JUNE, 1974
60c*

electronics

HI-FI TODAY INTERNATIONAL

Registered for posting as a periodical – Category C

STEREO FM SOON!

JAPAN ELECTRONICS SHOW

-SPECIAL ETI OFFER

FIVE MINI-METERS TO WIN!

PROJECT: BUILD A TIMING LIGHT FOR YOUR CAR

You wouldn't buy the wrong pair of shoes for your feet.

A-3300

So why buy the wrong tape deck for your home?

It can happen. There are so many to choose from. Each has its own way of enticing you.

Yet the TEAC A-3300 stereo tape deck stands out. It has everything a serious amateur would want, plus many features that even the professionals love.

It accepts the big 10½ inch reels. So when you give your next party, you'll have uninterrupted music for many hours. Instead of having to change tapes all the time.

Your own recording technique will improve also. Because the A-3300 has TEAC's unique Edi-Q, an electrical record pause control. It eliminates the clicks and snaps that can occur when you pause and then restart. The professionals use it. Now you can also.

You'll especially appreciate the front panel bias switch for the proper selection of bias current and recording equalization. It's an important feature; it gives you the most enjoyment from the new low noise/high output tapes, as well as regular tapes.

Attach TEAC's AN-180 to the deck. It's our Dolby* Noise Reduction Unit. You'll enjoy sound perfection because the Dolby eliminates unwanted tape hiss and noise. Music never sounded so good.

We invite you to take the step and bring this TEAC package of sound into your home.

Notice how well it fits.

AN-180

TEAC
The sound of perfection

AUSTRALIAN DISTRIBUTORS: Australian Musical Industries P/L., 155 Gladstone St., South. 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. Miltons Department Stores Ltd., P.O. Box 146, Norfolk Island. OCEANIC DISTRIBUTORS: New Zealand: Direct Imports (N.Z.) Ltd., 590W Southampton 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.

electronics TODAY INTERNATIONAL

JUNE 1974 Vol. 4 No. 3

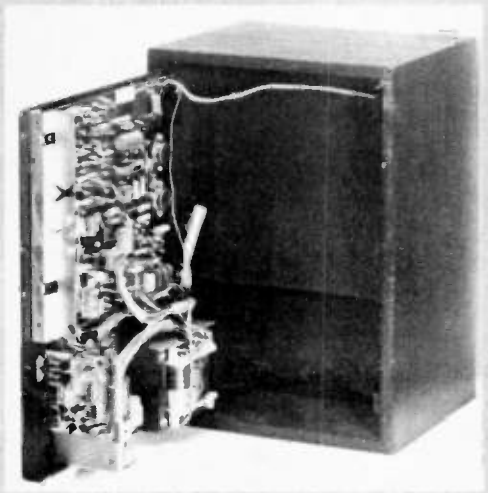
main features

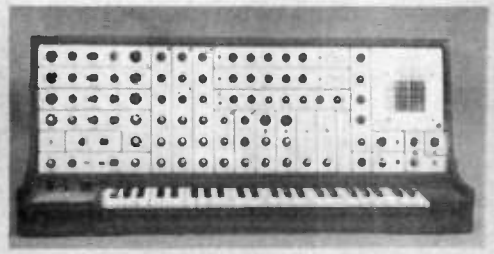
projects

product tests

reviews

news & information





Australia is to have FM broadcasting soon – paving the way for future stereo transmissions. Our cover picture shows Pioneer's QX 9900 – a four-channel tuner/amplifier.

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Unplayable Records

PLANNED obsolesence can sometimes be justified on the grounds that rapid improvements in technology will outdate an otherwise satisfactory product.

But even with planned obsolescence one reasonably expects a product to perform satisfactorily when new.

Not so apparently with gramophone records.

During the past two or three years we have seen the quality of records drop to the point where the products of some manufacturers are virtually unplayable.

In particular, many British-produced Decca group records have quite excessive surface noise, whilst we can't remember when we last saw a British-made EMI record that was even flat.

Two years ago we criticised the Australian record industry for the generally poor quality of their products. But now the disease is spreading and even the once impeccable DGM recordings are no longer invariably so.

This is fast becoming an intolerable situation, and it is one that affects everyone involved in hi-fi reproduction. Including the hi-fi industry.

Unless high quality programme material is available there is little point in using first class equipment.

For who needs to hear record pops and crackles, optimally reproduced?

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Introducing The AKAI Complete Protection Plan:*

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2. 12 Months Free Insurance.
3. Life-time Guarantee on all GX recording heads.

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The benefits of the AKAI Complete Protection Plan are: *firstly*, a 12 months warranty on all AKAI equipment covering both parts and labour. *Secondly*, free 12 months insurance cover. *Thirdly*, a lifetime guarantee on all AKAI GX recording heads.
The Complete Protection Plan covers all AKAI cassette recorders and decks, tape recorders and decks, amplifiers, turntables and speakers purchased in Australia. (Note: the C.P.P. only covers equipment imported by AKAI Australia Pty. Ltd. We ask you to insist that your dealer provide the C.P.P. card with any AKAI equipment you wish to purchase).

Only AKAI could possibly afford to take such a step
Long regarded as the makers of the world's most sophisticated hi-fi equipment, and with advanced technical exclusives such as GX heads with a lifetime guarantee, self-lubricating motors capable of 10,000 hours operation without oiling, stereo cassette decks with built-in amplifiers, and Automatic Distortion Reduction Systems, AKAI now introduce yet another exclusive: The Complete Protection Plan.

Sufficient reasons, we hope, for you to choose AKAI equipment. All of it superb, most of it unique.

Distributed by AKAI Australia Pty. Ltd. Sydney 61 9881, Melbourne 81 0574, Perth 65 5833, Adelaide 74 1162, Launceston 31 5815, Brisbane 44 0171, Darwin 81 3801.

AKAI

The very real sound experience

*Ensure that this card is with the equipment you purchase

AKI07

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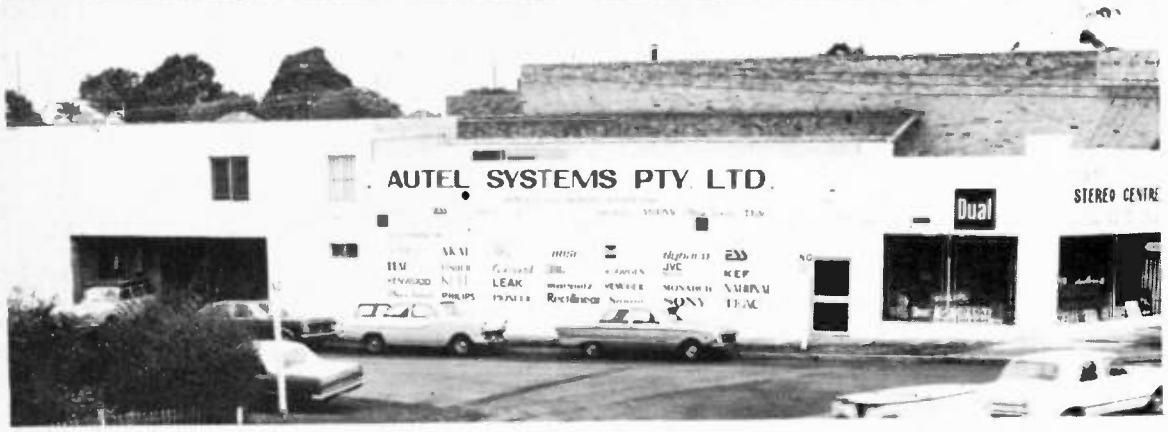

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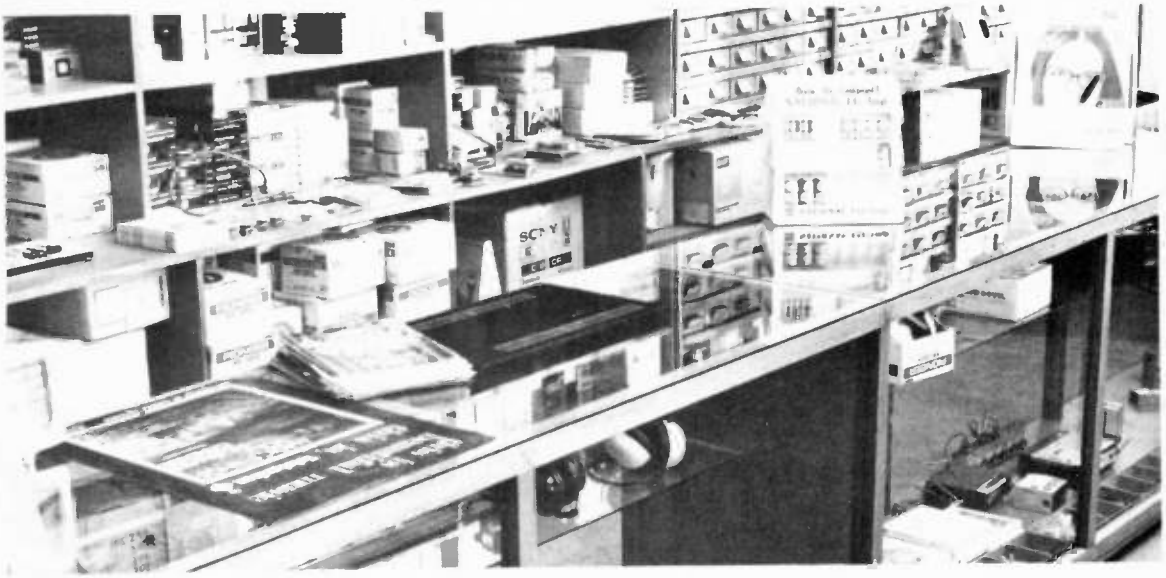

Want a lead to suit your set to match that accessory? Want any type of plug? Also, complete stocks of spare parts for National, Nivico, Teac, Jorgen, ESS, Marantz, and many others. Largest range of equivalent parts to suit those hard-to-get spare parts for rare models.

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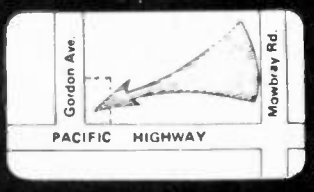


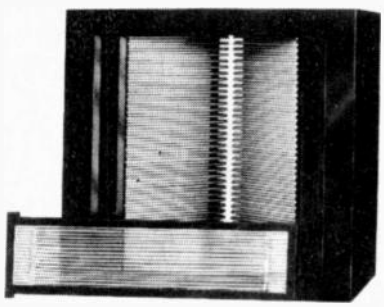
LIGHT YEA

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.

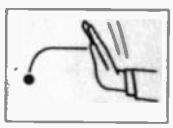
Instead of trying to displace air molecules with the forward-backward motion of a flat or cone surface, the Heil Air Motion Transformer harnesses the power-purchase of a pneumatic "lever" and by applying small squeezing forces over a large surface area produces air movements *five times greater* than 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



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

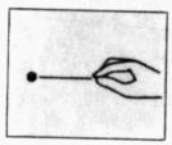
result of this greater, more direct and near massless transfer of energy, the Heil Air Motion Transformer approaches instantaneous acceleration for flawless transients, has no "cone breakup" to create coloration, and shows distortion figures as fine as modern electronics to recreate the sharpest of images, the cleanest of attacks and the highest harmonics with a clarity and immediacy never before experienced.

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

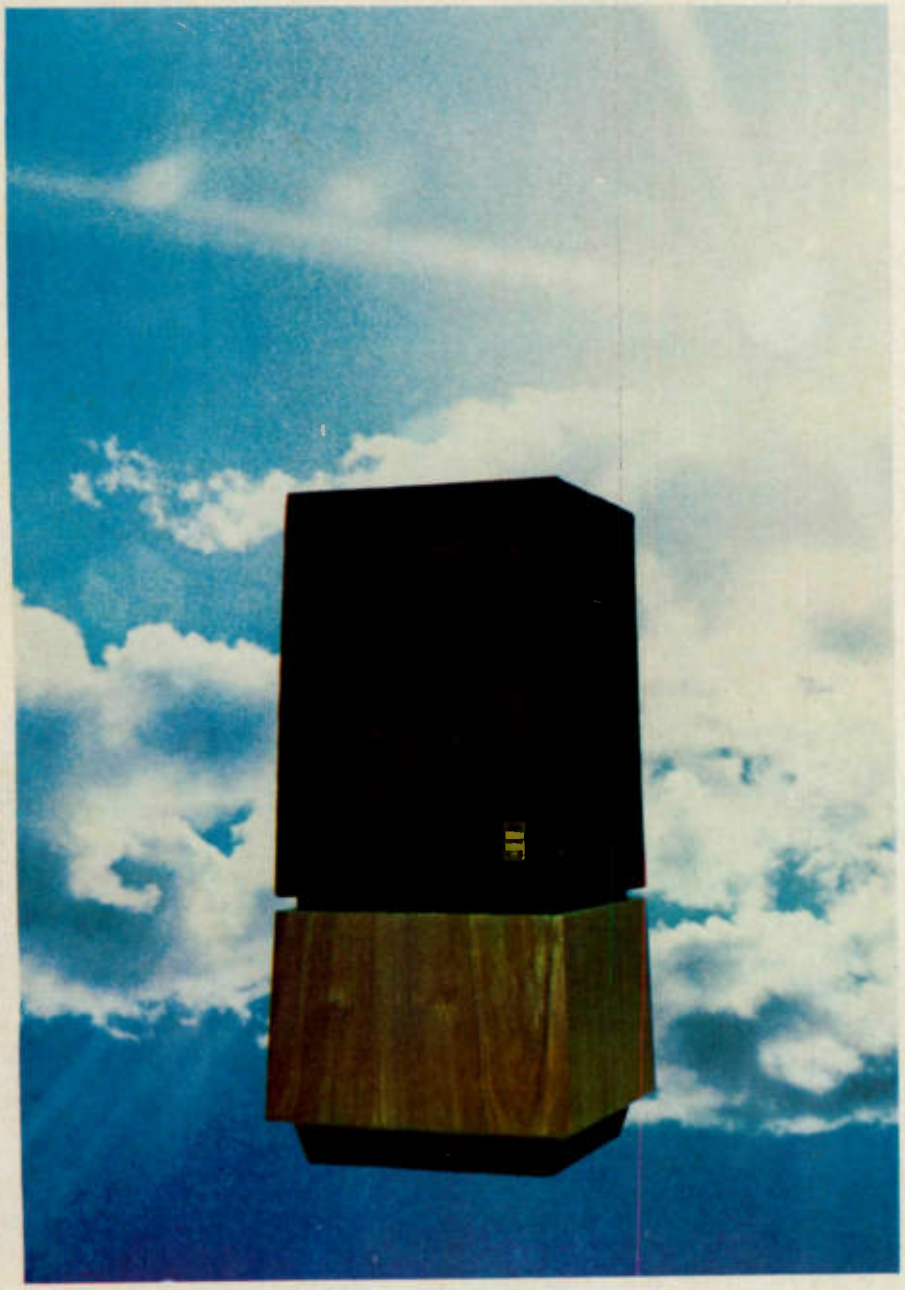


the cherry pit with a small but powerfully effective lever-like movement of only the tips of your fingers.

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 imput 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: 63 9321

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

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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

MADE IN U.S.A.

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., MI, c/o 220 West St., Crows Nest, N.S.W. 2065 Ph. 922-3423

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.

Instrol System 239

Featuring the Audioson "Camelot" speaker systems, the Rota amplifier (12 Watts RMS per channel), the high quality Garrard Player with magnetic cartridge, base and cover, and you have unbeatable value at the list price of $313.80; let alone at the special Instrol price of $239.00

Complete Hi-Fi Catalogue 50 cents

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

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INSTROL FOR QUALITY SOU HO

Featuring the Monarch 80 amplifier (15 watts RMS per channel), the now famous Audioson "Camelot" Speaker Systems, the Garrard SL-72B changer, base and cover, and the smooth response of the ADC magnetic cartridge. This is value plus at $339.00

Instrol System 339

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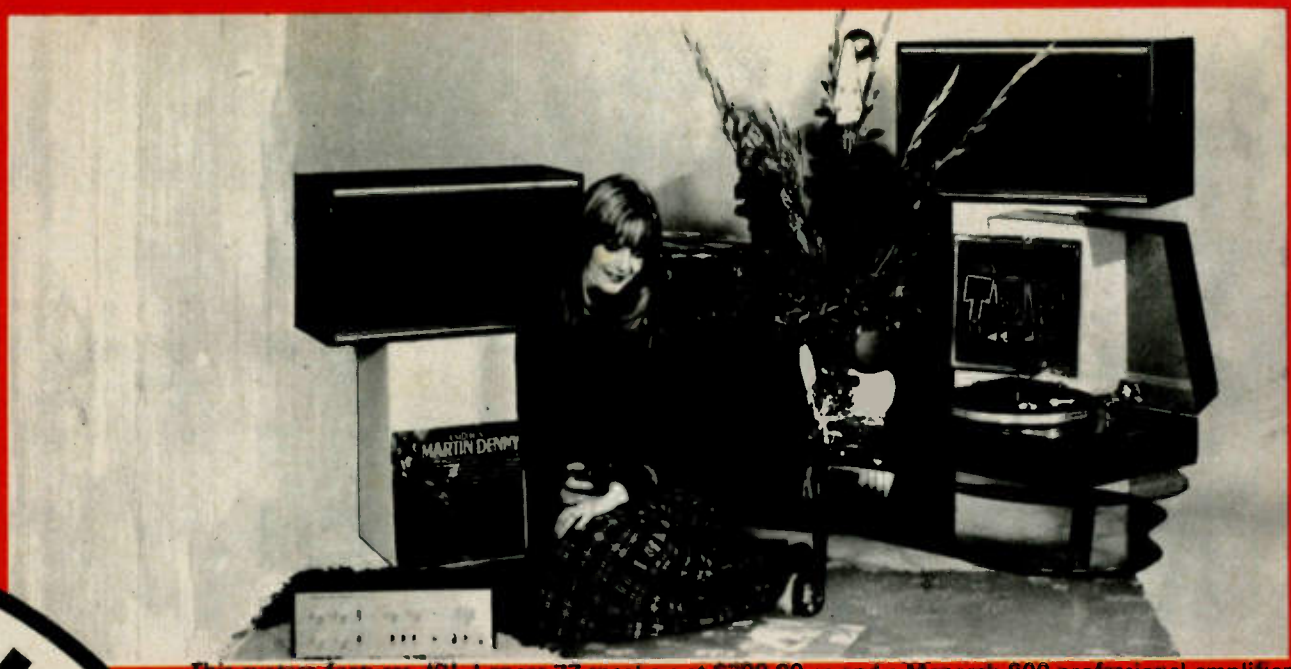

This system features JBL Lancer 77 speakers at $299.00 ea and a Monarch 800 professional amplifier at $228.00, thus totalling $826.00. Instrol now have reduced this to $799.00 including FREE OF CHARGE the JH belt-drive turntable, featuring the Excel tone-arm ADC 220XE, acoustically sprung base and hinged cover. Special System offer $799.00

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Never before have the omnidirectional Sonab V1 speakers been available in a quality system at such an attractive price. They are backed by a 5 year warranty and come in the largest range of colours of any speakers in the world. The Monarch 80 amplifier, JH belt-drive turntable combination and ADC magnetic cartridge complete this system. All for only $429.00

SONAB
System
429

DOUGLAS SELLS SOUND FOR LESS!

LIKE THESE FABULOUS NEW AKAI 1974 MODELS

AKAI CS30 D

Top quality deck **$149**

AKAI CS33D DOLBY

for under **$200**

AKAI GXC-46D DOLBY-ADR

Worlds best value, life time warranty heads **$255**

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3 heads super value **$219**

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3 motor deck cross field heads

$299

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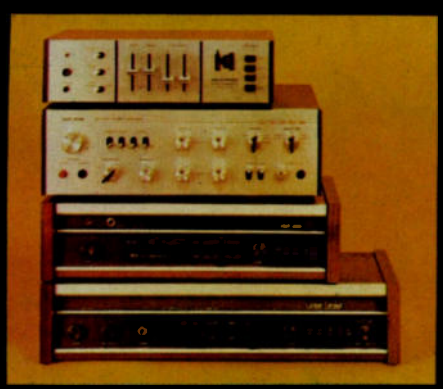
full recorder, complete **$269**

Plus these LINEAR DESIGN Hi-Fi Amplifiers all with 2 YEAR warranty



A107	20 watts rms	$ 89
8000	100 watts rms	$199
169-B	32 watts rms	$ 95
2500	50 watts rms	$149

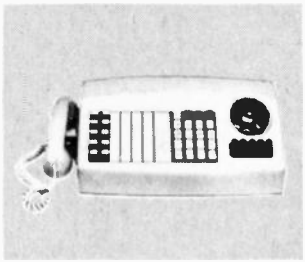
**POST YOUR ENQUIRY OR ORDER TODAY!*

DOUGLAS TRADING for HI-FI SOUND

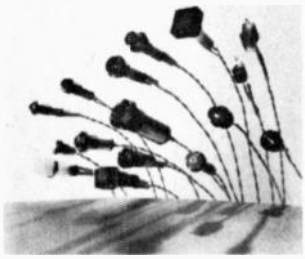
185-191 BOURKE STREET, MELBOURNE – PHONE 63 9321

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

Australia

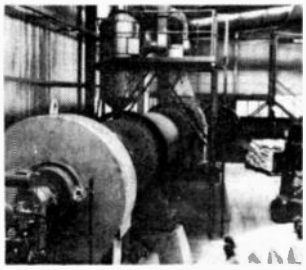


'PABX' — manufactured by Plessey Telecommunications this private automatic branch exchange system employs crossbar switching and componentry similar to that used by the Australian Post Office in the national telephone network.

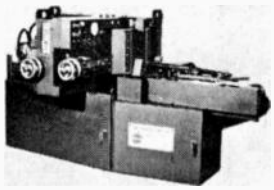


Plessey Rodan indicator lamps designed for compatibility with and to enhance the presentation of electronic electrical and industrial equipment. These indication lamps are just some of the vast range available from Plessey Ducon.

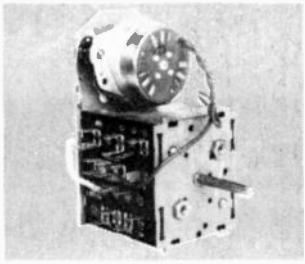
The do it yourself stereo amplifier kit from Plessey Ducon. This simple and easy to assemble kit will provide truly first class reproduction at a cost far below that of equivalent powered units.



Plessey Rola is Australia's largest manufacturer of magnetic materials. Under agreement with BHP Plessey have exclusive marketing rights for hematite and ferrite powders produced from Yampi Sound.

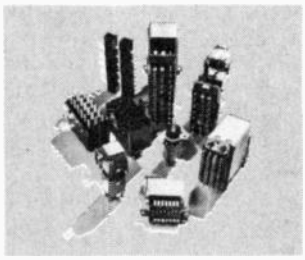


Designed and produced in Australia by Plessey Telecommunications is the Computermatic timber grader completely eliminates the guesswork from visual timber grading. Electronic grading ensures that timber is accurately classified by strength and stability before use.

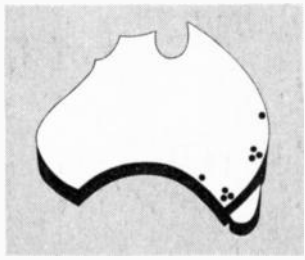


Plessey Malleny interval timer switch — commonly used in automatic washing machines and electric ranges are supplied by Plessey Ducon located at Villawood, NSW.

This direct reading digital clock is one of a wide range of models supplied by Plessey Communication Systems. Extremely accurate the clocks are built for indoor use or weatherproofed and illuminated for outdoors.



Some of the wide range of multicontact connectors marketed by Plessey Ducon all of which are of ability and quality proven.



Number of plants 8
Factory capacity 1 million sq ft
Employees 1000

Plessey

news digest

BATTERY BUSES

The oil 'crisis' has increased interest in battery-powered cars but despite years of research and development they seem no nearer than ever they were.

The weight of the batteries, the limited range and the long recharging time have proved to be major problems.

There is one branch of transportation however where these problems are not too serious: buses. Analysis of bus usage has shown that half the buses on city centre journeys during peak periods cover less than 25 miles with an average speed of 8.5 m.p.h.

These facts led to the cooperation of Chloride and Selnec (South East Lancs and North East Cheshire Transport Authority) in the UK to produce a full size, battery-powered bus. The makers and operators emphasis that this is not an experimental vehicle and it will be in daily operation within months.

Silent Rider, as the bus is known, carries 50 passengers, has a very low noise level and is pollution free. It has a range of 40 miles with a top speed of 40 m.p.h. and an acceleration of 1m/s/s.

The power pack comprises a lead acid battery with 165 cells giving 330V fitted with an automatic topping up device. A revolutionary charger is used which cuts the time from 8 hours to 3½ hours. The charger is known as PRV (Programmed Rate of Rise of Voltage). It can also be used for boost charging, replacing 1% of the battery capacity every minute up to 75% capacity.

Other companies associated with this project are Sevcon, who developed the electronic controller, Seddon who built the body and EDC who made the special motors.

Precise control of speed is provided by a thyristor chopper system which is regulated by the accelerator pedal. The controller can handle 280A at 330V continuously and for short periods up to 1000A.

Braking is mainly electronic and, during braking, the motors act in reverse as generators and partially recharge the batteries thus improving the range.

In the event of failure of either the main batteries or the main circuitry, a separate 24V battery can be connected to the motor giving sufficient power to move slowly out of the main thoroughfare. To reduce maintenance costs the direction contactors, which often create problems, are switched in the zero current condition.

Among the companies involved, Chloride especially have great faith in the future of battery powered buses. A Mark 2 version is already being developed with a replaceable battery pack. Chloride has spent considerable sums in TV and press advertising promoting the idea, presumably in the hope that other transport authorities will take up the idea.

The cost of Silent Rider is considerably more than for a conventional diesel, though running costs are similar. The Mark 2 however is expected to show running costs in favour of the battery-powered buses.

LIE-DETECTION – 1974

A new form of lie detector is becoming widely used in the USA.

The device, known as the Dektor psychological stress analyser works by analysing the human voice – and can be used without the subject's knowledge.

Operating principle is that the muscles that vibrate the human vocal chords normally (not under stress) add a 8 Hz to 12 Hz component to the voice.

Under stress this component changes – and the change is detected by the Dektor instrument.

The manufacturers advise that the device merely indicates stress – not necessarily lies, but an alarming number of private companies are using the devices during employment interviews and even for regular employee checking.

As a demonstration of the instrument's capabilities, the manufacturers analysed the broadcast Watergate hearings and told the press just whom they thought were lying. To date they have been remarkably correct!

There is an increasingly strong reaction against the use of these devices, and US Senator Sam Ervin has now introduced a bill to ban their use by private industry.

EXPLODING CASSETTE RECORDERS

A claim that a number of cassette recorders were liable to explode was made recently by The Educational Products Information Exchange Institute (EPIE) in the USA.

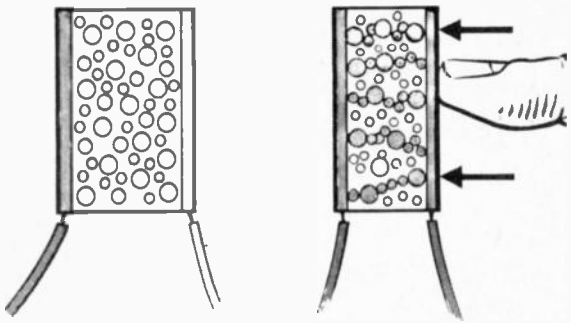
The Institute plans to file a charge of hazardous practice with the Federal Trade Commission.

The alleged problem concerns a number of recorders that are designed for dual mains/battery operation – if the units are fitted with long-life alkaline batteries.

EPIE director, Ken Komoski claims that battery leakage and/or explosion can occur when the recorders are connected to the ac mains.

The cassette machines named by the Institute are the Wollensak 810; the Sharp PD 428U and RD 464AV; Voice of Music VM 772; Norelco 1420; Craig 2603, 2623 and 8134; and the Sharp RD 465UA.

NEW SWITCH MATERIAL IS A CONDUCTIVE ELASTOMER



LEFT: A cross sectional diagram of Spherax in its relaxed state with the shaded area showing the live feed. RIGHT: Spherax in its compressed state. When pressure is applied the metallic particles, represented by the spheres, form a chain creating a circuit through which current (the shaded area) flows.

LUCAS SPHERAX is a formulation of compounded metallo-organic materials which are capable of conducting an electric current. A number of formulations are available which provide a variety of mechanical and electrical characteristics and are suitable for many different applications as switches or inert conductors.

A new switch material called 'Spherax' has just been announced by Britain's Lucas group.

'Spherax' looks like a piece of rubber. It is, in fact, a conductive elastomer. This material has the property of acting as a conductor when it is compressed, thus it is ideally suited for use in vehicle switchgear.

One of Britain's top automotive manufacturers plans to use it as a horn push in a forthcoming model. But many other applications for 'Spherax' are envisaged by the Lucas research team who have been experimenting with it for use in the automotive environment.

These include: touch switches, panel switches, courtesy light switches, brake light switches, direction indication switches, gear lever and steering column lock switches, oil pressure and temperature switches and electronic direction indication switches.

Vehicle manufacturers in several parts of the world who have been given a preview of the 'Spherax' qualities are showing great interest in various combinations of possible applications.

Conductive elastomers (metallic-silicone compounds) are materials whose electrical conductivities are increased as the materials are compressed. The millivolt drop per ampere flowing through the material is a function of the pressure.

Those designed for connector (as distinct from switching applications) are conductive whether stressed or unstressed.

Technical advantages foreseen for switches and connectors employing conductive elastomers include:

Reduction in heat generated, longer life, rheostatic nature of switch provides substantial arc suppression, increased resistance to adverse environmental conditions.

For cables, advantages include the capability of connecting virtually any type of electrical conductor, in any combination, without the use of rivets, terminals and suchlike, no loss in performance resulting from repeated disconnection and reconnection, good ageing stability in various environmental conditions, water-tight connections readily obtained.

In most metal-to-metal contact and connection systems only a small number of actual interfacial contacts are obtained. Consequently high current densities are produced at these points.

But, because of the elasticity of conductive elastomer materials, the contours of contacting surfaces adapt to each other, resulting in a greater number of interfacial conducting paths and less than half the millivolt drop and energy loss of conventional systems.

'Spherax' is being developed technically in conjunction with Essex International.

MASSIVE PULSES

The massive electromagnetic pulse that is generated by a nuclear blast induces very high voltage pulses in nearby electronic equipment.

A system to test these effects is now in use at the Air Force Weapons Laboratory at the Kirtland Air Force Base (Albuquerque, New Mexico).

The simulated electromagnetic pulse is produced by Marx generators i.e. capacitors are charged in parallel and then discharged in series. The resultant eight million volt pulse is then discharged into two wires running either side of the aircraft under test.

A major problem in designing the facility was to ensure that the electromagnetic pulse would not affect electronic equipment used to monitor the equipment under evaluation.

Isolation has been achieved by using an LED transmitter and fibre-optic link.

The circuitry used to initiate the electromagnetic discharge is also linked via fibre-optic cables.

MONEY IDENTIFIER FOR BLIND PERSONS

The cliche "money talks" will soon acquire a new literal meaning for blind business persons thanks to a simple paper money identifier developed from NASA technology.

The device will enable a blind person to identify paper money by its sound "signature". Until now no reliable paper money identifier for the blind has been available.

To determine its denomination, a bank note is passed under a light source on the small, inexpensive device. A phototransistor measures changes in the note's light patterns. These changes are converted into sound signals by an oscillator – producing sounds much like the "beeping" tones one hears when making a long-distance telephone call. Since the design of various denominations of paper money differs, each bank note gives off its own easily identified sounds.

Tests of an early version of the money identifier were successfully conducted by Arkansas Enterprises for the Blind in Little Rock. It was found that after about three hours of practice a subject could easily distinguish the sound patterns of different denominations of paper money.

The "talking money" concept was developed by NASA's Bio-medical Applications Team at the Southwest Research Institute, San Antonio, Tex. It stems from technology first reported in 1969 by NASA for the semi-automatic inspection of microfilm records. (NASA Tech Brief 69-10301).

The paper money identifier is being produced by the Marchak Engineering and Manufacturing Co., Austin, Tex. It is being marketed by Applied Rehabilitation Systems, 3902 Idlewild, Austin. It is available to training centres and schools for the blind as well as individuals.

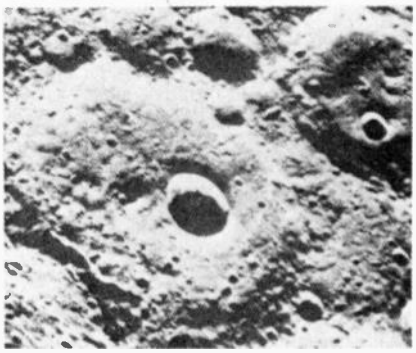
EMI – TOSHIBA

EMI Australia Ltd, has been appointed temporary sole distributor of Toshiba products in Australia. Further plans are being drawn up between EMI and Tokyo Shibaura Electric Co Ltd, of Japan, for the formation of a joint company in Australia to market Toshiba more thoroughly than has previously been the case.

The interim operation, as announced by EMI Managing Director, Mr Ken East, will take effect as from July 1, 1974. The new operation will be under the direct control of Mr Norm Flood, who is presently managing Director of the EMI subsidiary, Healing Electronics Pty Ltd. Mr Flood will be appointed Managing Director of the new company on its formation.

news digest

PLANET MERCURY – FIRST REPORT



The planet Mercury has a surface that is cratered like the moon, indicates the first data transmitted back to Earth by Mariner 10.

Unlike the Moon however, Mercury has a slight atmosphere (less than 0.01 millibar) containing helium and perhaps argon and neon. There is also a minor magnetic field – about ten times stronger than the field in outer space.

Mid-day surface temperature near the equator is 370°F (187°C) falling to -280°F (-173°C) by local midnight.

SUPERCOOLED MOTORS MAY SAVE SHIPS FUEL

Current development of an electrical propulsion system using superconducting generators and motors chilled close to absolute zero, promises fuel savings for ships like hydrofoils and destroyers.

The system is being developed in the United States by the General Electric Research and Development Center under a three year contract from the U.S. Naval Ship Systems Command, Washington, D.C.

The three-phase, U.S.$3.9 million project calls for evaluation, design, and manufacture of a superconducting direct-current drive system capable of producing 4474 kilowatt (6000 horsepower). The unique propulsion system would be tested by the U.S. Navy aboard a 19.8 metre test craft.

Superconducting machinery takes advantage of the fact that certain metals and alloys offer zero electrical resistance and demonstrate unique magnetic properties at temperatures close to absolute zero (minus 273°C,). For shipboard applications, such machinery promises improved fuel consumption, reduced size and weight of propulsion systems, and greater flexibility for locating engines within a vessel.

First phase of the contract is under way at the General Electric Research and Development Centre, Schenectady, New York. It involves a six-month-long study of superconducting systems for propelling high-speed hydrofoils, lightweight small-wetted-area-twin-hull (SWATH) vessels, and powerful surface-effect ships.

Another firm, Intermagnetics General Corp., of Albany, New York – a supplier of superconductive magnets, material, and systems – also is involved in the project.

"The new contract is an extension of earlier research done for the Navy two years ago, when General Electric engineers developed a prototype, 150 kilowatt (200 horsepower), superconducting dc electric generator", Dr. Arthur M. Bueche, General Electric vice president for Research and development, said. The U.S. Navy has been studying the technical feasibility of superconducting ship drives for a number of years. "There appear to be no basic technological barriers to the development of such a system," the General Electric vice president added.

The propulsion system would consist of super-cooled generators driven by turbines. The generators, in turn, would power adjustable speed superconducting motors to drive the ship's propellers. The system would be cooled by liquid helium and would include cryogenic refrigeration equipment. Since the propellers would spin independently of the turbine, the latter always could be operated at optimum speeds for minimum fuel consumption.

According to earlier studies, a superconducting propulsion unit would provide a destroyer with significant fuel savings, depending upon the type and number of propellers per generator.

Another area of application for superconducting machinery would be in surface-effect ships, which ride across the water on a cushion of air created by large fans. Electric propulsion, using lightweight superconducting machinery, would offer a more efficient method of distributing power to the ship's propellers and fan motors.

US NAVY DROP SANGUINE PROJECT

Work has been suspended on the US Navy's controversial Project Sanguine – a system intended for communication with submerged missile-launching nuclear submarines.

Project Sanguine was intended to operate at extremely low frequency and would have consisted of a massive antenna buried beneath the surface and powered by a multi-million watt transmitter.

Although the system has been bitterly attacked by environmentalists – who feared the effect of massive electromagnetic radiation on plant and animal life – the reason for the system's demise has been simply financial.

So far the US Navy has spent US$73 million on the project. It has overspent the current year's allocation of US$8.3 million by some 42 per cent.

Industry sources however suggest that the Project Sanguine may only be postponed not totally dropped, for as they point out, ultra low frequency transmission is the only known way of communicating with submerged vessels.

WATTS RMS IN USA

The US Federal Trade Commission is expected to announce soon that the national standard rating of amplifier power output will be 'watts rms'.

The rating is expected to be very similar to that made mandatory last August by the Dept of Consumer Affairs in New York City.

The rule provides for standard test conditions for manufacturers' measure of power output. All advertising, print or broadcast, making power output claims, on such items as radios, phonographs, tape equipment and component audio amplifiers, will have to use a standard of continuous power output capability (RMS).

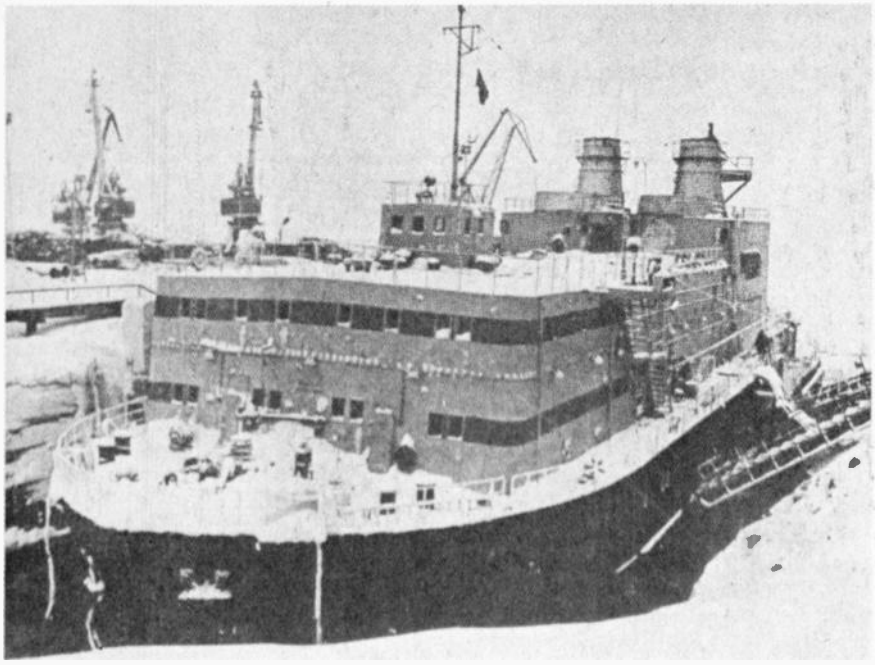
This will replace a variety of types of measurements such as Instantaneous Peak Power (IPP) and other manufacturer rating claims the FTC feels are misleading. Agency research shows consumers can be deceived by the diverse claims. Customers will, for example, buy a stereo set advertised as having 100-watt amplification, in preference to a 50-watt set, when the latter might be as good or far better.

The rules for all radio and TV and print media advertising are expected to become effective in October.

Any advertising that makes claims as to output must also disclose total harmonic distortion, load impedance, and rated power band or the continuous average power output in watts per channel. The standard test conditions set up in the rules must be met when any claims are made in the advertising.

Advertising may refer to other operating characteristics or specifications not required in the FTC rule, such as "music power" or peak power, provided certain conditions are met. When any extra disclosures of this type are made, they must be less prominent than the standard test rating.

POWER TO THE PEOPLE



This is the first picture that has been released of the Soviet Union's unique floating power station.

The vessel, called Severnoye Siyanie (Northern Lights), houses a 20 MW gas turbine. At present moored at the mouth of the Kolyma River it supplies electrical power to the gold mining industry in that area.

The floating power station — of which Russia intends to build several more — has many advantages over conventional power stations for isolated regions. Floating stations can be built in industrial centres thus saving scarce local labour, and shore-based facilities, such as fuel storage, can be assembled whilst the vessel is being built, to say nothing of the advantages of having massive sources of mobile power readily available.

DRAFT STANDARDS FOR SOUND SYSTEM EQUIPMENT

The Standards Association is seeking comment on two draft Australian standards for sound system equipment, issued as DR 74037 and DR 74057.

These drafts are intended to be Parts 2 and 3 respectively of a series being prepared on this equipment (AS 1127); they relate to amplifiers (DR 74037) and microphones (DR 74057).

The drafts apply to audio amplifiers and microphones for both professional and domestic use. They are intended to standardize measuring methods for this equipment, and relevent methods of measurement are specified. The drafts also set out the rated conditions and normal working conditions which have been adopted as standard in specifying the characteristics for sound system equipment.

Copies of DR 74037 and DR 74057 may be obtained without charge from the various offices of the Standards Association in all capital cities and Newcastle.

Comment on the provisions of the drafts are invited from persons or organizations with experience of sound system equipment, in particular in the design, manufacture or use of sound system amplifiers or microphones, and should reach the head office of the Standards Association, 80 Arthur Street, North Sydney, NSW 2060, or any branch office, before 30 June 1974.

HIGH SPEED TRAIN

Railway engineers have long held that the upper limit for the traditional flanged wheel on steel rails would prevent trains from travelling at more than 200 mph. Hence the interest in hovertrains and magnetic levitation.

However, proof that the conventional form of wheel and rail is far from dead has been shown by a linear motor propelled research vehicle that recently set a new record of 234 mph.

The vehicle was designed and built by the US Federal Railway Administration at Pueblo, Colorado, to examine the possibilities of combining linear motor propulsion with conventional wheels and rails.

TELEVISION LISTENING AID FOR THE DEAF

A device developed in Britain by (AEM Hearing Aids Ltd. 7 Kelvin Way Crawley, Sussex, RH10 2LS, England) enables the hard of hearing to listen to radio and television broadcasts without disturbing others by listening at high levels of sound.

The device consists of an isolating transformer connected to the set and a loop of inductive cable. A listening unit, designed to rest on a chair arm, tunes into the loop and is connected to the earpiece by a flexible cord. There are no wires or cables directly linking the listener to the set.

A control on the listening unit enables the user to tune in to the loop and adjust the volume to his liking without altering the volume setting on the television. Any number of listening units can be linked to the loop and each user can adjust the volume to suit himself without affecting the level on other units.

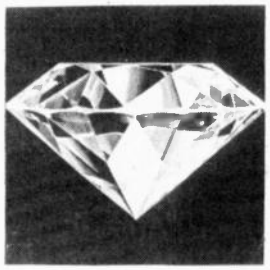
A switch on the transformer also enables the user to cut direct sound from the set and switch it entirely to the loop so that only he or she receives a signal. In this case volume on the set can be at full.

Power is supplied by a standard battery giving up to 400 hours of listening time. (The manufacturers are represented in Australia by Angus & Coote Acoustics, 418 Kent St., Sydney).

amcron

Crown International U.S.A.

BY CROWN INTERNATIONAL



If diamonds are the epitomy of value and quality in the realm of gems, then the Amcron IC150 control unit and D150 power amplifier is its equal in the sphere of electronics.

The superb craftsmanship required in cutting and polishing a diamond, is equal to the highest degree of craftsmanship employed at Amcron, where quality is a creed, not just a mere claim.

Unlike the price of diamonds, Amcron equipment is not sold by the carat (or watt), and the IC150/D150 amplifier combination is a reasonably priced superlative product.

You are assured of Amcron's unwavering and uncompromising dedication to excellence, when you consider the IC150/D150 combination, as the amplifier to grace your home. Your ears deserve Amcron.

$875

SPECIFICATIONS:

IC150

Frequency Response:— HI-LEVEL ±0.6 db 3 Hz-100 kHz; PHONO ±0.5 db of RIAA, calibrated. **Hum and Noise:**— HI-LEVEL 100 db below 2.5V, "A" weighted; PHONO 80 db below 10 MV input. **Distortion:**— THD essentially unmeasurable; IM .003% at rated output. **Phono Input:**— Sensitivity 1MV at 1kHz for 2.5V out; Overload 33-330 MV at 1kHz (adjustable). **Output:**— Rated at 2.5 volt, typically 10V before overload. **Volume Control:**— Over 60 db dynamic range with calibrated tracking. **Loudness:**— Excellent simulation of Fletcher Munson curves down to 60 phono, co-ordinated with volume control. **Phase Shift:**— Typically + 1° to —12° 20Hz to 20 kHz. **Tone Controls:**— ± 15 db at 30 Hz to 15 kHz. **Filters:**— (High and low filters).

D150

Frequency Response:— ± 0.1 db 20-20 kHz at 1 watt into 8 ohms; ± 1 db 4-100 kHz. **Power Output:**— 100 watt RMS into 8 ohm, both channels operating. **Power Bandwidth:**— ± 1 db, 5-20 kHz at 75 watt RMS into 8 ohms. **Distortion:**— THD typically 0.002%. (At .01 to 75 watts) IM typically 0.005%. **Damping Factor:**— Greater than 200 from zero to 1 kHz 8 ohms. **Weight:**— 25 lbs.

THE AMCRON PHILOSOPHY

"While the plastic generations of audio equipment come and go, the steadfast performance, the unflinching quality, and the unparalleled construction of all Amcron equipment will remain."

Audio Magazine said:— "IC150 — We were all able to measure hum and noise levels of approximately — 93 db below 2.5 volts output, and phono noise of about .50 microvolts — D150 — at a typical output of 75 watts (8 ohms) IM was measured at 0.002%, by implication, THD might be expected to be approx. 0.0005% which neither Amcron nor we could measure. If you want the very best, our endorsement of the IC150/D150 is completely given without any reservations.

Stereo Review said:— IC150 "We found the frequency response to be down only 0.3 db at our lowest limit of 5 Hz and 1 db at 225 kHz. The RIAA equalization was so accurate (±0.25 db) that we may have been checking the residual errors in our setup."
D150 — "There are not many speaker systems capable of absorbing the full output of the D150, but since its distortion at any level, can only be measured with the most advanced test equipment, one would expect it to sound first rate, and indeed it did."

AVAILABLE FROM:

QLD:
Stereo Supplies — Brisbane 213-623.
Brisbane Agencies Audio Centre — Valley 219-139.

NSW:
Instrol — Sydney 29-4258.
Kent HiFI — Sydney 29-6973
Arrow Electronics — Sydney 29-8580.
Miranda HIFI — Miranda Fair 525-6745.
Audio Gallery — Warringah Mall 938-2205.
Audio World — Wollongong 295-110.

ACT:
High Fidelity Sound Centre — Fyshwick 95-3459.

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:
Douglas Trading (W.A.) Perth 22-5177

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

news digest

FOUR-CHANNEL BROADCASTING STANDARD

It now seems virtually certain that the US Federal Communications Commission will eventually lay down a standard for discrete four-channel FM broadcasting.

General Electric, Zenith, RCA, Nippon Columbia, and Lou Dorrin all have discrete systems under evaluation by the National Quadrasonic Evaluation Committee.

Matrixed quadrasonic recordings are now broadcast by a number of stations around the USA, but station managements are obviously reluctant to spend a great deal of money on equipment that may soon be technically obsolete.

Nevertheless CBS has over 250 FM stations currently transmitting SQ encoded material – and Sansui are making strenuous efforts to have their QS system adopted as a broadcasting industry standard.

Although the scene is still very confusing it looks as if four-channel broadcasting may well end up using one of the five competing discrete systems – and techniques will be devised for processing matrix material in such a way that it can be transmitted via the discrete broadcasting link.

PRINTED CIRCUIT BOARD SUPPLY MAY EASE BY 1975

Although the current world-wide shortage of printed circuit board material is now severe, present indications are that it should ease shortly.

"Availability this year should be 40 per cent greater than last – the panic should be over by 1975" says Jack Schwebel, president of the US Clark-Schwebel Fiber Glass Corp.

A Dow Chemical spokesman, James Norbury, confirmed this prediction, adding that whilst epoxy resin is still on short supply, the situation will have eased by the end of this year.

"OPERATION ENERGY" – COMPUTERIZED CAR-POOLING SYSTEM

The Burroughs Corporation (Burroughs Place Detroit, Michigan) has announced the development of a computerized car-pooling system which it calls "Operation Energy". The Detroit-based computer maker offered, as a public service, to give its program without charge "to any organization, any company, any government that wishes to use it, throughout the world". The offer was made at a news conference in Detroit by Ben L. Rouse, Burroughs Executive Vice President for Marketing Operations.

Rouse described "Operation Energy" as a "very complete computerized program for organizations wishing to establish a car-pooling system for employees, or any government unit seeking to encourage the general public to make use of car pools". A consulting firm retained by the Federal Department of Transportation and the Urban Mass Transportation Administration has reviewed "Operation Energy," Rouse said, and reported that the Burroughs program was "a very well documented" program and a "second-generation approach" to computerized car-pooling.

"All car-pooling systems," Rouse said, "have certain common elements. They all seek to establish for as many people as possible concise lists of other commuters who live near them and travel to and from the same destination area at about the same time each day. The difficulty which organizers of car pools face is the need to correlate their data easily and efficiently. Here, the computer can play a vital role as the tool for car pool organization."

"Operation Energy" uses a simple grid-map to enable participants to locate their residences in a form which the computer will recognize. The participants indicate the times at which they normally travel, and their work destination. The computer searches all the information furnished by participants, and creates a printout for each, which contains a listing of other commuters with whom car pools might logically be formed.

The computer program provides for as many as 99 distant destination areas within one geographic region. This flexibility permits very large organizations with many plants in a single area to pool all their employees, and by designating each plant as a distinct destination, match those employees with others working at the same location. The program contains features which also would allow larger organizations to invite their smaller neighbours to participate with them in an area car-pooling program.

Rouse said transportation authorities will find the Burroughs program of use in conducting area-wide studies for the planning of new service of the modification of existing service. "The data base is established," he said. "Each individual transportation authority need only adapt the program to obtain from that data base the specialized information required."

NEW SYDNEY PARTS STORE

Electronic Agencies' new store, situated corner of Lloyd George Avenue and Parramatta Road, Concord, NSW, due to open on Monday June 3rd.

In order to service both mail-order and 'over-the-counter' customers, the store will deal with mail-order work during mornings and will be open for normal sales from 12 noon until 6.00 pm daily (8.30 – 1.00 pm, Sats).

NEW QUAD SYSTEM

Nippon Columbia's newUD-4 (that's right UD-4!) quad system was recently demonstrated to a small invited audience at New York's Hilton hotel.

The UD-4 system, developed jointly by Nippon Columbia and Dr Duane Cooper of the University of Illinois incorporates both matrix and discrete quad formats in a single unit.

news digest

Nippon Columbia President, Takami Shobochi claims that the system is completely universal – for not only can it handle both discrete and matrix recordings without the need for switching – but it is completely compatible in both stereo and mono modes as well.

Currently UD-4 is an engineering concept and the main purpose of the demonstrations was to convince both equipment and record manufacturers of UD-4's potential value and to solicit licencing agreements. There must have been some takers because Takayasu Yoshida, manager of Nippon Columbia's record division has since stated that the UD-4 system would be on sale in Japan and Europe by the end of 1974.

