSTRALIAN DISTRIBUTORS

WEDDERSPOON

W. C. WEDDERSPOON PTY LTD

193 Clarence Street Sydney 29 6681

BOSE®

YOU CAN EARN BIG MONEY IN RADIO— TELEVISION ELECTRONICS

ASK YOURSELF THESE 3 QUESTIONS!

1. Am I in a dead-end job? 2. Could I earn more by learning more? 3. Could I use my spare time to get ahead?

If the answer is yes, there is room for you in radio/television/electronics.

NOW IS THE TIME TO TRAIN!

Does your job offer good prospects—real security? Does it hold your interest? If not, now is the time to do something about it. Electronics is expanding daily. It's the most exciting subject you can study. The sky's the limit for the trained electronic technician . . . but only the trained man. Radio and television technicians are in huge demand. Train for success now, in Australia's fastest-growing industry! **Join the ranks of skilled men** . . . the Australian Radio and Television College can train you for a bright future with unlimited prospects. Send for the free booklet, "Careers In Radio, TV and Electronics" and find out how A.R.T.C. can bring you success—in your own business or as well-paid technical staff.

A.R.T.C. CAN TRAIN YOU AS IT HAS THOUSANDS OF OTHERS

For nearly 40 years A.R.T.C. has successfully trained thousands of progressive Australians who realised how much the training could mean to them. Now they're making big money in radio and television. Training can bring you success, too.

FOR A FEW CENTS PER DAY YOU CAN STUDY THE A.R.T.C. WAY

. . . in your spare time, you can equip yourself for a rewarding career in electronics. The future belongs to the trained. **A.R.T.C. teaches you from the ground up . . . step by step . . . at your own pace.** Remember, opportunity is always knocking for the trained man!

PRACTICAL UP-TO-DATE LESSONS

At the work benches and lecture halls of A.R.T.C.—or in your own home by correspondence—you can learn every necessary aspect of radio, television and electronics. The Course gives you both basic and advanced instruction.

No previous experience or high educational standard required . . . only enthusiasm and normal intelligence. A.R.T.C. will give you all the instruction you need. Each lesson is made easy to understand by numerous illustrations and diagrams. The Course adapts itself to your requirements, your speed. It's up to you! Instruction is individual and intensely practical.

THOUSANDS OF SUCCESSFUL STUDENTS HAVE PROVED THIS

Make your spare time earn money for you while training at home.

Many students make extra money after only a few weeks' tuition. Train at the modern A.R.T.C. workshops, if more convenient.

GET INTO ONE OF THESE PROFITABLE CAREERS IN RADIO/TELEVISION ELECTRONICS

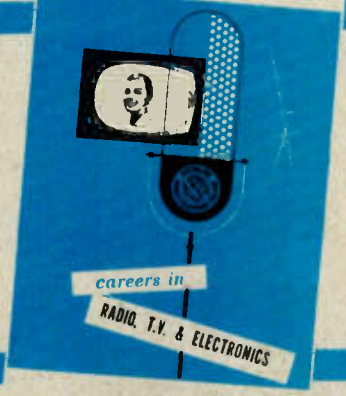
There is a career for you in one of the many branches of electronics, including manufacture, servicing, research, sales, executive positions, armed forces, audio, etc., etc.

A.R.T.C. can help you gain one of these sought-after careers. Remember, it's the trained man who wins, every time!

MAIL COUPON NOW!

Safeguard your future! You are invited to send in the coupon below. A.R.T.C. will mail you by return their big free and post-free booklet, "Careers In Radio, TV and Electronics". This exciting book shows you definite steps you can take towards a big future—how you can succeed in life and find satisfaction in doing a worthwhile job well.

AUSTRALIAN RADIO AND TELEVISION COLLEGE PTY. LTD.
A.N.Z. BANK BUILDING
Cnr. Broadway and City Road, Sydney.
(Opp. Grace Bros.) Phone 211-4244 (3 lines.)



AUSTRALIAN RADIO & TELEVISION COLLEGE PTY. LTD.
206 Broadway, Sydney, N.S.W.

Dear Sir,
Please send me, without obligation, your free booklet, "Careers In Radio, TV and Electronics".

NAME .....

ADDRESS .....

T402