ELECTRIC VEHICLES ON THE MOVE

Plans to increase the Australian market for electric vehicles were laid by the National Council of Australian Electric Vehicle Association at its inaugural meeting in Sydney last month.

Councillors representing the newly formed body's 152 members elected Mr R. G. Chapman, Assistant General Manager – Marketing, State Electricity Commission of Victoria, as the Association's first President.

Discussing the meeting Mr Chapman said today that Australian Electric Vehicle Association had been formed at an ideal time as environmental issues and the energy crisis were focussing increased attention on the advantages of electric vehicles.

Commenting on electric road vehicles, Mr Chapman said that the development of a viable light commercial vehicle in Australia would be one of the association's prime objectives. "One of our corporate members is importing immediately a vehicle from the United States for local assessment and from testing we hope to be able to develop a vehicle which can be built in Australia to meet the needs of Government and private industry. A major requirement is compatibility with other road vehicles.

The type of vehicle we are looking at has a half tonne load capacity and is capable of speeds up to 80 kilometres/hour. It is similar to 107 vehicles now being produced for the Electric Vehicle Council in US and represents the latest in electric vehicle technology. I would like to think that the Australian and State Governments will do all they can to assist this project. Indications are that we will have the vehicle in Australia by August and it will be demonstrated from September in all main centres in Australia."

Although Mr Chapman is enthusiastic about electric cars he doesn't expect them to replace conventional cars overnight. Taking the most optimistic view he estimates that it could be ten years before even 10% of cars used for commuting will be electric. "But now is the time to start developing them."

Membership of Australian Electric Vehicle Association is open to all companies and individuals who have an interest in the development, manufacture or use of electric vehicles or their components.

For further information contact: Adelaide: Don Rice (Phone: [08] 2943355). Brisbane: Keith Stenhouse (Phone: [072] 243011). Melbourne: Colin Bain, National Secretary (Phone: [03] 630491). Sydney: Roy Leembruggen (Phone: [02] 8489385).

AUDIO-TUTORIALS BETTER

Tape recorded lectures really can lead to better student performance than 'live' lectures – according to a study at the University of Illinois, Chicago.

The study, designed to compare effectiveness of audio-tutorial and lecture modes of instruction, showed that achievement of an audio-tutorial group as a whole was much higher than that of a lecture group. Although there was no significant difference in achievement in upper levels, in the lower halves the tape group scored much higher.

LASER SCANNED MEMORY

Laser scanning of microholograms forms the basis of a new data retrieval system developed by 3M Co.

3M scientists told a joint meeting of the American Physical Society of America in Washington, D.C. last month that data are stored on 10 x 10 cm. photographic plates. Each contains an array of 1 million microholograms, corresponding to a total of more than 50 million bits of information per plate. A laser beam scans the array and can access any microhologram in less than 10 millionths of a second. Readout appears on a cathode ray tube. ●

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.*

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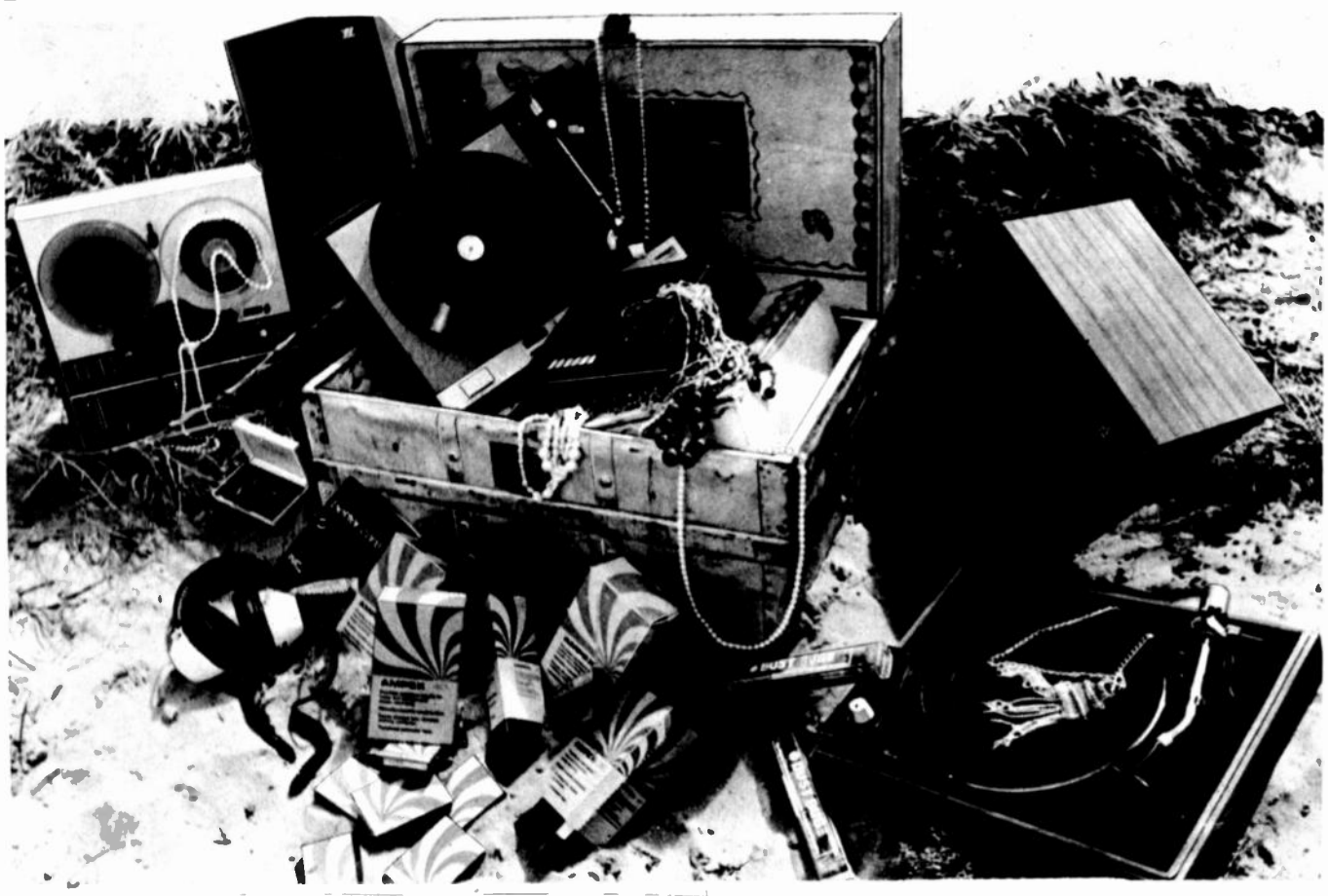
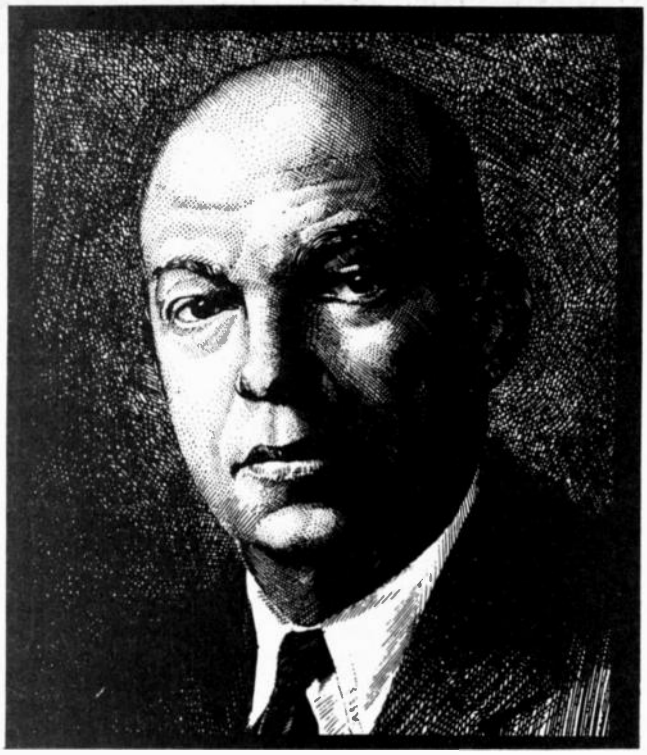


BROADCASTING IN STEREO

Photo: courtesy GTE Sylvania.

Coming high quality FM transmissions pave way for stereo broadcasting.



The man who started it all. Major Edwin. H. Armstrong, who pioneered FM radio in the 1930's.

THE DEVELOPMENT of a system for broadcasting stereophonic programme material followed very closely after the introduction of stereophonic recordings in the middle fifties.

Stereo records and tapes gained quick acceptance and it was only natural that interest should have been immediately aroused in the feasability of broadcasting such material over the air.

One important factor was quickly recognised by the broadcasting authorities. This was, that existing and future monophonic receivers would have to be able to receive mono or stereo programmes without degradation of monophonic reception. The system had to be compatible.

Early demonstrations of stereo broadcasts were set up by transmitting the two-channel information simultaneously over two AM stations in the MF broadcast band; by coupling one AM station with the sound channel of a local TV station during a "vacant" period in that station's programmes; or by using an already existing FM sound channel.

However, these transmissions were of a "public interest" nature. They were not practical for regular stereo broadcasting. The already overcrowded MF broadcast bands precluded allocating *two* frequencies for stereo broadcasting to each station.

Another of the more notable suggestions was to use single sideband transmissions, the upper and lower sidebands to carry the separate stereo channels. But the technical problems of producing low cost stable SSB receivers coupled with the non-compatibility of the system to existing receivers ruled this out.

Thoughts were also directed to the more interesting proposition of utilising the VHF (88-108 MHz) band, where high quality FM broadcasting was an already established service in many countries.

Before the Second World War, Major Edwin Armstrong had spectacularly demonstrated his frequency modulation technique. He showed how high quality, interference-free transmission could be achieved with results far superior to existing AM medium frequency broadcasts. (See inset on page 27).

During the subsequent hostilities, rapid development of VHF equipment and Armstrong's FM techniques took place. As a direct spin-off from this advanced technology, the early fifties saw the establishment of regular VHF FM broadcasting in the USA.

Experimental VHF stations were also set up in other countries. Notable among them was the BBC's transmitter at Wrotham from which test transmissions in the VHF were made. The merits of both AM and FM modulation were evaluated on these frequencies.

By the late fifties, services were in operation. These proliferated rapidly. Today most countries provide both AM and FM services.

TWO INTO ONE

With the introduction of sterophony a system was soon developed in the USA for the transmission of stereo information over existing FM channels. This system used a single carrier, such that the signal was fully compatible for reception by existing monophonic receiving equipment. With suitable decoders stereo information could be extracted and reproduced by stereo receivers — or modified monphonic units. By virtue of the techniques used, this system came to be known as "Stereo-Multiplex" FM broadcasting

Following a period of experimental broadcasting and evaluation. (towards the end of 1959), the early sixties saw the "phasing-in" of "Stereo Multiplex" by FM stations in the USA, and later in the decade, in Europe and other parts of the world.

It is interesting to note how rapidly this new technology came to be applied commercially. Even when "stereo-multiplex" was still being broadcast on an evaluatory basis, local kit manufacturers in the USA were already offering "add-on" decoder kits for existing mono FM tuners.

In the following section, the actual method of encoding a multiplexed signal and its subsequent decoding at the receiving end is discussed. Also the rules for transmission as laid down by the FCC are indicated. These have now been adopted in other countries as the accepted standard.

ENCODING AND TRANSMISSION OF STEREO INFORMATION

In a mono FM transmission, there is just one channel carrying the full audio information being transmitted.

With a stereo signal however, each audio channel only contains part of the overall information. In order for a stereo transmission to be mono-compatible, we have to somehow integrate the two signals for reception by a monophonic tuner.

This is done at the transmitter by taking the L and R channels and electronically adding them together. This composite signal (L+R) which we shall nominate as the "sum component" is now allowed to frequency modulate the main carrier. The actual carrier on which the FM transmission takes place is referred to as the main carrier.

By already established transmission standards (see box) the carrier modulation by the "sum component" covers a bandwidth of 50 — 15 000 Hz. A transmission is now possible which carries full mono information made up from the stereo signals. In order to be able to extract the stereo

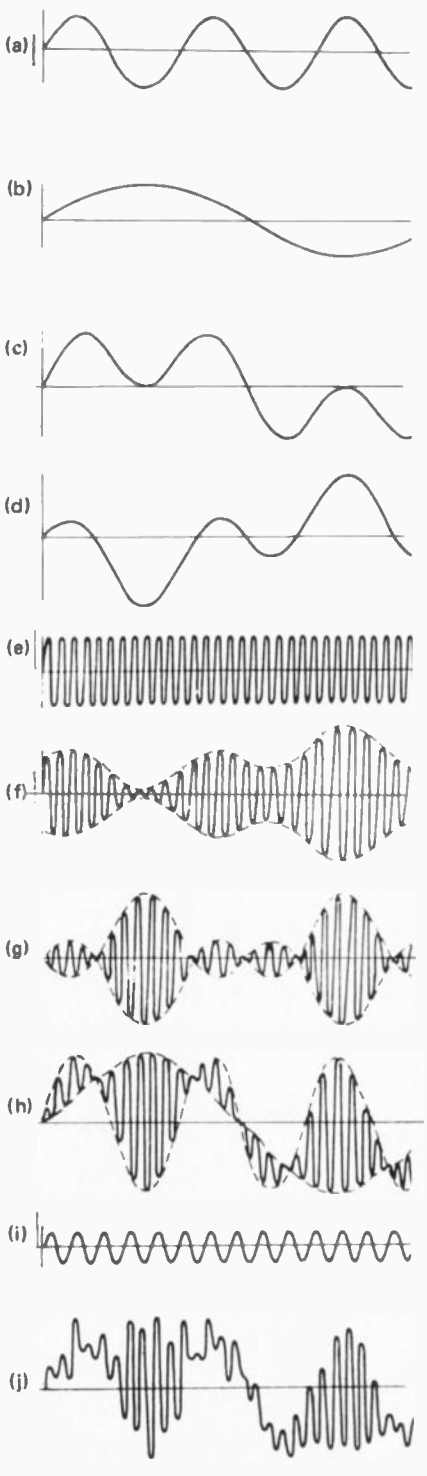
BROADCASTING IN STEREO

information at the receiving end, further information has to be added to the transmitted signal.

A second composite signal is now generated at the transmitter. The L and R signals are this time subtracted giving a "difference component" (L−R).

The problem now is to transmit this "difference component" also, such that it can be decoded at the receiving end without altering or affecting the "sum component". This is done by using a secondary carrier known as a 'sub-carrier'. This sub-carrier has a frequency of 38 kHz and is amplitude modulated by the "difference component", thus generating the normal plus and minus AM sidebands about this frequency. The audio bandwidth is 15 kHz so it can be seen that the sidebands will extend from 23 kHz to 53 kHz. (38 + 15 and 38 − 15). (See Fig. 2).

Fig.1. Composite waveforms making up multiplex signal.



The "difference component" has now been transformed into information lying in a band of frequencies from 23 to 53 kHz. It is important at this stage to note that the lowest frequency in this signal lies 8 kHz above the top frequency limit of the "sum component" (15 kHz). However, before taking the transformed "difference component" signal and modulating the main carrier with it, one more operation is performed on this signal.

The subcarrier constitutes zero modulation as far as the final received audio signal is concerned. It therefore performs no further useful purpose and if transmitted will only waste transmitter power. Because of this, the subcarrier is suppressed. The residual signal now contains only the sidebands generated by the "difference component".

Those readers familiar with amateur radio will immediately recognise that what now remains is in effect a double sideband suppressed carrier signal.

This signal is also allowed to frequency modulate the main carrier which is already carrying the "sum component" information.

Before leaving the transmitter one more modulating signal has to be inserted. This is a synchronising pilot tone or subcarrier required by the receiver for decoding. The frequency of this pilot tone is 19 000 Hz ±2 Hz and is synchronous with the 38 kHz subcarrier. It should be noted that this frequency lies exactly mid-way between the top frequency of the L+R component (15 kHz) and the bottom lower sideband of the L−R component (23 kHz). (The function of this pilot tone is discussed later). Again to conserve transmitter power, pilot tone modulation level of the main carrier is kept down to about 10% of the total.

A summary of the required signals to be transmitted, is itemised below. Reference should be made to Fig. 1 where the progressive waveforms making up the final complex "multiplexed signal" for two audio sine wave inputs (L and R signals) are shown:

1. Sum and Difference components of the two audio channels are generated (Fig. 1a, b, c and d).
2. A 38 kHz subcarrier is generated (Fig. 1e).
3. The "difference component" amplitude modulates the 38 kHz subcarrier (Fig. 1f).
4. The sub-carrier is suppressed with a resultant double sideband (DSB-SC) signal (Fig. 1g).
5. This double sideband suppressed carrier signal (DSB-SC) is added to the "sum component" signal (Fig. 1h).
6. The 18 kHz pilot tone is generated (Fig. 1i).
7. Adding the pilot tone to the composite signal results in the final "multiplex" waveform which is used to frequency modulate the main carrier (Fig. 1j).

These are the prerequisite signals from which a receiver can extract two channel audio information. The disposition of the various signals in the frequency spectrum is shown in Fig. 2.

A block diagram showing how the stereo multiplex signal is produced at the transmitter is shown in Fig. 3.

RECEPTION AND DECODING OF STEREO SIGNALS

Both stereo and mono receivers have virtually identical circuitry as far as the detector stage. It is only after the

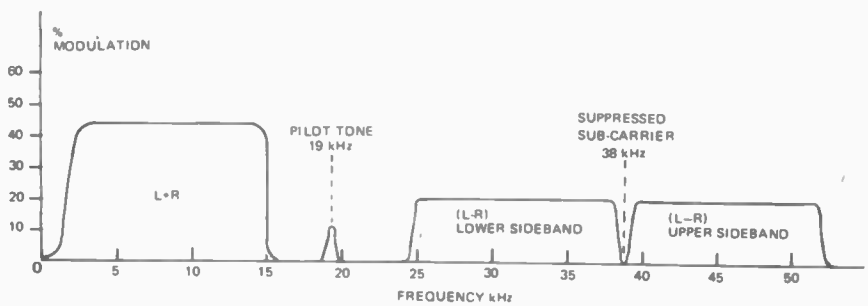


Fig.2. Frequency spectrum of stereo FM signal.

detector that decoding of the stereo information takes place.

After demodulation of the main carrier by the detector the multiplexed signal is amplified in the decoder.

The 19 kHz pilot tone is now separated from the rest of the signals and is used to synchronize a 38 kHz oscillator thus locking its frequency and phase with that of the subcarrier generated at the transmitter (which was suppressed before transmission).

This regenerated subcarrier must perform two functions:

The first function is to inject the subcarrier into the double sideband

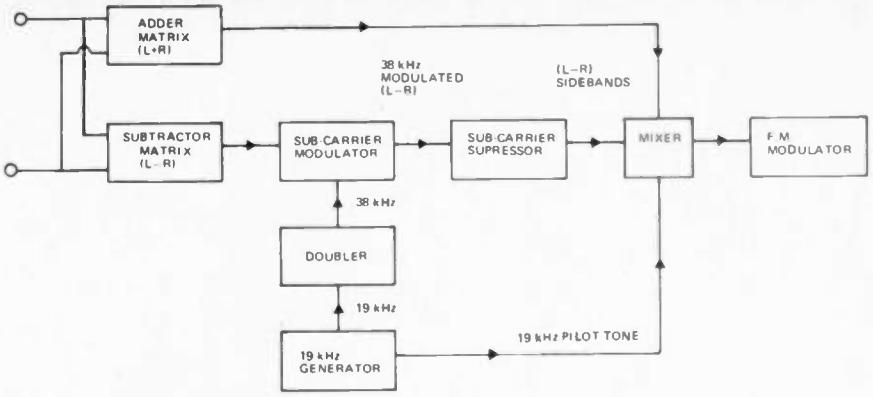


Fig. 3. Block diagram of stereo broadcasting encoding system.

FREQUENCY MODULATION – How it works

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.

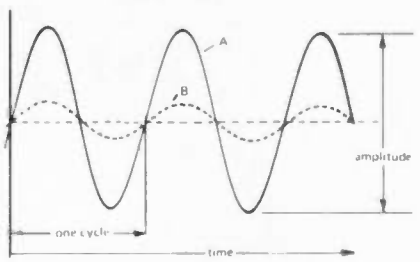


Fig. 1a. Two sine waves of same frequency but different amplitude.

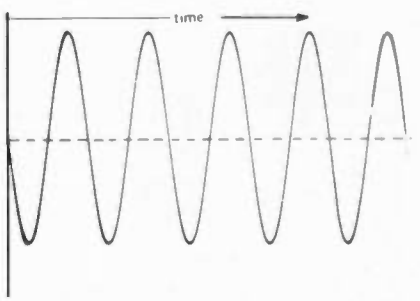


Fig. 1b. Sine wave having same amplitude as A in 1a but at twice the frequency.

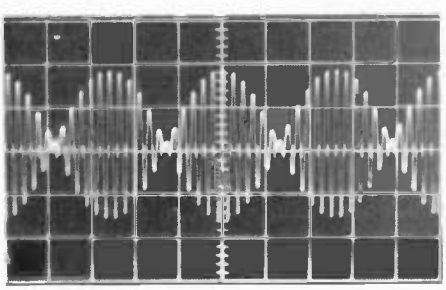


Fig. 2. Amplitude modulation – audio waveform causes corresponding changes in amplitude of sine-wave carrier.

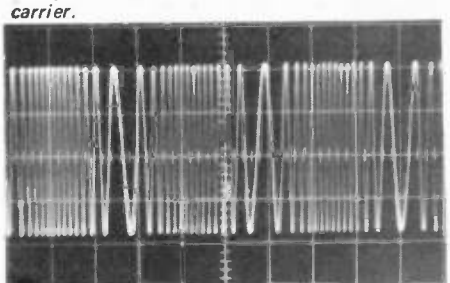


Fig. 3. Frequency modulation – audio waveform causes changes in frequency of carrier.

BROADCASTING IN STEREO

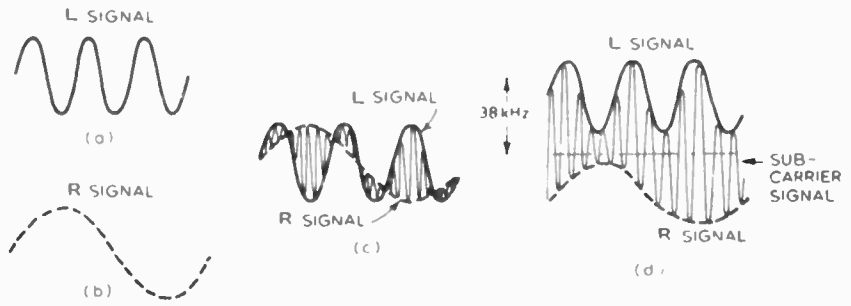


Fig.4. After reinsertion of sub-carrier L and R modulations appear on opposite halves of the carrier envelope.

signal so that it once more produces an amplitude modulated signal containing the (L −R) component. This has the effect of separating the L and −R components so that the L information modulates one half of the carrier envelope, the −R the other (see Fig. 4 where L and −R have been represented by sinewaves of two different frequencies.

Its second function is to provide synchronous pulses either for a detector of a matrix decoder or switching pulses for a "time division" multiplex type decoding circuit – depending on the system used.

The next step is to demodulate the subcarrier, but in a way that separates the top and bottom halves and the modulation thereon.

One method of doing this is by means of synchronous detection. The modulated subcarrier is applied to the input of two detectors, but in addition some pure unmodulated 38 kHz signal from the oscillator is added to the detectors such that the phase is opposite for each one. This has the effect of switching each detector on alternately, one on positive and the other on negative half-cycles. This means that one detector will sample only the positive going modulation and the other negative, thus the L information appearing at the output of the first detector, and the R information at the other.

The detectors can take the form of two transistors as shown in Fig. 5. The 38 kHz switching signal is applied in opposite phase to the base of each transistor. Both the mono (L+R) and the stereo (L−R) modulated signals are fed to the emitters. Each transistor is switched on and off in turn by the base 38 kHz switching signal, thus the L and R signals appear in their respective outputs. When mono is being received, the 38 kHz oscillator is muted so both transistors conduct all the time and the (L+R) signal appears in both collector circuits.

Another circuit uses four diodes connected in a similar configuration to a bridge circuit as shown in Fig. 6. The tuned transformer supplying the switching pulses is connected to points A and B. The 38 kHz switching signal causes these points to go alternately negative and positive, so that, when A is positive, diode 2 is biased off and no signal passes through it to the R channel. Diode 4 conducts at this time and thus the signal passes from B to the L channel. When switching phase is reversed on the next half cycle, diode 4 is reverse biased while diode 2 conducts to pass the signal from A to the R channel.

A standing dc voltage is applied across C and D, and this causes all the diodes to conduct in the absence of switching pulses. Thus when a mono signal is received, the L+R will appear at both L and R outputs.

Diodes 1 and 3 are needed for mono reception only, since, if dispensed with, the standing dc voltage cannot be applied and the circuit will not conduct in the absence of switching pulses when a mono transmission is received.

Many variations of this circuit are in common use on commercial receivers.

Another method of decoding is by matrixing. By selectively filtering out the "sum" and "difference" components then synchronously detecting the AM subcarrier the two composite audio signals are extracted (see Fig. 8). These signals L+R and L−R are then applied to a matrix circuit in which by a simple algebraic operation the individual L and R signals appear at the appropriate outputs (see decoding algebra box).

One further point has to be taken into consideration.

At the transmitter, pre-emphasis of the higher audio frequencies is applied. By applying appropriate de-emphasis at the receiver the status-quo of the audio signal is re-established, however with an improved signal to noise ratio at the higher audio frequencies. The amount of pre-emphasis is 75μS (US standards) and 50μS (UK/European standards). In mono tuners this is incorporated in the immediate post-detector circuitry, however in the case of a stereo tuner de-emphasis is applied to each channel after decoding. When converting a mono tuner to stereo, it is important to remove the de-emphasis circuitry as otherwise decoding will not take place correctly. This de-emphasis is then

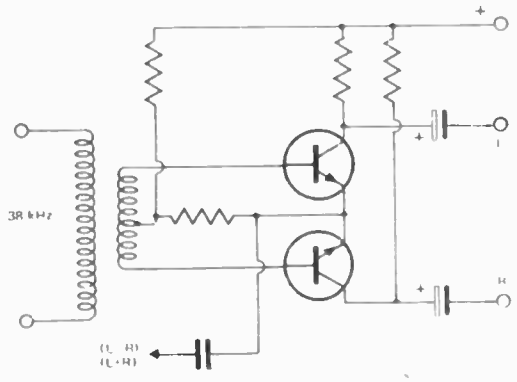


Fig.5. Synchronous detector using transistors. Each transistor is switched on and off alternately on successive half-cycles by the 38 kHz timing signal.

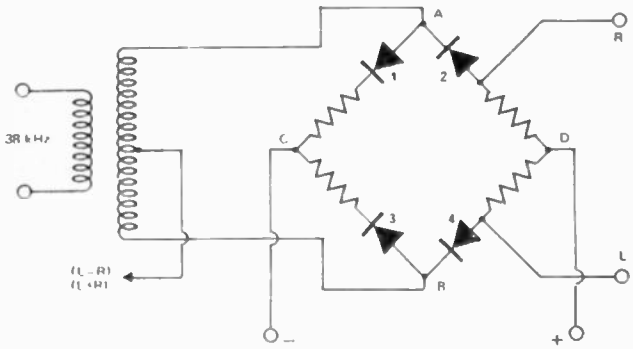


Fig.6. Detector using diodes in bridge circuit. Diodes 2 and 4 conduct alternately by the switching signal, Diodes 1 and 3 enable a dc voltage to be applied which switches all diodes on in the absence of the switching signal, thus passing the audio signal to both channels.

reapplied to the final audio outputs.

Unlike the ordinary AM radio, "tuning in" a station on FM is quite critical. Any slight mis-tuning results in deterioration of signal quality and a sharp rise in distortion to the point of unintelligibility. Since it is much harder to tune-in by "ear", a tuning indicator is required for optimum results. For correct tuning of stereo signals it is mandatory.

Early FM tuners were all valve units and some poorly designed units gave very inferior results. Drift in the front end necessitated periodic manual retuning if the annoying "whoosh" and distortion, when off frequency, were to be avoided.

Modern present day tuners are all solid state units incorporating many refinements including AFC or "auto-tuning". Once a station is tuned in, it can be "locked on" by switching in the auto-tune facility thus maintaining optimum performance without further adjustment being necessary.

FM STEREOPHONIC TRANSMISSION STANDARDS

" . . . The main channel refers to the band of frequencies from 50 to 15 000 hertz that frequency modulate the main carrier. The stereophonic subchannel is the band of frequencies from 23 to 53 kHz containing the stereophonic subcarrier and its associated sidebands. The pilot subcarrier is a control signal, and the stereophonic subcarrier is the second harmonic of the pilot subcarrier.

The basic system involves a separate pickup of the right hand and left hand signals, the sum of which modulates the main channel. This is the signal received by monophonic receivers.

The pilot subcarrier of 19 000 ±2 hertz, frequency modulates the main carrier between 8% and 10%. The stereophonic subcarrier is 38 kHz and is amplitude modulated by a signal equal to the difference between the left and right hand signals. The stereophonic subcarrier crosses the time axis simultaneously with each crossing by the pilot subcarrier and is suppressed to less than 1%."

Abstract: Rules and Regulations FCC. Para: 73.322.

An incidental use that is often made of the pilot tone is to give some indication that a stereo broadcast is being received. An output is taken from the 19 kHz amplifier and the tone applied to a transistor which switches on a lamp. This remains activated only when the tone is

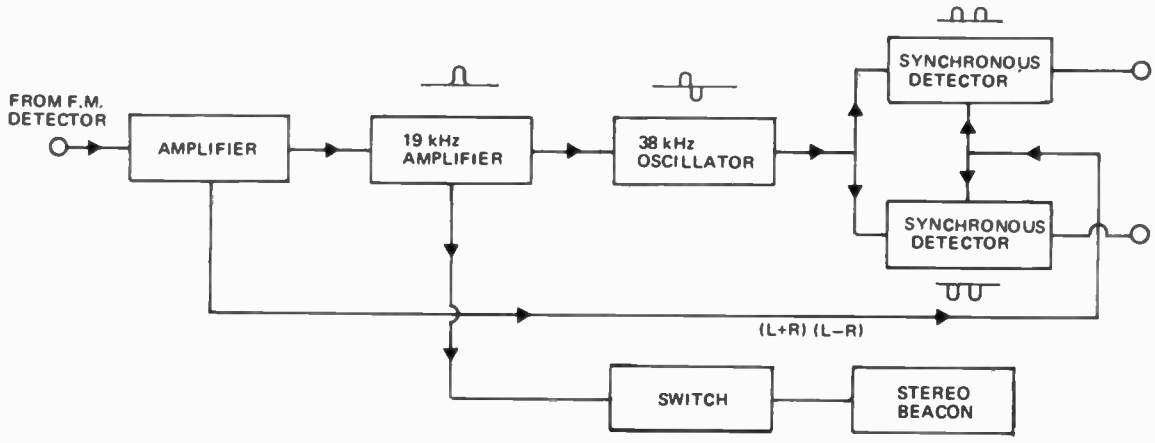


Fig.7. Block diagram of synchronous detector – decoding system.

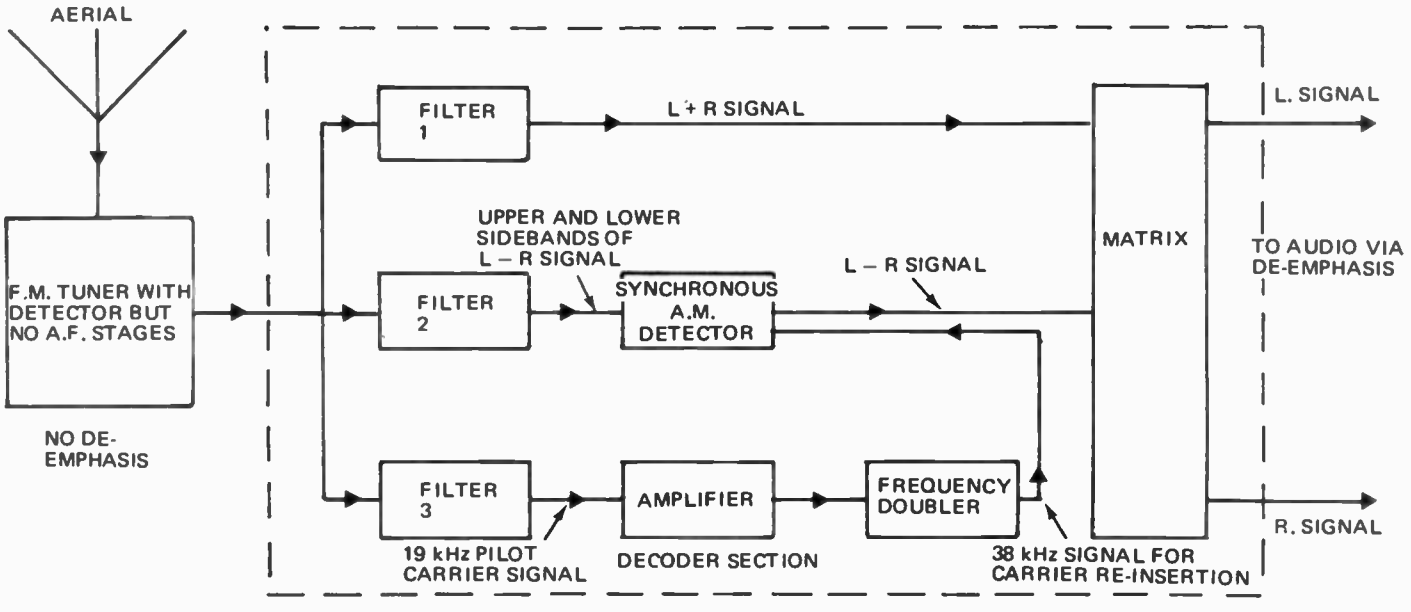


Fig.8. Block diagram of a matrix-decoder system.

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BROADCASTING IN STEREO

(Continued from page 29)

present. The popular name for this facility is a "stereo beacon".

At long last we are about to have FM radio!

It is to be hoped that after lagging behind for so long, we will at least see the simultaneous introduction of stereo-multiplex to bring this country's services into line with those of other nations.

With the introduction of four channel sound a new dimension is again opening up in the audio field. Already consideration of its broadcasting is being given in the USA. It is interesting to note that thinking is in terms of a discrete system being used. How such a system, compatible with existing methods, will evolve and how soon we will see its introduction in Australia is something yet to be resolved. ●

THE SIMPLE ALGEBRA OF DECODING STEREO MULTIPLEX SIGNALS

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Difference: (L+R) – (L–R) = L+R–L+R = 2R – Right channel output.

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BYTING THE SCENE

. . . optical data digitizers enable computers to communicate with visual scenes. Dr. Sydenham reports on the latest developments.

TECHNOLOGICAL progress is very much controlled by our ability to communicate with computers. Although there is still a long way to go with the use of computers themselves, a lot more can be achieved with given computing power if the data describing the real-world process can be obtained in a signal form that is compatible with computers and at a rate that suits the high-speed capability of modern machines.

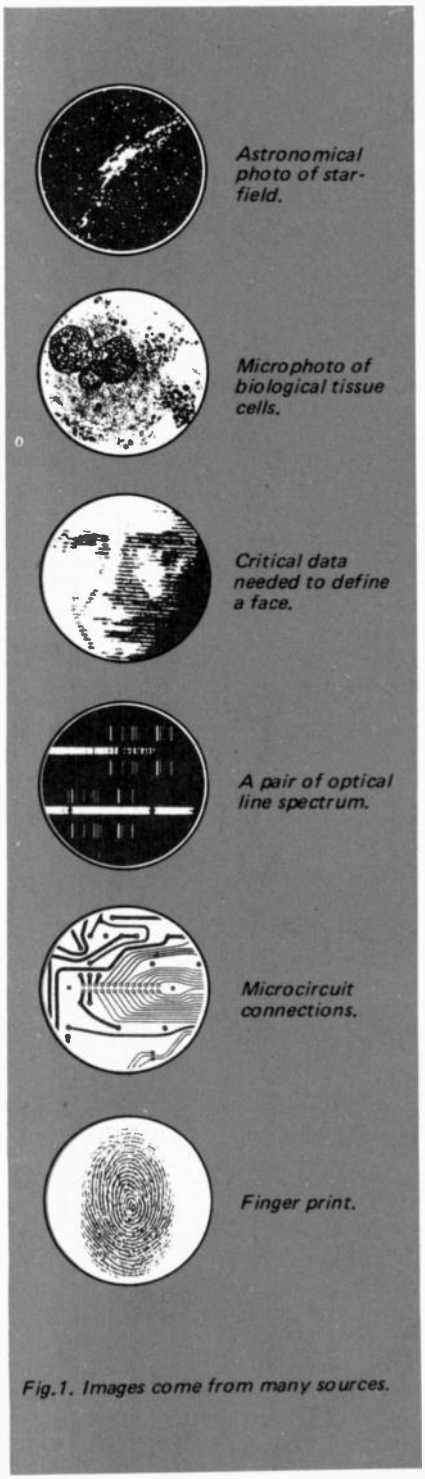

Fig.1. Images come from many sources.

THE NEED TO TAKE BYTES

It is now old hat to converse with the computer through punched-paper cards, paper tape and magnetic tape interfacing. These media are quite satisfactory for many applications . . . data input for complicated scientific calculations, for payrolls and accounts, for statistical calculations and the like . . . for there it does not really matter if the work is performed sometime after the event to which the data pertains.

There are, however, many processes that need immediate data processing as the related events occur. If the process is already instrumented to provide equivalent electrical signals these can be fed into a computer . . . used solely for this one purpose (known as a dedicated computer) one of the many commonly used minis or special purpose units . . . via the appropriate interface circuitry. The majority of transducers outputs occur in analogue signal form so the need is usually for analogue-digital converters that provide equivalent digital signals ready for use by the computing machine. Such a generated sequence of adjacent binary digits are called (in computer jargon) bytes; several bytes form a computer 'word'.

One class of process that constantly crops up as needing conversion to digital bytes is the two-dimensional (and three dimensional but less often) scene or picture, the latter being a permanent record of transient scenes. It is beyond our resources to list the areas of application in detail (see Fig.1) for they must surely run to thousands. To illustrate the need here are just a few well-defined uses for optical data digitizers (ODD's for short).

Astronomy — Astronomical observers use telescopes to catch 'pictures' of phenomena in space.

These may be photographs (visible and other wave-lengths) of star fields for mapping purposes; spectroscopic line sets formed by dispersing the radiation received from a chosen region; galactic radio signal intensities transposed into two-dimensional chart record or CRO pictures.

Once the data is procured in this form it then needs to be processed to extract the information sought.

A few decades ago, visual examination, with the aid of special purpose measuring machines, was regarded as the most satisfactory way to process the pictures, for their rate of production was relatively slow. In these times computing ability is such that machines can consume data at enormous rates . . . if they can be fed fast enough. Astronomers operating in large teams employ computers in force, so techniques that produce bytes from scenes are indeed valuable provided they have the desired speed and accuracy capabilities. An astronomical group at Cambridge University is currently developing a system that can process 10 000 000 images a day!

Medicine — even though this discipline seems far removed from astronomy, similar basic techniques are required.

It is not so long ago that the best way to take a blood count or to analyse and classify biological cells was to make a slide for the microscope and laboriously observe it by eye for considerable periods.

Today we can do a lot better although, of course, the cost prevents everyone from having sophisticated optical data digitizers that can characterize criteria of cell count, shape, colour, fluorescence and movement.

Many of the 'visual' processes used in medicine are limited in usefulness by the allowable exposure time for the radiation used. Over-doses of radiation, X-rays and ultrasonics will cause permanent damage, so the length of time spent obtaining and studying the picture produced must be kept short unless the brightness of the display can be enhanced by external means . . . image intensifiers etc.

By storing the two-dimensional picture in a computer as it is produced, the exposure time can be reduced in certain modes of use and the picture can then be restored at the will of the diagnostic operator. ODDs can play a part in this task.

Spectroscopy — when substances are made gaseous they emit or absorb the various wavelengths of radiation — to varying extents. By studying this process the composition of the substance can be broken down into

the elements forming it . . . this is spectroscopy.

Today analysers can be deployed with on-line processes; gases from exhaust stacks that need monitoring; metals in a refinement process to be checked; chemicals in production and air to be tested for purity. The task of identifying the composition from the special line 'code' is laborious, so human methods tend to include error. Furthermore the human eye and brain system is often not fast enough, nor accurate enough, for the task. Optical data digitizers can act as the interface between the optical spectrometer and the computer.

Criminology — Spectroscopy and bio-chemical analysis form the main part of the modern forensic scientist's toolkit but there are many, relatively new, areas where ODD could become invaluable.

Finger-print identification is one such. The usual method is visually to compare the matching of the many prints found at the scene of the crime with those held in the police record files. This can take a considerable period and faster methods are being studied. One method makes use of direct optical correlation using Fourier methods, another the use of computer matching. Every minute that the criminal is not identified is valuable, for tracing him becomes more difficult as time proceeds. Similar arguments apply for the matching of photographs and Identikit buildups. The detection limits are not set by intrinsic computer ability but by our ingenuity at programming and data conversion.

Interpretation of photographs — Quality photographs contain an enormous amount of information but most of it is redundant for normal purposes. Optical data digitizing methods enable this to be studied in an attempt to extract the vital data relevant to the experiment being performed. The versatility of the centralised computer on an ODD system design enables many different transfer functions to be used. Fig. 2 shows a few treatments of the same basic portrait photograph.

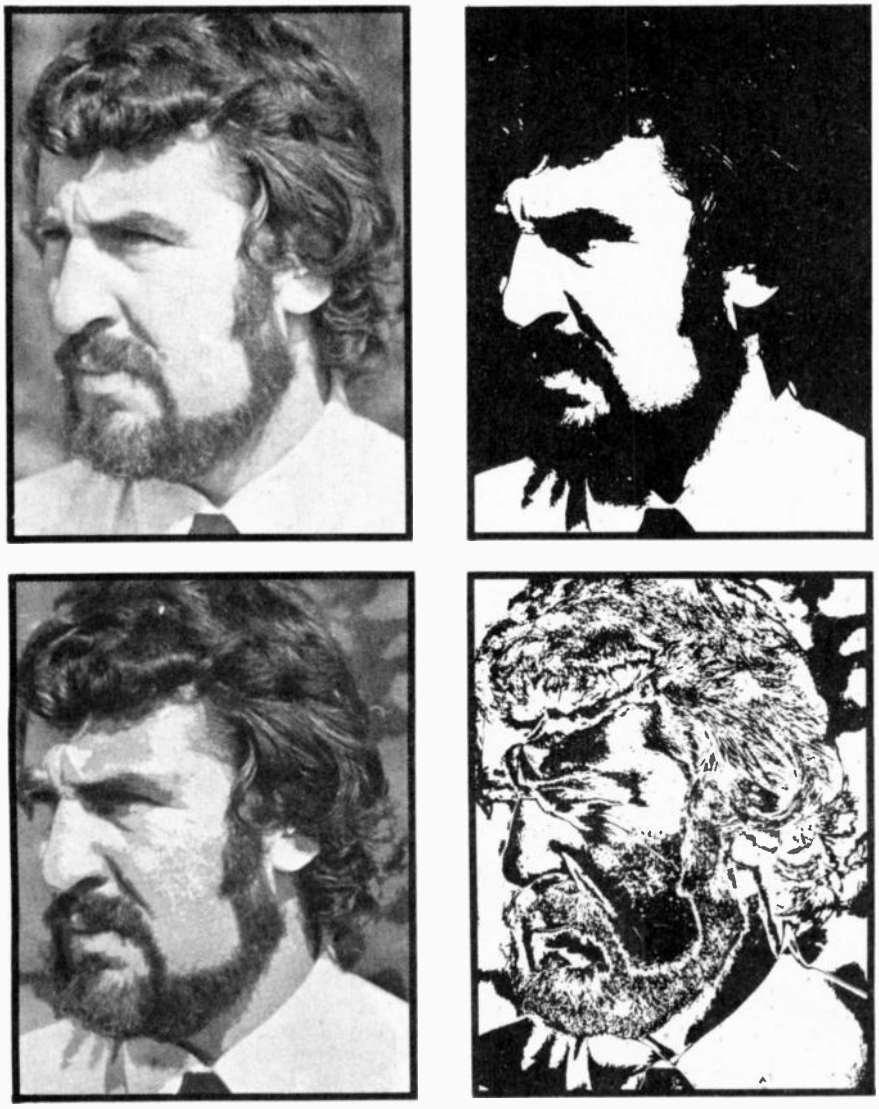

Fig.2. Once the image is digitized it is comparatively easy to process it. (a) the original portrait. (b) two grey levels only allowed (c) eight grey levels only (d) sixteen grey levels and alternately contoured black and white.

In bubble-chamber research, high energy particles under study are made to form vapour trails in a volume of gas. These trails are photographed in plane and stereo for further study.

CERN, in Europe, produces millions of these bubble-chamber photographs each year and each one has to be analysed for track direction, branching, length, brightness, and location in the vapour chamber. Clearly, as with star-plate reading, the task is laborious and operators are assisted where finance permits with automatic ODDs.

Inspection — Any process that uses human inspection is prone to error for no one can maintain 100% inspection accuracy for long. Our biological optical data transducer is just not up to it! It is however, an easy task for an ODD to seek out and detect disconnects in a micro circuit with extreme reliability.

Printing — The above examples are mainly concerned with measurement problems but here is one closer to most of us . . . the composition of pages in magazines and the like. A system on sale today, (see Fig.3), enables the editor to feed characters, symbols, art shapes, galley copy, and even illustrations of line or half-tone form into a mini computer using an ODD input facility. Once there, software is used to instruct the output film-writer to arrange the page as a complete unit with all words and pictures balanced within the required format. In the publishing world it is common practice to use typewriters that justify (or stretch) the words to just fill the line, but pictures must be photographically doctored to obtain the size needed for a given space. This computer based method does away with this for the programme automatically decides the final size of the rewritten pictures. It can also be used to remove sections of the picture and filter out noise to clean it up. The page produced by the film writer is directly ready for offset printing thus eliminating the stage known as pasting up wherein each page is carefully composed by sticking the text, illustrations and adverts into the page format. The film-writer unit offered can put down 60,000 points each second so it only takes a matter of minutes to write out a complete page once the computer has been fed with basic data.

Although few such systems are in use as yet they clearly are turning

BYTING THE SCENE

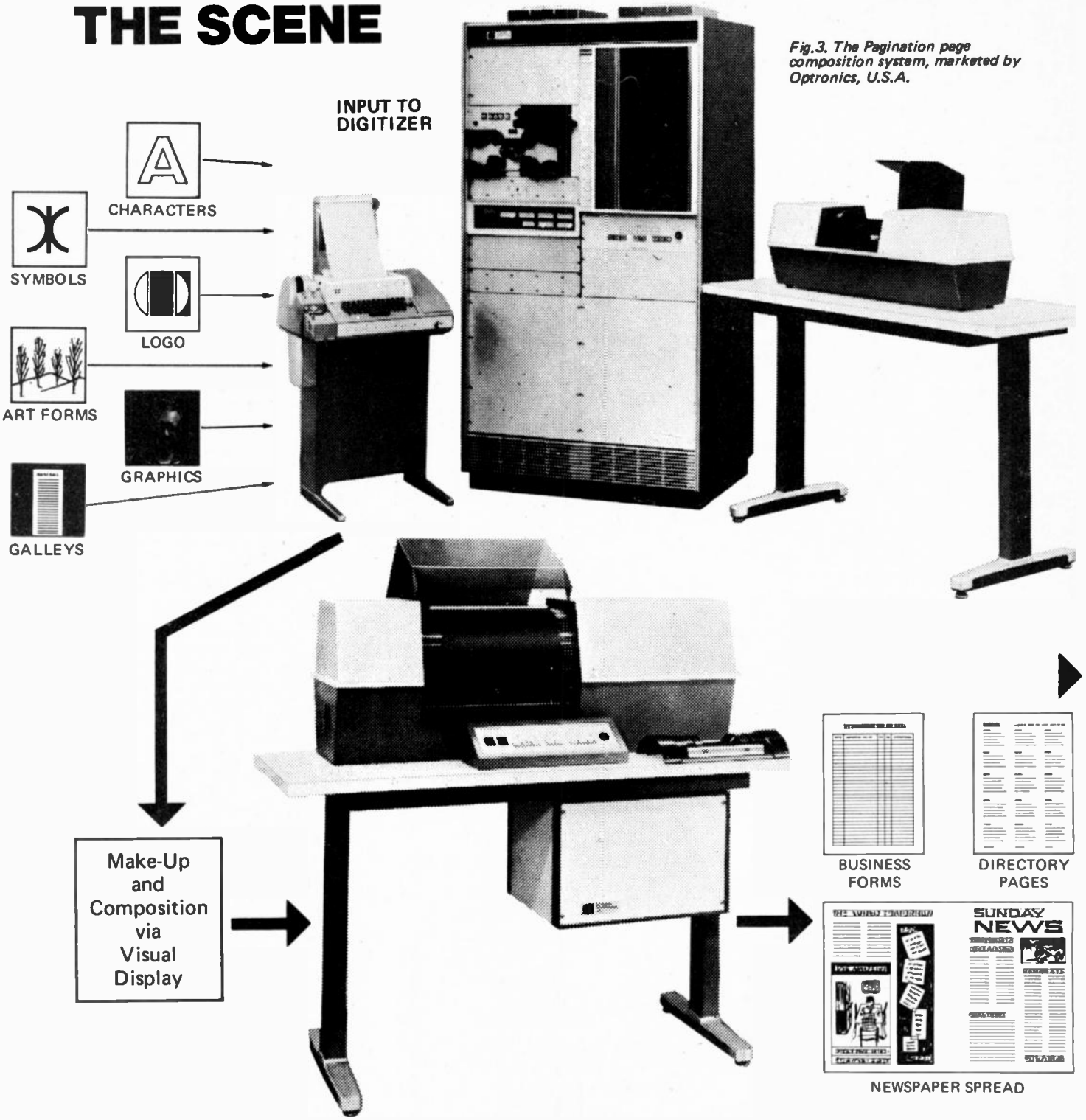

Fig.3. The Pagination page composition system, marketed by Optronics, U.S.A.

yesterdays fantasy into todays reality.

So much for where ODDs can be used; now to a quick look at what the state of our knowledge tells us about the workings of the human system.

THE BIOLOGICAL OPTICAL DATA DIGITIZING PROCESS

In hardware terms, the human eye consists of an automatic lens system that provides focussing, an automatic iris to stop down the light intensity and a detector matrix on which the image of the scene is formed (upsidedown). The system design is given in Fig.4.

It is hard to know what really goes on in the brain for there is little to see. The retina can, however, be looked at and we know a lot about its operation. It consists of many individual sensor elements that stand perpendicular to the retinal surface. These come as rods or cones and are shaped as the names imply. They see radiation colour and intensity by an electro-chemical process that produces signals for transmission to the brain.

The signals generated are predominantly pulse-trains but this

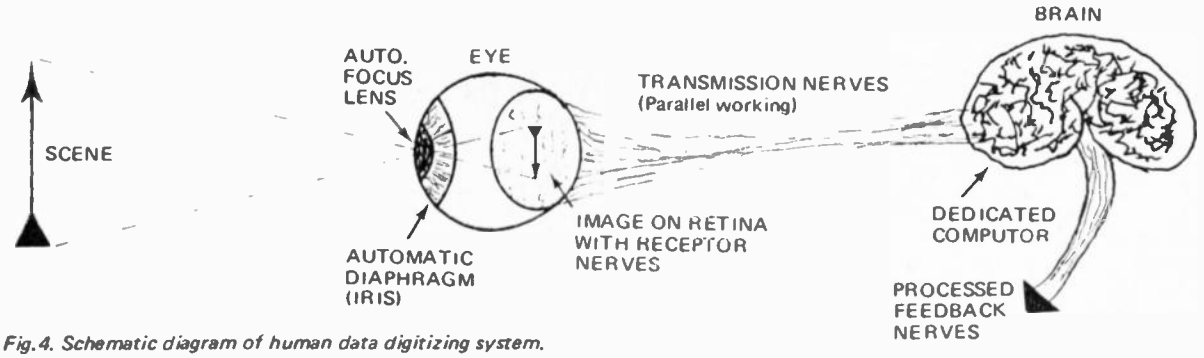

Fig.4. Schematic diagram of human data digitizing system.

simple concept might be misleading, for the signals are really quite complex. There are about 20 000 000 receptor nerves in the human retina and these paralleled channels feed to the brain via some 2 000 000 outgoing nerves. (How's that for parallel working!)

Other 'facts' (but much is still conjecture) about the human ODD system is that 1% of the 10^{10} neurons (the brains digital storage elements) are dedicated to *seeing* processes and that 60% more help on a time-sharing basis. It has been estimated by one person that the eye can transmit information to the brain at 4 000 000 bits per second. (There are several bits in a byte). Another research worker estimates the figure to be 1 000 000 000 bits per second if the illumination level is high. To give some idea of what these figures mean, this is more data than is contained in a t.v. picture but less than in a cinema screen frame.

Colours are differentiated by the cone detectors which are found mainly in the centre of the retina. Retinal acuity is greatest in the centre.

Looked at this way the human ODD is rather fantastic but for all of its apparent power it is not reliable enough for many of our desired tasks and lacks acuity. The best it can do unaided is about 0.5 minutes of arc resolution.

OPTICAL VERSUS MECHANICAL METHODS

Classification of optical digitizing systems can be made on many different criteria. For instance, they can be divided into those that view images in free space and those that look at permanent images on some form of media . . . photographs, films and chart plots.

In each, there is always a need to provide the two-dimensional information as a serial signal. (Systems do exist that read out the data in parallel channels but they are still in their infancy compared with serial methods). The human ODD operates in parallel. Most of our own devised techniques, however, read out the data bit by bit in sequence, using some form of repetitive scanning motion.

This scanning process largely controls the capability of the now many different means of digitizing images. Each has its merits and disadvantages and no one method is superior in all ways to the others.

MECHANICAL METHODS OF SCANNING

In all methods an image of the scene is formed by an optical system. This scales the scene to the appropriate size ready for scanning. This stage may, or may not, be incorporated in the scanner unit; it depends on the application. A very small part of the total image is then sampled with a sensitive radiation detector; photomultiplier tubes, silicon photocells, phototransistors and many options exist. The thing to note is that these detectors can sense the amplitude of radiation but cannot give information about its spatial qualities. To cover a two-dimensional scene the detector is made to move relative to the image, with some form of scanning arrangement such as those illustrated in Fig. 5.

The scanner can have many forms. It may use a combination of two mirrors or mirrored drums that nod or rotate continuously (Fig. 5a), another

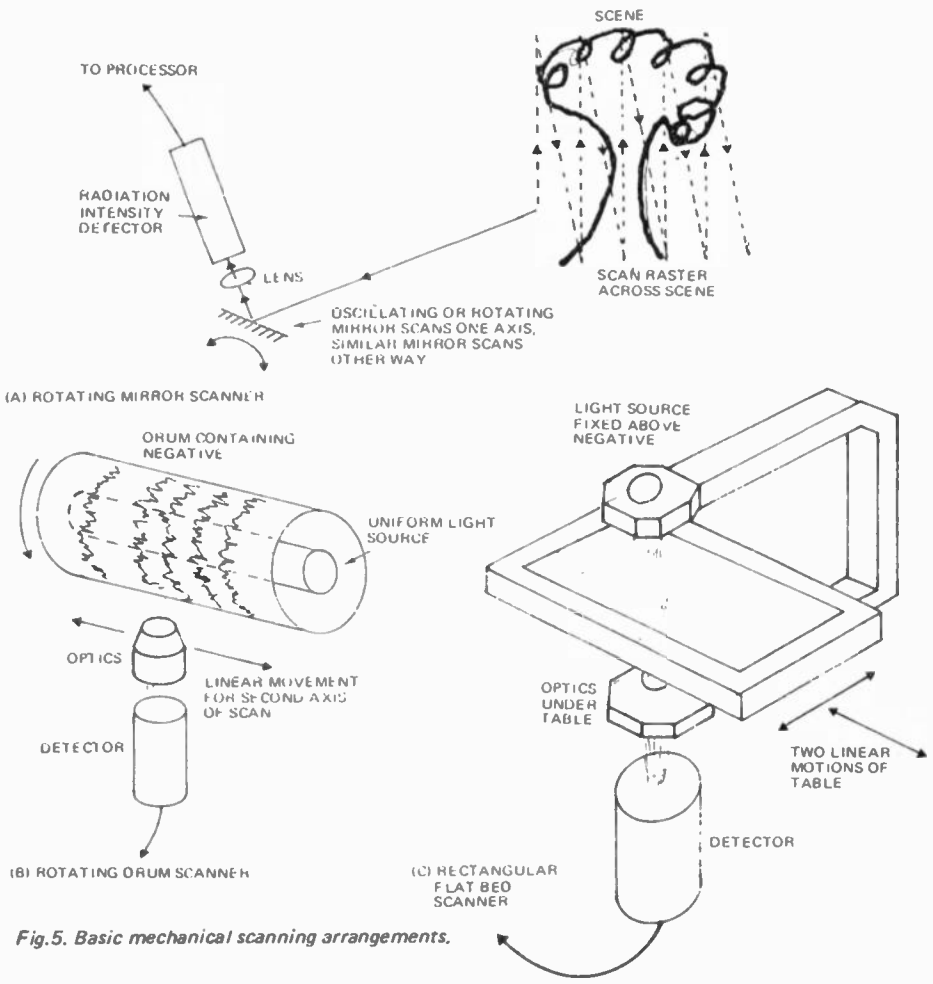

Fig.5. Basic mechanical scanning arrangements.

BYTING THE SCENE

method uses straight X-Y translations (Fig. 5c), this is called the flat-bed processor.

One early method uses a spiral scanning motion and similar to this is the, now historic, Nipkow disk scanner used in early television developments. As the Nipkow disk rotated (at around 8000 rpm) the scene to be scanned was viewed by a photocell through a series of minute holes drilled through the disk in the shape of a spiral. As the disk moved around, the scene was progressively sampled by the holes each one being a little higher than the previous one. At the end of each scan the next scan repeated the process. There were considerable difficulties of technology in their design for the data rate needed for the (then) smallest holes possible required the disk to run at a speed close to flying apart . . . the viscous drag alone produced significant heating of the disk so it was contained in an evacuated enclosure that also acted as an explosion shield. It was far from the portable t.v. cameras of today!

Mechanical systems now can provide high raster scan speeds, wide dynamic intensity range cover and, above all, the ultimate in positional accuracy. They are, in principle, highly accurate controlled movement inspection machines combined with a microdensitometer and computer backing.

In the commercial drum scanner shown in Fig. 6 the film negative is positioned on the drum. It then rotates past the optics which consists of highly uniform and stable light source located inside the drum and an outside photodetector that sees a tiny section of the film through the optical objective (seen in the middle lower part of the unit).

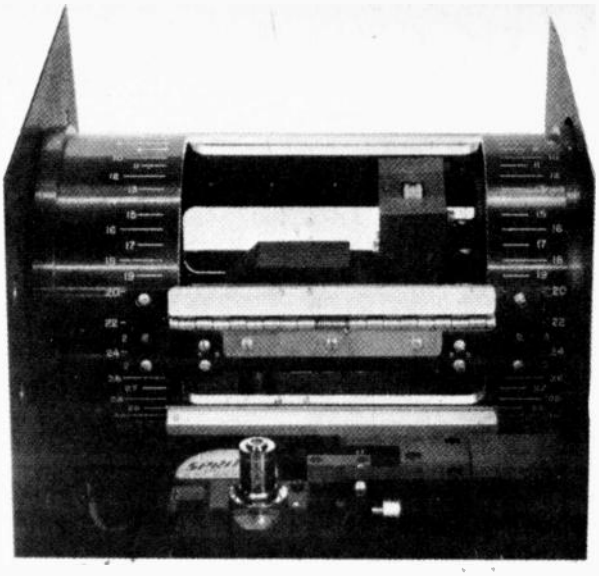

Fig.6. Rotating drum scanner.

The signal is then converted to 256 levels of greyness and finally digitized ready for display, recording or computer interfacing. After each complete revolution of the drum the cross-slide is incremented across by one scan resolution width. In this way the second dimension of the picture is recorded. Signals are synchronised by a shaft-angle encoder that is driven from the scanner-drum shaft. Such systems can resolve 10 micrometre dots, sampling at 60 000 points per second.

Flat bed units, (Fig. 7 shows a micro-densitometer that can be coupled to a mini-computer) also move the image past the optics. These generally are capable of finer detail . . . a spot size of 300 nm is quoted in one manufacturer's sales literature . . . and can resolve greyness to 1024 levels at rates of 1000 points per second. The most recent designs incorporate laser interferometers for positional control and measurement. It is probably clear that the sensitivity largely depends upon the detector used, but in general if integrational methods are used to enhance the radiation sensitivity there must be a corresponding loss of time-response.

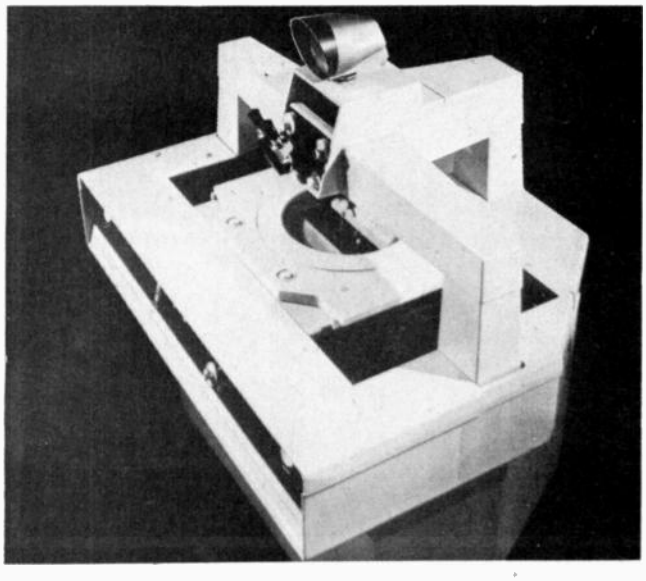

Fig.7. This Joyce-Loebel scanning microdensitometer is of flat-bed design.

ELECTRO OPTICAL METHODS OF SCANNING

The general feeling is that a system devoid of moving mechanical parts is superior in the long run, for less faults can develop. There are a number of devices that can scan an image using electro-optical techniques but in general these are unable to match the accuracy of mechanical counterparts. On the other hand they are smaller, lighter, more robust and have greater flexibility of use.

Figure 8 shows the schematic block diagram of a typical optical data digitizer that uses electro-optical principles. The input image impinges on the faceplate of a sensor. The illumination level on the target of the sensor is read off with electronic methods, point by point, as a continuous scan process. The intensity function detector provides a signal to the encoder that converts it into the appropriate computer-compatible digital signal, binary in the case shown. The computer, in this system, has the ability to drive the scanner deflection system in any way that is desired. For example, if the computer decided there is a particular part of the image that needs more carful attention it can cause the scan to cover that area only, ignoring the rest of the image. Packaged, the unit couldn't look more like a theoretical black box — Fig. 9!

Way back in the sixties, there was considerable general interest in

television trackers for tracking missiles in flight. The operator viewed the scene in real-time watching for targets. Once a target was identified on his monitor he placed what are called gates around the missile. These were, in fact, signals that told the computer to recognise the image contained in a small area of the total area and hold the anti-missile onto this target and no other. These are still current in military warfare but now they can handle many targets at once remembering which are 'friend' and which are 'foe'. Figure 10 shows a recently 'released' unit.

A number of sensors can be used, the most common being based on the vidicon principle. In these the target acquires charge in proportion to the light intensity falling or. it. The charge magnitude at each point on the target is read out by monitoring the beam current of an electron beam generated by an electron gun. The beam is deflected by electrostatic or electromagnetic fields to scan across the image charge-pattern in the required manner.

The choice of sensor depends upon the image needs . . . is it transient and, therefore, requires high speed data capability, or is it very low in intensity such as for seeing in the night, or, does the system need maximum available spatial resolution? The outcome will be a compromise. Image dissector sensors can resolve to 2048 by 2048 elements, addressing a small step in 2 micro-seconds and seeing light levels of 5-50 footcandles. Silicon vidicons, (a vidicon with enhanced sensitivity) can see down to 3 10^{-5} foot candle seconds (the sensitivity depends on the integration time used) and the silicon-intensified vidicons can go three orders of magnitude better than this. Generally, however, the more sensitive the tube the more likely the chance of damaging the target with ambient light.

In all cases the best accuracy of electro-optic scanners is around 2%, with repeatability a little better, so it is clear that these do not compete with mechanical ODDs where the best can provide only 0.0001% error. On the other hand random access can be made in the electro-optical methods in about 50 microseconds; the inertia of the necessarily rigid slideways and drums of mechanical scanners does not allow speeds such as this to be obtained.

No doubt you can see numerous uses for optical data digitizers and it is not hard to see that they will be used more and more as time goes by. Our computing capability is advancing at least as fast as our inputing capability so there will be no slackening in demand for cheaper, faster, lighter and more robust ODDs. ●

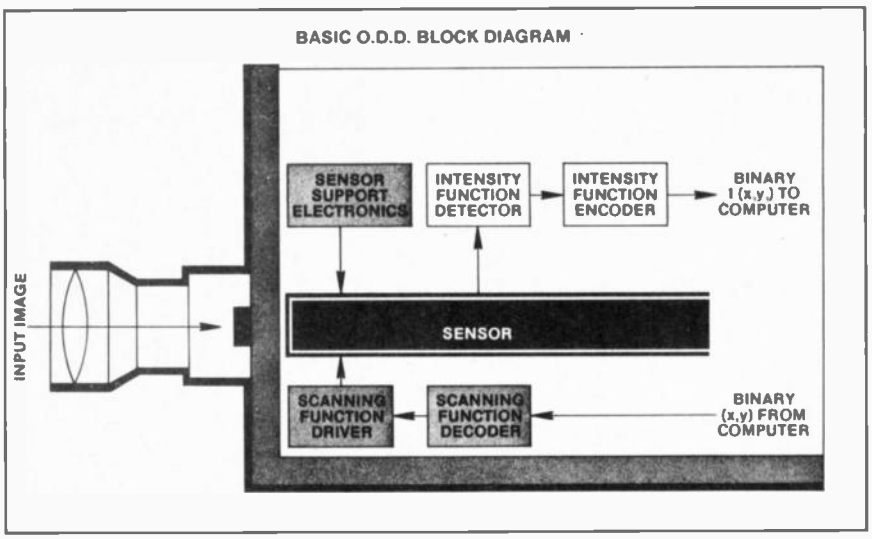

Fig.8. Basic optical data digitizer block diagram.

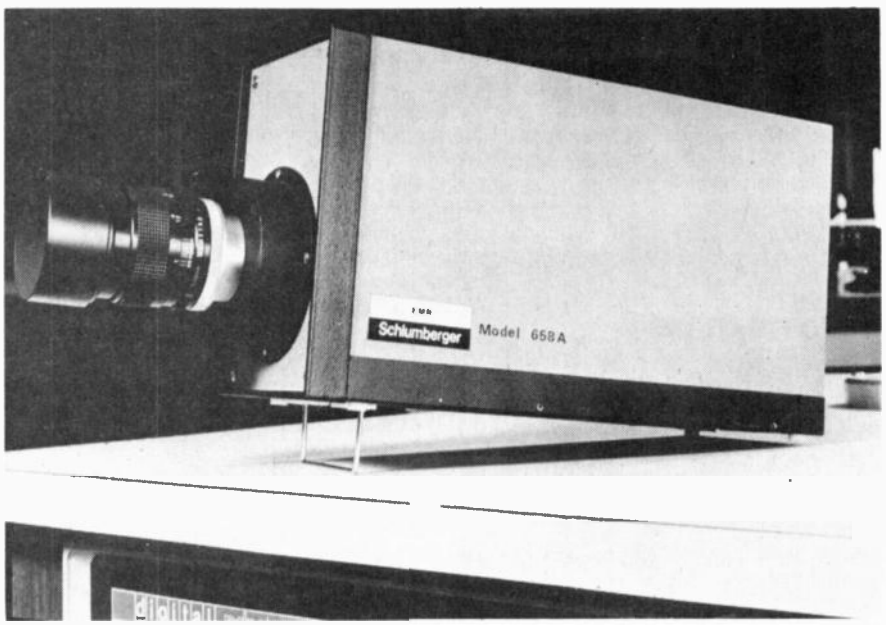

Fig.9. Electro-optical data digitizers contain no moving parts. This unit is intended for use with the mini-computer it is sitting on.

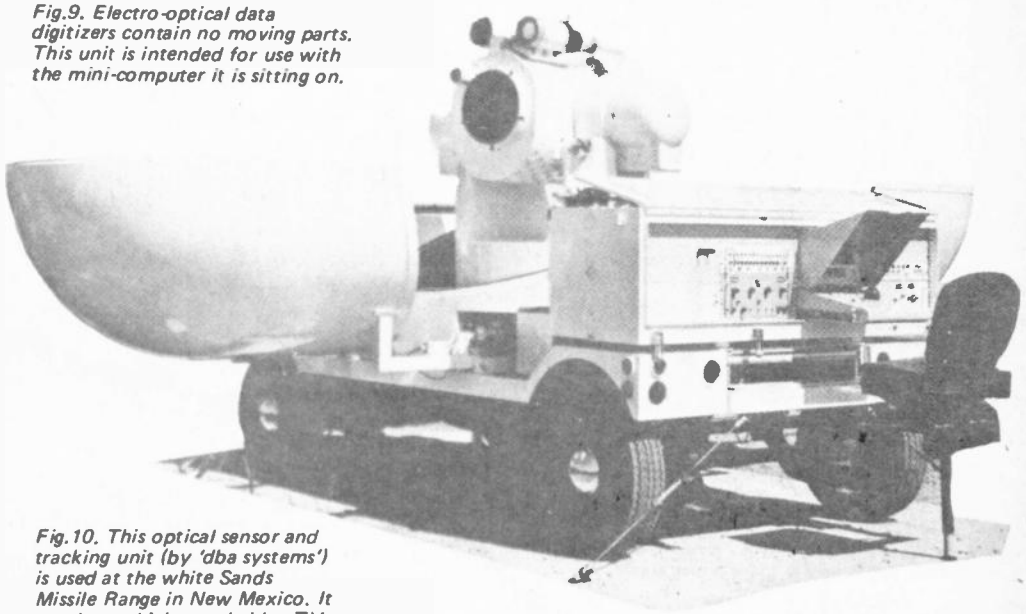

Fig.10. This optical sensor and tracking unit (by 'dba systems') is used at the white Sands Missile Range in New Mexico. It employs a high-speed video TV sensor that is controlled by a mini-computer.

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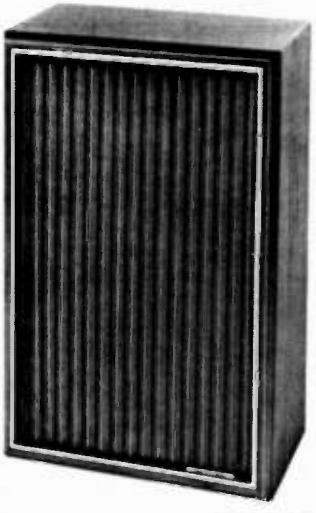

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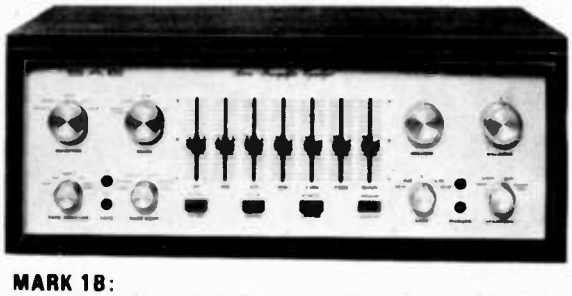

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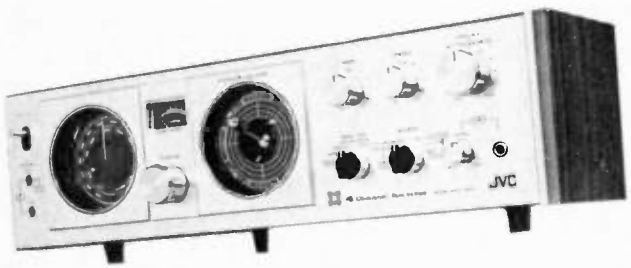

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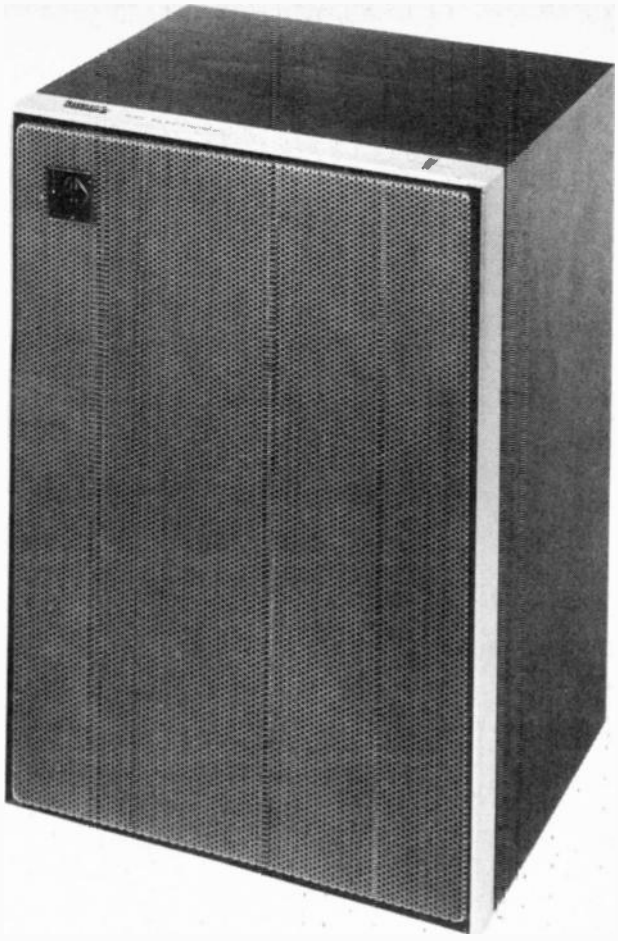
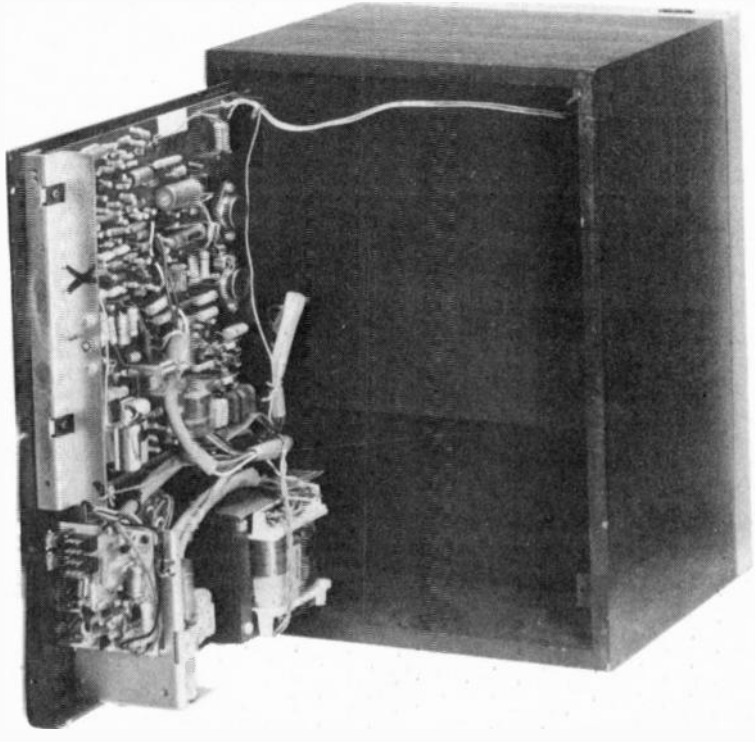


MOTIONAL FEEDBACK

Our October 1973 issue contained a short article describing Philip's Motional Feedback Loudspeaker.

The article attracted a great deal of reader interest and many people asked us for further details — here then is the full story on this new concept in loudspeaker design.



Main amplifiers and associated power supply are housed on this swing-out panel at the rear of the speaker enclosure.

NEGATIVE FEEDBACK has been used to reduce distortion in audio power amplifiers since well before World War II.

It functions by feeding back to the input a small sample of the output signal. The feedback signal is in opposite sense to the input (180° out of phase) and hence opposes the input signal. Thus the overall gain of the amplifier is reduced substantially.

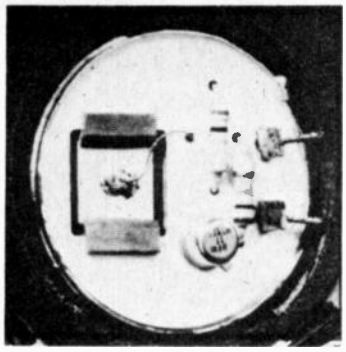
This loss in gain is more than compensated by three major advantages obtained by using feedback.

Firstly negative feedback tends to make the gain of the amplifier less dependant on the gains of the individual transistor stages within the amplifier, which can, and do change from device to device and with time. The bandwidth of the amplifier is also extended at both the low and high frequency ends.

Secondly, as the distortion components are also subject to feedback, they are reduced in the same proportion as the amplifier gain. Thus a power amplifier without feedback may have a distortion of 3%. With feedback this may well be reduced to 0.02% or less.

Thirdly, the input impedance is also increased by the same factor as the gain is reduced. Thus the operation of previous stages will be less affected by loading.

Thus the overall effect of feedback is to increase input impedance, increase bandwidth and reduce distortion.



This is the acceleration transducer – it is mounted at the apex of the bass driver speaker cone.

Although overall gain is also reduced, this can readily be compensated for in the pre-amplifier stages which are inherently less prone to distortion.

The use of negative feedback is absolutely essential with present-day amplifier technology – without it it would be impossible to reduce distortion to acceptable levels.

But in a conventional hi-fi system, negative feedback does not include within its 'loop' the very component that most needs it.

That is the loudspeaker.

Currently, the loudspeaker is very much the weak link in the hi-fi equipment chain.

HOW IT WORKS

The input signal to the enclosure is fed to an active high-pass filter and an active low-pass filter via the sensitivity switch SW2.

Both filters have a slope of 18 dB/octave.

The low-pass filter (base-emitter circuitry of Q1) passes signals from 35 Hz – 500 Hz. The signal is taken from the emitter of Q1 and then fed into a high-pass filter. This attenuates all frequencies below 35 Hz (at 12 dB/octave) thus preventing the feedback control loop from attempting to force the speaker cone into long excursion very low frequency movements.

The 35 Hz – 500 Hz signal, together with the feedback signal derived from the acceleration transducer, is now passed on to an adding circuit (Q3) which has a gain of approximately unity.

The combined signal is then fed to the power amplifier.

FEEDBACK CIRCUIT

As described briefly in the main text, the feedback transducer is a ceramic acceleration-conscious device clamped directly onto the bass driver voice coil.

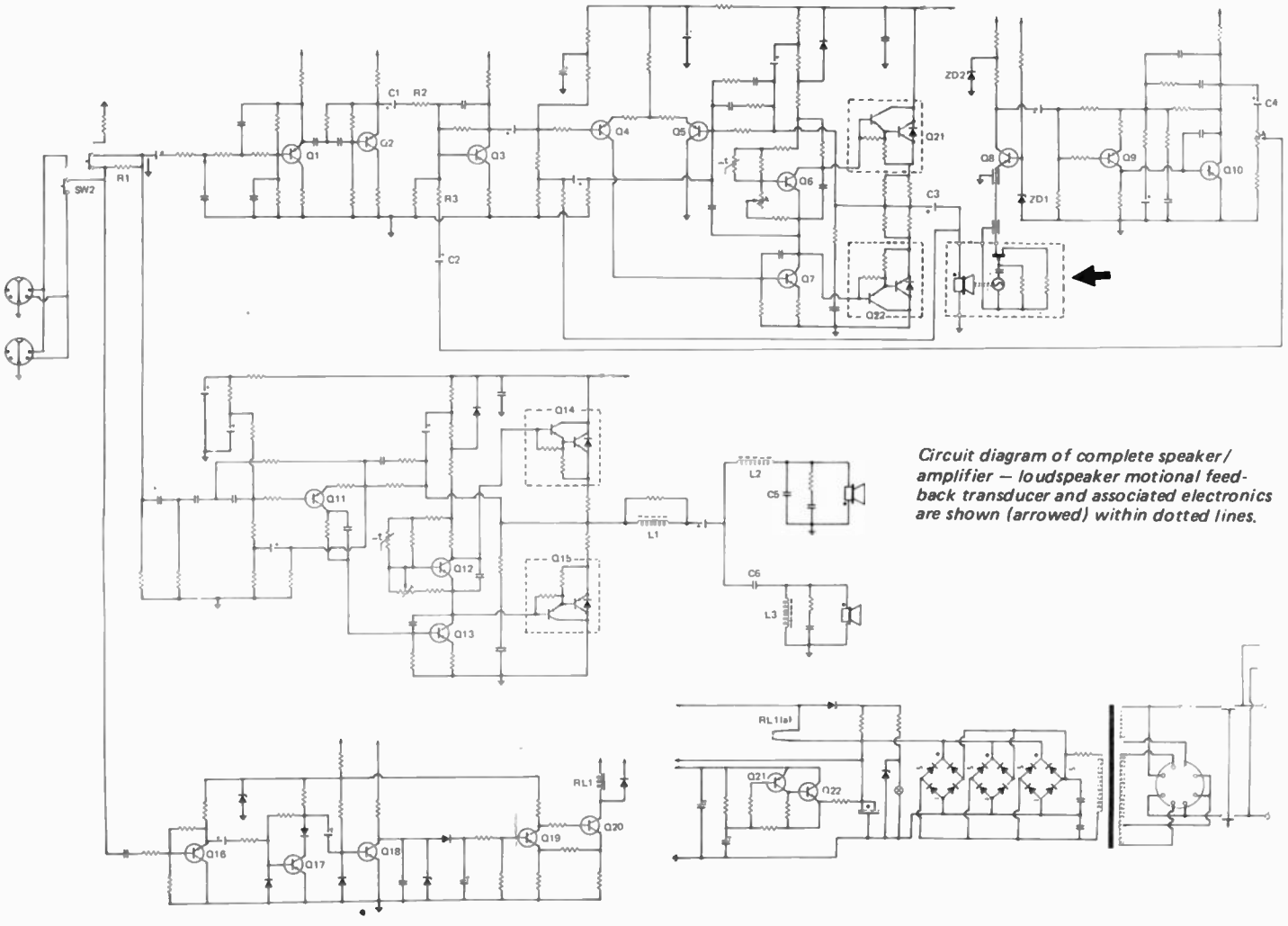
Transducer output is taken via Q8 to frequency correction stage Q9 and Q10. This stage has a flat response down to 80 Hz. Below that the signal has a slope of 6 dB/octave. Purpose of this correction stage is to 'tailor' the amplifier to suit the characteristics of the speaker itself.

MID AND HIGH FREQUENCIES

Signals above 500 Hz are handled by a second amplifier. This unit is of fairly conventional design. In order to eliminate cross-over distortion, operation is in class A up to one watt. Above that, the amplifier switches to class AB. The output stage is a fully complementary Darlington power amplifier.

The RC networks across both tweeter and mid-range drivers are for correcting impedance at high frequencies. The small coil (L1) at the amplifier output is for stabilisation.

Transistors Q16 – Q20 and associated components are an automatic switching circuit that disconnects power to the amplifier circuits if there is no input signal to the enclosure.



Circuit diagram of complete speaker/amplifier – loudspeaker motional feedback transducer and associated electronics are shown (arrowed) within dotted lines.

It is by far the most prominent source of distortion – particularly in the bass and lower bass regions – indeed the lowest usable frequency is often limited by harmonic distortion rising to unacceptable levels.

This fact has long since been realised by audio engineers – in fact a number of commercial hi-fi systems using overall negative feedback have been marketed in the past two decades.

Common to all these systems is the need to obtain an electrical signal proportional to the loudspeaker cone movement i.e. – the feedback signal.

Several ways of doing this have been tried.

Early techniques involved sensing the signal across the voice coil – or taking the signal from a second winding on the voice coil. Neither was wholly satisfactory.

Philips have used a new approach. They use a small transducer clamped to the cone of the bass driver itself.

The transducer used is a ceramic device which produces an electrical signal that is proportional to the acceleration of the cone.

Connected to the output of this transducer is a small amplifier stage which is used to correct minor frequency non-linearities inherent in the loudspeaker.

This arrangement – shown in dotted lines in Fig. 1 ensures a flat frequency response. The junction FET included in this circuit is an impedance matching device – Zener diode ZD1 ensures that the drain-source voltage of the FET does not exceed a predetermined value.

So far, Philips have used their new feedback technique in just one application. This is a small loudspeaker/amplifier combination – which they have named the '532 – Electronic'.

Although this is a physically small unit (380 x 286 x 21.6mm) it contains considerably more than would at first appear. Not only does it contain bass, mid-range and tweeter but two 40 watt amplifiers as well! The bass driver is a 203mm (8") unit. Motional feedback is applied to this unit alone – over the frequency range 35-500 Hz.

Power for this driver is supplied by a class AB 40 watt (into 4 ohms) amplifier.

The mid and upper ranges are covered by a 127mm (5") and a 25.4mm (1") driver. Both of these units are powered by a second amplifier.

This second amplifier is of similar design to the bass unit but is terminated in 8 ohms so that power output is limited to 20 watts. Sliding operation is used for this unit – it being class A at low levels and class AB at higher levels. This is done to minimize cross-over distortion.

Included within the enclosure is a complete regulated power supply, all that is required externally is a programme source and a pre-amplifier with an output of one volt or so – and a mains 50/60 Hz supply.

Clearly what Philips have done is to concentrate on obtaining improved performance from a small enclosure rather than using the new technique to improve performance per se.

The results are excellent. Low frequency performance is very good right down to 40 Hz, and distortion, at average sound levels is at least no worse than that normally generated by much larger enclosures.

Basically the end result is the type of performance that one would normally expect from a big enclosure – but Philips' new devices are small enough to sit on a bookshelf. ●

This Philips turntable/ tuner/pre-amplifier combination has been specifically designed to match the motional feedback speaker/amplifier enclosures.

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.

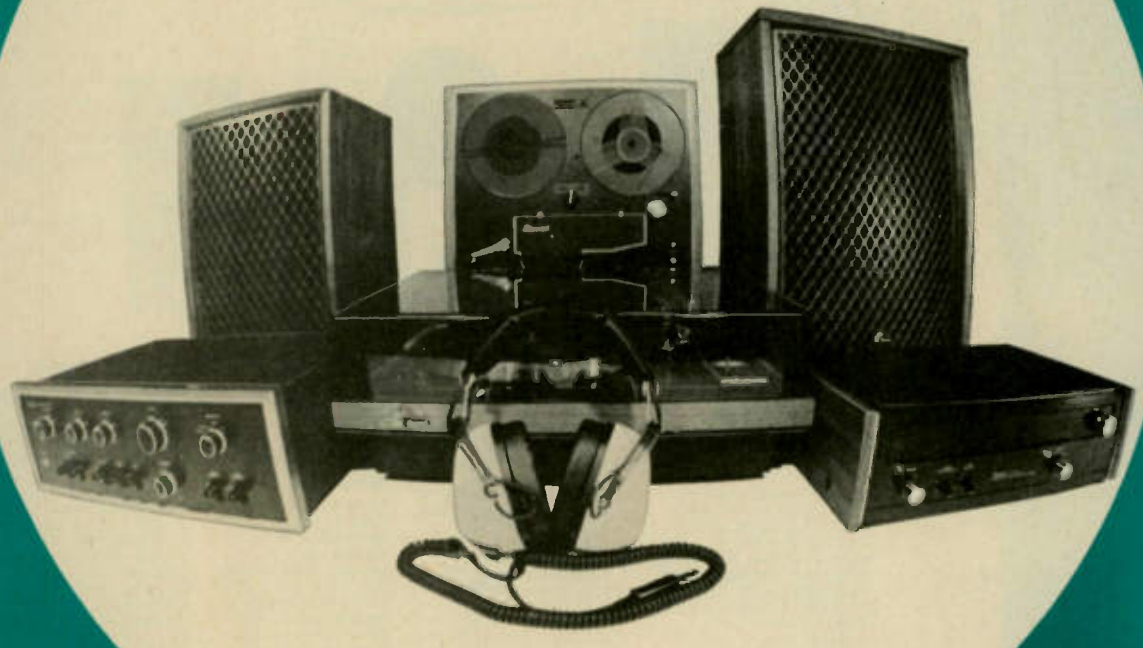
Sansui

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, Sugiaami-Ku, Tokyo, Japan.

Sansui Distributors: Australia, excluding W.A.:

RIA — 1745

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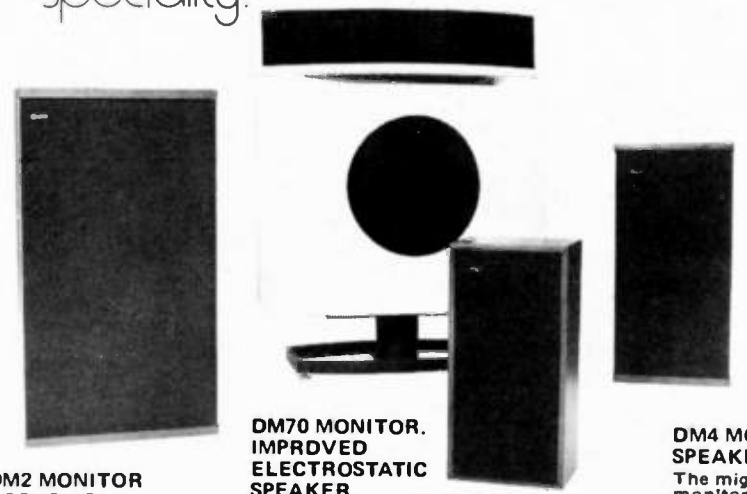
At Convoy Technocentre, they know what they're listening about. When you specialise in the best hi-fi equipment you have to.

Spend $300-$3,000 or just a little of your time. Call in and talk over your particular hi-fi needs. The people at Convoy will listen; after all that's their speciality.



DM2 MONITOR ACOUSTIC LINE SPEAKER
The DM2 is a 3 unit medium size monitor loud speaker, employing an acoustic wave line system for extended low frequency response, exceptional mid frequency linearity and high power handling. Power handling: suitable for all quality amplifiers with true RMS output of between 25-60 watts.

DM70 MONITOR. IMPRDVED ELECTROSTATIC SPEAKER
The ultimate in non-compromised sound. The DM70 is a hybrid design employing an exclusive 11 element, wide dispersion electrostatic unit, and a 13" high powered, low distortion, moving coil base unit. Power handling: suitable for all quality amplifiers with a true RMS output of between 25-60 watts.

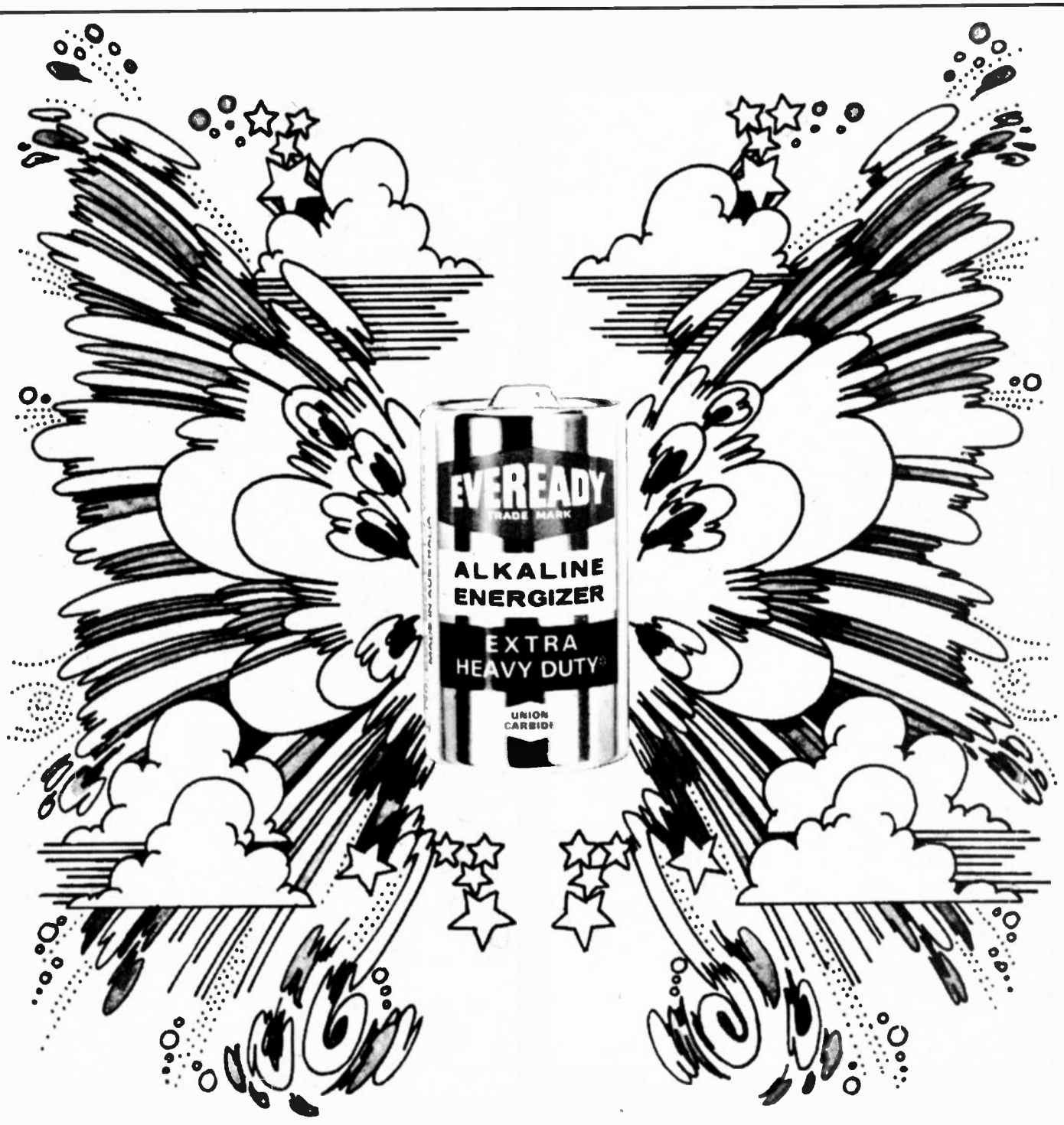
D5 MONITOR SPEAKER
True sound value. This is the speaker ideally suited for the person who wants B & W quality in compact size at a budget price. Power handling: suitable for all quality amplifiers with true RMS output of between 10-25 watts.

DM4 MONITOR SPEAKER
The mighty mini monitor. Small in size . . . enormous in sound reproduction, from high to low frequency. This is the sound they said could not be obtained in a speaker of its size! Power handling: suitable for all quality amplifiers with true RMS output of between 10-30 watts.

B&W

Convoy Technocentre. The white building facing the end of Plunkett Street, Woolloomooloo. Open all day Saturday and late Thursday. Ample parking.

Convoy Technocentre
Phone 357 2444



To Dream the Impossible Battery.

Why impossible?
Well, a battery which outperforms all others, with continuous use in high drain equipment; a battery to operate over a wide range of temperatures; remain utterly sealed; deliver a more consistent voltage at all times; give low impedance and resultant fidelity improvement in sound equipment.

Whew. But, we built it. 'Eveready' Gold Alkaline Energizer. Against all odds.
Spread the word.
The impossible can happen.

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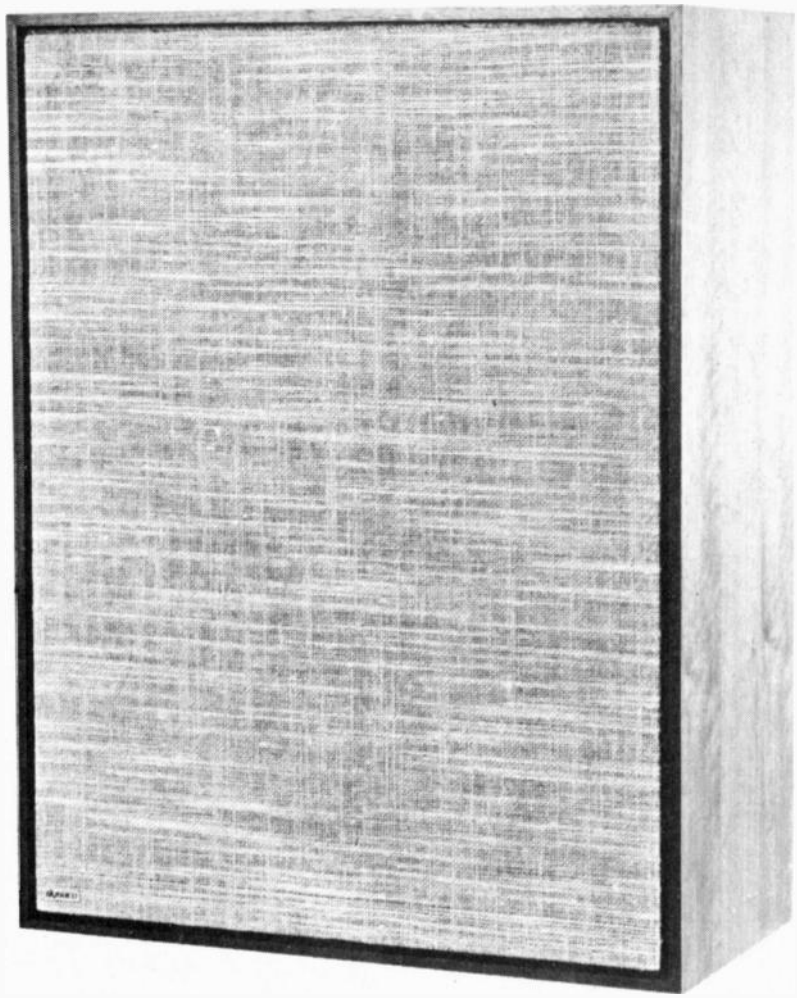


ETI PRODUCT TEST

(Recommended Retail Price $450.00 per pair).

DYNACO A-50 LOUDSPEAKERS

'high sound levels, especially at bass frequencies'

DYNACO manufacture a number of speaker systems incorporating what they call aperiodic venting. These speakers incorporate identical woofer and tweeter designs and vary only in size of enclosures and slight variations in venting arrangements.

The A-50 is the big brother of the range. It has a similar appearance to that of the A-25 (reviewed ETI, March 1973), with a teak finished enclosure and a plain flecked beige face cloth. The face of the grill cloth fits flush with the woodwork leaving a darker 1cm border which accentuates the lighter cloth.

Two 25 cm woofers are located in an exclusive double compartment cabinet design with each woofer internally vented to the other. This results in a variable volume action providing critical damping at resonance.

The enclosure also incorporates a 3.5 cm dome tweeter with a cross-over frequency of 1 kHz. The enclosure is fully sealed externally relying entirely on internal venting for damping. This system provides a flatter frequency response and acoustic impedance than would normally be possible with a conventional design.

HOW THEY SOUNDED

Subjectively, the speaker had a well-defined high frequency response. This was very noticeable with string instruments (which generate higher harmonics above 10 kHz). However the excellent high frequency response was not equalled in the mid-frequency

range. This was confirmed by subsequent measurements.

The frequency range between 1.5 kHz and 8 kHz had a pronounced dip which left the listener with the feeling of not being amongst the music, a disturbing effect of somehow being too far away.

Dynaco have achieved a very good blending through the cross-over frequency range – as is shown in our frequency response, where it is virtually impossible to pick the cross-over point.

The low frequency drivers have been well designed and cope very well with transient energy. This is probably a result of the individual tailoring of the speakers to minimise overshoot on very low frequency square waves. Dynaco's use of two identical woofers has resulted in clear sound up to 1 kHz, and enables the enclosures to handle considerable bass power – very noticeable on prolonged drum rolls for example.

The careful attention paid to the woofer design has not been carried over to the tweeter to the same extent.The speaker reproduces high frequencies extremely well on axis but is very directional – as shown in our measured results at 30° to the axis. There is a loss of presence in the mid-range frequency response and this is further accentuated by the ever present mid-frequency absorption of a normal living room.

MEASURED PERFORMANCE

The A-50s showed a very good frequency response, being ±7 dB from 40 Hz to 20 kHz. Distortion at a normal listening level was below 1%.

Frequency analysis of the distortion showed a marked increase between 2 kHz and 7 kHz compared to frequencies either side of this range.

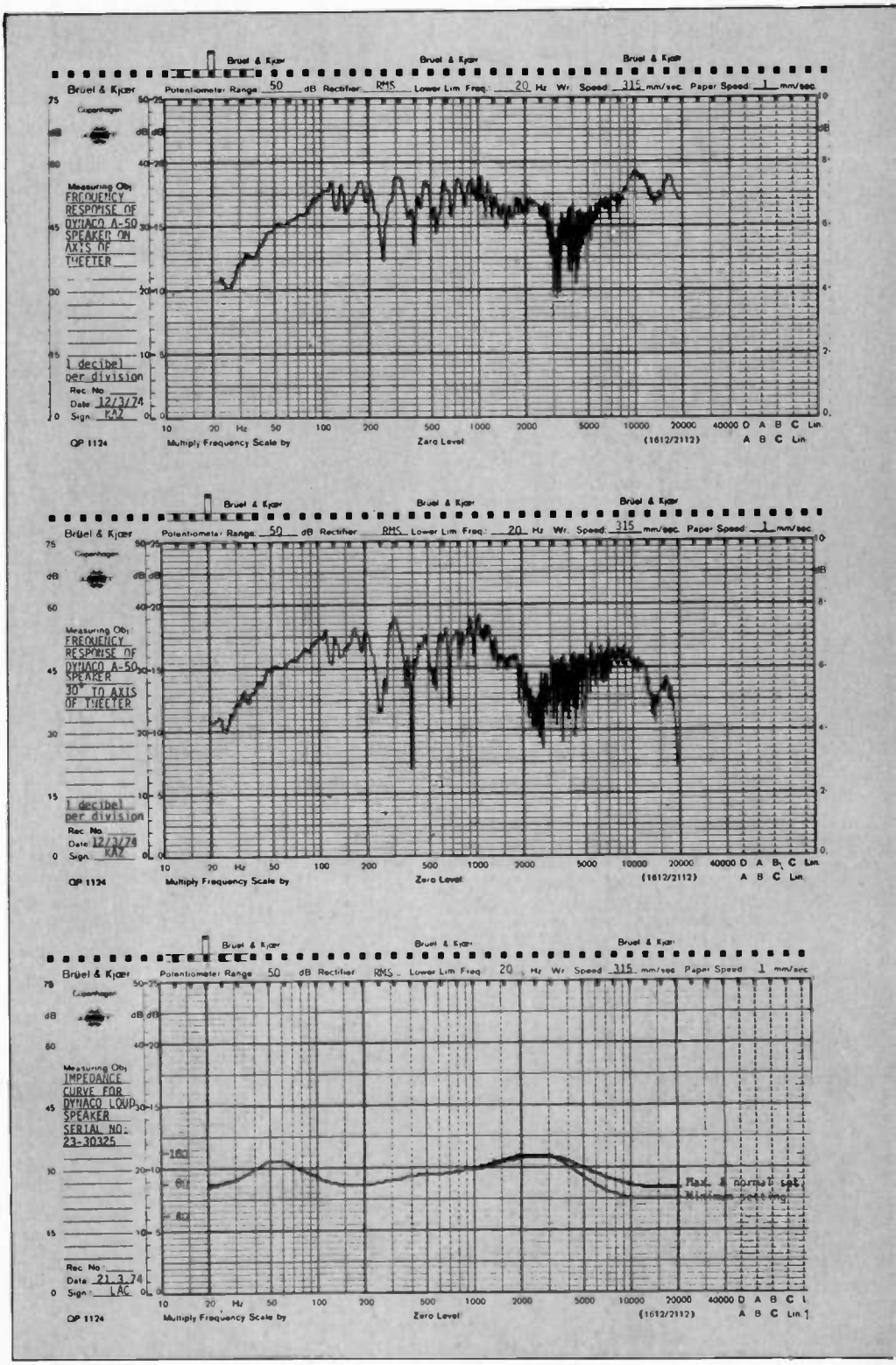
This increase in harmonic distortion was not markedly noticeable in subjective analysis because of the loss in sensitivity at these frequencies as shown in our frequency response curve.

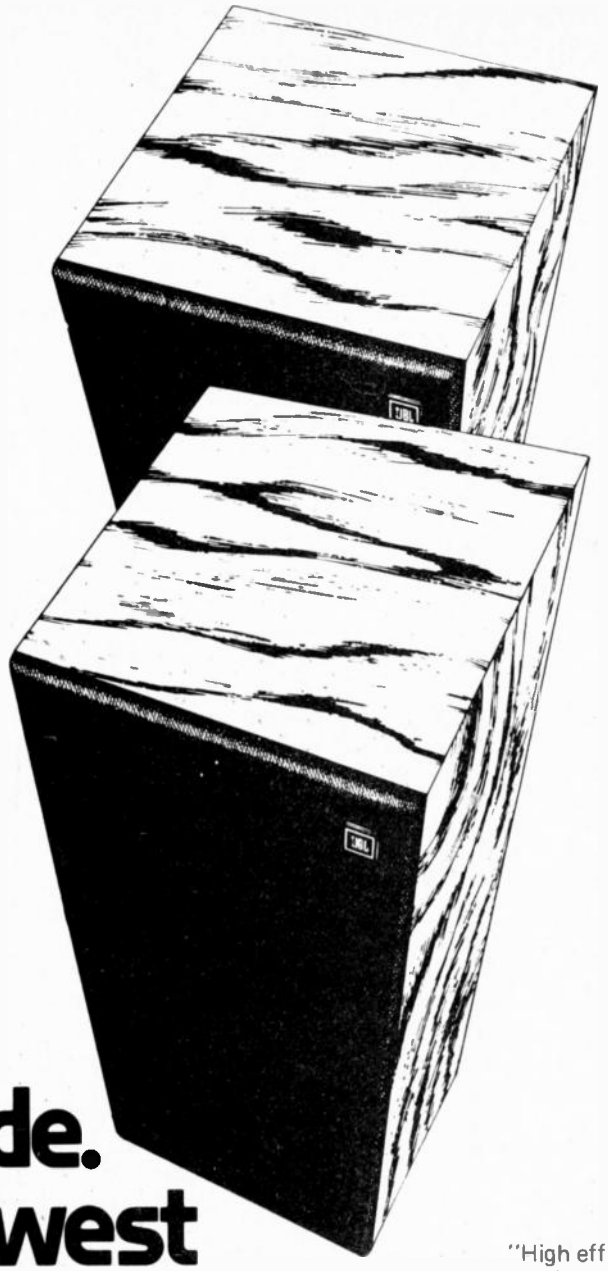
The electro-acoustic efficiency was slightly better than that of the A-25, being in the order of 0.5% – the lower range of sensitivity for speakers of this general type.

The A-50s outperformed their smaller counterparts, the A25s, and this was specifically noticed during high level organ music and drum beats. We found that at normal listening levels it was difficult to induce the woofer to break up. Extended drum beats brought about the familiar distortion heard on most other speakers but with the A-50s this distortion was only apparent at much higher listening levels.

Performance was in fact extremely good in the low and very high frequency region, and most instrumental records were reproduced very clearly. However, vocal pieces, and some instrumental records, showed up an annoying tendency of being too 'distant'. This was probably accentuated by the relatively high mid-frequency absorption in our listening area and may well be less disturbing in an area not fitted with heavy curtains and soft carpeting. This loss in mid-frequency sensitivity tended to be masked by the poor off-axis high frequency response.

Considering the size of the enclosure (54 x 71 x 25 cms) the low frequency response is very good indeed and combined with its moderate mid-frequency and excellent high frequency performance the Dynaco A-50 would be a reasonable speaker for the enthusiast seeking high sound levels especially at bass frequencies.



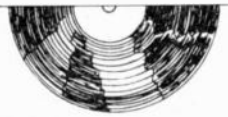


Decade.
JBL's newest loudspeaker.

(The price has been strategically placed in a later paragraph of this advertisement. We can't have you running into your JBL dealer's because of "price." That's not even the right reason.)

Some of us think Decade is the best two-way sound system we've ever made. If you'll forgive a few buzz words, we'll tell you why:

"Definition." That's a loudspeaker's capacity for letting the listener hear each part, every part of a whole sound. JBL's Decade has almost perfect definition.



What makes JBL loudspeakers so different from the rest?

Well, we grew up on the other side of the sound tracks, in the music business, making loudspeakers for recording engineers, professional musicians – people who listen to music for a living.

Would it impress you to know that the top professional recording studios like Warner Brothers and Capitol and Elektra and MGM use JBL loudspeakers to record, play back, mix down and master their music? It's true.

"High efficiency". Very important. Most loudspeakers are low efficiency speakers they need a big amplifier to give you back a big sound. Not JBL. The big sound is built in, and a little amplifier goes a long way.

"$189". That means if you've been saving up for a JBL loudspeaker, stop.

Come hear JBL's new Decade. Except for the price it sounds expensive.

JBL

James B. Lansing Sound Inc. 3249 Casitas Avenue, Los Angeles 90039. High fidelity loudspeakers from $189 to $4,000.

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DYNACO A-50 LOUDSPEAKERS

MEASURED PERFORMANCE OF DYNACO A-50 SPEAKER
SERIAL NO: 23-303252

Frequency Response		± 7 dB	40 Hz-20 kHz
Total Harmonic Distortion			
(for 90 dB at 2 metres on axis)	100 Hz	1 kHz	6.3 kHz
	0.9%	0.4%	0.6%
Electro-Acoustic Efficiency at 1 kHz			
(for 90 dB at 2 metres on axis)			0.5%
Cross-over Frequency			1 kHz
Measured Impedance	100 Hz	1 kHz	6.3 kHz
	8Ω	12Ω	10Ω
Weight	21.3 kg.		
Dimensions	540 x 711 x 254 mm.		

COMMENT

We have come to expect very fair and objective criticism and subjective examination of products submitted for scrutiny by your technical section. The present review is no exception.

The comment we wish to make is perhaps timely, and while it is particularly true of the Dynaco loudspeakers from our range, to be absolutely fair, it is true of many fine products fully imported by our competitive colleagues in the Hi-Fi Industry.

Dynaco loudspeakers are the same price today as they were when we first started business in 1972. The reasons are (1) Australian market acceptance resulting in bulk purchases (2) government reduction of duty.

Even though shipping and handling charges have virtually doubled in this two year period, no price rises in the Dynaco loudspeaker range are envisaged (before May 18).

Bill Martin
Jervis Australia Pty Ltd.

Now there's no need to worry about selecting components, connections, complex operations and adjustments for wonderful 4-channel stereo sound. Sony has solved the problem with Model SQP-400A. We successfully and triumphantly compact all the necessary components in the SQP-400A for excellent 4-channel stereo sound: FM stereo/FM-AM tuner, disc player system, amplifier and 4 two-way speakers. With this model alone you can enjoy all available 4-channel performances: SQ and other matrix records and FM broadcasts. The SQP-400A finds signals hidden in ordinary 2-channel stereo sources and feeds them to the back speakers for 4-channel effects. And it comes complete with inputs for discrete sources such as 4-channel tape decks. The facilities are carefully designed and easy to operate. The true-to-life sound leads you into a wonderland—sometimes the softness of the music will move you, other times the dynamic force of the music will excite you. The SQP-400A is for those who want to enjoy rich 4-channel sound easily and fully at a truly competitive price

YOU CAN'T GET COMPLETE 4-CHANNEL MORE COMPACT THAN THIS! And it's Sony-For only $439·60*

*Recommended retail price

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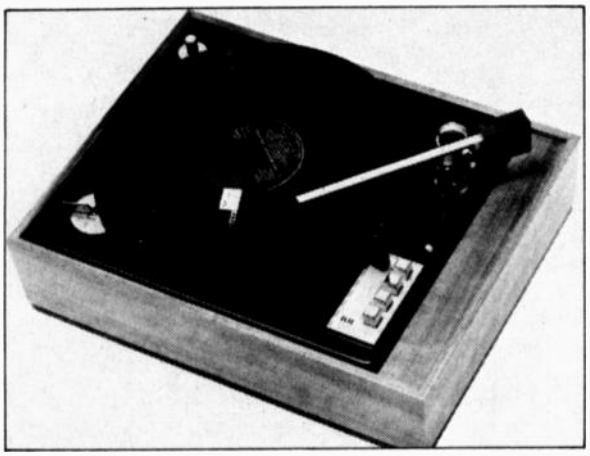
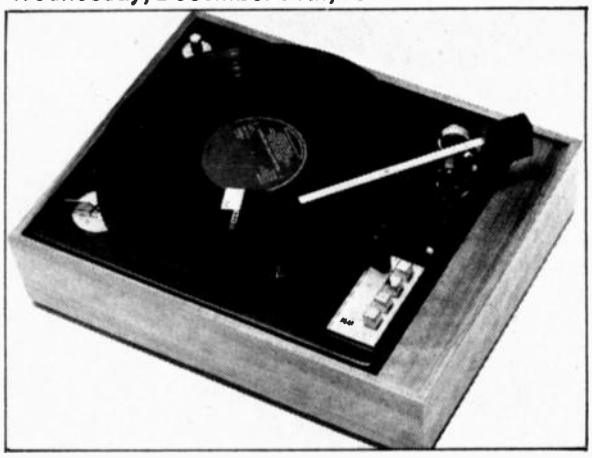
SK463

9 a.m. Monday, April 2nd, 1973.



6,160 hours later:
Wednesday, December 26th, 1973.



The Sceptics gave up.

Choosing the right turntable is extremely important. You want it to give first rate reproduction, to look good, to be reliable, and to not wear out your records.

The people at Sutherland Sound Fidelity Centre were a little sceptical about our reliability and non-record-wear claims.

Over 8 months of 1812

So they took the Elac Miracord 50HII turntable, put it in their window tilted at a 40° angle for display (incidentally, they thought it would make the turntable work that much harder) and started to play Tchaikovsky's 1812 Overture.

The turntable was set on automatic replay so it played continuously.

They sat back and waited . . . and waited . . . and waited . . .

Eight months and three weeks later, they'd had enough Tchaikovsky to last them a lifetime.

They were tired of waiting for the turntable to fall apart and decided the point had been proved.

A Lifetime's wear and tear

The Elac turntable had played one side of the 1812 Overture 21,120 times, at an angle of 40°, for 6,160 hours. Continuously.

The platter had revolved 12,318,768 times. The Elac's motor rotor had revolved 554,400,000 times.

The Elac turntable had gone through more than a lifetime's wear and tear, yet the mechanism was in surprisingly good condition. And, whereas lesser motors would have burnt out long before, the Elac motor showed very few signs of the gruelling test.

No grumble from the grooves

The record and the 50HII were then sent to Louis Challis and Associates a NATA laboratory, and internationally recognised authorities on the testing of hi-fi equipment.

Their verdict: the record showed a remarkably low level of wear — consistent with what they expected to find for a record having been played less than 200 times and certainly not over 21,000 times. Proof that an Elac will not wear out your records. Secondly, after a mere change of the idler wheel, the turntable almost met its original specifications. Proof that an Elac Turntable will give you the ultimate in reliable performance.

So if your a little sceptical about turntables — choose an Elac.

"We couldn't stand it any longer."

Sutherland Sound Fidelity Centre.

ELAC

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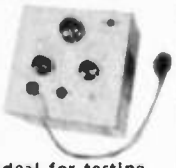
PRE-STOCKTAKING

CLEARANCE SALE

DEFINITELY THIS MONTH ONLY

AUDIO OSCILLATOR MODULE



An attractive valve oscillator with a frequency 12 HZ to 50 kHz in 5 ranges plus spot calibration frequencies of 100 HZ, 1 KHz, 10 KHz. Frequency adjustment is by way of fine and coarse controls but is not calibrated to scale. Ideal for testing amplifiers and radio etc. Operates from 240V AC, with power supply kit supplied and is Australian-made. Finished in grey hammertone with engraved aluminium front panel. Size 6" x 6" x 4" deep. Price $13.50., post 50c.

DUPLEX LIGHT BEAM SWITCH

A 3 transistor electronic switch featuring stop/start functions using 2 photo-diodes. Ideal for batch counting, industrial control, proximity switching etc. Circuit-diagram and application data included. Operates from 12V DC and is housed in clear plastic case. Price $3.25, post 25c.

MINI-RELAYS

I.B.M. Silver Wire change-over Relays. Operating voltage 24V-48V, 4 pole 20c ea. 6 pole 25c ea. 12 pole 30c ea. Compact in size suits P.C. Board mounting. Post 20c.

RUNNING TIME METER

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3 WATT AM.P. TRANSISTOR PAK

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eti PROJECT 310

IGNITION TIMING LIGHT

◀ *The ignition timing light complete with battery leads and spark-lead transducer.*

Obtain maximum performance and economy from your car.

A CAR'S performance and fuel consumption is affected quite drastically by the condition of the ignition system and upon correct ignition timing.

Before the advent of high performance engines and high octane fuel, ignition timing could be optimized by adjusting it until 'pinking' could just be heard under heavy load at low speed in top gear.

But these days have long since gone. In fact if an engine, running on high octane fuel, can be heard 'pinking' then it is grossly over-advanced and bearing damage will be caused.

Despite this there are still garage mechanics who blithely set ignition timing 'by ear'.

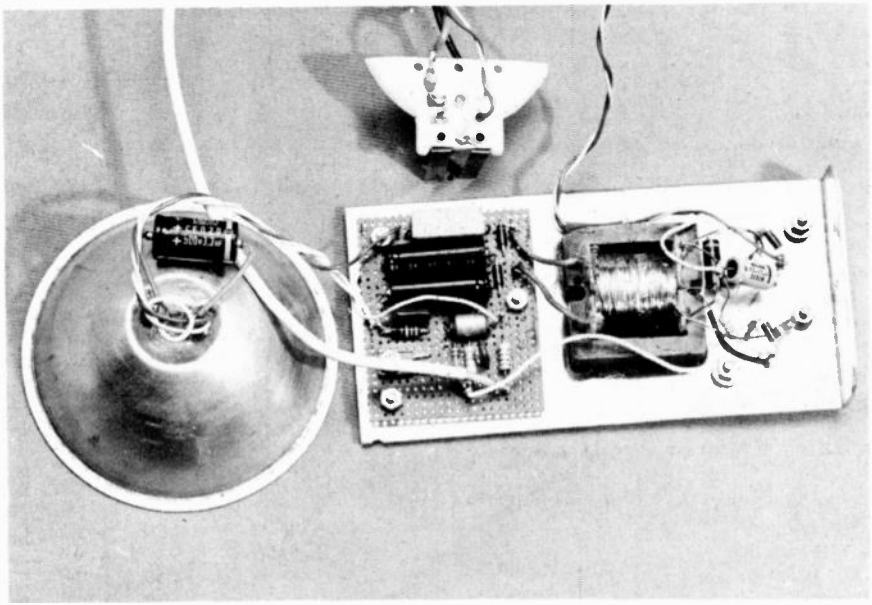
There is only one way to set ignition timing accurately. That is with a timing light specifically designed for that purpose.

Timing lights in common use range from a simple neon to the complex units used by auto electricians.

Neon timing lights are barely acceptable. Their light output is necessarily limited – to the extent that most have to be used in darkness. And, due to their low light output, they become a safety hazard as one attempts to hold them close to the timing mark – and to the rapidly turning fan blades.

Timing lights incorporating a Xenon flash tube are a much better proposition. As with neon lights, they are triggered by the firing of the first sparking plug in the engine firing order, but, as their flash energy is supplied directly from the vehicle battery they have a much greater light output.

The simple unit described in this project operates in this way.

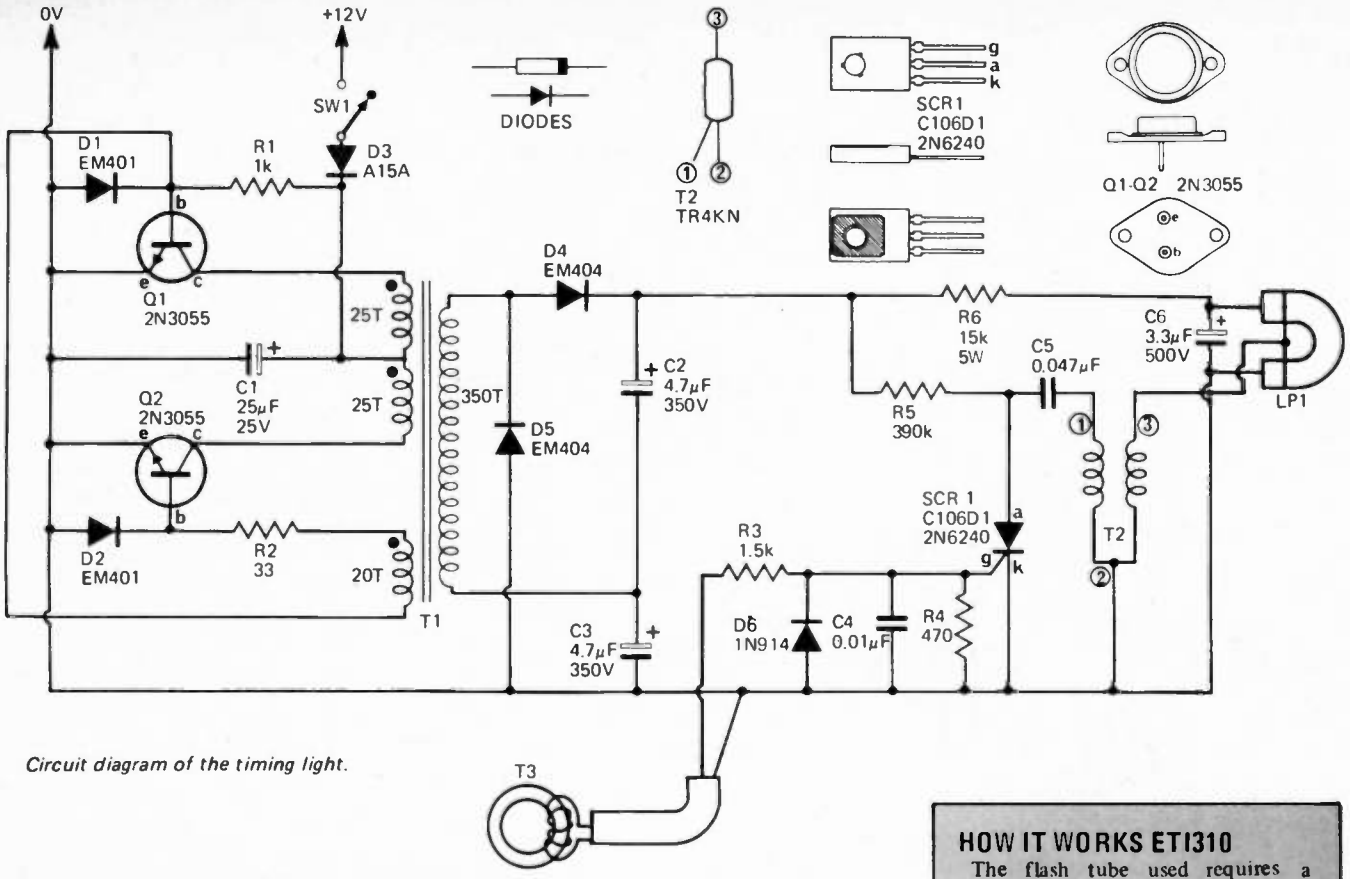


The completed electronics of the timing light. Note that diode D3 is mounted on the rear of the switch assembly and C6 on the rear of the reflector.

CONSTRUCTION

The layout and construction of the timing light will vary depending on the housing.

We purchased a cheap torch (readily available from chain stores) which



Circuit diagram of the timing light.

TABLE 1. Transformer Winding Details

WINDING	TURNS	GAUGE	NOTES
Primary 1	25	20 B&S	Bifilar wound
Primary 2	25	20 B&S	
Feedback	18	26 B&S	
	0.01 inches insulation between primary and secondary windings		
Secondary	350	26 B&S	

Core 2 x "E" core Philips type 4322 020 34720
Coil Former Philips type 4312 021 28622
or Philips type 4322 021 31830
(the latter type has solder pins on former)

TABLE 2. Transducer Winding Details
Core Philips type 4322 020 36570
20 turns of audio coax, inner as detailed in text and illustration.

NOTE

The peak current drawn by the flash lamp is approximately 50 amps. This current is supplied by the discharge capacitor C6 and is in excess of manufacturer's ratings. Even polyester or paper capacitors (which are larger and more expensive) are not designed for such peak currents and, although they would last longer, are not really economical to use.

Hence it is recommended that when the flash tube requires replacement, (20-100 hours of use) capacitor C6 also be replaced.

SPECIFICATION

Energy per flash	0.2 joule
Maximum flash rate	>50/sec (6000 rpm)
Trigger method	current transformer on No 1 spark lead.
Input voltage	10-14 volts dc

HOW IT WORKS ETI310

The flash tube used requires a supply of 300 to 400 volts. This is obtained by stepping up the vehicle 12 volts supply by means of an inverter.

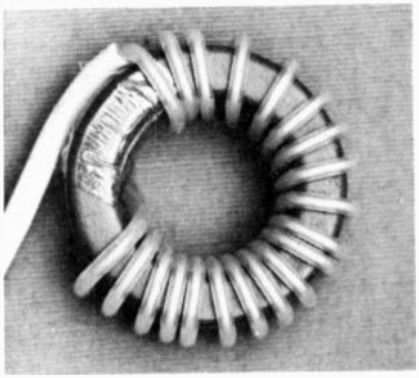
Transformer T1, together with transistors Q1 and Q2 form a self oscillatory inverter. The frequency of operation, 2 kHz on 12 volt supply in our case, is primarily determined by the core material, the number of primary turns and the supply voltage. Protection against reversed supply leads is afforded by diode D3.

Output from the secondary of T1 is voltage doubled by D4, 5 and C2, 3 to provide about 350 volts dc which charges C5 via R5.

The pickup coil T3, which is fitted over number one spark-plug lead, generates a pulse when the spark plug fires and draws current through the lead. This pulse is used to trigger SCR1 into conduction thus discharging C5 into the pulse transformer. The secondary of the pulse transformer provides a high voltage pulse, to the trigger electrode of the flash tube, causing the gas to ionize. The tube becomes a low resistance and C6 discharges through the tube providing the flash energy. Whilst the flash tube is in a virtual "short circuit" condition, current from the inverter is limited by resistor R6.

When capacitor C6 is fully discharged, the tube reverts to a high impedance allowing C6 to be recharged via R6. The current in R5 is not sufficient to hold SCR1 on and it too ceases to conduct. The maximum flash rate is in excess of 50 per second corresponding to 6000 RPM on a four cycle engine.

IGNITION TIMING LIGHT



How the transducer is made.

takes four size 'D' batteries.

Our layout and method of construction can be seen from the illustration but this can readily be varied to suit the housing used.

As there are only a few components, tag strips or veroboard could easily be used – rather than matrix board.

The inverter power transistors should be mounted on, but insulated from, a heatsink made from aluminium sheet of at least 40 square centimetres area.

Details of the transformer are given in Table 1. As there are relatively few turns, this transformer may quite readily be wound by the home constructor. Ensure that the polarities of the primary (25T + 25T) and feedback (20T) windings are as shown in the circuit diagram – this is important!

If the unit will not oscillate, (you will hear a 2 kHz whistle when it is oscillating) try reversing the feedback winding.

The secondary voltage is around 350 volts and care should therefore be taken to insert insulation as specified in Table 2, between the primary and secondary windings in the transformer, and to keep the windings separate on the matrix board.

PARTS LIST

Ignition Timing Light ETI 310

R1	Resistor	1k	½ watt 5%
R2	"	33	5 watt 5 %
R3	"	1.5k	½ watt 5%
R4	"	470	½ watt 5%
R5	"	390k	½ watt 5%
R6	"	15k	5 watt 5%
C1	Capacitor	25µF	25 volt electrolytic
C2,3	"	4.7µF	350 volt electrolytic
C4	"	0.01µF	polyester
C5	"	0.047µF	400 volt polyester
C6	"	3.3µF	500 volt electrolytic
Q1,Q2	Transistor	2N3055 with mounting kit.	
D1,2	Diode	EM401, 1N4001 or similar	
D3	"	A15A or similar	
D4,5	"	EM404,1N4004 or similar	
D6	"	1N914 or similar	
SCR1	SCR	2N6240,C106D1 or similar	
T1	Transformer	(see table 1)	
T2	Pulse transformer	TR4KN	
T3	Pickup coil	(see table 2)	
LP1	Flash tube	MFT-1000, MFT1210 or similar	

Reflector box, aluminium heat sink etc. see text.

The reflector of the torch may be modified to house the flash lamp in the following manner.

Remove the existing socket, using a pair of pliers or cutters, and file the opening until it is large enough to accept the flash lamp with about one millimetre clearance all round. Wind some tinned copper wire around the flash lamp, as shown in the photograph, to act as a trigger electrode, and bring the wire out between the two main electrodes. Insert the lamp from the front and use modeling clay at the rear of the reflector to hold the lamp and seal the opening. Then pour quick-dry epoxy cement into the reflector until there is sufficient around the base of the tube to secure it in place. Be careful not to get epoxy elsewhere on the reflector. When dry, remove the clay and use more epoxy to fill any recesses in the rear.

If and when the tube is to be replaced a hot soldering iron may be used to destroy the epoxy thus permitting removal.

The discharge capacitor, C6, should be mounted on the rear of the flash-tube/reflector assembly as shown in the photograph. Note also that we mounted diode D3 on the rear of the torch switch assembly.

The transducer is wound on a toroidal ferrite core, as shown in the photograph, using shielded audio cable as follows. Remove about 0.8 metres of the inner cable from its shield and wind 20 turns of this around the ferrite core. Then solder the end of the inner conductor to the shield thus creating a complete loop. Finally tape up the whole assembly as shown in the photograph.

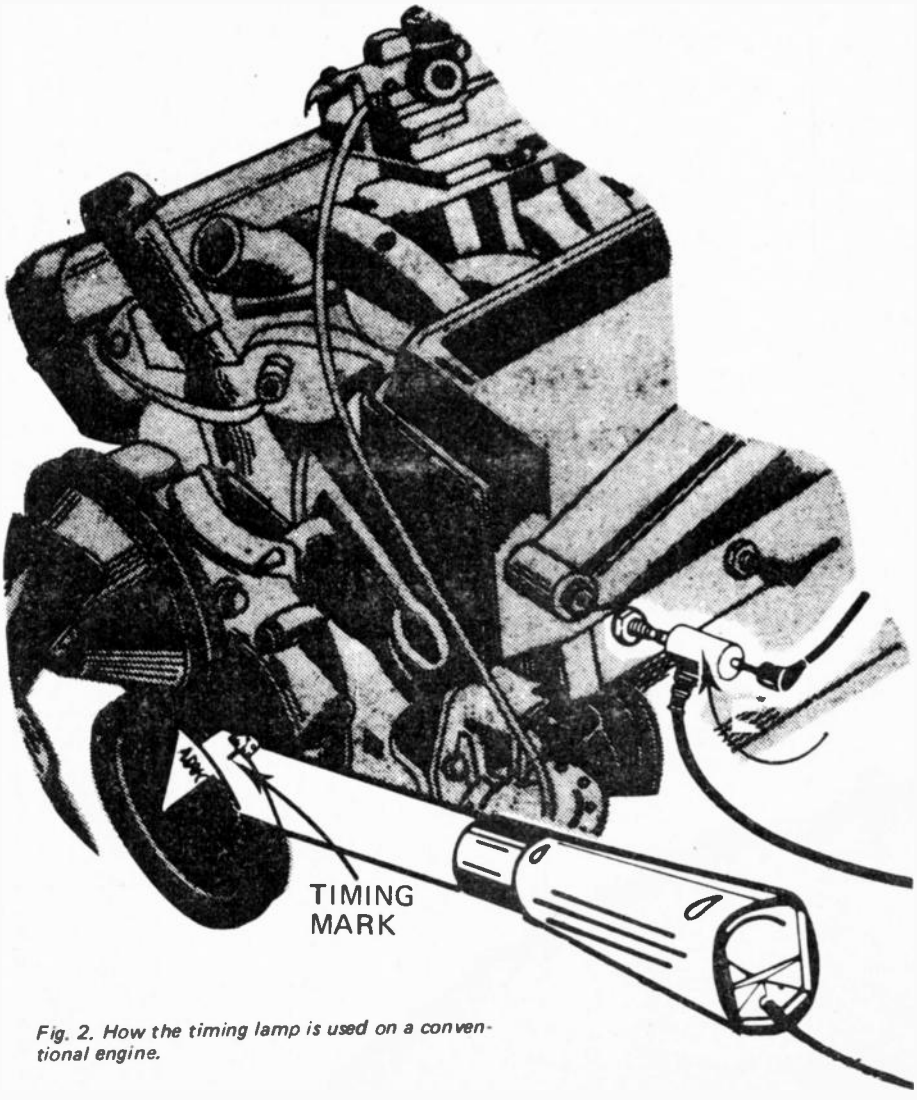


Fig. 2. How the timing lamp is used on a conventional engine.

USING THE TIMING LIGHT

To time an engine, first establish the position and *significance* of the ignition timing mark. This information will be found in the manufacturer's handbook.

The timing mark – usually displayed as an engraved '0' or straight line – is generally located on the crankshaft pulley or occasionally on the engine flywheel.

On nearly all modern cars the timing mark is engraved the appropriate number of crankshaft degrees before TDC. Certain others have a complete scale starting at TDC and extending to 40 degrees before TDC.

A few vehicles have the mark at TDC.

Some form of pointer will be found attached to the engine block – or flywheel housing – to act as a datum point for the timing mark.

Except where the timing mark indicates TDC only, ignition timing is a simple affair.

Firstly clean off any dirt or grease that might obscure the timing mark, then connect the timing light power leads to the vehicle battery and place the pick-up transducer over number one spark plug lead. Now start the engine.

The light should flash – note that the transducer produces more stable flashes with one side facing the engine block than the other. Establish which is the best way and mark the transducer accordingly.

Remove the rubber pipe to the vacuum advance mechanism (if fitted) and set engine tick-over to the speed recommended in the vehicle handbook. (if you don't have a rev counter set idling speed to lowest possible).

Now shine the timing light onto the timing mark. With the distributor clamp loosened slightly, slowly rotate the distributor a few degrees in either direction.

The timing mark will now appear to move relative to the datum pointer. Set the distributor so that the mark aligns exactly with the pointer and retighten the clamp once the correct setting has been obtained.

A very similar method is used for vehicles where the timing mark is a calibrated scale. In this case the manufacturer's recommended setting should be used.

Where the mark indicates TDC only it is necessary firstly to place a chalk mark at the appropriate number of degrees before TDC and to use this as the timing mark.

A quick check that the automatic advance and retard is working can be made by speeding up the engine. If all is well the timing mark should appear to move away from the datum pointer as engine speed increases.

If the timing mark appears to oscillate to and fro by more than a degree or so this is an indication that the timing is actually changing in this fashion. This is a fault generally caused by a worn distributor spindle, and/or sloppy drive to the distributor offtake.

Remember to re-connect the vacuum line when timing is completed. ●

WARNING

On some cars the fan blades rotate close to or at a multiple of the crankshaft speed. When strobed by the timing light, the fan may appear to be stationary or rotating slowly.

This is common to all strobe light timers and failure to remember this can result in serious personal injury, or a wrecked timing light.

ALWAYS – keep well clear of the fan.

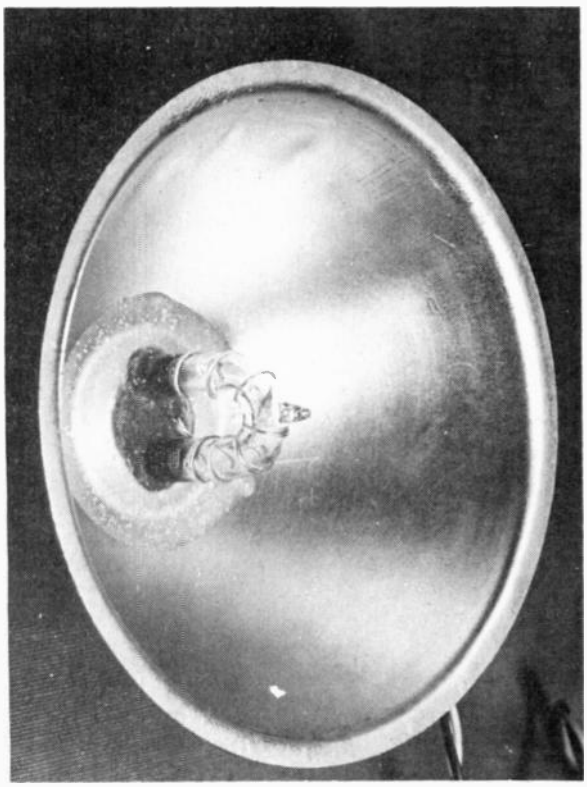
NEXT MONTH

A more complex version of this timing light will be described in ETI next month.

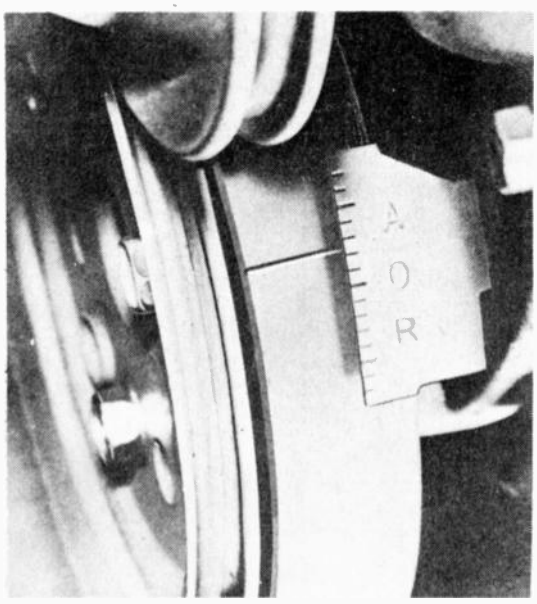
This more advanced unit incorporates a calibrated delay which indicates on a meter the actual degrees of ignition advance at any engine speed.

This not only allows very accurate timing to be obtained regardless of the timing mark form of indication, but enables the serious motoring enthusiast to check out the complete distributor advance curve.

The more advanced unit uses all parts specified for this month's project. Why not build now and update later!



◀ *Method of mounting the flash tube in a torch reflector with 5 minute epoxy. Note the trigger lead coiled around the tube and taken out through the bottom.*



A typical method ▶ of marking top dead centre on the crankshaft pulley.

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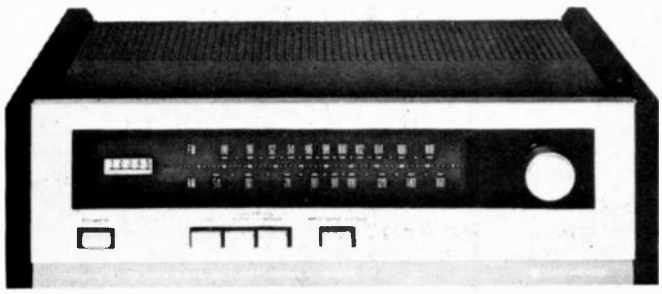

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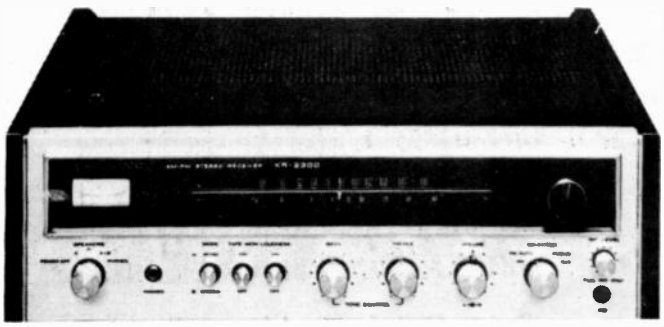

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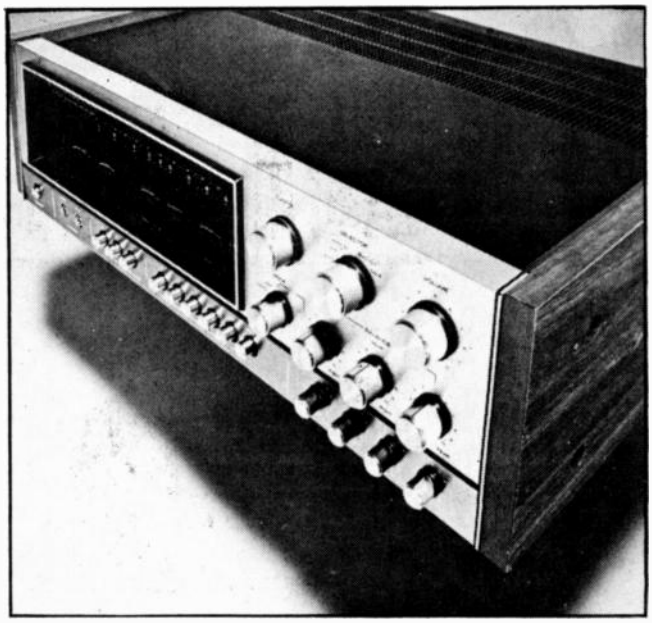

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JM/K-44-74

MONOPHONIC ORGAN

Due to a platemaking error in last month's issue, the component overlay for the monophonic organ was omitted from the printed circuit board pattern shown as Fig.3 (page 60). The correct drawing is shown here – if desired it may be cut out and pasted over the incomplete drawing in the May issue.

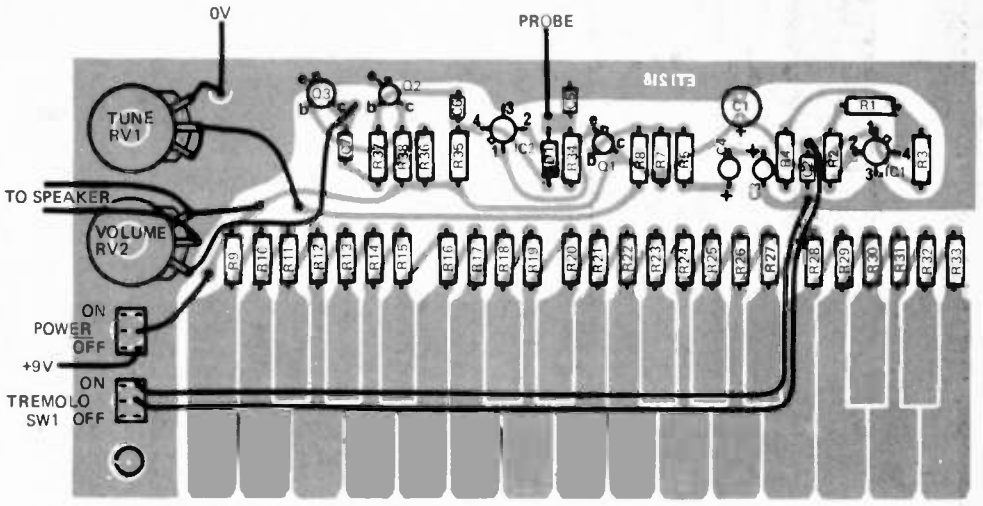

Fig.3. Component overlay shows positions of the components on the board. Watch polarities of capacitors, transistors etc.

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93. Ferrite Aerial with Coil — small flat ferrite rod 0.65" x 0.15" x 2.2" long with standard 2 section coil. $1.00.
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95. Radio Knob Asstd — a selection of 15 useful plastic and metal knobs suit car radios, mantels, portables, transistors etc., 15 for $1.00.
96. Miniature 5k ohm volume controls — for transistor radios. Universal type used by most manufacturers. Ideal for building pocket radios and for repairs. 4 supplied with plastic knobs for only $1.00.
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98. 3 Bank Push-Button Switch — from McMurdo — a modern, miniature Isostat switch bank for P.C. or lead wiring. Features 3 non-interlocking or independent DPDT switches mounted in one row with attractive black rectangular knobs. Would enhance the appearance of any amplifier or front panel. $1.45.
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100. 3 — SPST Rotary Wafer Switches — standard OAK Type, 3/8" mounting hole, ½" long shaft. $1.00.
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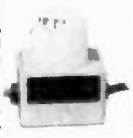

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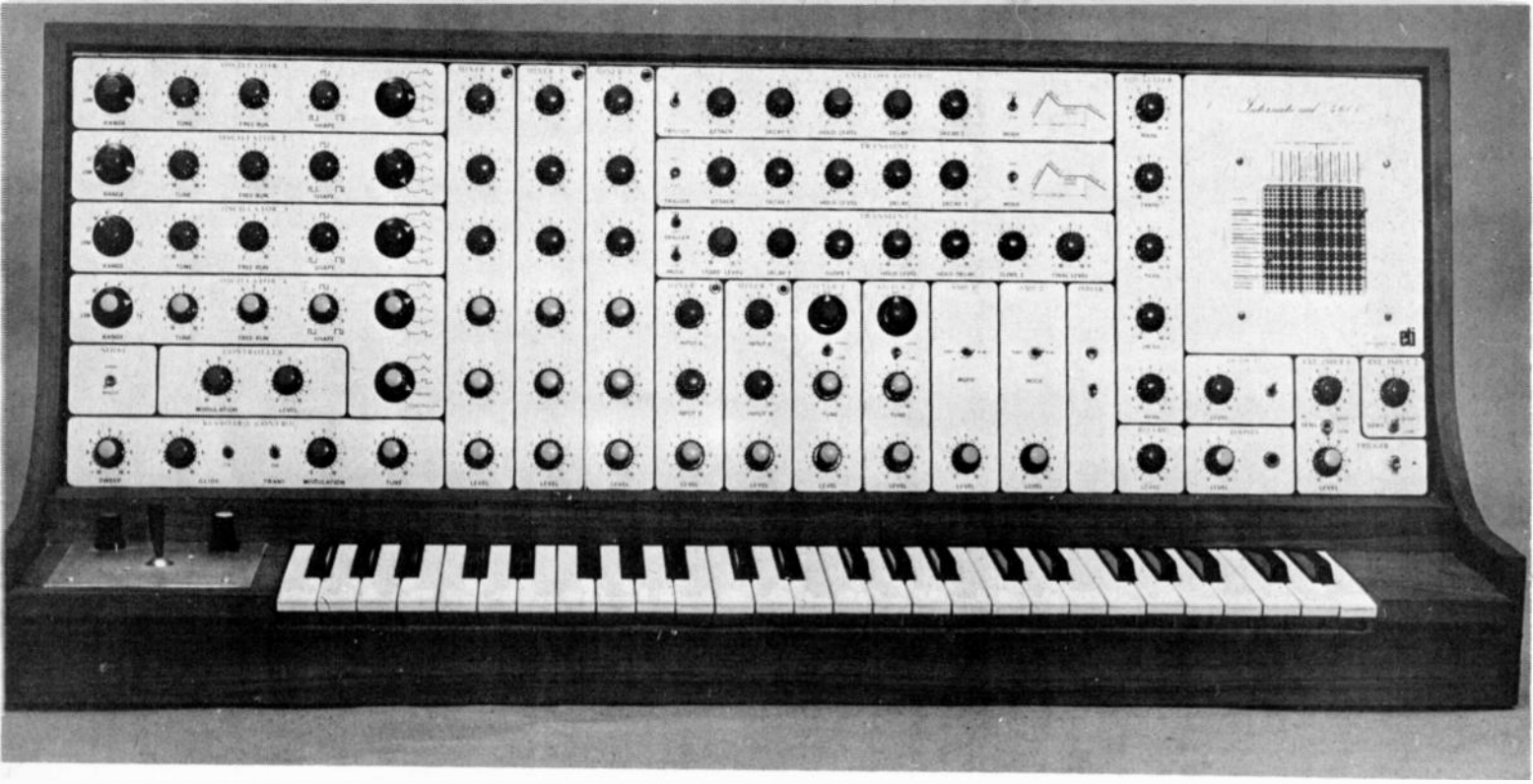


The completed International 4600 synthesizer.

INTERNATIONAL MUSIC SYNTHESIZERS

3600/4600

External input module, keyboard details — and a keyboard controller modification.

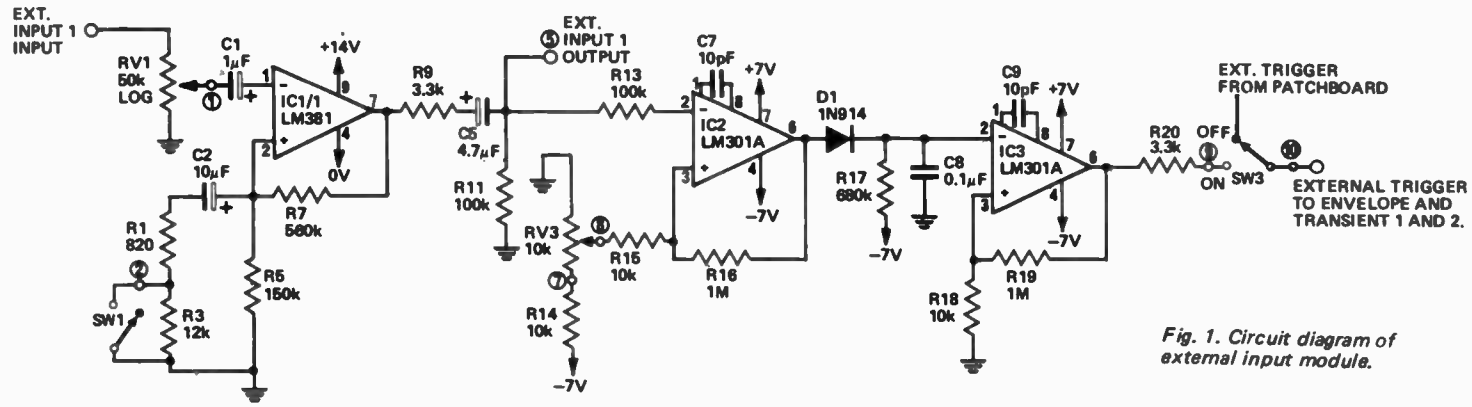


Fig. 1. Circuit diagram of external input module.

HOW IT WORKS – External Inputs

The two preamplifiers for the external inputs are provided by a low-noise dual integrated circuit type LM381. A 50 k potentiometer at the input allows attenuation of the input and sets the input impedance.

The LM381 IC differs from the normal operational amplifier we have been using in that it uses a single power supply of +14 volts and, in that the output has to be biased to

mid-voltage (7 to 8 V) by an external network – in our case R5 and R7. Gain of the amplifier is set by R7/(R1 + R3) and, since R3 may be switched in or out, two gain ranges are available. These are 56 dB and 32 dB (voltage gains of 630 and 40). These, of course, are fully variable by means of the input potentiometer.

The frequency response of the amplifiers is 20 Hz to 50 kHz +0 –3 dB.

Input 1 is provided with a trigger facility. If the peak negative output falls below the voltage selected by RV3, the output of IC2 (acting as a comparator) will go to +6 volts and remain there whilst the RV3 voltage is exceeded. At all other times the output of IC2 will be at –6 volts.

During the positive excursion of IC2, C8 charges rapidly to +6 volts and when IC2 goes negative again C8 discharges slowly via R17 to –7 volts. Another comparator, IC3, will have its output at –6 volts if the voltage on C8 is above 0 volts, and at +6 volts if the voltage on C8 is below '0' volts.

The envelope from a conventional instrument will usually have an initial attack period, a sustain period and then a decay. With this type of envelope the trigger will start high, go low whenever the envelope is greater than the preset level and then go high again. It will not respond to individual cycles due to the slow discharge of C8 by R17. The release time is about 20 milliseconds.

SPECIFICATION
EXTERNAL INPUT MODULE

Input levels	2 mV–5 V rms
Input Impedance	50 k
Frequency response	
20 Hz–50 kHz	+0 –3 dB
Maximum gain	
high sensitivity	56 dB
low sensitivity	34 dB
Trigger level	adjustable 0 to +5V
Trigger release time	approx 20 mS

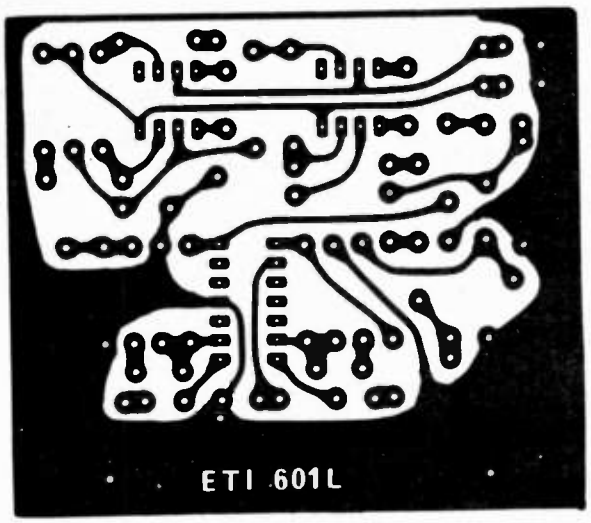


Fig. 2. Printed circuit pattern for the external input module.

THIS month we provide details of the external input amplifier and of a modification to the keyboard controller.

Using the external input circuitry, other electronic instruments (such as an electric guitar) may be fed into the synthesizer modules in order to obtain new and different sounds. One of the two inputs has circuitry which generates trigger pulses from the external instrument's signal, thus allowing the transient generators to be triggered.

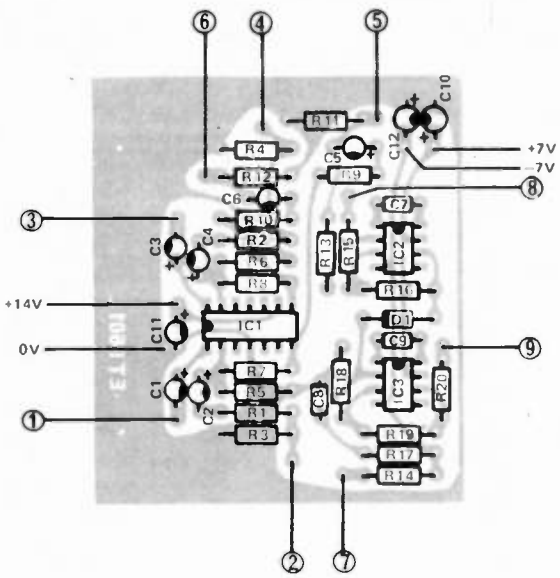


Fig. 3. Component overlay – external input module.

CONSTRUCTION

As with all other modules, a small aluminium bracket is used to support the printed circuit board, potentiometers and switches. The components should be mounted onto the printed circuit board in accordance with the component overlay Fig. 3, taking care with the orientation of polarized components.

The switches and potentiometers should then be wired as shown in Fig. 4. The input sockets are best mounted on a panel at the rear of the synthesizer.

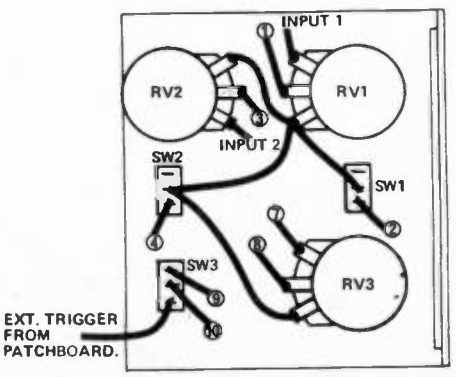
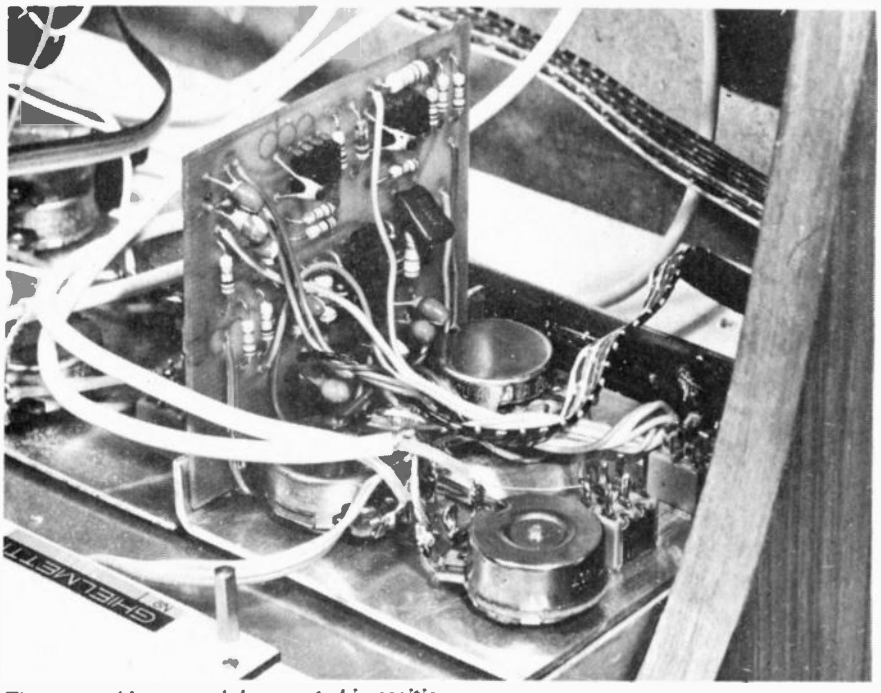


Fig. 4. Wiring to potentiometers and switches – external input module. ▶



The external input module mounted in position.

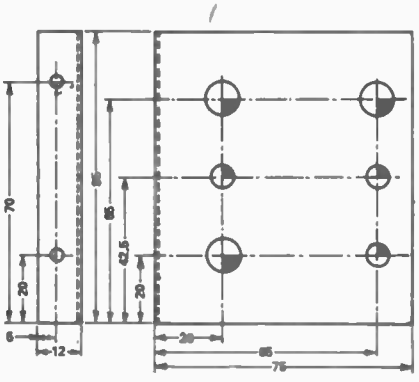


Fig. 5. Drilling details for external input mounting bracket.

PARTS LIST — External Inputs ETI601L

R1,2	Resistor	820	¼ W	5%
R9,10,20	"	3.3k	"	"
R14,15,18	"	10k	"	"
R3,4	"	12k	"	"
R11,12,13	"	100k	"	"
R5,6	"	150k	"	"
R7,8	"	560k	"	"
R17	"	680k	"	"
R16,19	"	1M	"	"

RV1,2 Potentiometer 50k log rotary
RV3 " 10k lin rotary

C7,9 Capacitor 10pF ceramic
C8 " 0.1μF polyester
C1,3 " 1μF 16V electrolytic*
C5,6 " 4.7μF 16V "
C2,4,10,11,12 Capacitor 10μF 16V electrolytic*
* PC mounting or tag tantalum

IC1 Integrated circuit LM381
IC2,3 " " LM301A

D1 Diode IN914

SW1,2,3 Toggle switch SPDT

PC board ETI 601L
Metal bracket to Fig. 5.
Patchboard McMurdo type 673-11-024-01
Patch pins McMurdo type 673-31-100-04.

KEYBOARD

Any 48 note keyboard may be used. We used an F to F organ keyboard but C to C keyboards may be used, if desired, simply by appropriately tuning the oscillators.

Keyboards are quite difficult to obtain in Australia at present, however there are a limited quantity of 49 note (F to F) keyboards available. These should be available through kitset suppliers for around $25. They are not fitted with contacts or springs and these must be added by the constructor.

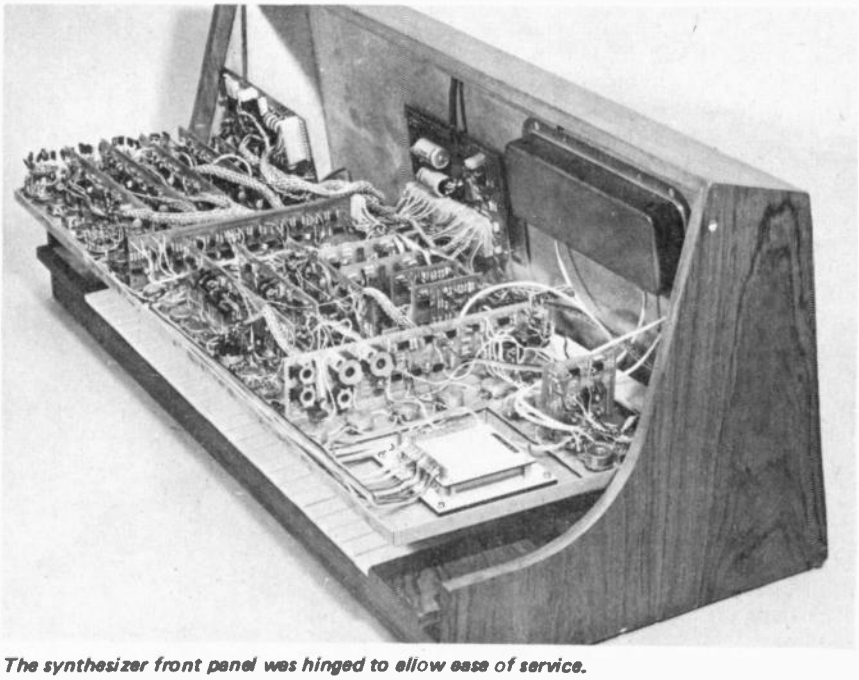
The only other alternative at present, is to import a keyboard from overseas. Those made by Kimber Allen of UK are suitable. These are fitted with contacts and springs, and are available for around £21 plus freight and insurance. Their address is:—

Kimber Allen Ltd
Broomfield Works
London Road, Swanley
Kent BR8 8DF UK
Tel: Swanley 3234-5-6

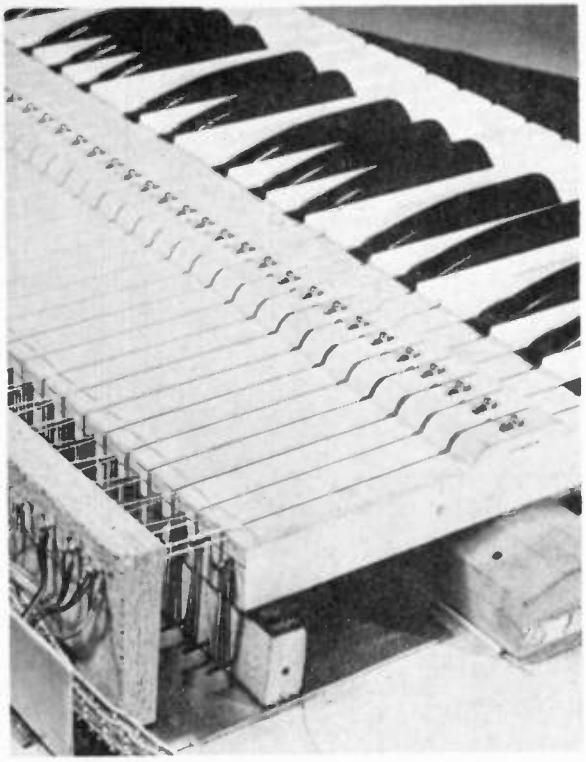
If the local keyboards are used the 49th key (top F) should be discarded and contacts and springs fitted to the remaining keys. The photographs illustrate the methods that we used, but as contacts are not as critical in a synthesizer as in an organ, these may readily be varied to suit individual needs.

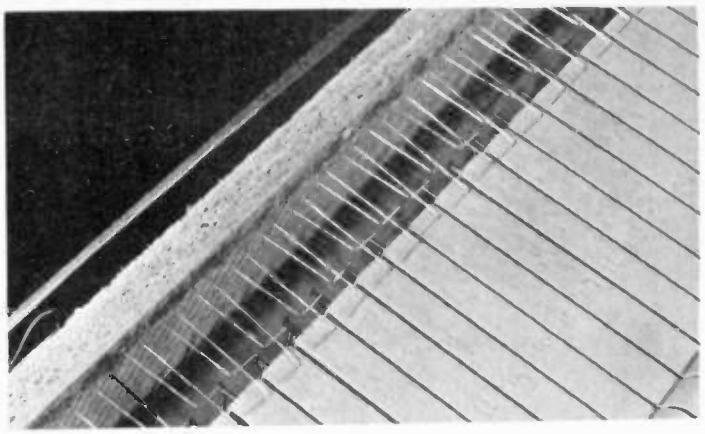
Gold plated wire was used to make our contacts (this also has to be imported) but nichrome wire is readily available, is springy and does not tarnish — it will be just as suitable.

The wire contacts were simply glued



The synthesizer front panel was hinged to allow ease of service.





▲ *Gold or nichrome wire may be used to make the key-contacts.*

◀ *This simple method of springing the keys was found to be entirely adequate.*

into a piece of chipboard. The ends were left protruding from the rear so that wires may be soldered directly to them.

The small key-return springs were purchased from a hardware store and we used two per key. On an earlier prototype we used rubber bands. These were entirely adequate and were still serviceable after 12 months use.

Tension of the springs should be such that a pressure of about 85 gms is required to depress the key. The key should have a total travel of 12 mm and the contact should make at between 6 and 8 mm depression.

KEYBOARD CONTROLLER MODIFICATION

A problem has been found to exist with the sample-and-hold circuitry of the keyboard controller. The problem, which was not apparent on our prototype is that, when a key is released and another quickly pressed, the voltage generating circuitry moves from the previous setting before the sample-and-hold has released. This is due to propagation delays in the detection circuitry.

The solution to the problem is unfortunately a little complex, and a separate PC board is required to contain the new components.

Note that, on the circuit of the keyboard controller modification, the parts in the shaded areas already exist on the main controller board.

HOW IT WORKS – Keyboard controller mod.

Transistors Q1, 2 and 3 form a 5 millisecond time delay for the trigger control signal. When a key is pressed the output of IC1/1 (on existing board) goes to +7 volts. When this occurs, C1 charges via R1, until, at about 0.6V, (set by R2 and R3) transistor Q1 starts to conduct turning on Q2 which by feedback turns on Q1 even harder. The result is that C1 is discharged by Q1 and Q2 to about −6 volts and Q1 and Q2 are held on due to the current through R1.

As Q3 is also turned on, the output voltage falls to −7 volts when the 5 millisecond period has elapsed. Now, when the key is released, the output of IC1/1 goes to −7 volts and, due to D1, transistors Q1, 2 and 3 all turn off. The output transition of Q3 is further delayed by R5 and C2 and then passed back to the CMOS gate IC1/3 where it is squared up and becomes the trigger signal.

The total time lag introduced between pressing the key and the production of the trigger signal is about 20 milliseconds, and the trigger signal continues for about 15 milliseconds after release.

We now have two sample and hold circuits. Transistor Q4 and IC2 form a temporary store which is capable of holding the required analogue voltage for a 10 millisecond period. When a key is pressed the following procedure takes place:–

1. The desired note is selected and appears at the output of IC8 (ETI601e).
2. After 5 milliseconds this voltage is transferred to the temporary store.
3. After a further 5 milliseconds this hold is disconnected and a second hold circuit initiated thus transferring the voltage into the main memory.
4. After a total of 20 milliseconds, the trigger signal appears and activates the transient generators etc.
5. The two sample-and-holds are operated alternately at about 100 times a second. There is a slight gap between them so that it is impossible for them to both be on together.
6. When the key is released both sample and hold circuits are broken.

The result of all this manipulation is that the information going into the second and main memory, is always at least 5 milliseconds old and hence cannot be affected by the propogation delay.

Gates IC1/1 and IC1/2 form a multivibrator which is switched on and off by the output of Q3. The network R6, C3 ensures that the multivibrator always starts in the same sequence. The outputs from IC1/2 and IC1/2 are coupled respectively to IC1/3 and IC1/4 by capacitors C6 and C4. Those gates (IC1/3, IC1/4) form a monostable which produces a pulse having a 4 millisecond period and, since these pulses occur every 5 milliseconds, they have a 1 millisecond period between them. The output of Q3 controls these gates directly (via IC1/3 pin 8 and IC1/4 pin 13) thus over-riding the monostable input. The outputs of IC1/3 and IC1/4 control FETs Q4 and Q7 (ETI 601e).

This sampling technique increases the delay of the glide potentiometer and if this effect is found to be undesirable the value of the glide potentiometer may be reduced to about 2 megohm.

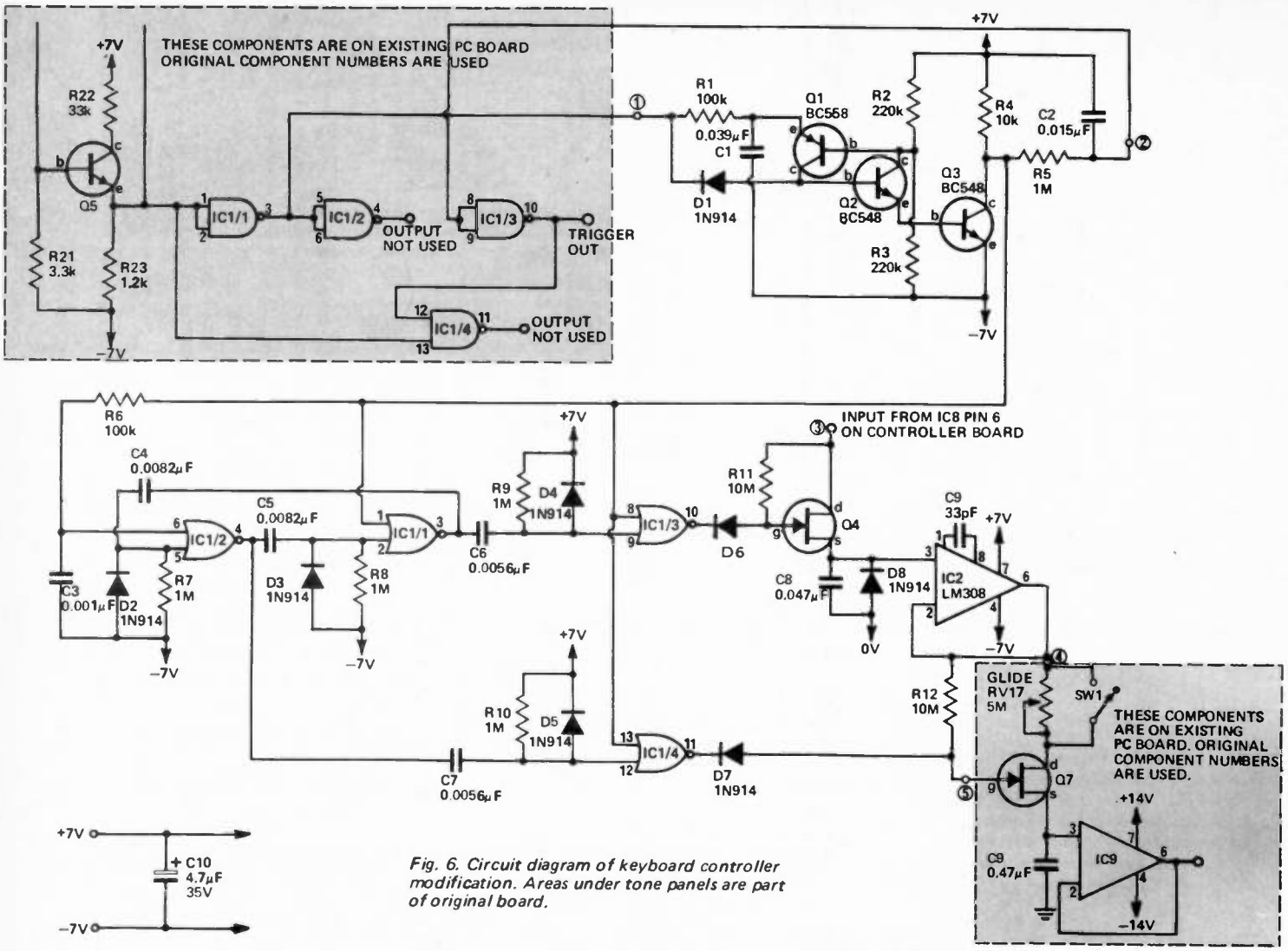
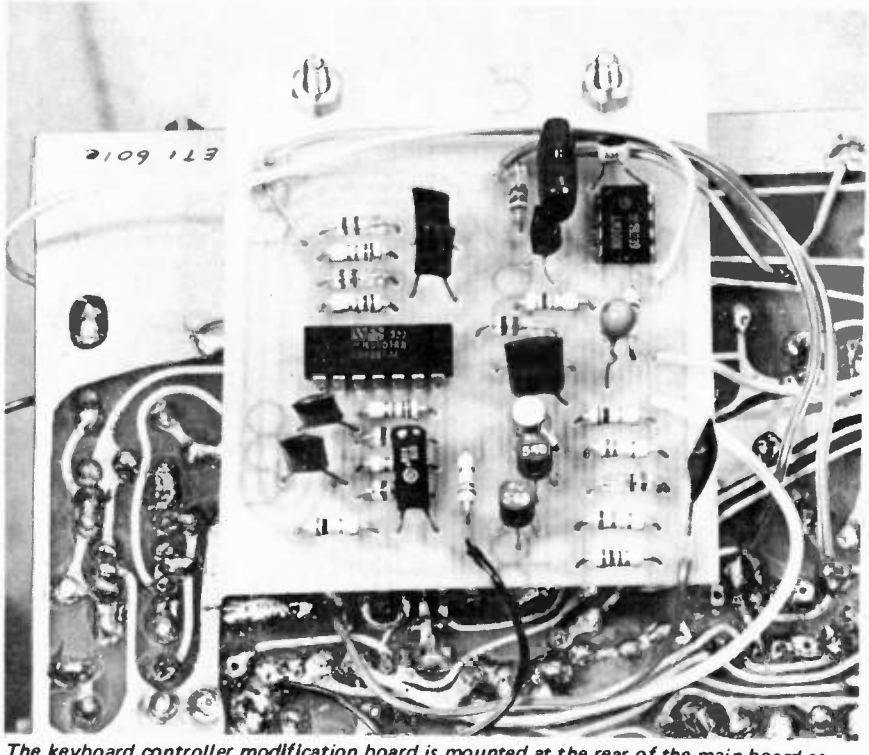


Fig. 6. Circuit diagram of keyboard controller modification. Areas under tone panels are part of original board.



The keyboard controller modification board is mounted at the rear of the main board as shown.

PARTS LIST — Keyboard Controller Modification

R4	Resistor	10k	¼W	5%
R1,6	"	100k	"	"
R2,3	"	220k	"	"
R5,7,8	"	1M	"	"
R9,10	"	1M	"	"
R11,12	"	10M	"	"
C9	Capacitor	33pF ceramic		
C3	"	0.001µF Polyester		
C6,7	"	0.0056µF	"	
C4,5	"	0.0082µF	"	
C2	"	0.015µF	"	
C1	"	0.039µF	"	
C8	"	0.047µF	"	
C10	"	4.7µF 35V electrolytic		
IC1	Integrated circuit 4011 CMOS			
IC2	"	" LM308		
Q1	Transistor	BC558, BC178 or similar		
Q2,3	"	BC548, BC108	"	"
Q4	"	2N5458 *		

* from controller board

D1-D8 Diode IN914

PC board ETI 601M.

2 by 13 mm spacers, 2 nuts, 2 by 20 mm screws.

CONSTRUCTION

Assemble components to the PC board in accordance with the overlay Fig. 8, again taking care with polarization of components. It is recommended that a socket be used for the CMOS ICs.

We mounted the board on the back of the controller via two 13 mm spacers as shown in the photograph.

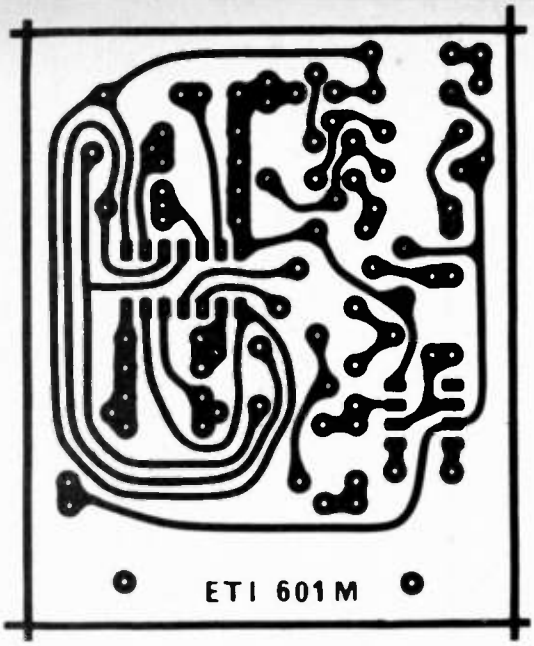


Fig. 7. Printed circuit pattern for keyboard-controller modification.

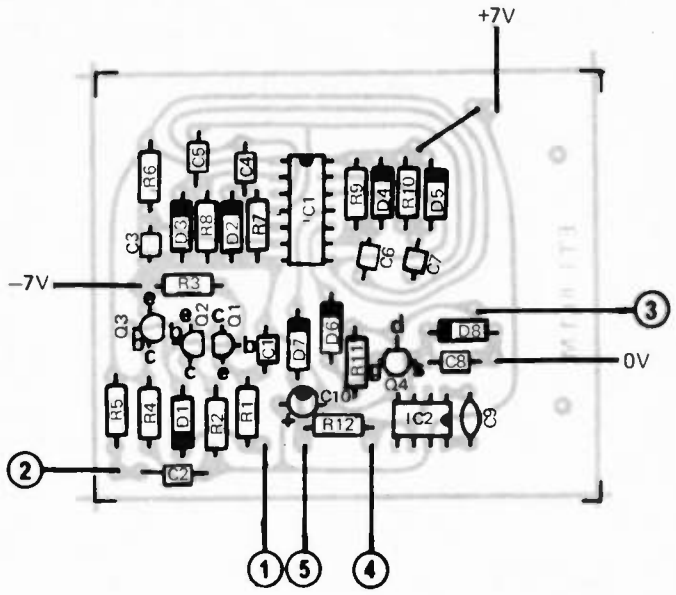


Fig. 8. Component overlay for keyboard controller modification.

Only one additional hole has to be drilled.

The interconnections and modifications necessary are as follows:—

1. Remove Q8 (can be used as new Q4), R48, C1, R26, D2 and the link numbered 40 which goes from IC8 pin 6 to RV17.
2. Connect the +7V, 0V and −7V to the new board from convenient points on the old board. We used pin 14 (+7V) and pin 7 (−7v) of IC1 and a point on the outer copper track for 0V.
3. Link point 1 to pin 3 on IC1/1 (ETI601e).
4. Link point 2 to pin 8/9 on IC1/1 (ETI 601e).
5. Link point 3 to point 40 IC8 (ETI601e).
6. Link point 4 to point 40 on RV17 (ETI601e).
7. Link point 5 to the track joining Q7 and Q8 (ETI601e).

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*** Stereo Elliptical * Matrix 4 channel * 4 channel discrete**

After producing superb cartridges for 20 years, Grace, in conjunction with NHK (Government sponsored Broadcasting Institute of Japan) continued its search for an even better cartridge. This resulted in the F8L, then the Broadcast Standard Sigma 709 was developed from the commercial broadcasting field. From this came the F8C for critical hi-fi enthusiasts, and now comes the F8F Shibata 4 channel.

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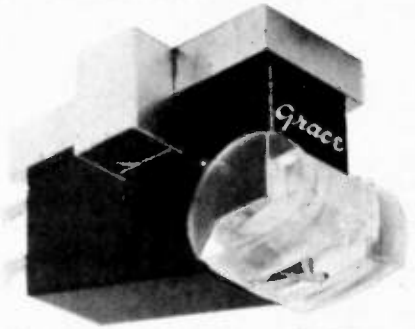
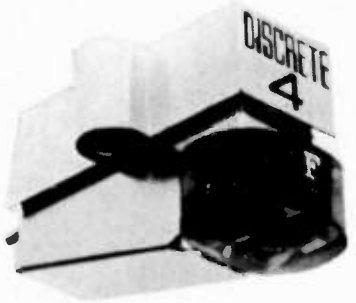


CANADIAN STEREO GUIDE *said about Grace: "all in all, a very fine cartridge that deserves a place among the top performers".*



F8F MATRICAL FLUX 4 CHANNEL CARTRIDGE

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

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

INTERNATIONAL 422 STEREO AMPLIFIER

PROJECT 422

Details of metal and woodwork.

THIS month we present the metal and woodwork drawings, for those people wishing to construct their own chassis and cabinet, together with a summary of points arising since the first article appeared.

Some people have had difficulty in obtaining the 18 volt zener, ZD3, which supplies the stabilized 18 volts for the preamplifier. If an 18 volt zener is not obtainable, a 16 volt unit may be used without further modification. A 20 volt zener may also be used, but in this case R53 and R54 should be increased in value from 56k to 68k.

The amplifier, because of its wide frequency response, will reproduce pops and clicks, etc, introduced into the mains by equipment (such as refrigerators) switching on and off. Some protection against this is given by C18 (across the primary of the power transformer). If this is insufficient, 0.0047 microforad capacitors may be fitted between the active end of C18 and earth, and also between the neutral end of C18 and earth.

Note that values higher than 0.0047 microfarad *should not be used.* The use of higher values is illegal, and is a safety hazard. Take care to insulate the leads of these capacitors to avoid accidental personal contact. ●

Fig. 11. Artwork for front-panel escutcheon (half-size).

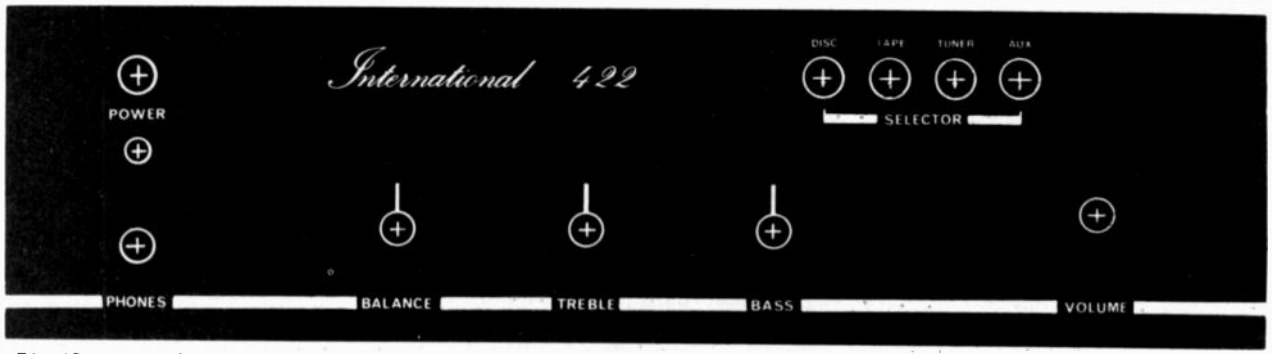
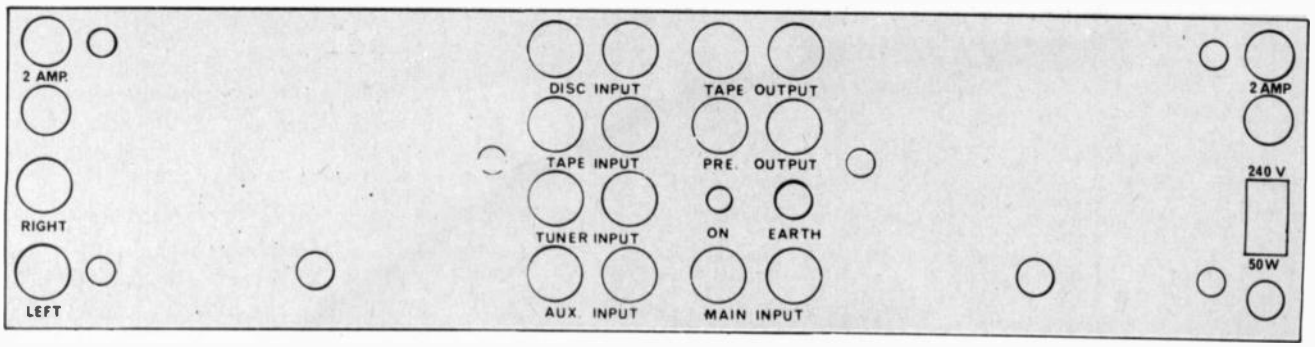


Fig. 12 Artwork for rear-panel escutcheon (half-size).



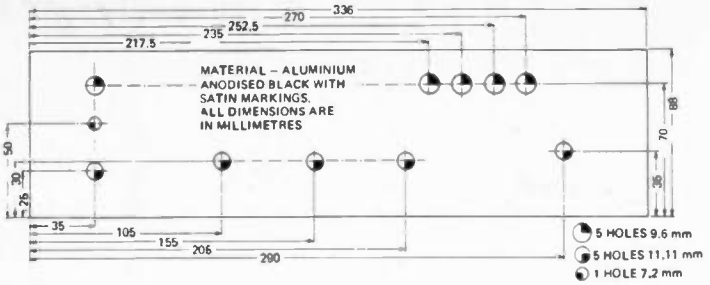


Fig. 13. Drilling details of the front panel escutcheon.

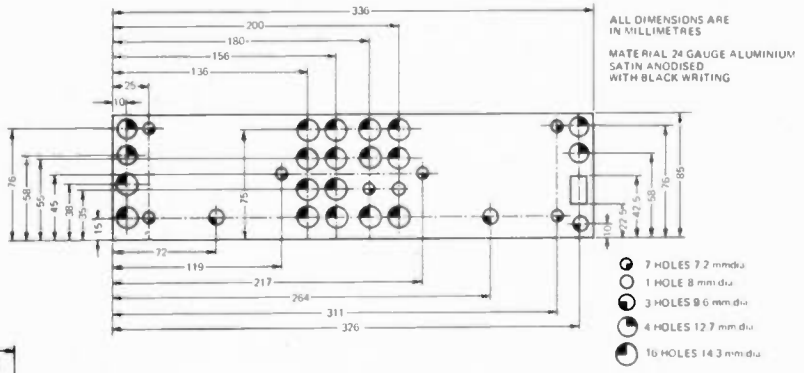


Fig. 14. Drilling details for rear-panel escutcheon.

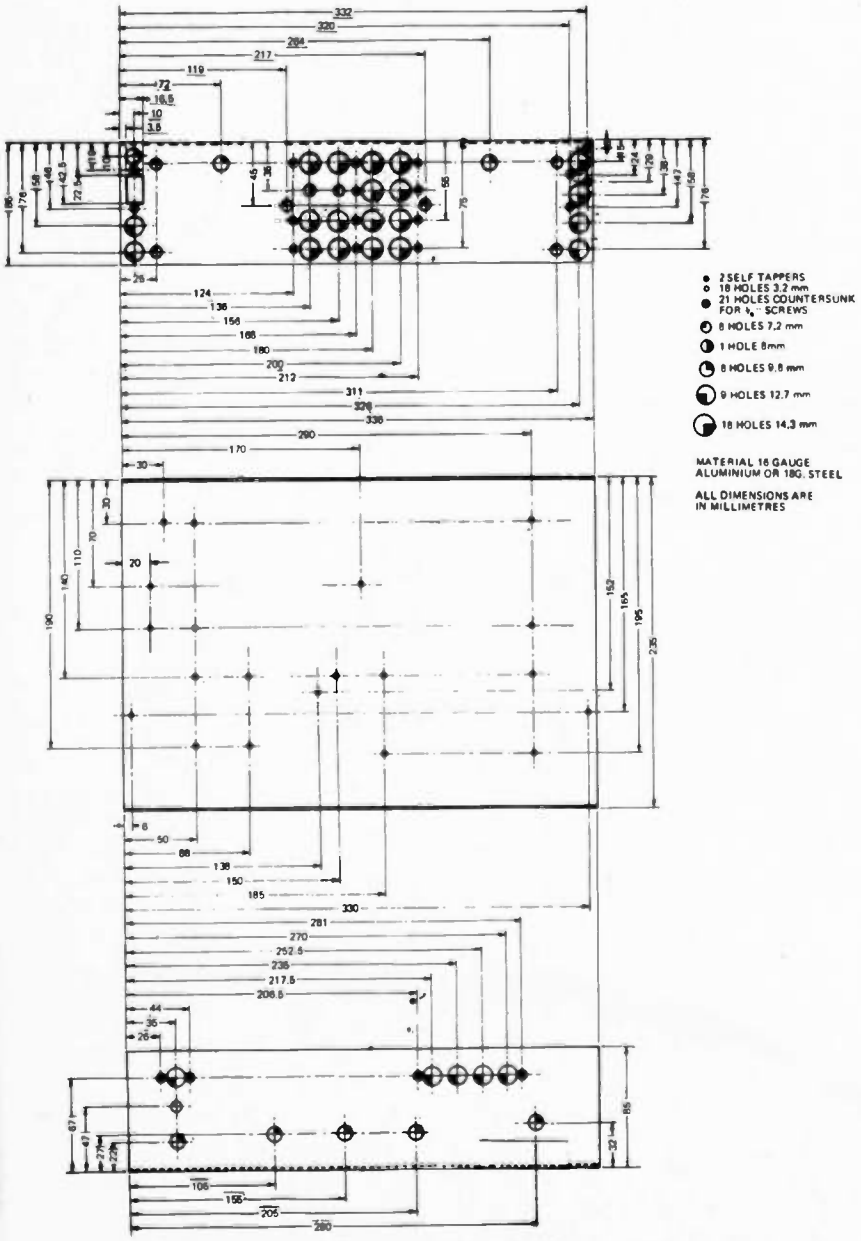


Fig. 15. Drilling details and dimensions of the chassis.

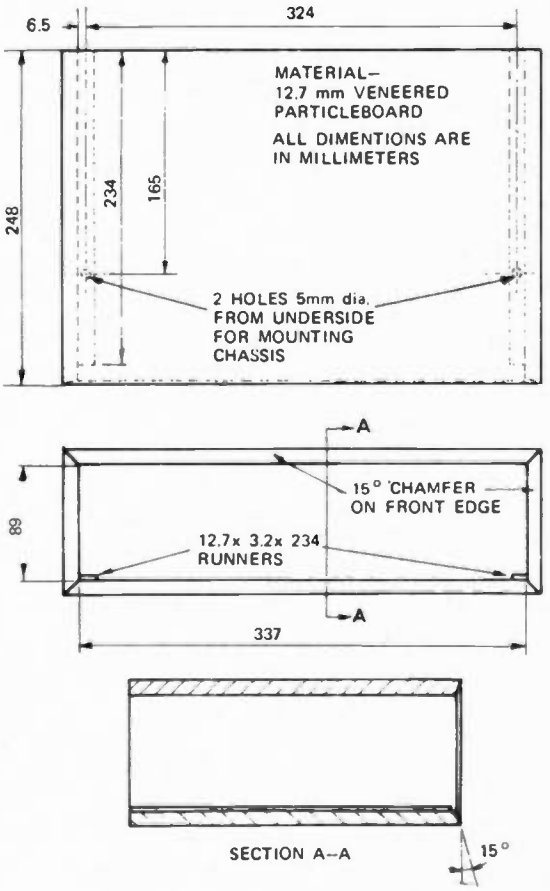


Fig. 16. Constructional details of the cabinet.

ERRATA

MAY 1974 page 73, SPECIFICATION. Frequency response should be 20 Hz-20 kHz ±0.5 dB not 5 dB as published.

Page 74, circuit diagram. Voltage at junction of R55 and R57 should be 1.7 volts not 2.9 volts as published.

Dick Smith Ele

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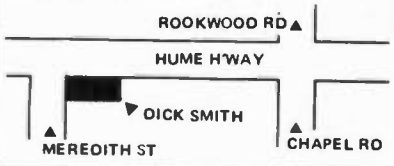

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AD149 Use OC26		
AD161	1.40	1.30
AD162	1.40	1.30
AD161 / 162 Pair	2.80	2.60
AF114	.90	.85
AF115	.90	.85
AF116	.90	.85
AF117	.90	.85
AF118	1.40	1.30
ASZ15 (OC28)	3.60	3.40
ASZ16 (OC29)	3.65	3.45
ASZ17 (OC35)	3.60	3.40
ASZ18 (OC36)	3.65	3.45
AY8140	1.50	1.40
AY9140	1.50	1.40
AY8171	1.20	1.10
AY9171	1.20	1.10
AY8149	1.20	1.10
AY9149	1.40	1.20
BC107 (C3547)	.25	.22
BC108 (BC548)	.25	.22
BC108B	.45	.40
BC109 (BC549)	.25	.22
BC109C	.45	.40
BC147	.45	.40
BC148	.45	.40
BC149	.45	.40
BC157(BC177)	.30	.26
BC158(BC178)	.30	.26
BC159 (BC179)	.30	.26
BC188	.70	.65
BCY70	.70	.65
BCY71	.85	.80
BCY72	.70	.65
BD137	1.70	1.60
BD138	1.75	1.65
BD137 / 138 Pair	3.40	3.20
BD139	1.50	1.45
BD140	1.60	1.55
BD139 / 140	3.10	3.00
BDY20 Use 2N3055		
BF115	.70	.65
BF167	.65	.60
BF173	.85	.80
BF177 (BF336)	1.50	1.40
BF178 (BF336)	1.50	1.40
BF179 (BF337)	1.60	1.50
BF180	1.20	1.10
BF184	.65	.60
BF185	.65	.60
BF194	.50	.45
BF195	.50	.45
BF200	1.25	1.20
BFW10 Use 2N5459		
BFW11	1.45	1.35
BFW61	1.30	1.20
BFY50 (2N3053)	.80	.70
BFY51	.80	.70
BFY52	.80	.70
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MPF104(2N5458)	1.10	1.00
MPF105(2N5459)	.95	.90
MPF106 (2N5485)	.95	.90
MPF121	.95	.95
OC26 (AD149)	1.60	1.40
OC28 Use ASZ15		
OC44	.45	.42
OC45	.45	.42
OC70	.40	.36
OC71	.40	.36
OC72	.45	.42
OC74	.45	.42
OC75	.45	.42
OCP71 (Photo)	1.40	1.30
TT797	1.20	1.10
TT798	1.20	1.10
TTB00	1.00	.95
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2N706A	.90	.80
2N2646	1.40	1.30
2N2926	.50	.48
2N3053	.80	.70
2N3054	1.70	1.60
2N3055	1.20	1.00
2N3564	.55	.50
2N3566	.65	.60
2N3567	.65	.60
2N3568	.75	.70
2N3569	.65	.60
2N3638	.45	.40
2N3638A	.55	.50
2N3702	.50	.45
2N3640	.60	.50
2N3641	.45	.40
2N3642	.45	.42
2N3643	.55	.50
2N3644	.45	.40
2N3645	.55	.50
2N4292	.50	.45
40250 Use 2N3054		
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40409	3.00	2.90
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SN7402N	.60	.54	.48
SN7403N	.60	.54	.48
SN7404N	.60	.54	.48
SN7405N	.60	.54	.48
SN7408N	.60	.54	.48
SN7409N	.60	.54	.48
SN7410N	.60	.54	.48
SN7413N	.80	.72	.65
SN7420N	.60	.54	.48
SN7430N	.60	.54	.48
SN7437N	1.20	1.10	1.00
SN7440N	.60	.54	.48
SN7441AN	2.20	2.10	2.00
SN7442N	2.00	1.90	1.80
SN7447N	3.00	2.80	2.60
SN7450N	.60	.54	.48
SN7451N	.60	.54	.48
SN7453N	.60	.54	.48
SN7454N	.60	.54	.48
SN7460N	.80	.84	.48
SN7470N	1.00	.95	.90
SN7472N	1.00	.95	.90
SN7473N	1.20	1.10	1.00
SN7474N	1.20	1.10	1.00
SN7475N	1.50	1.40	1.30
SN7476N	1.20	1.10	1.00
SN7480N	1.80	1.75	1.70
SN7482N	1.90	1.85	1.80
SN7483N	2.45	2.40	2.35
SN7486N	1.20	1.10	1.00
SN7490N	1.25	1.20	1.15
SN7491AN	1.60	1.55	1.50
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ELECTRONICS -it's easy!

PART 7

Introducing inductive and capacitive reactance.

CAPACITORS and inductors modify any sudden change in voltage that is applied to them. The way in which this happens was explained in last month's article in this series.

We will now look at what happens when a square wave is applied to CR and LR circuits that have a time constant that is short compared to the duration of one half cycle of the square wave.

In case (A) of Fig. 1, the capacitive current will be high when the square wave goes positive (time t_1), and will rapidly lessen as the capacitor becomes charged. The same thing will happen when the square wave goes negative (time t_2) except that the capacitor will now supply current back to the supply and hence the current will flow the other way. The current waveform through the network will thus be as shown in waveform 2.

In case (B) the inductor resists a change of current, and hence, the current will initially be low and will increase slowly until the maximum value is reached. When the square wave goes down again the inductor tries to keep the current flowing.

The current will thus gradually decrease until the field of the inductor is zero. Thus the current wave shape will be as shown in waveform 3.

In cases (A) and (B) the output voltage (across the capacitor in (A) and across R2 in B) for both will be as shown in waveform 4. Thus, in terms of voltage-in versus voltage-out, both these arrangements tend to smooth the input waveform. They are therefore known as smoothing (or integrator) circuits.

Now in circuits (C) and (D) we still have the series LR and CR arrangements but this time we have taken the output from across the inductor instead of the resistor as in (B), and from across the resistor in (D) instead of the capacitor as in (A).

The current waveforms will be the same as before as shown in waveforms (5) and (6), and the output voltage in both cases will be as shown in waveform (7).

In these arrangements then, the output is a pulse which corresponds with an input change, and the polarity of the pulse is the same as the direction of the change. These arrangements therefore are known as differentiator circuits (output only when there is a change).

These circuits are fundamental to all electronics and are extensively used to modify an input signal to some different requirement.

As an exercise, see if you can draw the waveforms generated when the time constant of the network is firstly one tenth of the time t, t_1, t_2, and secondly, ten times t, t_1, t_2. You will obtain some interesting results. The time constant in the waveforms given is about one fifth of t_1 to t_2.

We move on now to consider the behaviour of the three basic passive circuit components (R, L and C) when they are excited by a continuous sinewave signal. Our discussion will be restricted to sinewave signals at present — as these are the most basic kind.

RESISTORS AND AC SIGNALS

As resistors cannot store electrical energy, they cannot *alone* affect the time characteristics of a signal. They will however, change the amplitude of the signal if connected to form a voltage-divider network such as is shown in Fig.2. In this example the original 10 V peak to peak sinewave is attenuated to provide an output of 5 V p.p. The attenuation is easily calculated in such cases, for Ohms law (previously used in dc circuits in this course), applies equally as well to ac signals when the circuit is built entirely of resistors — or devices that are effectively resistors. We say such circuits are purely resistive.

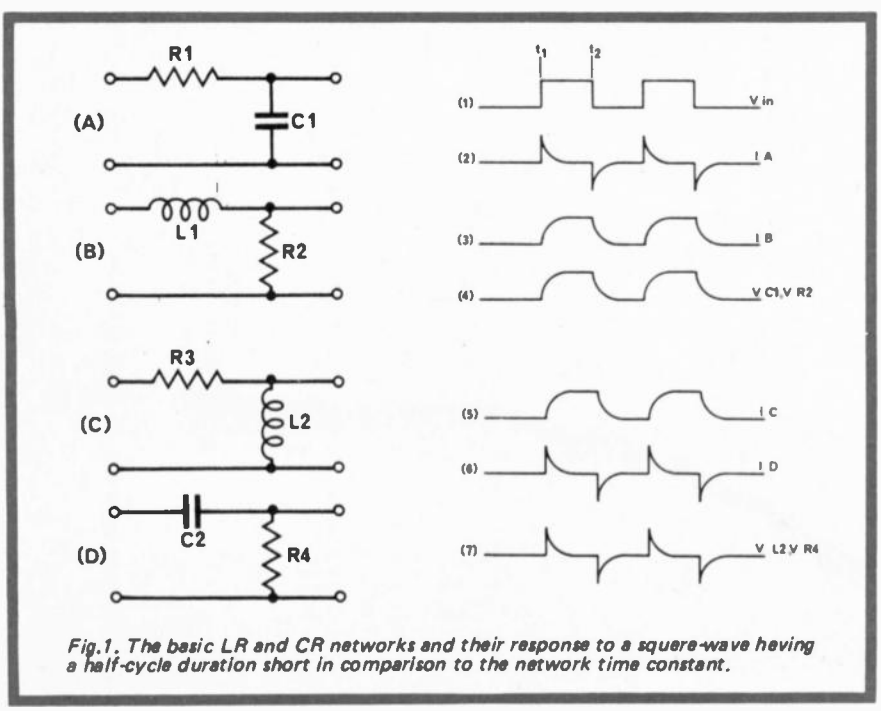

Fig.1. The basic LR and CR networks and their response to a square-wave having a half-cycle duration short in comparison to the network time constant.

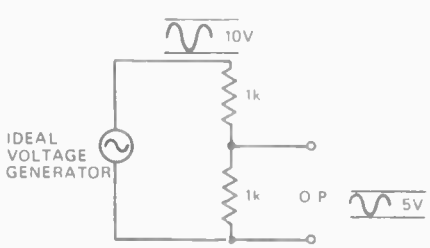

Fig.2. Resistors above cannot change waveshape, they can only reduce the amplitude.

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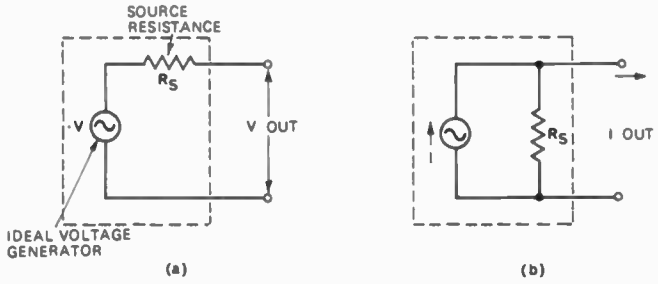


Fig.3a. Equivalent circuit of a practical voltage generator. (3b). Equivalent circuit of a practical current generator.

Note that the voltage-divider cannot provide signals of greater amplitude than the input. This may seem an obvious statement but we will see in the next part that storage elements, when connected in certain ways, can, in fact, magnify the voltage.

INTERNAL RESISTANCE OF SUPPLIES

In Fig.2 the two resistors forming the voltage divider are obvious. In many other cases they are not so easily recognised.

The ideal or perfect source of voltage has no internal resistance and is represented as shown in Fig.2. But in practice all sources have internal resistance so our equivalent circuit is more realistically the ideal voltage generator together with a series-connected internal or source resistance — represented in Fig.3 by Rs. The source resistance Rs is, in fact, the value that is measured (or would be) looking back into the source, and this applies no matter how complicated the power supply is.

Mostly we tend to think in terms of voltages when seeking an understanding of circuitry. But it is sometimes more convenient to make use of currents instead. The perfect current source, again representable as a black box, provides constant value of current regardless of load value. However, practical current generators always have shunt resistance — that seen looking back into the black box.

As with voltage sources we must tolerate resistive losses, this time as a shunt that diverts current from the load. The equivalent circuit of a practical current generator is shown in Fig. 3b.

With a few exceptions, we can regard voltage and current sources as purely resistive devices comprising a perfect lossless generator and a suitably connected source resistor: it is however, not possible to separate the two.

LOADING OF SUPPLIES

In Fig.4 a resistor is connected across a voltage supply. It is clearly forming a voltage-divider chain with the internal supply resistance. In this example the output voltage, will be attenuated to half of that value provided by the supply in the unloaded condition.

The internal resistance of a supply is a vital parameter if the voltage is to hold up and remain constant as the load is changed. A varying load condition imposed on the supply (such as occurs in, say, a hi-fi system as the loudness demand varies would continually alter the system voltage supplying the circuits, with subsequent loss of correct operation.

A little thought reveals that a source resistance very much lower than the minimum load resistance reduces this attenuation effect; at least ten-times less is a good yardstick. Simple power supplies, like that specified earlier as a project, are unable to provide an adequately low internal resistance and, therefore, suffer from loading effects. Special stabilised supplies, although complicated in construction, simply provide a more ideal source by effectively providing a much reduced source resistance — tenths of ohms downward.

Similarly the current supply ideally should provide a constant current with load demand variation, but the inherent shunt resistor diverts the current from the load. The stabilised current supply, therefore, is designed to reduce this effect to a minimum.

It is possible, then, to regard voltage and current sources as black boxes with an internal resistance — in other words as resistive circuits. When studying the coupling of black boxes (stage-to-stage in a circuit or complete sub-system to the next) the preceding one is regarded as the source of voltage or current as is preferred — and the loading effect of that following is easily found from the above reasoning. Fig. 5 illustrates this: it is quite similar to the problem of meter loading discussed in Part 3.

In summary then, when the equivalent resistance of stages has been assessed, or measured, the coupling or loading effect is easily calculated using Ohms law. This concept applies to both dc and ac signals if the circuit is purely resistive.

The voltages and currents flowing in inductors and capacitors can also be handled this way if we use a simple calculation (discussed next) to obtain their effective resistance before using the various circuit laws.

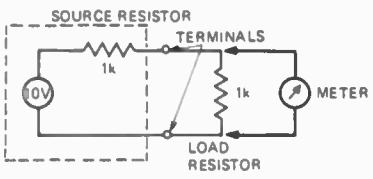


Fig.4. The source resistance, and the load resistance together make a voltage divider. Thus the voltage delivered to the load is less than the maximum available from the generator, and depends on load current.

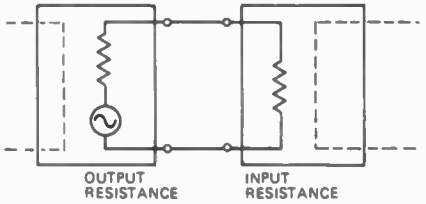


Fig.5. When coupling black boxes, the loading effects must be taken into account. Thus the output and input resistances must be taken into account.

THE CAPACITOR, INDUCTOR AND AC SIGNALS

We have seen how the storage of energy in the electric field of a capacitor, or in the magnetic field of an inductor, modifies the nature of a transient signal impressed across them. It can be said that the capacitor or inductor opposes the transient and tries to prevent its transmission.

If the applied signal is continuously varying from positive to negative — that is, it is an ac signal — it is, in effect, providing a continuous train of transients. We would, therefore, expect storage components to attenuate ac signals in some way. And this in fact is what they do.

INDUCTORS

As just pointed out an inductance opposes sinusoidal current flow. It does not change the time character of the waveform but does reduce the amplitude. The effective resistance is calculated from the formula.

$$X_L = 2\pi fL$$

where X_L is the inductive *reactance,*

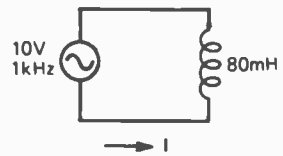


Fig.6. Current in this circuit is limited by the reactance of the inductor.

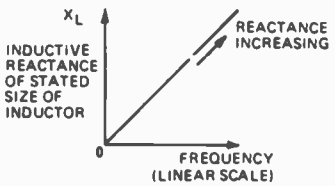


Fig.7. Variation of inductive reactance with frequency.

the frequency of the sinewave signal and L the inductance in Henries.

Reactance is a term used to describe this particular kind of circuit opposition. It is sometimes called *apparent* resistance. The effect must not be confused with that of pure resistance, for reactance, although limiting current flow and producing voltage drops, *does not dissipate energy.*

The term $2\pi f$ is often replaced by a simple symbol

Thus $X_L = 2\pi fL = \omega L$.

A simple exercise illustrates how the formula is used. In Fig.6 an 80 mH inductor is energised by a 10 V rms, 1 kHz source. We wish to calculate the current flowing in the loop.

The formula gives the reactance as

$X_L = 2\pi \times 10^3 \times 80/10^3 = 500$ ohms.

Knowing the effective resistance to such a signal we can now apply Ohms law to obtain the current

$$I = \frac{V}{X_L} = \frac{10}{500} = 20 \text{ mA}$$

Study of the X_L formula shows that it is frequency dependent so the current will be different if the frequency is changed. For example, if in this example we alter the frequency to 10 kHz, X_L increases to 1000 ohms and the current falls to 10 mA. The frequency effect can be portrayed graphically — see Fig. 7 — showing that X_L increases linearly with increase in frequency.

Practical inductors are made of wire — hence they have resistance as well as reactance. This resistance will deter the current flowing by a small amount. So do not be disturbed if calculations do not exactly agree with any measurements made of such circuits. As our background develops further we will see how to take this into account. For the moment it is sufficient to say that — *the resistance value and reactance value CANNOT be directly added to obtain the total resistance.*

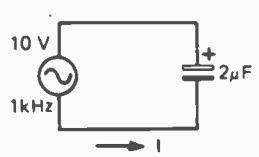


Fig.8. Current in this circuit is limited by the reactance of the capacitor.

CAPACITORS

Having seen how inductors behave when a sinewaves are applied to them, we would expect a somewhat similar pattern of behaviour to occur with capacitors. Capacitive reactance X_C is calculated from the expression

$$X_C = \frac{1}{2\pi fC}$$

where C is in Farads and the other terms are as in the inductive reactance formula given above.

In Fig.8 the capacitive reactance is

$X_C = 1/2\pi \times 10^3 \times 2 \times 10^{-6} = 80$ ohms

and the current I is $V/X_C = 10/80 = 125$ mA.

This time if the frequency is raised to 10 kHz, X_C becomes 40 ohms and the current *rises* to 250 mA. Thus as the frequency rises the capacitive reactance falls whereas the inductive reactance rises. Put another way, at very high frequencies the capacitor may be considered as a low-resistance link, the inductor on the other hand is a low resistance link only at dc.

Fig.9 shows the variation of X_C with frequency. Note that in contrast with the frequency versus reactance characteristic of the inductor, that for a capacitor is not linear, but hyperbolic.

Although the calculation of X_L and X_C is straightforward it can become tedious when many values are to be found. To ease this task a reactance chart may be used from which the reactance at any frequency may be directly determined. A reactance chart is included for your future reference on page 86.

INVALUABLE ELEMENTS

Compared with the simplicity of dc circuits it might seem that the introduction of ac signals makes unnecessary complications. But now we are in a position to see how much of electronic technique is, in fact, based on ac methods.

In an earlier part of this series we saw how signals can be multiplexed onto a common communication channel if ac forms were used. The system design to accomplish this needs circuit techniques that can separate frequencies into individual channels. That is where the inductor and

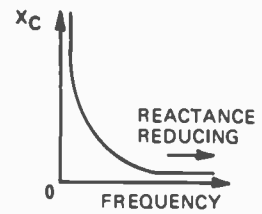


Fig.9. Variation of capacitive reactance with frequency.

capacitor are of value, for the signal magnitude passed by them depends upon the frequency of the signal applied to them. Using combinations of both components we are able to produce frequency selective circuits that let selected frequency signals through without loss, whilst attenuating those lying either side of the chosen frequency. This is the way in which radio tuners separate the desired programme from all the others picked up by the antenna.

In the power supply project the capacitor was used to smooth out pulsations of the rectified waveform. Thus the capacitor may be seen to provide us with a means of averaging varying signals.

These examples illustrate why its absolutely essential to have a solid grounding in the behaviour of inductors and capacitors. Like Ohms Law, a knowledge of reactance is absolutely essential. Take time to make sure you understand it thoroughly.

COUPLING BLACK BOXES

Two basic methods may be used to couple circuits together. These are ac coupling and dc coupling.

Where the signal from black box (A) Fig.10 is to be coupled into black box (B), we must first examine the signal to see what frequency range it covers. If it extends down to zero, that is dc, then direct coupling must be used.

In this method the output of (A) is simply joined by means of a wire link or a resistor, to the input of (B).

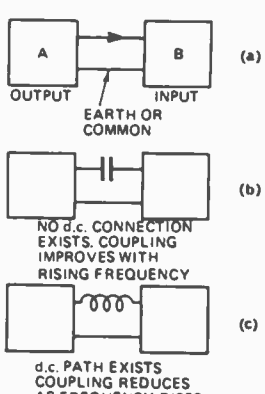


Fig.10. Coupling methods.
(a) direct
(b) capacitive
(c) inductive

However if the mean dc voltages at the output of (A) and the input of (B) are different, a current will flow between them, which may upset the operation of either or both. Thus where dc coupling is required, the black boxes must be designed so that the dc voltage at the output of (A) is the same as that at the input to (B).

Where it is not necessary to operate down to dc, an ac link may be used. This usually takes the form of a series capacitor which blocks dc (and thus allows the dc operating points of (A) output and (B) input to be different) but offers negligible impedance to the ac signal.

It is only necessary to use a capacitor in one lead, in order to block dc, the other can be left as a direct coupling. The capacitor is nearly always wired into the non-grounded (non-earthed) lead.

Ac coupling may however change the signal that is being transferred from A to B.

A signal containing many frequencies – a square-wave, for example – may arrive at B as seen earlier, with shape changed and possibly its amplitude reduced. This is because the various sinusoidal waveforms that compose the signal are each attenuated by differing amounts (for X_C varies with frequency). The net result is a new wave shape. The extent to which the shape is changed depends upon the frequencies present and the value of the capacitor.

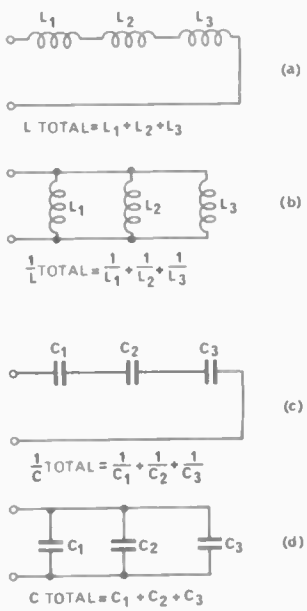
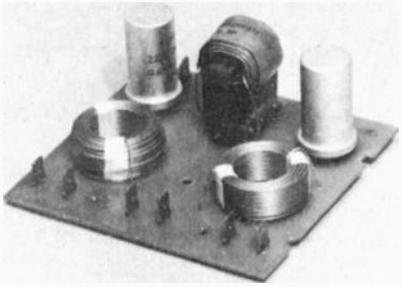


Fig.11. Rules for combining series and parallel inductors or capacitors to an equivalent single value.



Inductors and capacitors are used to form this Philips loudspeaker crossover network.

By suitable choice of components this effect may be minimized. Referring back to the section on LR and CR networks, if circuit D is used to couple circuits, and the time constant is chosen to be long in comparison with a half cycle of the signal, then the signal will be little changed by the network. Do some sums on this for yourself and see what effects different time constants have. For example assuming that a circuit has an input resistance of 10 k ohm (R4) what value of C2 would be required to pass a 20 Hz square wave without too much change in shape?

A single frequency sinusoidal signal passes with its shape unchanged. Its amplitude, however, will be altered in accordance with the reactance of the capacitor at that frequency, and any other resistances in the circuit that go with the capacitor to form a voltage-divider chain.

Zero frequency dc signals, as said before, will not pass at all, for the capacitor has no direct coupled path – it only "passes" current when the charges are moving. The capacitor, therefore, provides us with a means to *block* dc whilst allowing ac to flow. This means the steady-state dc voltage level at A can be quite different from that at B yet there is no danger in connecting them together provided a capacitor is in series.

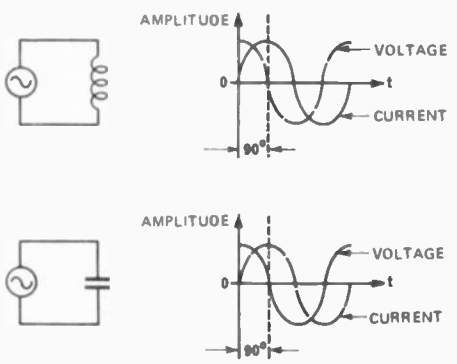


Fig.12. Amplitude – time graphs for voltage and current in an inductor, and in a capacitor.

The higher the excitation frequency the lower is the capacitive reactance. The capacitive coupling therefore, becomes lower in effective resistance as the frequency rises. By appropriate choice of component value (relative to the circuit resistance) it is possible to provide a coupling that is as good as a direct lossless link yet still blocks dc.

Inductors, see Fig. 10c, have the opposite effect (reactance increasing with frequency whilst providing a good dc path). Thus they are commonly used where it is desired to allow dc current flow whilst blocking ac signals. They are also extensively used in combination circuits which separate a signal, or group of signals, from all others. More about this in the next part of the course.

Inductors, then provide increasing coupling resistance with frequency increase and do not block dc. In this role they are able to smooth out fluctuations in a signal: the higher frequencies are attenuated more than lower frequencies. Inductors are often used in this role in which case they are termed chokes.

STORAGE COMPONENTS IN SERIES AND PARALLEL

It is often necessary to calculate the combined effect of inductors or capacitors when they are wired in series or in parallel. The discussion of this section applies only to connections having only inductors, or only capacitors. We will see later that combinations of the two provide vastly different behaviour.

Inductors – the total inductance of series-connected inductors is equal to the sum of each – refer to Fig. 11a.

The total inductance of paralleled inductors obey the reciprocal law found with paralleled resistors – refer to Fig. 11b. Inductors, then, follow the laws of resistors in this respect. It might be helpful if you remember that inductors in series provide a "bigger" inductor. These rules apply *only when the magnetic fields of each are not interacting.*

Capacitors – these follow the same law but in reverse. Series capacitors obey the reciprocal law, paralleled capacitors obey the additive law – refer Fig. 11c and 11d. An easy way to remember this is that parelleled capacitors effectively increase the plate area thus increasing the capacitor size.

These rules are used to calculate the total component value. From this it is easy to obtain the total reactance as though only one component existed.

But do remember *the laws apply only to groups of similar components.*

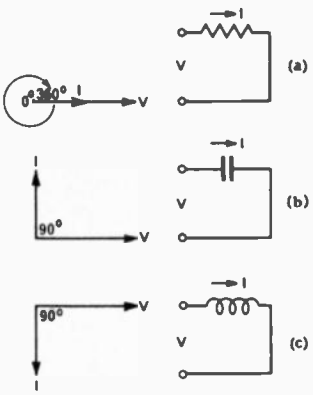


Fig.13. Vector (or phasor) diagrams for resistance, capacitance and inductance.

If you have a circuit with many capacitors and many inductors the rules work to reduce series or parallel groups of either component to an equivalent, but may not be applied to combinations of different component types.

PHASE RELATIONSHIPS

The voltage developed across an inductor reaches its maximum value when the rate of change of current passing through it is a maximum. This occurs in sinewaves when the current magnitude is zero.

We, therefore, have two distinct components of the signal to consider – current and voltage. They are both sinewaves but they pass through their various levels at different times. A good way to comprehend this is to draw a small piece of the amplitude-time graph of each (as in Fig. 12a). It is clear that the current curve reaches its maximum 90° (or one quarter of a full cycle) behind the driving voltage. In electrical jargon we say the current *lags* the voltage by 90°. (We do not say it leads by 270°: it would only complicate the issue).

The phase effect is opposite with capacitors, for maximum current flows when the charging rate is maximum; this occurs when the applied voltage is zero. Again then, the current and voltage are not in phase and the current leads the voltage by 90° as shown in Fig. 12b.

VECTORS

In order to assess the total effect of combinations of resistors, capacitors and inductors, we need to combine their respective signals, making allowance for the different phase shifts in each case.

Special mathematics (called *complex algebra*) can be used to calculate the resultant effect but it is an approach devoid of intuitive feeling for what is happening. It also needs special training to understand it.

Instead we can manage quite well using a purely graphical method in which the length of a line is used to represent longitude of the voltage or current and the *direction* of the line to represent phase. These lines are called vectors (or phasors) to differentiate them from normal lines in which direction is unimportant.

As a sinusoidal signal repeats continously, there is no need to draw each sinewave and add them step by step to see the combined total – this does work but is completely unnecessary. We, in fact, disregard the cyclic changes in instantaneous amplitude and represent the rms or peak value of the signal amplitude by the length of a line. This line is drawn in a certain direction, related to its phase difference. Fig. 13a is a vector diagram for the voltage and current in a purely resistive circuit: the current and voltage are in phase so each vector lies along the same direction. The right-hand, horizontal position shown is always taken as zero phase angle.

The vector diagrams of the basic capacitive and basic inductive loop are also given in Fig.13b and 13c. The 90° phase difference between voltage and current results in the current vector being 90° around from the datum

When interpreting such diagrams, convention says that the observer moves around the diagram in a clockwise direction – it is wrong to rotate the diagram past the observer.

The reference vector is chosen to be the circuit parameter that is common to each component – current in a series circuit, voltage in a parallel circuit.

VECTOR ADDITION

If two or more compatible signals (eg, a pair of voltages, or a pair of currents, but *not* a voltage and a current) exist with a phase difference they *must* be added as vectors – it is wrong to add their amplitudes directly unless they are in-phase.

Referring to Fig. 14, the vector diagram shows two voltages V_1 and V_2 where V_2 leads V_1 by 90°. They are scaled to represent 10 V and 15 V respectively. The net resultant of the two is not 10 plus 15 because they are not in phase.

The correct sum is, instead, found graphically by drawing lines (at 90° at each axis) out to their intersection point V_r. The distance from the origin to the intersection is the resultant voltage. The resultant phase angle is given as the angle θ also shown in Fig. 14. If they are 180° out of phase they can be arithmetically subtracted.

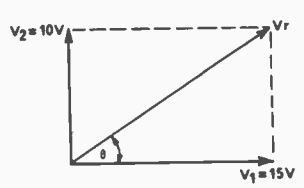


Fig.14. Graphical addition of vectors.

RESISTANCE AND INDUCTANCE IN SERIES

When resistors are used with inductors or capacitors, the signal across them is similarly involved with phasing problems. To find out what happens requires vector addition of voltages and currents.

The vector diagrams of a resistor and inductor in series is given in Fig. 15. The reference signal is current (common to all components) and the voltage developed across the resistor is in-phase with the current. That across the inductor, however, leads the current by 90° (it leads rather than lags this time as our reference is now current – be careful about which leads or lags what). The parallelogram has been completed to give V_r and θ.

In practice, inductors always possess measurable resistance so the phase angle of the practical inductor never quite reaches 90°. Ignoring this though, when the phase angle is 90° in these diagrams (as can be reasonably assumed for inductors and capacitors) we do not need to draw the vector diagram but, instead, make use of the rules of right-angle triangles to calculate the unknowns. The Pythagoras rule tells us that

$$V_r^2 = V_R^2 + V_L^2$$

from which we can show that the apparent resistance of two combined elements (called the *impedance* Z) is given by

$Z^2 = R^2 + X_L^2$ for inductors.

ie. $Z = \sqrt{R^2 + X_L^2}$

Hence the impedance of a circuit containing inductors is only calculable if the frequency is stated (since X_L is frequency dependent).

The phase angle in degrees is found from the trigonometric formula

$$\tan\theta = \frac{X_L}{R}$$

RESISTANCE AND CAPACITANCE IN SERIES

These are treated in the same way as inductors and resistors giving the same Z (impedance) formula but where X_L is now X_C. Here is an example of how impedance is used to determine

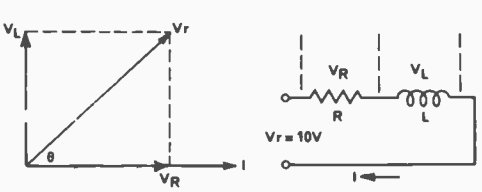


Fig.15. Vector diagram of current and voltages in a series RL circuit.

ELECTRONICS -it's easy!

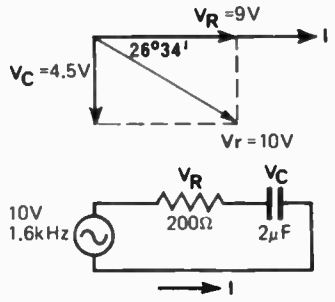


Fig.16. An RC circuit and its vector diagram.

currents and voltages in a circuit fed from ac.

In Fig. 16 a 200 ohm resistor is in series with a 2 μF capacitor. It is required to decide what voltage is across each component and what value phase angle is seen at the terminals.

Knowing the frequency, first calculate X_C (it will be about 100 ohms). The impedance is then found as

$$Z = \sqrt{R^2 + X_C^2} = 223 \text{ ohms}$$

The phase angle is tan θ $\frac{X_c}{R}$ = 0.5 and the tables give the angle as 26° 34'. Finally, we reason out that the phase angle is leading.

The current flowing in the series loop is found from Ohms law but here we take impedance as the total circuit resistance.

$$I = V/Z = 10/223 = 45 \text{ mA.}$$

Ohms law can now be applied (ignoring that we have vector quantities in the current for this is now allowed for) to arrive at the voltage across each element. Across the resistor will be

$V_R = 45 \times 10^{-3} \times 200 = 9$ V across the resistor

$V_C = 45 \times 10^{-3}$ 100 = 4.5 V

Note that these do not add up to 10 V (as might be expected) and that the sum is always more than the source.

Finally, as a check, it is sound practice to draw a scaled vector diagram. This should agree with your figures. This is done in Fig. 16.

Practical capacitors can be made closer to the ideal than inductors so in most capacitor circuits we do not need to make allowances for their internal resistance.

Q-FACTOR

Practical inductors possess both storage and dissipative capabilities at the same time. As they are intended to *store* energy not waste it, it is useful to form a criterion to express their goodness.

A perfect inductor has no resistance, only reactance. The ratio of these two (for a particular frequency, therefore) is a measure of quality. This ratio $\frac{X_L}{R}$ is called the quality factor or simply the Q-factor (or Q) of the coil.

Practical coils can reach Q's of several hundred. To go higher, special circuits have been developed in which the effective Q is many times higher.

Use of the Q-factor is not confined to inductors. It is used to express the quality of many types of energy storage systems — capacitors, mechanical systems, acoustic cavities, etc.

In the next part of this series we will look at inductors and capacitors in parallel circuits with resistors and then study what happens when both are used together. There we will see some quite astounding effects. ●

ELECTRONICS -in practice

A RELAXATION OSCILLATOR

THE circuit of Fig. 17 shows how the charge-discharge behaviour of an LC circuit and a neon lamp (note the circuit symbol) may be used to produce a continuous ac signal. Such a circuit, capable of producing a continuous ac waveform is called an oscillator. The circuit provides, when the correct component values are used,

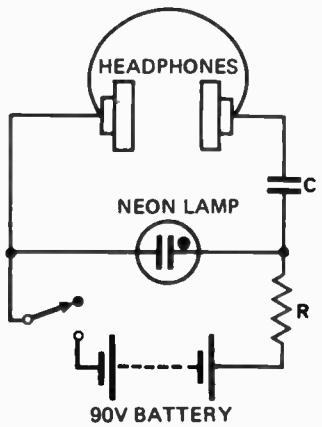


Fig.17a. Relaxation oscillator circuit for Morse Code practice.

an audio-frequency tone that may be heard in headphones.

Neon lamps are small lamps having two metallic elements spaced a short distance apart and enclosed in neon gas at fairly low pressure. At a voltage dependant on electrode spacing and lamp pressure, a glow discharge (due to ionization of the gas) will occur and the current though the lamp will rise to a level limited only, in the main, by the external circuit resistance. This voltage for small neon lamps such as the NE2 or the NE23 is typically around 75 to 80 volts. The lamp will continue to conduct until the supply voltage falls below a point called the maintaining voltage. This typically will be 60 volts or less.

To return to our circuit, the operation is as follows:— When the switch is closed, capacitor C will charge relatively slowly (via resistor R and the headphones) from the battery in a time equal to roughly three times the total resistance in Ohms times the capacitance in Farads (remember T = RC). When the voltage across the capacitor reaches approximately 80 volts, the neon lamp ionizes and draws current from C, discharging it. Were it not for the resistance of the headphones, this discharge would be almost instantaneous. The discharge continues until the voltage across the capacitor falls to 60 V, the neon lamp de-ionizes (thus is again a high resistance) and the capacitor will again charge towards 80 volts. A waveform will thus be generated having a shape similar to that shown in Fig. 17b.

This waveform is obviously not sinusoidal — it is more like a sawtooth. The sound heard in the headphones will therefore be quite harsh because of the harmonics which are present in addition to the fundamental frequency.

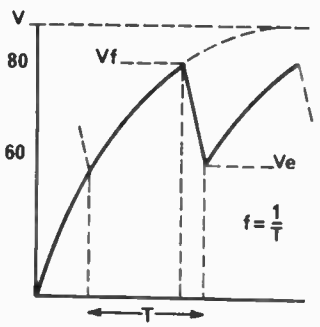


Fig.17b. After the initial half cycle, the neon oscillator will produce a sawtooth having an amplitude of $V_f - V_e$, and a frequency of f = 1/T.

It is impossible to predict, accurately, the frequency at which the circuit will oscillate because of variations in firing and maintaining voltages of the neon and gas ionization and de-ionization times. Below 200 Hz the approximate formula is

$$f = \frac{1}{2.3\ RC \log \frac{V - Ve}{V - Vf}}$$

For your guidance the graph of Fig. 17c shows frequency of oscillation of an NE23 neon with various RC values.

Using values of series resistance below one megohm may shorten the life, of the NE23 neon, due to arc discharges. Values above 15 megohm may prevent oscillation occurring at all. Maximum frequency of oscillation is around 20 kHz being limited by the ionization and de-ionization times of the neon gas. The only limit to low frequency oscillation is obtaining capacitors having high capacitance and low leakage.

The headphones used should be around 2 kohm impedance. Alternately, if high impedance crystal type are used, these should be shunted by a resistor of 2 k ohm in parallel. Remember that the headphone impedance is part of the charge/discharge circuit and will affect the frequency of operation.

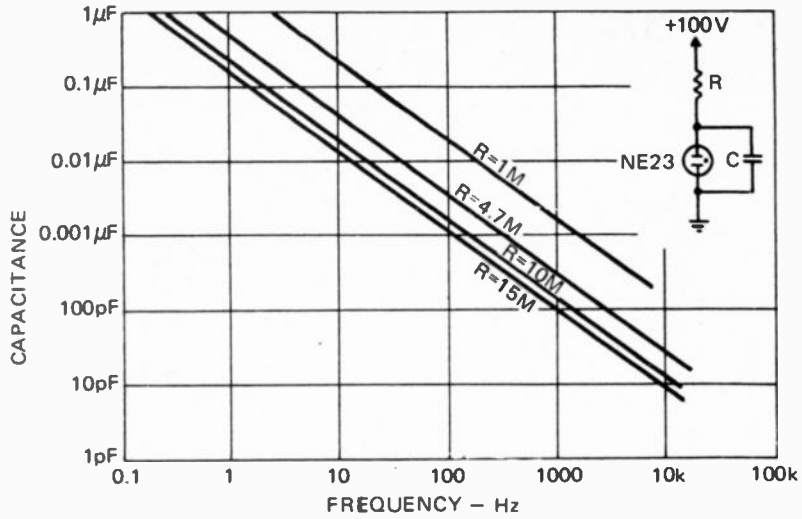


Fig. 17c. Operating frequency of NE23 oscillator with various values of resistance and capacitance. (approximate only).

Note that some small neon lamps are specially designed as indicators for 240 volt ac applications. Such lamps have a built in resistor of high value to limit current through the lamp. These are unsuitable for use in oscillator circuits.

It is interesting to note how such a simple circuit as this has so many factors which must be taken into consideration. Indeed there are even more factors than have been mentioned here – only the important ones have been listed.

Lesson – never take anything for granted, even in simple circuits. ●

ERRATA

Graphs 6b and 9b on pages 90 91 of ETI May 1974 should be transposed.

RESULTS

ELECTRONICS -it's easy CONTEST No. 2

HERE are the results of our Mykit 50 in 1 contest published in ETI March 1974.

ALAN O'NEILL, of Ryde, NSW – aged 11 (!).

BRUCE BATES, of Stafford, Qld. – aged 14.

NEVILLE HORNER, of Mt. Pleasant, W.A. – aged 16.

MICHAEL RYAN, of Teneriffe, Qld. – aged 16.

NICK REDGRAVE, of Templestowe, Templestowe, Vic. – aged 13.

Congratulations! Your Mykit sets have been sent off to you all and you should have received them by the time that this issue is published.

Best entry received was that from 16 year old Neville Horner.

Neville's winning entry is reproduced below.

1/ Explain the difference between active and passive components?

An active component is a part of an electric circuit which contains a source of energy whereas a passive component contains no source of power.

2/ What is a binary device?

A binary device is a device which has only two unique states e.g. a switch is either on or off.

3/ How fast do electrons flow in a conductor?

Although electromagnetic waves travel at the speed of light along a conductor, the drift velocity of electrons in it is given by:

$vel = \frac{I}{e.n.A}$ *where* I = *current in the conductor*
e = *charge on an electron*
n = *free electrons per metre*^{3}
A = *cross-sectional area*

4/ What is meant by period in electronics?

The cycle time of a waveform; the time it takes to complete a cycle and return to a similar starting point, is known as the period of that waveform.

5/ Explain the meaning of the abbreviation r.m.s.

RMS stands for Root of the Mean of the sum of the Squares which is an expression of true mean energy flowing of some recurring variable quantity.

6/ A harmonic – what is it?

A harmonic is an oscillation of a periodically varying quantity having a frequency which is an integral multiple of the fundamental frequency.

7/ How many volts in a nanovolt?

1 nanovolt = 1nV = 10^{-9} V
= .000000001 Volts

8/ Explain rectification.

Rectification is the conversion of ac current to dc. Half-wave rectification occurs when the negative half is blocked, the more efficient full-wave rectification reverses this half cycle.

9/ What is an L.D.R.?

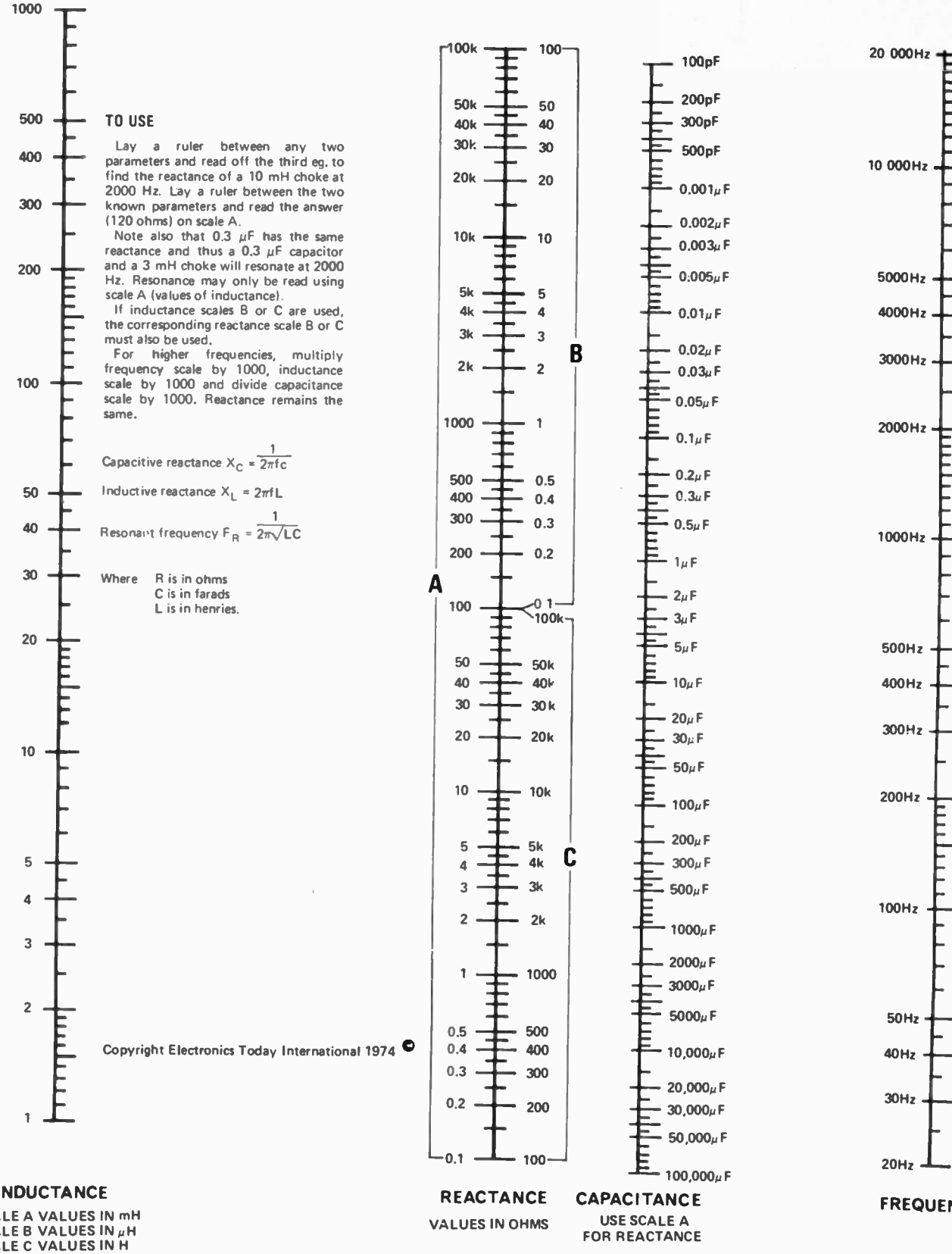
An L.D.R. is a semiconductor whose resistance varies with different light intensities, such that the stronger the light the lower the resistance.

10/ Express your age (in years) in decimal and also in binary numbers.

decimal numbers = 16
binary form = 1000

See page 87 of this issue for another great ETI contest.

eti REACTANCE CHART



TO USE

Lay a ruler between any two parameters and read off the third eg. to find the reactance of a 10 mH choke at 2000 Hz. Lay a ruler between the two known parameters and read the answer (120 ohms) on scale A.

Note also that 0.3 μF has the same reactance and thus a 0.3 μF capacitor and a 3 mH choke will resonate at 2000 Hz. Resonance may only be read using scale A (values of inductance).

If inductance scales B or C are used, the corresponding reactance scale B or C must also be used.

For higher frequencies, multiply frequency scale by 1000, inductance scale by 1000 and divide capacitance scale by 1000. Reactance remains the same.

Capacitive reactance $X_C = \frac{1}{2\pi fc}$

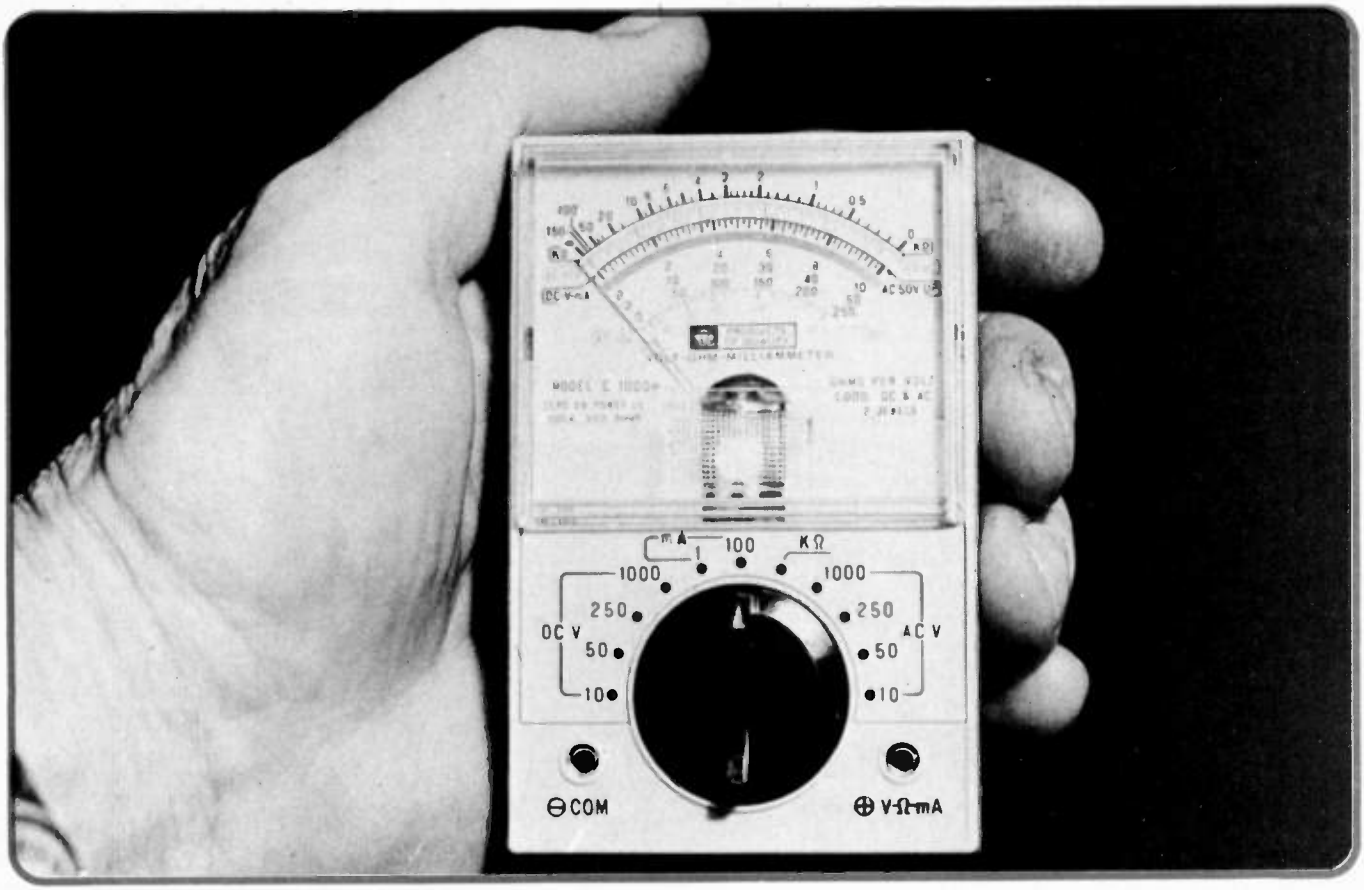
Inductive reactance $X_L = 2\pi fL$

Resonant frequency $F_R = \frac{1}{2\pi\sqrt{LC}}$

Where R is in ohms
C is in farads
L is in henries.

ELECTRONICS -it's easy CONTEST No.4

FIVE MINI-METERS TO BE WON!



Entrants must answer all 10 of the following questions – the answers to which may be found by studying the current and previous parts of the 'Electronics – it's easy' series.

Each question should be answered in not more than 30 words.

The five prizes will be awarded to those entrants submitting the clearest and most concise correct answers.

1. In what basic way do capacitors and inductors differ from resistors?
2. Where is a dielectric commonly used – and why?
3. How can you reinforce the magnetic field due to current flow in a conductor?
4. Name and define the unit of inductance.
5. What is reactance?
6. Give the formulae for inductive and capacitive reactance.
7. Calculate the reactance of a 3 millihenry choke at a frequency of 750 Hz.
8. What capacitor has the same reactance at 750 Hz as the choke in question seven?
9. What is impedance?
10. What is the impedance of a series combination of an 8 ohm resistor and a 3 millihenry choke at 750 Hz.

To encourage our younger readers two of the prizes will be specifically awarded as prizes to boys and girls who are less than 17 years old on the closing date for entries – Monday 24th June 1974.

Winners will be notified by mail and results will be published in the earliest possible issue.

Proof of age may be required if you are under 17.

Please be absolutely certain that you have included name, address and age in BLOCK LETTERS, with your entry.

Entries must be addressed to:–
Electronics Today International,
15-17 Boundary St.,
Rushcutter's Bay, NSW 2011.

CLOSING DATE: Monday 24th June 1974.

The five C1000M mini-testers to be awarded as prizes in this contest have been donated by Dick Smith Electronics Centre. Thanks Dick!

UNDER 17's. Two of these mini-testers have been specifically reserved for entrants under 17 years old.

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THEY SOUND AS POWERFUL AS THEY LOOK

Looks can be deceiving. And size isn't everything. Unless you're talking about a Jensen Speaker System. When the wraps are off a Jensen (as on our Models 4, 5, or 6-left to right) you can see all the power you're looking for.

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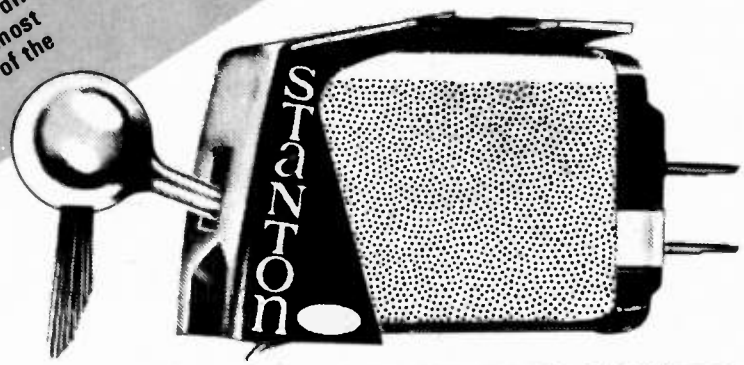
THE STANTON CARTRIDGE . . .
A Critique by the experts

HI-FI STEREO REVIEW The tracking was excellent and distinctly better in this respect than any other cartridge we have tested. The frequency response of the Stanton 681EE was the flattest of the cartridges tested, within ±1dB over most of the audio range.

AUDIO The 681's low-mass stylus assembly is probably responsible for the cartridge's superb tracking performance at such low forces as 1 gram. We found that the Stanton 681EE tracked some previously "unplayable" records . . . 681EE is not at all susceptible to hum pickup . . . The 681EE stands among the top few cartridges on the market.

STEREO & HI-FI TIMES "I have subjected the cartridge to a series of standard test records which I use for all cartridges I test. In all cases this Stanton is as good as any I have yet checked, better in some cases than all others, no worse in any case than any other. Stanton calls this cartridge a "calibration standard". My tests confirm these figures."

HIGH FIDELITY The cartridge's vertical angle was exactly 15 degrees—the first, incidentally, that CBS labs has ever measured that was exactly 15 degrees! This is a cartridge that can reveal acoustic differences among recordings, that accommodates itself to the musical demands of the recorded material, and that can track the most demanding of groove passages like a champion. We mark it, in fact, as one of the very best yet auditioned.



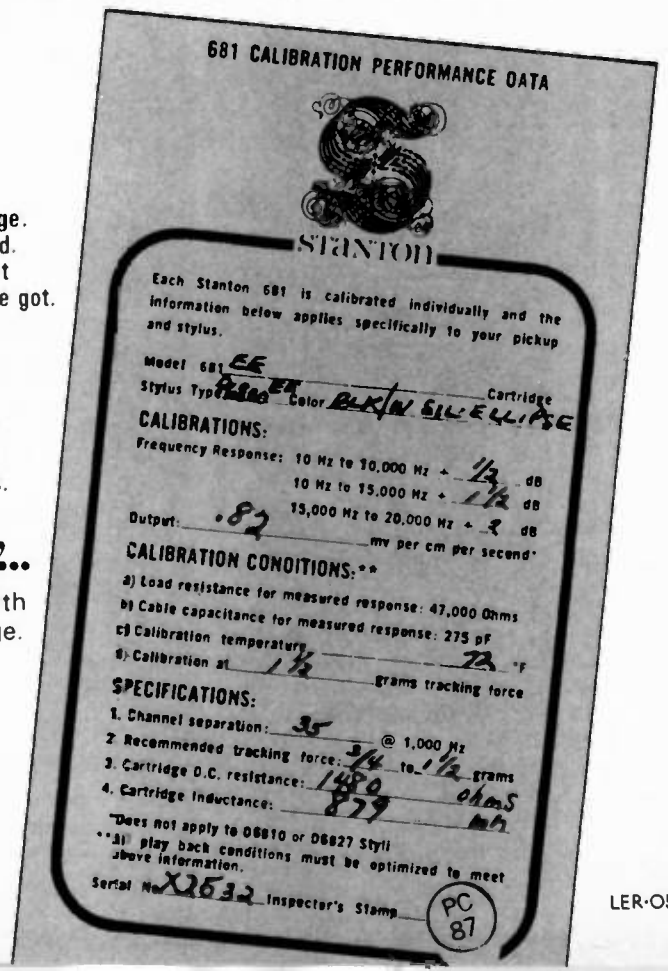
but YOUR Cartridge didn't get a good review!

Perhaps one like it did. Same make same model, but not the one in your turntable.

Pickup cartridges are notoriously variable in quality. Take a dozen Brand A Model X and you can get a dozen different sounds.

That's why the Pro's use Stanton 681EE, the **Calibration standard Cartridge**. Every 681EE, not just one in ten, or one per hundred, is individually measured. if its not up to specification (and what a specification!) it is rejected. It's not sold to you on the strength of a review that a hand-picked special might have got. Rigid quality control is expensive. That's why the Stanton 681EE sells for $72.00. Expensive. Not a rip-off price, but expensive. Still you'll get more improvement for $72.00 by changing to Stanton 681EE than any other $72.00 you could spend on your gear.

So you know that the Stanton Cartridge you buy for your turntable is exactly the same in all significant parameters as the one that got rave reviews from "High Fidelity", "Audio", "Hi-Fi/Stereo Review", and other top authorities.


681 CALIBRATION PERFORMANCE DATA

STANTON

Each Stanton 681 is calibrated individually and the information below applies specifically to your pickup and stylus.

Model 681 EE Cartridge

Stylus Type Replac. EE Color BLK/W SILVER ELLIPSE

CALIBRATIONS:

Frequency Response: 10 Hz to 10,000 Hz ± 1½ dB

10 Hz to 15,000 Hz ± 1½ dB

15,000 Hz to 20,000 Hz ± 3 dB

Output: .87 mv per cm per second*

CALIBRATION CONDITIONS:**

a) Load resistance for measured response: 47,000 Ohms

b) Cable capacitance for measured response: 275 pF

c) Calibration temperature 72 °F

d) Calibration at 1½ grams tracking force

SPECIFICATIONS:

1. Channel separation: 35 @ 1,000 Hz
2. Recommended tracking force: ¾ to 1½ grams
3. Cartridge D.C. resistance: 1480 ohms
4. Cartridge inductance: 879 mh

*Does not apply to 08810 or 08827 Styli

**All play back conditions must be optimized to meet above information.

Serial No. X2632 Inspector's Stamp PC 87

the proof of Stanton Superiority...

This unque calibration performance chart is supplied with every Stanton 681EE cartridge.

Sole Australian Distributors

Leroya Industries PTY. LTD.

266 Hay St., Subiaco, Western Australia 6008.

VIC: BJD Electronics P/L., 202 Pelham St., Carlton. 3053.
QLD.: Brisbane Agencies, 72 Wickham St., Fortitude Valley. 4006
NSW: W. C. Wedderspoon P/L., 3 Ford St., Greenacre. 2190.
S.A. Sound Spectrum, 33 Regents Arcade, Adelaide, 5000.

LER·055.

COMPONENT NEWS

GUNN OSCILLATORS FOR INTRUDER ALARMS

New X-Brand Gunn-effect oscillators, Types GDO 2-4, announced by Plessey, are solid state microwave sources designed specifically for intruder alarm applications in the frequency ranges 9.2 – 9.9 GHz and 10.2 – 10.9 GHz.

These oscillators are intended for fixed frequency operation and can be preset to any frequency in the above ranges. Power outputs up to 100 mW are available. They have a frequency/temperature coefficient of – 200 kHz/°C maximum and a power/temperature coefficient of -0.02 dB/°C maximum, over the temperature range -40° to +70°C.

Commercial enquiries should be addressed to Professional Components, Ducon Pty Ltd, Christina Road, Villawood, NSW 2163.

SINGLE-CHIP CRYSTAL OSCILLATORS FROM 100 kHz TO 20 MHz SIMULTANEOUS SINE, TTL AND COMPLEMENTARY MECL OUTPUTS

Motorola has produced two new integrated circuits which have far-reaching applications in communications, industrial control and instrumentation in addition to the watch and clock market.

The two new IC's fall into the MSI class and combine a crystal oscillator and a buffer amplifier, together with sine-to-MECL and sine-to-TTL level translators so that sine-wave, complementary-MECL and TTL outputs are provided. The chips feature internal voltage regulation and automatic gain control.

Both devices are designed to be operated with an external crystal in the fundamental series mode. In addition to the crystal, two external by-pass capacitors are required and, if desired, further components can be incorporated to 'pull' the crystal frequency for fine frequency adjustment.

Together the two devices cover the frequency range 100 kHz to 20 MHz: below 2 MHz use the MC12060 and above use the MC12061. Stability is very good, averaging –0.08 ppm/°C for the MC12060 and –0.16 for the higher frequency device.

Power supply voltage requirements are +5 V or –5.2 V with the power dissipation being typically 175 mW for MC12060 and 210 mW for MC12061. The sine wave output voltage is dependent on output loading and ranges for 800 mV to 500 mV peak-to-peak for no-load and full load respectively.

The MC12060 and the MC12061 are supplied in a standard 16-pin dual-in-line package for operation over the industrial temperature range 0 to 70°C. Shortly, full military temperature range (–55 to 125°C) versions will become available. These will be designated types MC12560 and MC12561.

NEW RANGE OF INDUSTRIAL RELAYS

Scanelec Pty Ltd, is now marketing a new range of special purpose relays.

The range includes circuit-breaker trip counters, memory relays and automatic reclosing relays.

The circuit-breaker trip counters (single and three phase units) are designed for use by power supply authorities. The units contain special circuitry to avoid false registrations due to contact bounce. Designed for easy installation, the trip counters are mounted in standard relay cases.

The memory relays are designed mainly to overcome problems, such as pulse distortion, in monitoring and control systems. The relays receive a pulse that may be distorted by transmission over a communications network and regenerate a uniform pulse for the operation of appropriate equipment.

The automatic reclosing relays allow control of reclosing time of circuit breakers, which may be tripped by surges and lightning, and prevent indiscriminate and repetitive reclosing of the breakers.

Further details from: Scanelec Pty Ltd, 16 Chapel Street, Marrickville 2204.

LOW PRICE AMPLIFIER

A 25 watt pre-assembled stereo amplifier module is now available from Dick Smith Electronics.

It is supplied complete with pre-amplifier, requiring only a power supply and four rotary potentiometers to be supplied by the home constructor.

Normally we do not quote prices in this column but this time we are making an exception – for a basic price of $15 is *news*.

NEW LOW-COST DIGITAL TURNS-COUNTING DIAL

Bourns has introduced a highly accurate, low-cost digital turns-counting dial. The new Bourns Model H-357 KNOBPOT Digital Dial is designed for use with 1/4-inch shaft (diameter) precision potentiometers – or other rotating devices. Readout accuracy is 0.1% and readability is 1 part in 2,000.

The large, easy-to-read digital readout is integral to the 7/8-inch diameter knob. A recessed lens protects the readout. Materials and construction are industrial grade.

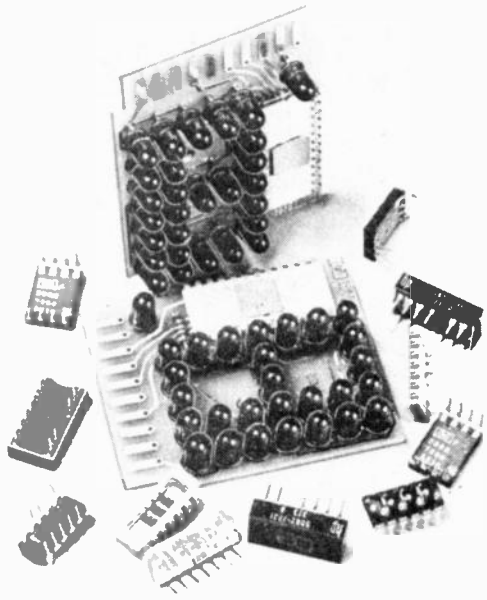
A brake option is available to lock the unit at any desired setting. According to Bourns, the brake will not change the value setting when engaged.

Further details from: Sydney: P.O. Box 12, Marrickville N.S.W.; Melbourne: P.O. Box 180, Northcote, Vic. 3070.

GEORGE BROWN TO OPEN MELBOURNE BRANCH

Sydney based distributor George Brown & Co. Pty Ltd. will open a Melbourne office on May 1st. This branch, as with the Sydney and A.C.T. operations of George Brown, will carry a full range of electronic components.

The George Brown Melbourne office will be headed by Geoff Atkinson and all enquiries should be directed to him at telephone 419-3986. Their address is – 93 Sackville Street, Collingwood, Vic.



the numbers game

HP has a Solid State Display built right for you.

It all adds up to this. If you are in electronics, you need to select your LED displays from a wide range of components that are reliable and suit your individual applications. Hewlett-Packard has the range and the reliability. Get in touch direct or through any HP distributors listed below.

HP *DISTRIBUTORS*

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DIGITRONICS AUSTRALIA PTY LTD
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Maryville, N.S.W. 2293
Phone 69 2040

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RADIO DESPATCH SERVICE
869 George Street
Sydney, 2000
Phone 211 0816

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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

W.A.
EVERETT AGENCY PTY LTD
17 Northwood Street
West Leederville
Western Australia, 6007
Phone 81 5500

QLD.
M. O. WALTON (ELECTRONICS) PTY. LTD.
3 Moore Street
Enoggera, 4051

A.C.T.
ELECTRIC COMPONENTS PTY LTD
3 Pirie Street
Fyshwick, 2600
Phone 95 6811

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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

90417A/3016?

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.

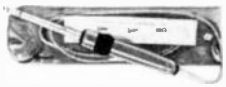
VERSATILE
Copes with all soldering jobs—from miniature components to large solder lugs. Temperature control at your finger tips. Heat only when, where and as much as needed.

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.

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AMATEUR RADIO

Roger Harrison VK2ZTB

THE STATE OF THE ART

OSCAR-7 SATELLITE

DETAILS have been announced of the next *Oscar* (orbital satellite carrying amateur radio) package. *Oscar-7* will be the second in the *Amsat-Oscar B (A-O-B)* series of long life amateur satellites. It is intended that the orbit will be sun-synchronous and similar to that of *Oscar-6* which still remains operational. The satellite will incorporate the following facilities:

1. AMSAT repeater (designed by Karl Meinzer, *DJ4ZC*);
- input frequency passband between 423.125 and 432.175 MHz;
- output frequency passband between 145.975 and 145.925 MHz;
- power output (high power mode) is 14 W PEP;
- down-link passband is inverted from up-link passband;
- repeater is 45% efficient using envelope elimination and restoration technique;
- linear operation – SSB and CW are preferred modes;
- repeater is commandable to either 3.75 or 14 W PEP output;
- telemetry beacon at 145.980 MHz (200 mW);
- up-link power required: 300-400 W/erp.

2. AMSAT 2 to 10 m repeater (designed by Perry Klein, *K3JTE*):
- input frequency passband between 145.85 and 145.95 MHz;
- output frequency passband between 29.40 and 29.50 MHz;
- power output is 2 W PEP;
- down-link passband is not inverted from up-link passband;
- linear operation – SSB and CW are preferred modes;
- telemetry beacon at 29.50 MHz (not same as Oscar-6).

3. Morse code telemetry encoder (designed by John Goode, *W5CAY*):
- 24 analogue input channels;
- converts each analogue value into a two-digit Morse code number or "word";
- a third digit precedes the telemetry value and gives the line number in which the word is located;
- format is arranged 4 words per line, six lines per telemetry frame;
- Morse code rate is commandable to 10 words per minute or 20 words per minute.

4. Teletype telemetry encoder (developed by Peter Hammer, *VK 3ZPI* and Edwin Schoell, *VK3BDS*):
- 60 analogue input channels;
- converts each analogue channel to a three-digit number transmitted in Baudot code;
- each three-digit value is preceded by its channel number; making a five-digit telemetry word;
- the data are arranged 10 words per line by six lines per telemetry frame;
- two lines of status information follow the analogue matrix and give the spacecraft time (i.e., time in "counts" from launch, 1 count = 96 minutes);
- output keys 435.1 MHz beacon in FSK: 850-Hz shift; 45.5 bauds (reversed from United States standard). Also keys 145.98 and 29.50 MHz beacons as AFSK, on command.

5. Beacon transmitter on 435.1 MHz (developed by Larry Kayser, *VE3QB* and Bob Pepper, *VE2AO*):
- beacon output frequency is 435.10 MHz;
- power output is 0.4 W at an efficiency of 45%;
- beacon is FSK modulated 850-Hz shift.

6. Small beacon transmitter on 2304 MHz (developed by San Bernardino Microwave Society);
- 0.1 W at 2304 MHz;
- turned on by command only for 30-minute periods;
- CW keyed – HI followed by 30-second carrier. Also keyed with Morse code telemetry on command.

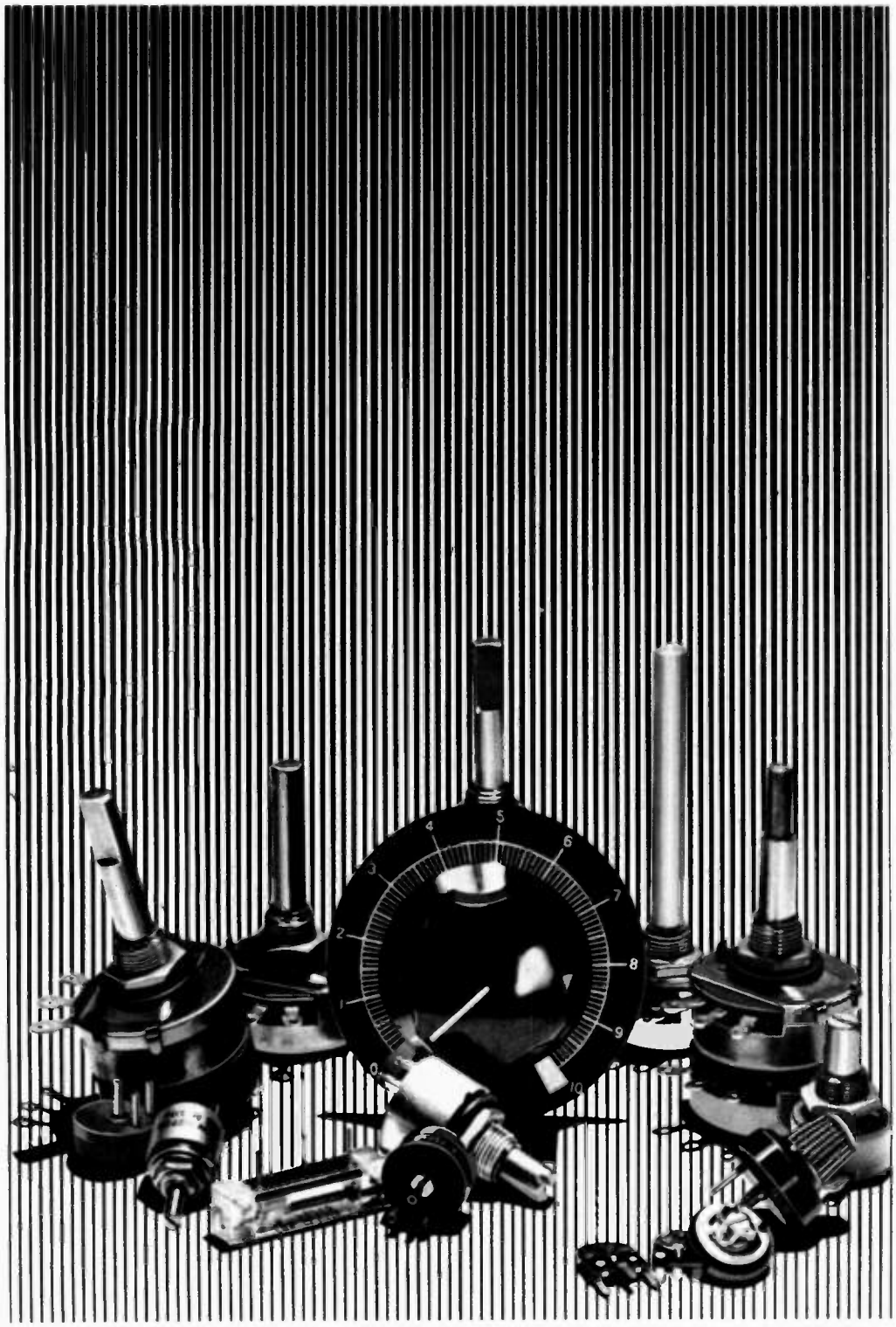
7. Codestore – message store-and-forward system (built by John Goode, *W5CAY*):
- 896 bit memory capacity using COS/MOS shift register memory;
- loaded via command link;
- output code speed is 13 words per minute.

8. Experiment control logic (designed by Jan King, *W3GEY*):
- selects the spacecraft operating modes;
- protects satellite against excessive battery drain by reducing repeater output power or by shutting it off completely.

9. Input solar power, battery charge regulator (developed by Karl Meinzer, *DJ4ZC* and Werner Haas, *DJ5KQ*):
- converts 6.4 V at arrays to 14 V to charge battery or to supply the spacecraft experiments;
- senses overcharge of battery and reduces charging current;
- senses failure of either of the two redundant regulators and switches to the opposite regulator automatically.

The equipment in Oscar-7 has been assembled and tested by AMSAT, and the constructional work has been carried out by amateurs in Australia, Canada, the Federal Republic of Germany and the United States. AMSAT is supported by amateur radio operators located in 46 different countries. – *International Amateur Radio Union Region I Divisional/Amateur Radio Satellite Corporation.* ●

PLESSEY PROFESSIONAL CONTROLS



Plessey provides the widest selection of Professional class carbon and wire-wound resistive controls of both commercial and DEF Qualification standard.

The range offers miniature potentiometers rated upwards from 50mW to power rheostats of 500W, together with a choice of resistances, tapers, shafts, mounting arrangements, ganged and dual types and specials to suit customers' specifications. Ganged potentiometers with track matching to within 1.6db. are available for stereophonic equipment, test instruments and other applications.

Potentiometers employ a hot moulded carbon track construction giving extremely low electrical noise throughout a long, trouble-free life. Life expectancy is in the order of 9 million cycles of rotation with a resistance change of no greater than 1%.

Plessey potentiometer tracks consist of a phenolic moulding loaded with carefully controlled proportions of conducting carbon filler providing superior power dissipation and temperature coefficient characteristics compared to carbon film types.

A standardised range is available ex stock. Literature is available on request to the Professional Components Division.

PLESSEY

Plessey Ducon Pty. Limited
Box 2, Villawood, N.S.W. 2163
Telephone 72 0133. Telex 20384
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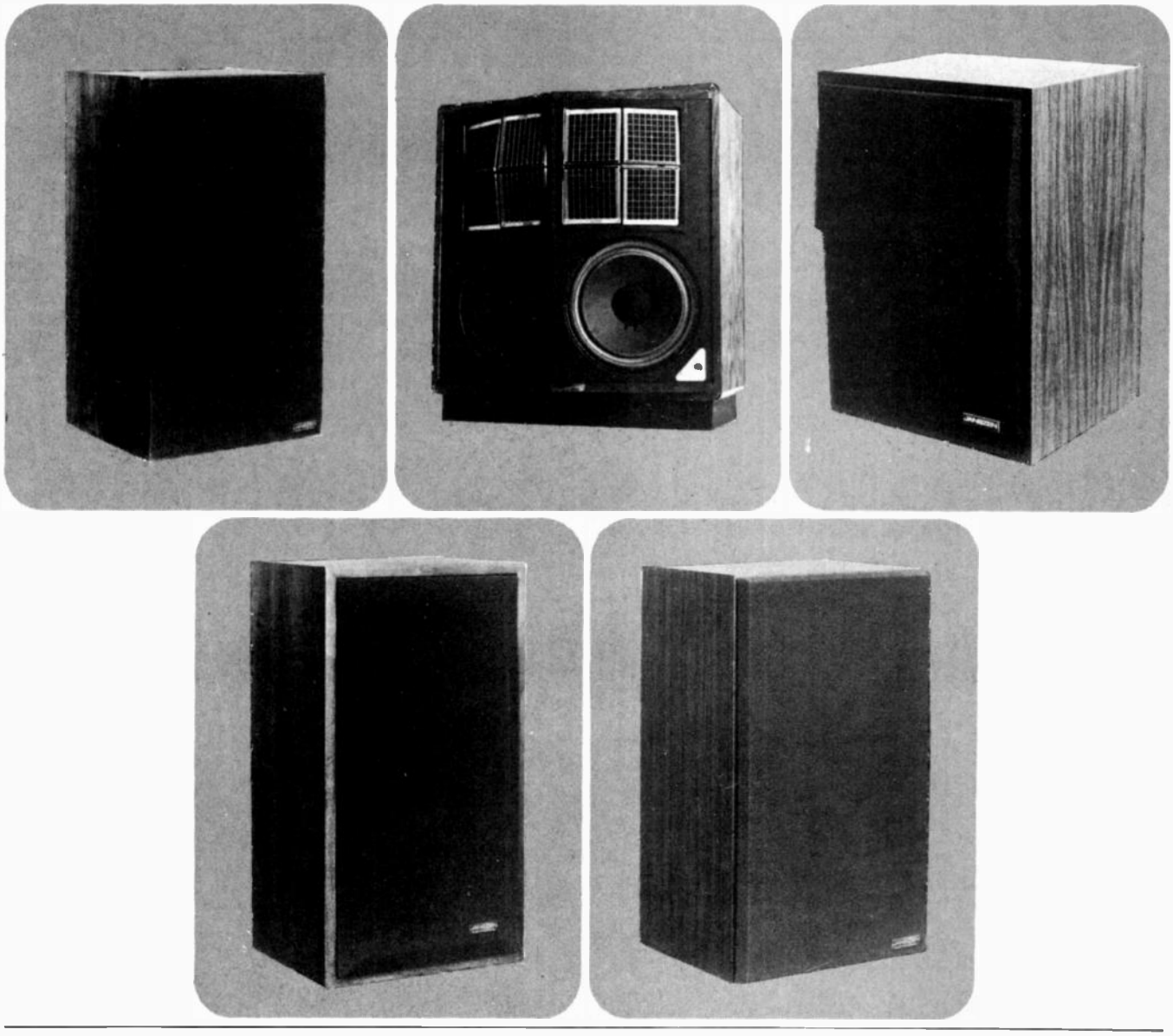
INCOMPARABLE JANSZEN



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When we say Janszen is incomparable we mean it . . .
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Janszen was the original electrostatic manufacturer in the United States, and has developed electrostatic speakers for more than 20 years.
Janszen offers the dedicated high fidelity enthusiast the highest level of technical excellence and performance that is unmatched.
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See your high fidelity retailer now.

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

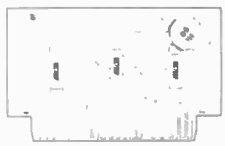
*With open collector output

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

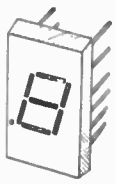
Set of 5 boards and sockets with data and applications $7.95

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 section module for clocks, counter or other numerical display needs.

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

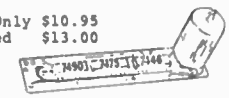
A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven-segment decoder driver. The 7447 accomplishes blanking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

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

Circuit board is .8" wide and 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 seen at a distance of 30 feet. The tube has a standard nine-pin base (solderable) and a left-hand decimal point.

Each $4.00
SPECIAL 5 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.

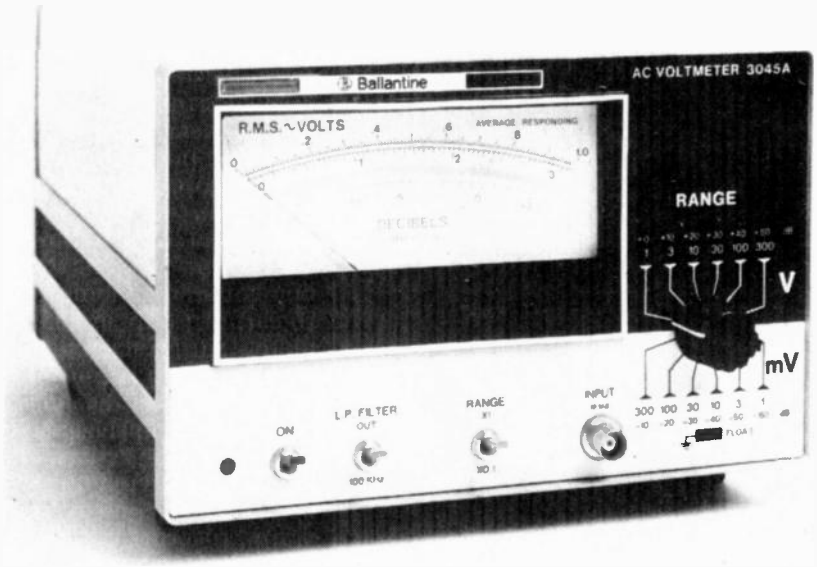
Each $1.50 5 for $7.00

Babylon Electronics Inc.

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

EQUIPMENT NEWS

NEW BALLANTINE SERIES OF SOLID-STATE BROADBAND AC VOLTMETER/AMPLIFIERS



Ballantine Laboratories Inc. has introduced a new series of solid-state broadband ac voltmeter/amplifiers with significant state-of-the-art advances. The pioneer firm whose ac voltmeters and calibrators have served as standards for the industry, will show the first two instruments in the new line at the 1974 IEEE Convention in New York City.

The Ballantine Models 3045A and 3046A are rugged, portable precision ac voltmeters which also function as precise gain broadband amplifiers and ac to dc converters. Both offer a broad bandwidth for analogue, average-responding type instruments, 5 Hz to 15 MHz, and are useable to 20 MHz. Sensitivity is 100 microvolts full scale with 12 ranges plus a "Range X 0.1" mode, providing full scale voltage ranges from 100 microvolts to 300 volts. Accurate readings down to less than 30 microvolts can be made with the 100 microvolt full scale sensitivity. With an optional probe, measurements can be made to 1000 volts.

The Model 3045A has a linear voltage and a logarithmic dB scale; the Model 3046A features Ballantine's logarithmic voltage scale and a linear dB scale. At no additional cost a front panel control is provided on the Model 3046A which allows a 3 dB adjustment of sensitivity. This feature permits the user to set the meter to a convenient level, such as 0 dB, when making relative measurements.

For both instruments, midband accuracy between 40 Hz and 2 MHz in terms of ± (% full scale + % reading) is ± (1 + 0); at 10 Hz and 10 MHz accuracy is ±(2.5 + 2.5), and at 5 Hz and 15 MHz it is ±(5 + 5).

Input is single ended or at the user's option a front panel slide switch gives floating input by separating signal and chassis grounds. Measurements can thus be made in both grounded and floating circuits. The floating capability permits safe operation to ± 500 volts (dc to peak ac) with respect to the chassis. Both instruments can be operated from either 115 or 230 volts ac lines or from one external 28 to 38 volt battery or dc source. An optional internal rechargeable nickel cadmium battery pack is available.

A 100 kHz low pass filter can be switched in with a front panel control. This facilitates readings on noisy low frequency signals.

When operated as an ac to dc converter, the Model 3045A/3046A provides a minimum of 1 volt at the dc output for full-scale meter indication. Recorders, digital indicators and control devices, may be driven by this output. As a stable wideband ac amplifier, this instrument has a minimum voltage gain of 43.5 dB (x150) from 10 Hz to 4 MHz, with an output of at least 150 millivolts rms.

Each instrument measures 13 centimetres high x 22 centimetres wide x 30 centimetres deep, weighs less than three kilograms; the battery-operated models weigh 3.5 kilograms.

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

COMPUTER BASED DATA ACQUISITION SYSTEM

Monitor Laboratories Model 9400 is a versatile computer based data logging system. The system comprises input scanner, measurement device, digital clock, controller, NOVA mini-computer, and output device.

Signals from transducers having analogue, digital and event status outputs may be scanned, measured, linearised etc and the data outputted to a wide range of peripherals.

The scanner mainframe may accept either relay or FET switching modules allowing low level signals as encountered in strain gauge and thermocouple applications to be measured with excellent thermal integrity and medium to high level signals to be measured at speeds as high as 10 000 channels/sec.

Scanning modes such as random address, first and last channel select, plus channel skip may be under computer control using standard software available in fortran and basic languages.

For simple data acquisition requirements Model 9400 may be operated as a free standing unit apart from the computer, still allowing sophisticated facilities such as linearisation of thermocouples and off limit detection.

Comprehensive display facilities for channel identity, measured variable, and clock display etc are standard features and ensure easy initial set up, particularly when using "blind" output devices such as magnetic tape recorders.

Model 9400 will interface to output devices, such as printers, paper punched tape, typewriters etc and under computer control onto V.D.U.'s and ticket printers.

Further details: Arlunya Pty. Ltd., PO Box 113, Balwyn, Vic, 3103.

LASER DOPPLER VELOCIMETER

A new instrument developed in the Brown Boveri Research Centre in Baden, Switzerland, is now being manufactured and marketed internationally by Goerz Electro GmbH of Vienna, Austria. Basic principles of coherent optics and electronics were investigated and have been practically utilised.

In Laser Doppler Anemometry, instead of a mechanical probe, at least one laser beam focussed on the measuring point is utilised. Position and size of the probe volume are determined by the focus of the beam(s). Microscopically small particles being carried in the flow

without slip scatter a part of the laser beam when they pass through the probe volume.

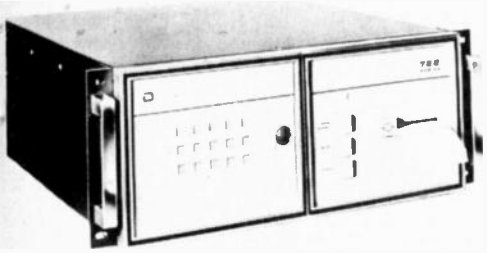
As a consequence of the doppler effect, the frequency of the scattered light is shifted from the original frequency of the laser beam by an amount proportional to the velocity of the particle. This frequency shift is traced electro-optically, processed electronically and evaluated.

The advantages of the Laser Doppler Velocimeter are: no mechanical contact, no interference with the flow configuration, absolute calibration, linear relationship between velocity and measured values, high spatial and temporal resolution, insensitive to corrosive substances, equally suitable for gases, liquids and solids.

The Laser Doppler Velocimeter is suited for applications in diverse fields. The manufacturer points out that the system can be made operational in only a few seconds to yield results of high accuracy and reproducibility being at the same time simple to operate. No special knowledge of optics and electronics is needed to use the instrument.

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

LOW COST DIGITAL PRINTERS



Just released in Australia is the Datadyne range of low cost digital printers.

These printers can print a maximum of 22 columns at up to 40 lines per second. Various print drums are available. All inputs are fully buffered.

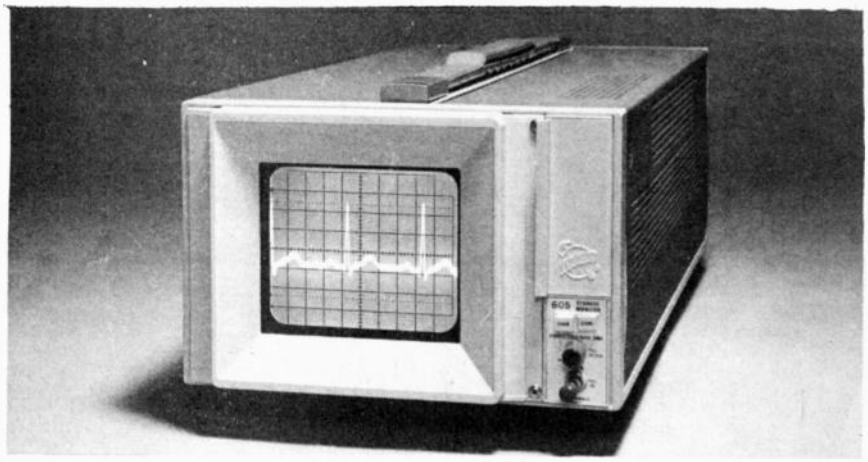
Other features include: Programmable zero suppression, column inhibit and formal control; external paper advance and line feed; plug-in IC's are used for quick maintenance.

ADE is currently looking for a representative to market this product range throughout Australia, being directly responsible to the principal in the USA.

Further details: Anderson Digital Electronics, 11 Hamilton Place, PO Box 322, Mt. Waverley, Vic. 3149.

EQUIPMENT NEWS

NEW, LOW COST VARIABLE PERSISTENCE STORAGE DISPLAY



Tektronix, Inc. has introduced a new Variable Persistence Storage Monitor as an addition to the company's comprehensive line of crt displays. This bright, fast writing speed, XYZ monitor can hold a display for periods from a fraction of a second to greater than five minutes, depending on the setting of the persistence control. Longer display times are possible in the "save" mode. When storage is not required the 605 can serve as a conventional non-storage display.

The 605 offers several important performance advantages in addition to its variable persistence. X and Y channels have a 3 MHz bandwidth and the bandwidth of the Z channel is 5 MHz. The 605 has a maximum writing speed of greater than 1 div/μs. Controls are on the front panel of the 605 and the remote programme interface to the monitor is TTL compatible. Remote programme lines are available for Storage Mode, Erase, Save, and Erase Verify. An optional time base provides six calibrated, internally triggered sweeps from 1 μs/div to 0.1 s/div allowing the 605 to be used as a basic waveform monitor.

With its variable persistence storage and gray scale capability (Z-axis input), the 605 Monitor is suited to raster scanning applications. The variable persistence of the 605 is also ideally suited to viewing low repetition rate signals.

Further details: Textronix Australia Pty. Ltd., 80 Waterloo Rd, North Ryde, NSW, 2113.

NEW RANGE 8 DIGIT FLOATING POINT CALCULATORS

NS Electronics are about to release the first models in their new 800 series calculator range.

First to be released, the model 820, will feature 8 digits, floating point and constant. Following close behind will be the model 823 which will add % key, memory and rechargeable batteries to the 820 specification.

Mr. Geoff Drury, Regional Manager of NS Electronics Systems Division said whilst prices had not yet been firmed the public could expect reductions when compared with similar currently available calculators – as had been the case with the introduction of the M600 and 900 models. The range will ultimately include scientific as well as printing and desk top models.

Further details: NS Electronics Pty. Ltd., Cnr. Stud Road & Mountain Highway, Bayswater, Vic. 3153.

INDUSTRIAL RANGE PRE-SET COUNTERS

The J.M.R. PC series of Pre-set Counters/Controllers allows the user to select an instrument to meet his specific application.

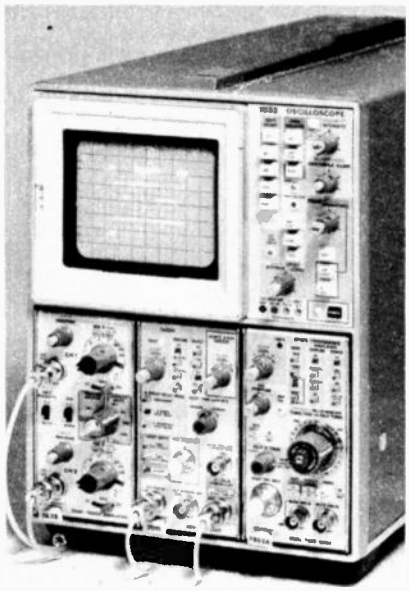
They are designed to operate in industrial environments under adverse conditions where large line voltage fluctuations, wide temperature excursions (0-60°C), machine vibration, dust, and high electric noise prevail.

The counters are of a modular design with one to five decades (expandable in field), or two pre-sets and counting speeds from 50 to 20 000 counts/sec.

A wide variety of input/output options are available and J.R.M. can supply common transducers such as proximity, magnetic, photoelectric etc.

Further details: Arlunya Pty. Ltd., P.O. Box 113, Balwyn, Vic. 3103.

1000 CM/μSEC AND 100 MHz BANDWIDTH STORAGE OSCILLOSCOPE



The 7633 Storage Oscilloscope is the newest in the "7000" Series of oscilloscope-based laboratory instruments from Tektronix.

Providing true 100-MHz-equivalent storage of its full bandwidth, the new 7633 captures and displays waveforms that until now could not be retained by storage instruments.

The instruments features multi-mode storage capabilities. Variable persistence, bi-stable, and conventional non-store modes are available. A fast writing 8 x 10 division (.45 cm/div) mode is included which provides the instrument's top writing speed. This variety of operating modes contained in one package allows the 7633 to be adapted to many applications.

Thirty different 7000 Series plug-ins, permit "custom tailoring" of the instrument for a specific job, and allow for later expansion of its capabilities as the needs arise.

A CRT alpha-numeric readout for quick on-screen reference is available as an optional facility.

Further details: Tektronix Australia Pty. Ltd., 80 Waterloo Rd, North Ryde, NSW, 2113.

NEW TWO-PEN RECORDER USES LINEAR MOTOR DRIVE

A new electronic chart recorder, the Clearspan P120L, has been introduced by Foster-Cambridge Limited and is now available from Kent Instruments (Australia) Pty. Ltd. – both member

companies of the George Kent Group.

The new instrument incorporates two servo-controlled linear motors arranged in parallel to provide full-scale drive for its two continuous-writing pens. Its introduction extends and completes the Clearspan 120 mm chart recorder series. The full P120L range of instruments now includes single-pen continuous-writing and multi-point dotting (two-, three- and six-point) versions as well as the new two-pen continuous-writing instrument.

A new servo-controlled linear motor, with lubricated-for-life ball bearings, has been developed for the new two-pen model. The new bearings give improved carriage location and the open construction of the second-generation design permits better access to internal parts.

The manufacturers claim an accuracy of better than ±0.5% of span with a full-scale response of less than two seconds. The P120L is marketed as an accurate, compact recorder or recorder/controller for the many process applications which do not warrant more costly, wide-chart instruments.

With the two-pen recorder one of a number of control modes can be fitted on the first channel. These include: 2-step on/off, 3-step high/low alarm or time-proportional P.I.D. control.

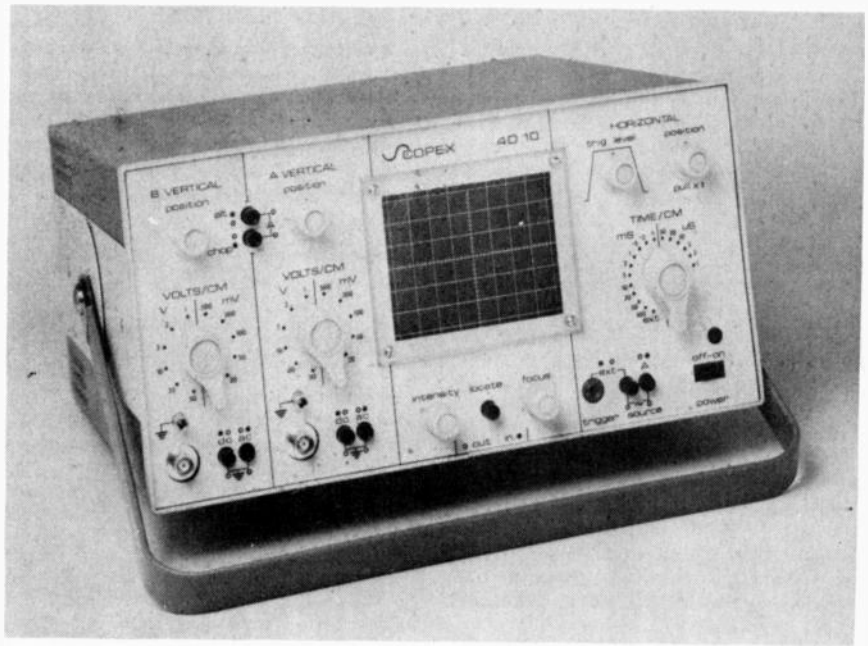
All the variants in the P120L range are built into a standard, compact case. A comprehensive selection of plug-in range cards is available for thermocouple, resistance thermometer, millivolt, humidity and gas analysis applications.

Cassette-type chart driving units are used in the P120L recorder, these are fully interchangeable to minimize down-time during maintenance or when changes of chart speed are necessary. Chart speeds from 5 mm/h to 3600 mm/h are available as standard.

Where the ranges for each pen vary, a second scale can be carried on a transparent cursor which may also be fitted with a chart tear-off facility.

Further details: Kent Instruments (Australia) Pty. Ltd., 70-78 Box Road (PO Box 333), Caringbah, NSW, 2229.

NEW PORTABLE OSCILLOSCOPE



Scopex Instruments was formed in 1971 to meet what was felt to be the need in the market for a low cost precision oscilloscope.

The company's latest unit, the model 4D-10 is a rugged, light-weight instrument offering dual trace operation to 10 MHz with 10 mV sensitivity. Trigger level and polarity are controlled with one knob which, in combination with beam location and direct calibration facilities, makes it a suitable instrument for colour TV servicing etc.

The 4D-10 may be used horizontally, vertically or tilted at pre-set angles.

Further details from: Arlunya Pty. Ltd., P.O. Box 113, Balwyn, Vic. 3103.

The world is yours...

with, SONY'S CRF-230B

Capture everything that's on the air . . . anywhere in the world . . . with SONY's exciting and fascinating new CRF-230B World Zone global receiver. Its 23 bands cover almost all broadcasting range in FM and AM: SW, MW and LW in every nation throughout the world. All with professional receiver quality. Get news broadcasts directly from the places where the news is happening. Tune in on exotic music from the farthest corners of the globe. Or eavesdrop on "ham" or citizen band amateur transmissions—in code or voice. Totally versatile, easy to operate, functions in any country or in any locality. The solid-state SONY World Zone is a masterpiece of radio technology.

Consider too, the 13-band CRF-160, the 9-band earth-orbiting CRF-5090 with airband or the 8-band CRF-5080.

SPECIFICATIONS

Model name	All Transistor AM/FM Radio Receiver
Circuits	Superheterodyne (FM, MW, LW, SW1) Double Superheterodyne (SW2~SW19)
Power requirements	AC 100, 120, 220V, 240V 50/60Hz DC 9V, Batteries Size D (UM-1)×6 DC 12V, With use of SONY Car Battery Cord, DCC-2AW
Transistors, diodes	4 FET's and 27 transistors for reception 17 transistors for AUX functions 34 diodes, 2 thermistor
Antenna system	FM: 2 telescopic antennas, 1000mm External antenna terminals (300 ohm) (75 ohm) are provided MW/LW: Built-in ferrite bar antenna, 10φ×180mm SW1/MW/LW: External antenna terminal is provided SW1~SW19: Telescopic antenna, 1470mm SW2~SW19: External antenna terminal (75 ohm) is provided
Frequency range	FM1: 76~90 MHz FM2: 87.5~108 MHz MW: 530~1605kHz (566~187m) LW: 150~400kHz (2000~750m) SW1: 1.6~4.5 MHz (187~67m) marine SW2: 2.0~2.6 MHz (120m) SW3: 3.0~3.6 MHz (90m) SW4: 3.5~4.1 MHz (75, 80m) SW5: 4.5~5.1 MHz (60m) SW6: 5.8~6.4 MHz (49m) SW7: 7.0~7.6 MHz (40, 41m) SW8: 9.5~10.1MHz (31m) SW9: 11.5~12.1MHz (25m) SW10: 14.0~14.6 MHz (20m)
Frequency range	SW11: 15.0~15.6 MHz (19m) SW12: 17.5~18.1 MHz (16m) SW13: 21.0~21.6 MHz (15m) SW14: 21.4~22.0 MHz (13m) SW15: 25.5~26.1 MHz (11m) SW16: 26.8~27.4 MHz (11m) SW17: 28.0~28.6 MHz (10m) SW18: 28.6~29.2 MHz (10m) SW19: 29.2~29.8 MHz (10m)
Intermediate frequency	FM: 10.7 MHz SW1, MW, LW: 455 kHz SW2~SW19: 1.6~2.2 MHz, 455 kHz
Maximum sensitivity (at output 50mW, S/N 6 dB)	FM: −2 dB (0.8μV) MW: 28 dB (25μV) LW: 36 dB (41μV) SW: 0 dB (1μV)
Signal-to-noise ratio	FM: 63 dB at 54 dB input, 400 Hz, 30% modulation MW: 37 dB at 60 dB input, 400 Hz, 30% modulation LW: 30 dB at 60 dB input, 400 Hz, 30% modulation SW: 44 dB at 44 dB input, 400 Hz, 30% modulation
Image rejection	FM1: 72 dB at 77 MHz FM2: 72 dB at 98 MHz MW: 60 dB at 1605 kHz LW: 80 dB at 360 kHz SW1: 30 dB at 4.5 MHz SW2: 80 dB at 2.1 MHz SW19: 30 dB at 29 MHz
Selectivity	LW, MW: 40 dB at (BROAD) position SW: 60 dB at (SHARP) position
Muting level	10 dB~30 dB (adjustable)
Frequency response	100~20,000 Hz ±10 dB (tone control)
Audio output	AC: 4W (undistorted) DC: 1.5W (undistorted)
Current drain	AC: 180mA (at zero signal) DC: 90mA (at zero signal)
Speaker	4⅜"×3⅜" (21×8cm), 8 ohms×2
AUX input jack	Maximum sensitivity: −53 dBm at 50mW output Input impedance: 5k ohms
MPX output jack	Output level: −24 dBm at 5k ohms load impedance Input impedance: 5k ohms
Recording jack	Output level: −50 dBm Output impedance: 2.2k ohms
Recording connector	Output level: −29.5 dB Output impedance: 80k ohms
External speaker jack	3~8 ohm speakers can be connected
Headphone jack	8 ohm headphones can be connected
Earphone jack	8 ohm earphones can be connected
Other controls	Tuning meter Calibrator reset knob AGC/MGC knob BFO switch and knob Selectivity switch Noise limiter switch Muting switch Sensitivity switch
Dimensions	17⅝"(W)×12⅝"(H)×7½"(D) (452×325×190mm)
Weight	31 lb. 14 kg (without batteries)
Supplied accessories	AC power cord Polishing cloth Short wave guide

SONY®

Sony Kemtron Services Pty. Ltd.

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SK 636

THREE-CHIP COLOUR DECODER

New three-chip colour decoder reduces external component count.

THE announcement of Motorola's new three chip PAL colour TV decoder at the recent Paris Components Show was delayed until the new circuits were in quantity production. Already the new devices are being employed by one major European manufacturer in their latest 1974 models.

The three chip-system processes the raw composite video input signals to produce Red, Green and Blue output signal drive via drive transistors directly to the colour tube.

The PAL decoder consists of two new circuits and the industry standard colour demodulator chip MC1327 – a circuit which was pioneered by Motorola and is now available as an equivalent from other manufacturers also. The new I.C.'s are the TBA395 chrominance combination and the TBA396 luminance combination.

By using the new circuits a complete PAL decoder cum R.G.B. matrix/output drive circuit can be incorporated on a circuit board measuring only 13 x 15 cm. A major advantage of this new approach is that only about half the number of external components are required compared to more conventional I.C. PAL decoders.

Functions included in the TBA395 include controlled chrominance amplifier, gated burst amplifier, phase-locked-loop reference oscillator, automatic chrominance control generator and colour killer. The TBA luminance I.C. contains such sections as black level clamping, beam current limiting, dc controls of brightness, contrast and saturation with contrast saturation tracking.

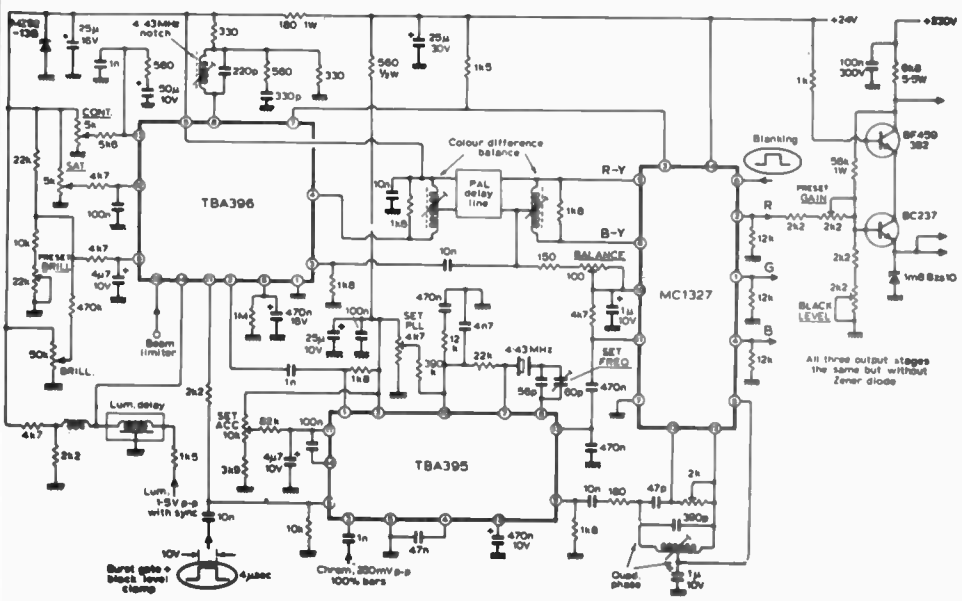
The final circuit in the trio (MC1327) contains a dual double-balance chroma demodulator, the Red, Green, Blue (RGB) output matrix and the PAL switch.

Only two power supply rails are required. The low voltage supply for the chips (24 V) and 230 V to the RGB drive transistors.

Main advantages claimed for the new decoder include increased reliability – due to the reduction in number of components; dc control of brightness, contrast and saturation; automatic colour control; beam current limiting; contrast/saturation tracking; improved differential output voltage temperature performance and black level clamping.

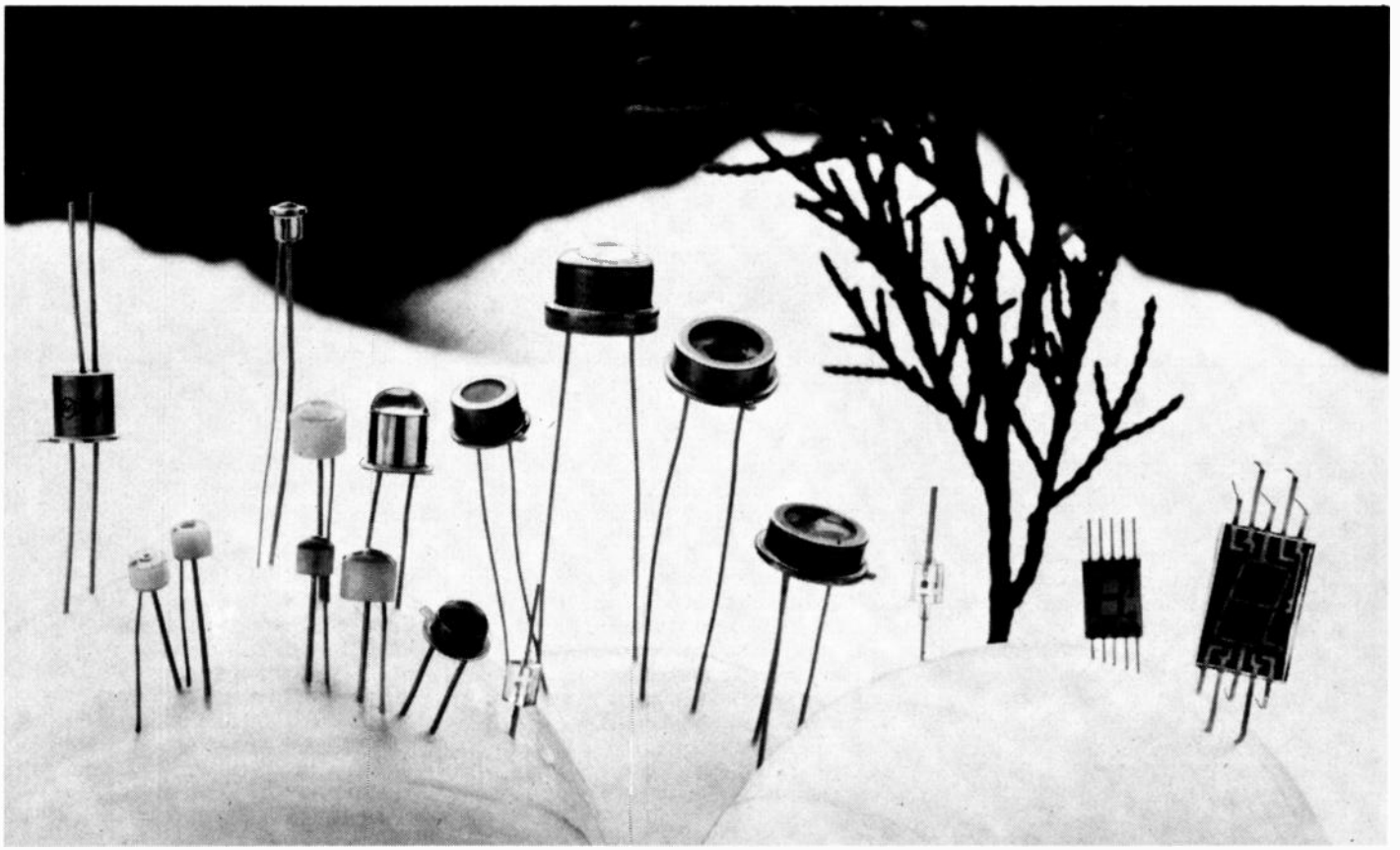
Independent gain and black-level potentiometers are incorporated in each output stage reducing setting up problems. In addition, the use of dc feedback greatly improves the overall stability and changes in supply voltage and load resistor value do not appreciably affect output voltages. Good frequency response is ensured by the very low output impedance.

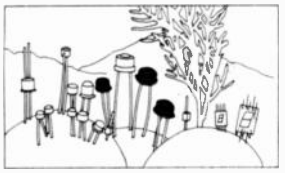
All three integrated circuits are housed in 14-lead plastic dual in line packages. ●



Typical decoder circuit using new chips.

The complete range of Optoelectronic devices

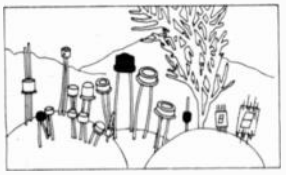




Photodiodes

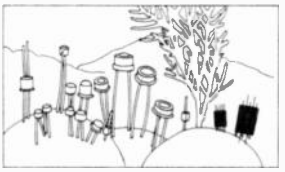
OKI photodiodes are of diffused planer silicon construction, feature high performance and reliability and are suitable for application in computer peripheral equipment, process control, industrial control, photo-meters or any other design requiring light sensitivity.

A 9-bit silicon photodiode array is available which finds application in punched paper tape readers of input machines for computer and NC equipment.



Phototransistors

OKI phototransistors are of planar silicon construction and are highly sensitive devices. They are particularly suitable for use in optical measuring equipment, control devices and other electronic applications.

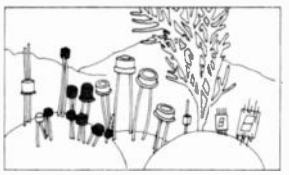


Solid-state Numeric and Alphanumeric Displays

OKI numeric displays are of GaAsP monolithic or hybrid, 7-segment composition. They are suitable for application in a wide variety of display apparatus. Features include high brightness with small current, numerals 0·9 and decimal point and rugged, vibration-resistant construction.

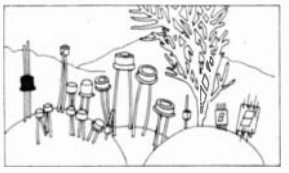
Typical applications include computer terminals, electronic desk and portable calculators, cameras, electronic wrist watches and various digital measuring instruments.

The alphanumeric display (not illustrated) is a 5 x 7 dot matrix of 36 GaAsP red L.E.D.s.



Light Emitting Diodes

OKI L.E.D.s are available in INFRARED, RED or GREEN versions. A wide range of body styles is available to suit a multitude of applications including solid-state indicators and displays, photo-choppers, photocouplers, photo-switches . . . e.g. punch tape readers, conveyor control, rotation counters, automatic weighing machines, position control and opto-isolators.



Photocouplers

The OKI photocoupler employs GaAs L.E.D.s and Si photo-transistors. Its light source and sensor are optically coupled with no electrical connection. Typical applications include pulse transformers, photoswitches, photorelays, power separation circuits (for analog and digital) and level converting circuits (for potential and impedance).

***Optical Mark Sensor**

(*not illustrated)

OKI manufacture an optical mark sensor which senses by the reflection method, 12-unit signal marks and a timing mark recorded on the paper for OCR use and converts the data into electrical signals.

It is composed of GaAsP L.E.D.s as the light source, planar silicon photodiodes as the sensor and IC preamplifier.

PLESSEY

Plessey Ducon Pty. Limited
Box 2, Villawood, N.S.W. 2163
Tel. 72 0133. Telex 20384
Melbourne: Zephyr Products Pty. Ltd.
56 7231. **Adelaide:** K. D. Fisher & Co.
42 2920. **Perth:** H. J. McQuillan
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AC79/R1

SUPERIOR STEREO TURNTABLES

CEC

5 Years Guarantee

BD 2000A

A manual player of simple trouble-free design, featuring:

- 4 pole synchronous motor.
- 30 cm aluminium die cast platter weighing 1.2 kg.
- 0.1% wow and flutter or less.
- Fitted with MC 10 magnetic cartridge with 0.7 mil diamond stylus.
- Overall dimensions: 460 mm (W) x 357 mm (D) x 185 mm (H).

Price $139

BD 6000

A manual player for the connoisseur with advanced tone arm design and extremely low rumble. Perfect for 4 channel.

- Completely isolated 4 pole synchronous motor.
- Less than .07% wow and flutter.
- Full anti skating compensation.
- Fully sprung suspension.
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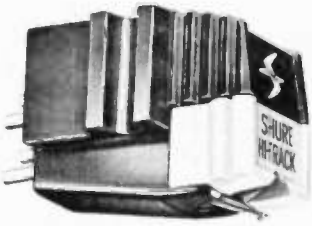

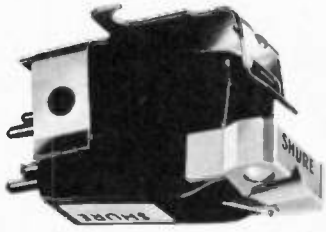

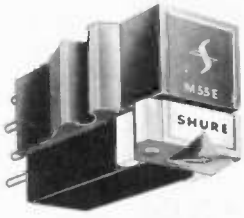

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HISTORY REPEATS ITSELF

BROWSING through nineteenth century learned journals is always fascinating, for although their prime intention was to report scientific ideas and findings, the descriptions often give an interesting insight into the ways of the times.

With excitement currently mounting at Siding Springs, N.S.W. over the almost complete Anglo-Australian 150 inch reflectiong telescope, it seems appropriate to present an unabridged letter about an earlier telescope that came from places far off to look at the Australian skies . . . the Great Melbourne telescope.

This telescope was equally as exciting to the then scientific world. For several years the scientific fraternity had been reading of proposals and designs. In 1868 the telescope arrived in Melbourne. This letter, sent to the sponsors, was published in the Proceedings of the Royal Society of London. The reports from this Institution started in 1664!

Several interesting points emerge from this letter written 105 years ago. Firstly, note the mail time. It was not far different from surface mail today, and what was the overland route?

The brick walls of the building were reasonably solid but that horrid galvanised iron roof was not in keeping with the rest of the structure. And who were the masons who toiled to finish the job on New Years day?

This was the last letter to the Royal Society concerning the installation. From then on the reports came in thick and fast as the new facility churned out new astronomical findings. ●

"Account of the Building in progress of erection at Melbourne for the Great Telescope." In a Letter addressed to the President of the Royal Society by Mr. R. J. ELLERY, of the Observatory, Melbourne. Communicated by the President. Received February 27, 1869.

Observatory, Melbourne, Jan. 4, 1869.

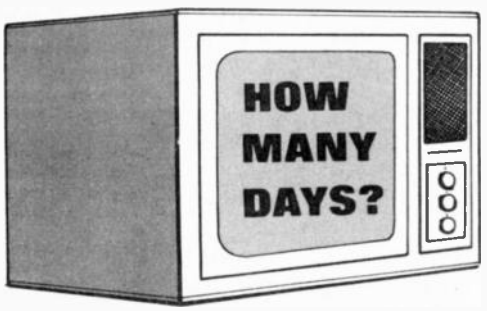
MY DEAR SIR, — The telescope has at length arrived, and we are now very busy getting it erected; for nothing could be done towards it till the great machine itself came to hand. It will be nearly two months before it can be fairly tried, when a spacious rectangular building and its travelling roof will be completed.

Mr Le Sueur arrived nearly two months before the telescope, having come by the overland mail, and the ship carrying the telescope making an unusually long passage.

The principal or more delicate portions of the instrument came out in good order: the specula are still in thin coats of varnish, and their surfaces appear in perfect good order. Some of the large castings and portions of the gearing had got rusted, but not to an injurious extent. The piers were completed on New Year's morning, and form a magnificent piece of masonry, the stone employed being the grey basalt, so common here (called "blue stone"), in blocks from one to three tons in weight each. The building we have finally decided upon is of stuccoed brickwork 80 feet long by 40 wide. Forty in length is taken up by the telescope-room, which is covered by a ridged roof of iron travelling on rails on the walls, and moves back on the other 40 feet of the building, leaving the telescope in the open air. The back 40 feet is covered by a fixed roof lower than the moveable one, and will contain a polishing and engine-room, a capacious laboratory, and an office for observer. The cost of piers, building, and roof will be about £1700. The Government, with hard economy in all other directions, have still acted very liberally about this work; and I only trust the telescope itself will turn out all that is expected of it. The micrometer and spectrum-apparatus have not arrived yet.

Our magnetographs do their work smoothly and satisfactorily. The photography has become a part of the routine of the Observatory now. I have been anxiously awaiting the arrival of the baro-and thermographs, and we look for them every day, although I have had no advices of their having been shipped. I suppose you will have seen Mr. Verdon long before this reaches you.

I remain, my dear Sir,
Yours faithfully,
ROBERT J. ELLERY.



FIVE men form a company to build colour TVs.

Bill Kopperloss, Helm Holtz, Wayne Bridge and Serge Arrestor can build one in 13 days; Bill, Helm, and Lou Scuppling build one every 15 days.

Now Bill, Helm, Wayne and Lou take 12 days whilst Bill, Wayne, Serge and Lou need 19 days.

As if that were not complicated enough, the group found that Tom, Wayne, Serge and Lou do one in 14 days.

How long do you think it would take the group to build one colour TV if all five worked at the same time — and who could build one fastest on his own?

A copy of K.G. Jackson's Dictionary of Electrical Engineering to the first correct entrant's answer opened after June 10th.

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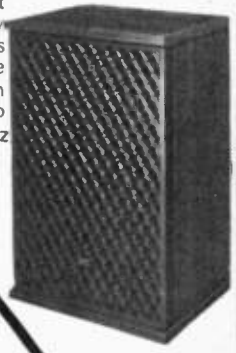
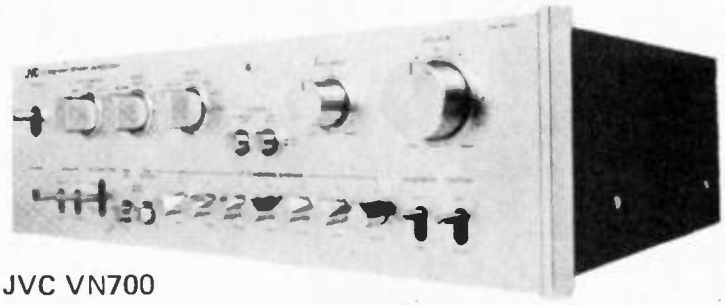
This high class speaker system is the result of JVC own intensive research programme. The SK 12 has a 12" free edge woofer, two 5" mid range speakers, two 2½" tweeters and horn super tweeter. Together these speakers give a total coverage with a flat frequency response over the whole audio range. A continuous lever control for the high frequency sounds makes the SK 12 match any room acoustics. The front grilles are removable so that the cabinet has no side edges to reflect high frequency sound. This heightens the smooth response to 25-22,000Hz



JVC SK12

Here is the purists delight with 70 watts (RMS) of output and specifications that are very impressive. In figures this means a frequency response of 20-50,000 Hz and a THD factor of 0.25% plus the feature of JVC's SEA tone control system that gives you ultimate control over sound at 40, 250, 1000, 5000 and 15000 Hz. This unit will connect up to two pairs of speakers, two tape recorders, turntable and three auxiliary components.



JVC VN700

"4-channel ready"

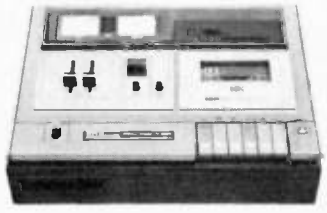
A look at this precision component will tell you its different, but a closer look will prove it. Notice how the TH universal tonearm houses a 4/2-channel compatible cartridge. And how the turntable's 4-pole synchronous motor and belt-drive system combine to give it the precision required for reproducing discrete 4-channel stereo records: wow and flutter of less than 0.1% WRMS and an S/N ratio of better than 5-db. In addition, auto-stop-return mechanics with anti-skating device and cueing lever. In fact, all that's required to convert the SRP-87 to immediate discrete 4-channel status is JVC's 4DD-5 demodulator and stylus (4DT 10X).

JVC-SRP 87

Stereo Cassette Deck with ANRS

The professionalism of the open reel deck is combined with the convenience of the cassette in this high-performing compact, a 'must' for any serious stereo enthusiast. Built-in Automatic Noise Reduction System (ARNS) Tape Selector Switch, long life head and electrically-governed DC motor enable the unit to offer frequency response of 30 to 13,000 Hz (±3 dB), a signal-to-noise ratio of 50 dB and low wow and flutter characteristics of 0.15% RMS. For optimum recording, the unit features a pair of large VU meters, separate sliding volume controls and convenient pushbuttons for all recording and playback functions, including one for Pause and Eject. For professional monitoring with headphones, a headphone level switch is included.

JVC 1667 V



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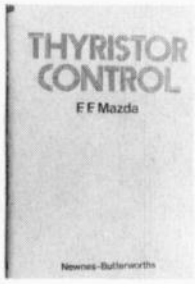
BOOK REVIEWS

Reviewers: Brian Chapman, Andrew Pozniak



THYRISTOR CONTROL by F.F. Mazda. Published by Newnes-Butterworth 1973. Hard cover, 381 pages 215 x 135 mm. Australian price $19.95.

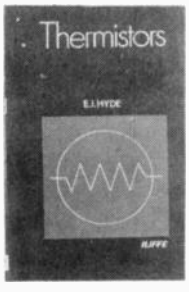
Since its discovery in 1957, the thyristor has gained rapid acceptance by engineers as a device for the control of power and of motor speed. But in addition, a wealth of thyristor applications have been found in general electronics that considerable simplify the implementation of many useful, but previously too expensive devices.

In particular, the greater use of frequency converter, invertors, choppers and cycloconverters is directly attributable to the economic savings inherent in the use of thyristors to implement such equipment.

Most previous text books on thyristors have either been slanted towards the home experiment or towards the design engineer. Hence, as far as the student of electrical engineering is concerned, the former have been too basic, and the latter have incorporated mathematical treatments which tended to dismay rather than to illuminate.

This book has been written specifically with the degree or diploma student in mind. It assumes very little and discusses the entire subject in a clear and easily understood manner. Relevant mathematics are included, but these do not cloud the text as so often happens in the heavier works.

The whole gamut of thyristor applications is covered, including the newer electronics. techniques mentioned earlier. Thus the book is not only suitable for students but should find acceptance by practising engineers. B.C.



THERMISTORS. By Professor F.J. Hyde, D.Sc., M.Sc., B.Sc. Published by Illife Books London 1971. Available in Australia through Butterworth & Co (Australia) Ltd. Hard covers, 197 pages 215 x 135 mm. Australian price $10.70.

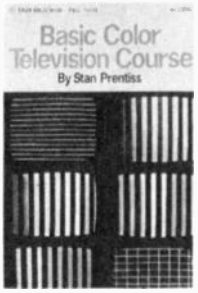
This is an elaborately researched book on thermistor devices. It is not a book for beginners, who would find it very heavy going indeed, nor does it purport to offer ready-designed circuits that can be extracted for a specific application.

It is a comprehensive text book that treats the subject in depth and from basic fundamentals. Mathematics is used extensively, including calculus and vector analysis, in developing design equations and in defining the behaviour of various devices.

In the sections dealing with practical applications, which comprise about half of the text, a very broad range of uses is covered, from the simple Wheatstone-bridge configuration thermometer, to the use of an indirectly-heated NTC thermistor as an ac/dc transfer standard. As elsewhere, design equations and behaviour parameters are given or developed from basic principles.

The long list of references to be found at the end of each chapter, and the comprehensive subject index, only enhance the impression of how thoroughly the late Professor Hyde had researched the subject.

This is a book that will find favour not only with students and engineers but also the research scientist involved with the detection, measurement or control of thermal parameters. A.P.



BASIC COLOR TELEVISION COURSE : By Stan Prentiss Published by TAB Books 1972. Soft covers, 420 pages 215 x 135 mm Price $7.50 available May 1974.

With colour television just around the corner in Australia, many people will be looking for basic texts on the subject. Fortunately there are very many available but because of this the choice is difficult – as only a cursory examination is possible in a book shop.

The book under review provides very complete coverage of colour television techniques and circuitry applicable to the servicing of colour sets manufactured in the United States specifically for the US 525 line 60 Hz NTSC system.

Thus, although much of the circuitry would be similar and hence of interest, the almost exclusive treatment of NTSC rather than PAL (and of domestic US receivers only) makes this book of little use to the Australian beginner. The relevant frequencies are different and the circuitry will be quite different from that in sets to be marketed in Australia.

As to the quality of the book itself, Stan Prentiss obviously knows his television, but unfortunately does not know how to write books. Many misleading and ambiguous statements are made throughout the book, not because Stan Prentiss doesn't know, but because he hasn't the ability to impart his knowledge in clear, unambiguous English.

So, if you know your TV and merely wish to see how things are done in the US, by all means buy the book, but beginners should look for something published in Australia or the UK. B.C.

RECORDINGS
classical

REVIEWER: Tanya Buchdahl

MAHLER: Symphony No.8 in E flat ('Symphony of a Thousand'). Joyce Barker, Elizabeth Simon, Norma Burrowes (sopranos); Joyce Blackham, Alfreda Hodgson (altos); John Mitchinson (tenor); Raymond Myers (baritone); Gwynne Howell (bass). New Philharmonia Chorus, The Bruckner-Mahler Choir of London, The Ambrosian Singers, the Orpington Junior Singers, Highgate School Choir, the Finchley Childrens' Music Group. Symphonica of London/Wyn Morris. Independent World Releases SYM 1-2 (two records in folder), $7.00. Distributed by Carinia.

Wyn Morris has done it again – another one of his marvellous Mahler performances.

This time he has chosen one of the most monumental of works and performed it with what may at first glance seem the most unlikely collection of artists, at least in comparison with the other formidable versions already in the catalogue. Not only is this quite a courageous undertaking in itself, but he does it with a new orchestra on a new label – not bad. The formula which brought it off was simply Wyn Morris plus the producer, Isabella Wallich, a woman of much energy and talent.

Independent World Releases, begun in order to provide cheap but good music (the present set sells in England for the ridiculously low price of about $2.40), is her second label; the first was Delyse. Some of you may already know the Morris recording of Des Knaben Wunderhorn, with Janet Baker and Geraint Evans, now on WRC but originally a Wallich/Delyse production. The Symphonica of London is also her own creation, formed only as recently as 1972 and with some of the best players in London; for example, Sidney Sax (leader and 1st violin), William Bennett (flute), Alan Civil (horn), John Wilbraham (trumpet), Leslie Pearson (organ), and so on. The first performance they gave was of this Mahler symphony, which was greeted with unanimous delight (I hear that the Albert Hall was full, despite the fact that some seats were selling for close to $40); and the present recording was made shortly before this concert was given.

To call the work a symphony is stretching the definition just about to its limits – it is strictly more like an oratorio. It is in two movements; the first is set to the hymm Veni, Creator Spiritus, the second is set to the closing scene of Goethe's Faust.

Neville Cardus said of this work, composed in 1907: "The Eighth Symphony is Everyman's symphony. It embraces in intention, at any rate, earth and heaven; the music speaks not of the individual but of the universal soul. The enormous choir and orchestra (of 125) are as the Time and Space dimensions; and fresh young voices relate birth to experiences as they lisp and choir, as young angels, of the blessed children born into the loftier ether. Eight soloists share the burden, like so many Atlases, of supporting Mahler's universe of song and tone."

Obviously it is not a work to be taken on lightly, and conductors have really only in the last eight years (Bernstein was the first of those currently available) come out of their reticence to record it – probably not least because of the technical problems involved in coping with so many performers. There are also versions by Kubelik, Haitink and Solti, the last of which is generally considered to be the best available (SET 534-5). I must say that overall I find very little to choose between Solti's and Morris's performances, though other reviewers seem to give the former the advantage. Solti takes the first movement faster than Morris and thus gives it more driving force; his final soprano soloist (whom I can't identify but is one of Heather Harper, Lucia Popp and Arleen Auger) is more successfully recorded and sings most movingly. On the other hand, the childrens' choir that Solti uses is the Vienna Boys' Choir, and I'm afraid that I find those dear, innocent little boys sound just too mature and self-assured – not at all the way Cardus (above) seems to have imagined them. Morris's children produce a most disconcertingly innocent sound without sacrificing any musicality at all. Solti's version sounds a little more "professional"; Morris's sounds more engagingly direct, probably because it was recorded in very long takes – surprisingly, only one or two blemishes are noticeable (but not objectionable) – the children rush the speed at the very start of side 4, and there is a messy mens' entry towards the end of it. The sopranos on both sets don't quite make their top C in the very last chorus, but neither painfully so.

Neither set is perfect in regard to its actual recording quality, understandably; but Solti manages a clear sound where Morris's is texturally thicker, though he has been careful to highlight 'effect' instruments well. This is terribly important in Mahler, who is arguably the best orchestrator who ever composed. Morris I think makes a more intelligent movement break over sides 3 and 4, after Gretchen's penitential song; Solti's break comes rather peculiarly in the middle of the dialogue between the Mystical Choir and Dr Marianus. As for the soloists, on both sets they are a bit variable but on the whole, excellent. I must make special mention of Norma Burrowes as Mater Gloriosa (Morris version) though, who sings ravishingly.

Obviously, either set is well worth having; you may well be decided by the extraordinarily low price of the Morris version, though, as all the others are full-price. I understand that this new recording is the result of a recent record-hunting trip overseas by Mr Kulakowski, Manager of Carinia – he deserves the highest praise for bringing it here, and it seems it should be well worth waiting to see what else he has brought back.

MOZART: Sonato for two pianos in D, K.448; Sonata for piano (four hands) in C, K.521. Justus Frantz, Christoph Eschenbach (pianos). DGG 2530-285 ($6.20).

The sonata composed for two performers at one piano is one of the simplest and most gregarious forms of chamber music. Two-piano sonatas tend to be rather less so because there are not so many two-piano families around. Nevertheless, both pieces on this record were written for domestic use, and both for women of considerable ability, judging by their difficulty. The question arises, that if works of considerable stature (as these undoubtedly are) are written for home productions, should prospective performers approach them as such, or as pieces basically for entertainment but which almost incidentally happen to be works of great substance? My attitude leans towards treating such works with the respect and care they deserve, at least in recorded performance, but this is merely opinion and others may prefer a more spontaneous-sounding performance; in that case, the present recording should be ideal.

Frantz and Eschenbach are both relatively young, but the latter is already noted for his crafty and intelligent, if somewhat shallow, performances of Mozart sonatas. They are obviously enjoying themselves thoroughly; apart from that they are obviously intelligent and can clearly see the structures of the sonatas – but

I don't think they see the depths of them. The four-hand sonato (K.521) fares rather better than the other for it can better support some laciness on it, but I think that K.448 is just too meaty to be treated with so much virtuosic sparkle, to the exclusion of almost everything else as it is here. However, the engineers treat them very well indeed, with a close but clear sound; the notes are brief but informative; and the cut-out-style photo of the two pianists on the back cover I understand is to be submitted for the Bikies of the Year Award (the red-hot Honda that Frantz is leaning on was unfortunately cut from the photo when they sheared it off at genital level).

If you like this type of music played as it would be in a domestic setting (or better), then, I recommend this recording; for Frantz and Eschenbach play with the right sort of spontaneity, but with a magnificently controlled touch, seem to have no problem with tangled hands, and show none of the non-sychronization which plagues amateur performances. If however you want deeper readings, you will probably have to hunt for them. K.521 I understand is only recorded otherwise by Alfons and Aloys Kontarsky on Three Centuries of Musick (unavailable here), which not only contains K.448 but the Fugue in C minor K.426 (four hands) as well. K.448 is available here (if you hunt) on Musidisc (RC-664) with Bonneau and Joy, which as I recall was a fine performance spoiled by a bad surface; otherwise the piece appears on CFP with Ogdon and Lucas; an old Decca recording with Ashkenazy and Frager; and an older Turnabout version with Brendel and Klien; but if any of them are available locally I haven't seen them. T.R.B.

MOZART: Lieder, Vol. 1. Edith Mathis (soprano), Bernhard Klee (piona), Takashi Ochi (mandolin)*. DGG 2530-319 ($6.20).

Das Veilchen K476; Als Luise die Briefe ihres ungetreuen Liebhabers verbrannte K520; Des Kleinen Friedrichs Geburtstag K529; Sei Du mein Trost K391; Der Fruehling K597; Die Verschweigung K518; Der Zauberer K472; Abendempfindungen an Laura K523; Ridente la calma K152; Un moto di gioia K579; Oiseaux, si tous les ans K307; Ah! Spiegarti, Oh Dio K178; Das Kinderspiel K598; Die Alte K517; *Die Zufriedenheit K349; Die kleine Spinnerin K531; Sehnsucht nach dem Fruehlinge K596.

All too few of Mozart's songs are on record — I can't see why.

His songs may not have the all-encompassing profundity of those of Schubert and Strauss, but many are perfect specimens of Mozart's genius, in miniature, and some of them represent the first of the great Lieder tradition.

Das Veilchen is one such. The text is Goethe's; the story of a tiny violet in a field which sees a young girl coming; it wishes to seem pretty to her that she would pluck it and hold it to her breast, though it knows it would die within the quarter-hour. The girl, however, doesn't even see the violet and steps on it as she passes — and still the violet is happy, because it dies through her. The text is pathetic, and so is Mozart's music, and from so little they make a masterpiece.

Not all the poems Mozart set were so inspired, though (it was probably the only one); Des kleinen Freidrichs Geburtstag (Little Frederick's Birthday) is the story (by Johann Schall) of an angelically good and diligent little boy who, like most goody-goodies, sounds pilly in the extreme, and who has a birthday at which everyone rejoices. Even God throws down a blessing or two. Mercifully, Edith Mathis dispenses with this song in an ingenuous fashion, not attempting to make any more of it that it is. She has a clear and direct voice, if not very big, and sings with a very direct approach which is mirrored delicately by Bernhard Klee, and which is ideal for these small-scale pieces that just do not bear over-interpretation. She has just the right sort of understated humour, too, to carry off such a delightful character pieces as Der Zauberer (The Magician) and Die Alte (The Old Woman).

Two of the songs on this record, Abendempfindungen (Evening Reflections) and Der Zauberer also appear on a recent record by Elizabeth Schwarzkopf (with Geoffrey Parsons: ASD 2844), and I find Miss Mathis to be every bit as good. In the former song she actually produces a tone not unlike Miss Schwarzkopf's, but without the matronly, blankety warmth the latter puts into her singing. Of these two songs, also, Elizabeth Schwarzkopf has transposed the first down a semitone and the second down a minor third. The top notes were only F and G respectively — surely she cannot be all that unsure of her upper range now?

Though the record appears to give very short measure, there is actually over 42 minutes on it, and the 17 songs represent almost exactly a half of Mozart's output for single voice and piano. The recording quality is excellent — not too forward — and texts plus translations are provided (though there are no notes). This is a fine release, and one which should make you look forward, as I do, to Volume 2 which presumably contains the other half of the songs. — T.R.B.

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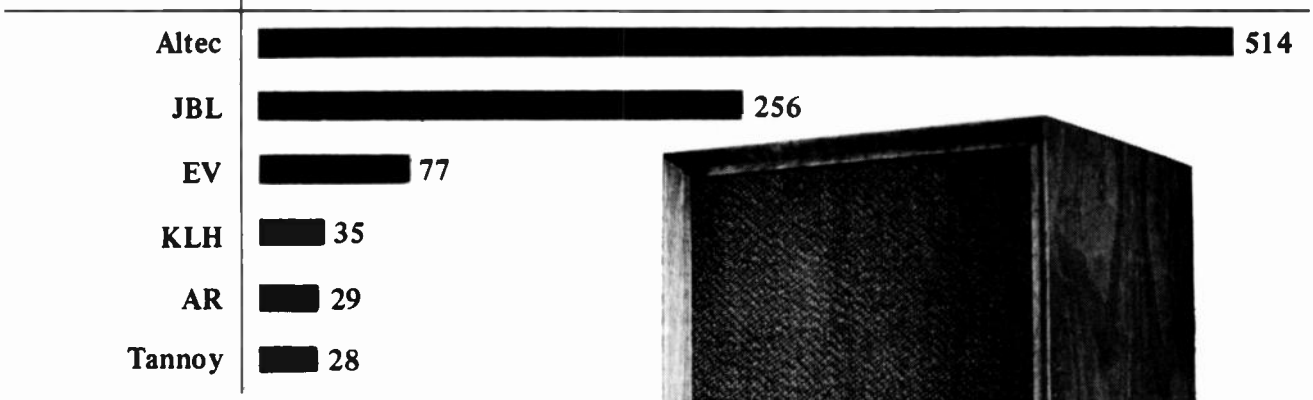
At Altec, we're not taking our leadership position for granted. We're always trying harder — challenging ourselves to develop studio monitor speakers that stay a step ahead of constant improvements in the contemporary recording process. And we can prove it. Here's the latest data on monitors installed in U.S. studios, as published in Billboard's 1973 International Directory of Recording Stuios.



But we're not really satisfied — even with this impressive track record.We're still trying to better ourselves. In fact, Altec has three all-new studio monitors available right now. They're a whole new generation of speakers designed tomeet the whole new range of tomorrow's dynamic recording techniques. Your studio may need them. Why not call us for full details.

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INPUT GATE

LETTERS FROM OUR READERS

RECORD NOISE

I refer to the April edition of ETI and particularly to a readers letter in "Input Gate".

H.B. of Homebush, N.S.W. poses the problem of having a quantity of old 78 RPM records that he would like to re-record onto tape cassettes. Unfortunately, he has run into the problem of surface noise etc. now present on his records and is wondering how he can eliminate it.

I would like to draw your attention to two pieces of equipment which Kenwood have manufactured to cater for this type of problem. Naturally these are for the hi-fi enthusiast and there has not been very much publicity because of the small market demand. The instruments concerned are the Audio De-Noisers Model KF-6011 and KF-8011.

The KF-6011 is the simpler and cheaper unit to use, basically these are designed to eliminate or reduce noise which has become superimposed over the programme material. A noise level control is situated it the front of the control panel and is used to vary the amount of noise reduction required. It is used in conjunction with a VU meter set on the panel.

The KF-8011 de-noising is a more sophisticated unit which allows the user to select maximum de-noising performance in the frequency range required, selected by four push buttons on the front panel. Both of these units are designed so that they can be switched-in or out of the system as required.

It is claimed by Kenwood that the De-noiser process does not attenuate frequencies recorded in the programme material and tests that we have conducted ourselves seem to bear out this point. The Kenwood people are most emphatic that this is not a Dolby noise reduction system and definitely does not work in the same process as the Dolby system.

Reg Hall,
Jacoby Mitchell Ltd,
North Rocks, N.S.W.

SIR AMBROSE FLEMING

I note in the current issue of "Electronics Today" that the invention of the Fleming Valve (Electrons for Cold Emitters) has been wrongly attributed to Sir Alexander Fleming.

Sir Alexander discovered penicillin! It was Sir Ambrose who invented the "Fleming Valve". Sir Ambrose was one time adviser to Marconi (Tribute to Marconi in the same issue) and was later Prof (Emeritus) of Electrical Engineering at the University of London. His standard Thesis "The Thermonic Valve and its development in Radio Telegraphy and Telephony" published in 1924 makes fascinating reading.

Jim White
Concord, N.S.W.

CONSECUTIVE PAGES

May I say how much I appreciate your editorial policy of printing all major articles on consecutive pages and then separating the articles by 'blocks' of advertising.

This makes ETI so much easier to read – and especially to file subsequently.

E.S. Holt,
Pennant Hills, N.S.W.

SPORTS AMPLIFIER

May I on behalf of many people, both old and young say "THANKS" to you and your small band of co-workers in sorting out our problems in the building of your project for a 100W P.A. System.

All who have heard or seen the finished unit have nothing to say but

Continued on Page 119

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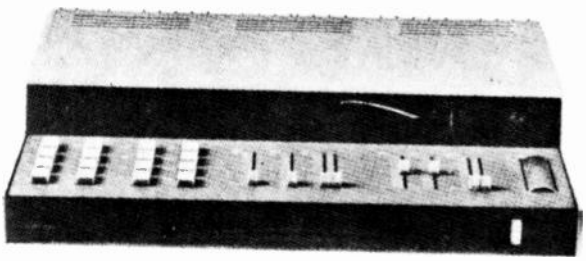
scan-dyna

Scan-Dyna 3000 tuner/amp

The ***Scan-Dyna*** 2000 and 2400 are typical of the very latest in Scandinavian design. The amplifier is dc-coupled, they are beautiful to look at, and have 22 wts rms and 30 wts rms per channel into an 8 ohm load. Into 4 ohms they deliver 25 wts and 40 wts rms respectively with an enormous music power rating. Distortion is, of course, very low. The 2400 has a mixer unit which controls three separate channels — two for disc and tape and a third for microphones.



2400 tuner/amp

The recommended selling prices are:
Scan-Dyna 2000 ***$289.00***
2400 ***$399.00***

The ***Scan-Dyna*** 3000 and 4000 are powerful. Indeed they are worth the money for the amplifier alone.
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(2 x 8 ohms music power) Price ***$369.00***
4000 2 x 60 wts rms 4 ohms
(2 x 90 wts music power) Price ***$399.00***

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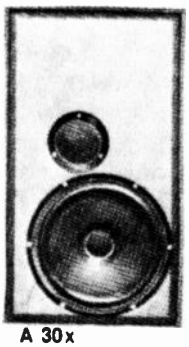
A 25x



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INPUT GATE

Continued from Page 116

praise for its compactness and sound producing qualities. It's just what is required on an athletic or sports field. No longer do we have to put out long lines of 240 V wires, up in the air to our old P.A. set, into the centre of the oval. We just put out our speakers and wires now, so much time saving and worry with so many children around.

Many people have asked about this project and have indicated that they would suggest its use in other avenues of sport.

V. Mapletoft,
Penrith, N.S.W. 2750

IMAGINATIVE SOUND

I read with interest the recent articles on Ambisonic Sound (ETI March and April 1974). There, for the first time, I saw the admission that, with only 4 channels, both horizontal and vertical dimensions of reproduced sound are possible.

As Prof. Fellgett points out, a tetrahedronal array of speakers is the minimum number required. The various possibilities for equidistant speakers are either at the apexes of, or face – centred on, regular polyhedra, as shown in this table:–

	Number of Speakers	
	At Apexes	Face-Centred
Tetrahedron	4	4
Octahedron	6	8
Cube	8	6
Dodecahedron	20	12
Icosahedron	12	20

The last two pose considerable architectural problems.

Both Dr. Farrimond and Prof. Fellgett place considerable emphasis on the realism of the concert hall, especially as to ambience and localisation of source. While the ideal of reproducing concert hall quality may be worthwhile in that it produces considerable consensus of opinion as to what constitutes good reproduction, it does seem rather shortsighted.

Electronic music (electronic whether by synthesis or reproduction) is capable of more than just plain "realism". Increasingly, one can expect music to be written specifically for the electronic medium – music that would be either horrendous or impossible in the concert halls of today. Apart from the range of completely new sounds (musical "colours") it offers new perspectives and possibilities in opening up "aural space". Directionality and the spatial localisation of sound (as in Prof. Fellgett's periphonic system) might effectively be used, for instance, in a score as a pas de deux for oboe and violin around the living room. It is, after all, only the Law of Gravity (with a capital G) that keeps the violinist and oboeist sitting in the one place all evening. Music (Art with a capital A) was not always so serious an affair.

To the wide range of "aural colour" would be added an "aural spatial perspective" that would immerse the listener in a huge symphonic canvas of ghostly aural images. A hideous thought for the purist, yet well within the realms of possibility, such musical architecture would be truly Ambisonic.

Thanking you for a stimulating magazine.

Allan G. Carfield,
Yeronga, Qld. 4104.

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•ELECTRONIC THERMOMETER MODEL GD-1019

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Attractive black cycolac case with teak patterned trim features large two digit display. Both Centigrade and Fahrenheit scales are provided with selection of indoor and outdoor temperatures. This six evening kit comes complete with 85ft. of cable and temperature sensors.
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JUNE ISSUE

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RECORDINGS POP

REVIEWER: Mike Delaney

"Loud 'n' Proud" – Nazareth. Phonogram/Vertigo. Stereo. 6303.103.
"Don't Be Fooled By The Name" – Geordie. E.M.I./Stereo. EMA.764.

Two more third generation urban English metaloids powered by the bedrock Purple/Zeppelin/Sabbath variety of blitzkreig bone cruncher:

Nazareth's "Loud 'N' Proud", their second local release, finds them marking time a little precariously on the strength of their excellent "Raz-Ma-Naz" set of some eight months back. The mixture is much the same, though somewhat less potent and inviting: a touch of Rod Stewart/Faces bawdy booze sodden roll, Slade's bulldozer attack, Purple's drive and momentum – everything rocking hard, spitfire fast and furious.

Material choice has been a bit too ambitious this time around and casualty rate is fairly high: Joni Mitchell's lyrical "This Flight Tonight", the classic Lowell George paean "Teenage Nervous Breakdown" and Bob Dylan's "Ballad Of Hollis Brown" number among those wounded and/or lost in the struggle – melody vs sonic energy orgasm. When things do come together though, as they tend with Nazareth, a better pneumatic riff rampage is hard to find: "Not Fakin' It", "Turn On Your Receiver" and a frantic "Go Down Fighting" are top quality seventies' heavy metal – the latter capturing the spark of their two fine singles "Bad, Bad Boy" and "Broken Down Angel" more than adequately.

Geordie's "Don't Be Fooled By The Name", their second album, is one of the better pieces of recent piledriving 12-bar machinery, an infinite improvement over the pedestrian, cliched "Hope You Like It" debut of last year. In every aspect, the band flaunt their Zeppelin/Purple metallic heritage with the enthusiasm, drama and punch drunk conviction of seasonal troupers – a far cry from their leaden meanderings of yore i.e. "Can You Do It". A vicious, hard-edged, pulsating set, Geordie somehow manage a freshness and unfettered vitality (at times genuinely melodic) mostly lacking from today's heavy metal kids: "Ten Feet Tall", "Got To Know", the ravenous "Goin' Down", a revised "House Of The Rising Sun" (perhaps *the* stick of gelignite on their recent tour) and a tender, romantic "Little Boy" are the picks. Most everything owes form to the "Led Zeppelin II" rule sheet, but then that is the way with most of the newer metaloids in any case.

Current score: Geordie ahead ten, Nazareth miss one turn.

"Be Good To Yourself At Least Once A Day" – Man. Festival/U.A. Stereo.L.34775.
"Back Into The Future" – Man. Import/United Artists. Stereo. UAG.60053/4.
"Iceberg" – Deke Leonard. Festival/U.A. Stereo.L.35001.

Man are one of the very few English groups to have come along so far in the last eighteen months with anything significantly (a.) different (b.) refreshing to say. Unlike 99% (Yes, Tull, Roxy though to T. Rex) they avoid inter-stellar-art-decoscience-fiction-glitter-fantasies and mega-noise-cosmic-metaloid hammerings for a music full of good cheer, humour, deftness and invention.

Similar to the early Caravan circa "If I Could Do It All Over Again" (deleted) Man deal largely in tone pieces, evolving, evincing sound-scrapes with equal parts Yes majesty, Pink Floyd intensity, drama and texture, and (surprise, surprise) a feel for joyfully hypnotic 12-bar boogie amazingly similar to our own Mike Rudd (Spectrum/Murtceps and most recently, Ariel) – a spectral dance ranging from blues to billowing jazz harmonic; spiralling spacious with rhythms that shimmer, glide, cascade, somehow guided and given form by their own momentum – Man juxtapose a constant stream of tones, tempi, textures; improvising forms, retaining and building on clarity, simplicity.

"Be Good To Yourself" is a set of four such pieces, each its own little journey: the jubilant, pacey "C'mon"; the loosely muscular, effervescent 12-bar "Life On The Road" and the two guitar/keyboard exchanges "Keep On Crinting", "Bananas" – both the

latter featuring some of the strongest, most exciting instrumental work to come along since "Careful With That Axe Eugene" (from Floyd's "Umma Gumma" – E.M.I./Stereo. SHDW.1/2.)

"Back Into The Future" is a more ambitious double, half recorded 'live' at London's Roundhouse – emphasis is further down to rock with a "C'mon" reprise, an excellent, lucid "Jam Up Jelly Tight/Spunk Rock '73" and two sides of more symmetrical studio cuts harder into straight boogie i.e. "A Night In Dad's Bag", "Ain't Their Fight" and the title "Back Into The Future". An engaging set, a little thin in places.

Ex-Man guitarist Deke Leonard shows where the sting came from in Man's earlier albums with the release of his "Iceberg" set – a thunderous, barn-storming blues/Boogie work out focusing on Leonard's pungent, stalking guitar/Keyboard interplays. One of the few out and out rock albums to punch like a bitch without leaving a face full of heavy metal. Good and nasty.

A note of interest: Deke Leonard has recently returned to dual lead opposite Man's Micky Jones, bringing the group back to possibly their funkiest line-up to date. You'll hear about it soon enough though.

"Rock On" – David Essex. C.B.S. Stereo. SBP.234444.

"My Coo Ca Choo" – Alvin Stardust. E.M.I. Stereo. EMC.2512.

Two sets of definitive high class bopper fodder from England's hottest

pre-fab pubescent pop personas – David Essex, former "Godspell" West End Jesus and "That'll Be The Day" star pin-up teen obsession turned top ten (twice) with a vengeance; Alvin Stardust, the revamped Shane Fenton, former Early sixties' English chartsters now enjoying mass histrionics as the last word in post Gary Glitter punk Presley mysterioso.

'Essentially, neither is so much an album, more so a peak in pop confectionery packaging compleat – as a series of deftly interchangeable poses manipulated by producers Jeff Wayne (ring leading the Essex erectile) and Peter Shelley (Alvin's songscribe *and* manager to boot). Both sets aim and achieve dead centre bulls eyes at the type of muscular myth-making overground vivacity and svelte scream-aged professionalism hell bent on instant chart success.

'The Essex stable concentrates on the David Cassidy brand of sublime blue-eyed romance vying between boogaloo and lush balladry with all emphasis on the slender-voiced evocatives; Alvin Stardust nudges in somewhere between Glitter's raunchy sentiment and Bolan's silver-studded sabre-tooth dream-mean, somewhat forbidding in stance, a perfect replica of the quintessential fifties' leather-clad punk. Dynamite for the babies put off by Gary's increasing paunch.

Both albums hardly put one foot out of place – playing, arrangements, choice in material is both varied and fairly inventive, slick to the pop nadir, absolutely choreographed to appear effortless. Production is without flaw.

"All American Boy" – Rick Derringer. C.B.S./Stereo. SBP.234455.

Ex-McCoys leader/guitarist, songwriter/producer and part-time guitar for both Johnny and Edgar Winter, Rick Derringer has finally unleashed his first entry in the Todd Rundgren stakes – a flash, expert, immediately charismatic solo set running the gamut from teen lament, fifties' romance, seventies' cocktail R 'n' B through to a whole mess of hefty rock 'n' roll and riff boogie. Keep your eye on the star folks: a scorching "Rock 'n' Roll Hoochie Koo", "Cheap Tequila", the surprisingly moving "Jump, Jump, Jump" and two new bonafide pube fantastics, "Teenage Queen" and "Teenage Love Affair" round out one of the most interesting, varied and vivaciously melodic albums so far this year. Real sleek rock 'n' roll sophisticate with just that right amounts of humour, funk, much taste. Well worth looking into . . .,Derringer embodies everything that Rick Springfield has promised for the last four years.

"Buffalo Springfield" – Buffalo Springfield. W.E.A./Atco. Stereo.SD.2-806.

"A Nice Pair" – Pink Floyd. E.M.I./Harvest. Stereo.SHDW.402-1/2.

Two exceptional band legacies from the mid-sixties' – one from the Californian folk/country/rock matrix, t'other from the '67 British psychedelic melting pot:

"Buffalo Springfield" is a thoroughly overdue double set detailing the brief, eventful and very nearly brilliant three album career from the only group to rival the Byrds in impact and influence over the entire West Coast rock/roots amalgam. Mother earth to such luminaries as Neil Young, Poco, Stephen Stills and Loggins / Messina; Buffalo Springfield virtually defined the super-structure both in style and approach of most subsequent band forays related to that particular music genre. The first, first, first and still largely the best – take note: Neil Young's "Nowadays Clancy Can't Even Sing", "Mr. Soul" and the radiant mega-ballad "Expecting To Fly"; Steve Stills' legendary "Rock 'n' Roll Woman"/"Bluebird" and menacing, political "For What It's Worth"; Richie Furay's majestic "In The Hour Of Not Quite Rain", "Kind Woman" and satiric "A Child's Claim To Fame" – the latter written about one of the many Young/Stills ego wars which eventually broke the band. Powerful, lasting music way ahead of its time. One of rocks classic groups.

"A Nice Pair", hot on the heels of the mammoth "Dark Side Of The Moon" success, is a retro-coupling of Floyd's first two albums, "The Pipers At The Gates Of Dawn" featuring the acid genius of founder/songwriter/guitarist Syd Barrett almost exclusively, and the transient, post-Barret "A Saucerful Of Secrets". Both mark definitives in British psychedelia, "Pipers" for the wit, humour and mysticism of the only real acid poet of nouveau rock; "Secrets" for the embryonic, though nevertheless evocative and compelling, sound-scapes of Messrs Waters-Gilmour-Mason-Wright, the combination which was later to produce several classics, "Atom Heart Mother", "Meddle" and the highly touted "Dark Side Of The Moon" master work.

Neither of the two Floyd sets age all that gracefully, but interest is far from minimal: Barrett's strange, whimsical, lop-sided rhymes and rhythmic vertigo can still hold you quite spellbound i.e. "Bike", the cacophonous "Astronomy Domine" and the eerie "Chapter 24" (culled from the I Ching Book of Change). "A Saucerful Of Secrets", has as its two highlights, the title track, and probably one of their most requested psychedelic dinosaurs, the mesmeric "Set The Controls For The Heart Of The Sun". As they say, a nice pair.

For those captivated sufficiently with Syd Barrett: Following his departure from the Floyd, and before he ultimately ate himself out in acid, Syd recorded two exceptional, rarely heard solo sets – "The Madcap Laughs" (Import. Harvest/Stereo.SHVL. 765). and the final "Barrett" (Import. Harvest/Stereo. SHSP. 4007). Both go far in expressing the deadpan cosmic giggle.

"A Hard Road" – Stevie Wright. Albert Productions/E.M.I. Stereo.APLP.005.

The much overdue solo from ex-Easybeat vocalist Stevie Wright – one of the best, most definitive rock 'n' roll voices in the business. Produced by the Easy's song team Vanda/Young, "Hard Road" is one of those vital, animated, positively infectious sets rollicking action-packed with some of the tastiest barrel-house boogie available. Everything as it should be: a little manic, always raunchy, ever urgent, insistently involving. An album's worth of hot blooded rock 'n' roll 12-bar, well varied in material choice, performed with intensity, colour and emotion. Guaranteed good time. Pick up on this one, through its sheer enthusiasm it'll make you dance those feet to stumps – joyfully. ●

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7407	.53	7460	.30	74153	1.45
7408	.29	7461	.30	74154	1.75
7409	.29	7464	.45	74155	1.35
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7426	.35	7489	3.25	74180	1.15
7427	.39	7490	1.25	74181	4.25
7430	.25	7491	1.40	74182	1.10
7432	.30	7492	1.05	74190	1.65
7437	.50	7493	1.05	74192	1.65
7438	.55	7494	1.10	74193	1.65
7440	.25	7495	1.05	74194	1.65
7441	1.25	7496	1.05	74195	1.15
7442	1.15	74100	1.65	74196	1.35
7443	1.25	74105	.55	74197	1.15
7444	1.30	74107	.55	74198	2.50
7445	1.25	74121	.65	74199	2.50
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74L10	.40	74L74	.80	74L165	2.95
74L20	.40	74L78	.80	85L52	2.95
74L30	.40	74L85	1.25	86L75	2.95
74L42	1.75	74L86	.95		
High Speed TTL					
74H	$ .40	74H21	$ .47	74H60	$ .45
74H01	.40	74H22	.47	74H61	.45
74H02	.40	74H30	.40	74H62	.45
74H04	.45	74H40	.40	74H72	.60
74H08	.45	74H50	.45	74H74	.70
74H10	.40	74H53	.47	74H76	.70
74H20	.40	74H55	.47		
8000 Series TTL					
8504	$ .45	8200	$2.95	8554	$2.95
8060	.30	8210	3.95	8750	2.95
8091	.69	8214	1.95	8600	1.15
8092	.69	8219	1.95	8810	.95
8093	.69	8220	1.95	8812	1.25
8094	.69	8280	.95	8830	.69
8121	1.05	8288	1.75	8831	2.95
8122	1.05	8520	1.45	8832	2.95
8123	1.75	8551	1.95	8836	.69
8130	2.50	8552	2.95	8830	1.50
8182	1.75				

Please specify which data sheets are required with order. Add $ .50 per data sheet for items priced less than $1.00 ea. All of above are Dual-In-Line packages.

DIGITAL CLOCK CHIPS WITH DISPLAYS

MM5311 Clock Chip
(28 pin) Any deadout, 6 digit BCD with
6 MAN3M & data $15.95/set

MM5312 Clock Chip
(24 pin) Any readout, 4 digit 1 pps BCD with
4 MAN3M & data $11.95/set

MM313 Clock Chip
(28 pin) Any readout, 6 digit 1 pps BCD with
6 MAN3M & data $15.95/set

MM5316 Clock Chip
(40 pin) Normal alarm, snooze alarm, sleep timer with
4 MAN3M & data $19.95/set

CALCULATOR CHIPS WITH DISPLAYS

5001 LSI Calculator Chip
40 pin — add, subtract, multiply and divide 12 digit with
12 MAN3M & data $17.95/set

5002 LSI Calculator Chip
Battery powered version of 5001 LSI with
12 MAN3M & data $19.95/set

18 Pin Calculator Kit
MM5736 18 pin calculator chip — four function — 6 digit.
A pair of 3-in-1 dip paks (6 digit) LED sim to DL-33
One 75492 hex digit driver.
Data supplied for above. Needs only switches, resistor, keyboard and battery for complete calculator.
$11.95/kit

CALCULATOR CHIPS

5001 LSI (40 pin) Add, subtract, multiply & divide 12 digit
Data supplied with chip ..... $6.95 ea.
Data only - Refundable w/purchase ..... 1.00 ea.
5002 LSI Similar to 5001 except designed for battery power
Data supplied with chip ..... $8.95 ea.
Data only - Refundable w/purchase ..... 1.00 ea.
5005 LSI (28 pin) Full four function memory. 12 digit display and calc. 7 segment multiplexed output
Data supplied with chip $10.95
Data only - Refundable w/purchase ..... 1.00 ea.

OPTO ISOLATORS

MCA 2-30	Darlington	$ .95 ea.
MCD 2	Diodes	1.95 ea.
MCT 2	Transistor	1.45 ea.

DIGITAL CLOCK CHIPS

MM 5311 (28 pin) Any readout 6 digit BCD with spec. sheet ..... $11.95 ea.
MM 5312 (24 pin) Any readout 4 digit 1pps BCD with spec. sheet ..... 8.95 ea.
MM 5313 (28 pin) Any readout 6 digit 1pps BCD with spec.sheet ..... 10.95 ea.
MM 5314 (24 pin) LED-incandescent readout 6 digit with spec. sheet ..... 10.95 ea.
MM 5316 (40 pin) Normal alarm, snooze alarm, sleep timer 12 or 24 hr. operation with spec. sheet ..... 15.95 ea.

LINEAR INTEGRATED CIRCUITS

300	Pos V Reg (super 723)	TO-5	$ .95 ea.
301	Hi performance AMPL	MINI-DIP	.45 ea.
302	Voltage Follower	TO-5	.95 ea.
304	Negative Voltage Regulator	TO-5	1.25 ea.
305	Positive Voltage Regulator	TO-5	1.25 ea.
307	Op AMP (super 741)	MINI-DIP	.45 ea.
308	Micro Power Op Amp	MINI-DIP	1.25 ea.
309H	5 V Regulator	TO-5	1.25 ea.
309K	5 V 1A Regulator	TO-3	1.95 ea.
310	Voltage Follower Op Amp	TO-5	1.45 ea.
311	Hi perf. Voltage Comparator	MINI-DIP	1.25 ea.
319	Hi Speed Dual Comparator	DIP	1.65 ea.
320	-5.2 V Negative Regulator	TO-3	1.95 ea.
320	-12 V Negative Regulator	TO-3	1.95 ea.
320	-15 V Negative Regulator	TO-3	1.95 ea.
339	Quad Comparator	DIP	1.95 ea.
340T	Positive Voltage Regulator (6V, 8V, 15V or 24V)	TO-220	2.25 ea.
370	AGC/Squelch AMPL	TO-5 or DIP	1.29 ea.
372	AF-IF Strip-derector	DIP	.85 ea.
373	AM/FM/SSB Strip	DIP	3.60 ea.
376	Pos. Volt Regulator	MINI-DIP	.65 ea.
380	2 Watt Audio Regulator	DIP	1.75 ea.
382	Low Noise Dual Pre-Amp	DIP	2.25 ea.
550	Precision Voltage Regulator	DIP	.95 ea.
703	RF-IF Amp	MINI-DIP	.59 ea.
709	Operational AMPL	TO-5 or DIP	.39 ea.
711	Dual Differential Comparator	DIP	.39 ea.
723	Voltage Regulator	DIP	.75 ea.
739	Dual Hi Perf. Op AMP	DIP	1.25 ea.
741	Comp. Op AMP	MINI-DIP	.45 ea.
747	Dual 741 Op AMP	TO-5 or DIP	.95 ea.
748	Freq Adj 741	MINI-DIP	.45 ea.
1303	Stereo Pre-Amp	DIP	.95 ea.
1304	FM Multiplex Stereo Demod.	DIP	1.50 ea.
1307	FM Multiplex Stereo Demod.	DIP	.95 ea.
1458	Dual Comp. Op. Amp.	MINI-DIP	.75 ea.
2111	Dual LM211 Volt. Comp.	DIP	2.95 ea.
3065	TV-FM Sound System	DIP	.75 ea.
3075	FM Det. — LMTR and Audio Pre-Amp.	DIP	.85 ea.
3900	Quad Amplifier	DIP	.75 ea.
3905	Precision Timer	MINI-DIP	.75 ea.
7524	Core Memory Sense AMPL	DIP	1.95 ea.
7525	Core Memory Sense AMPL	DIP	.95 ea.
7535	Core Memory Sense AMPL	DIP	.95 ea.
9601	Retriggerable One Shot	DIP	.95 ea.
75451	Dual Peripheral Driver	MINI-DIP	.49 ea.
75452	Dual Peripheral Driver	MINI-DIP	.49 ea.
75453	(351) Dual Peripheral Driver	MINI-DIP	.69 ea.

Please specify which data sheets are required with order. Add $ .50 per data sheet for items priced less than $1.00 each

MEMORIES

1101	256 bit RAM MOS (2501)	$2.50 ea.
1103	1024 bit RAM MOS	7.95 ea.
5260	1024 bit RAM 16 pin Low power consumption	7.95 ea.
7489	64 bit RAM TTL	3.25 ea.
8223	Programmable ROM	6.95 ea.

LED

MV108 Visible red SUPER SPECIAL ..... $ .25 ea.
MV50 type red emitting ..... .25 ea. 5/$1.00
MV5020 type large red ..... .35 ea. 3/$1.00
ME 4 Infra red TO18 ..... .69 ea.
MAN 1 The original ..... 3.95 ea.
MAN 3 type ..... 1.95 ea. 3 or more 1.49 ea.
MAN 4 type ..... 2.75 ea. 3 or more 2.50 ea.
Data-Lite 707 (MAN 1 repl) ..... 3.25 ea.

PHASE LOCKED LOOPS

560	Phase Locked Loop	DIP	2.95 ea.
561	Phase Locked Loop	DIP	2.95 ea.
562	Phase Locked Loop	DIP	2.95 ea.
565	Phase Locked Loop	DIP	2.95 ea.
566	Function Generator	MINI-DIP	2.95 ea.
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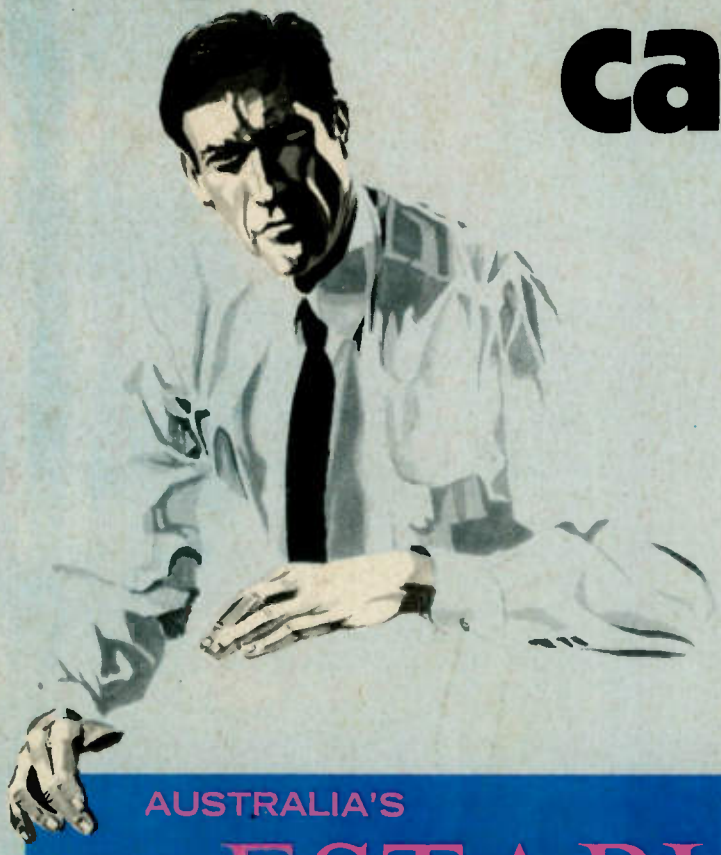

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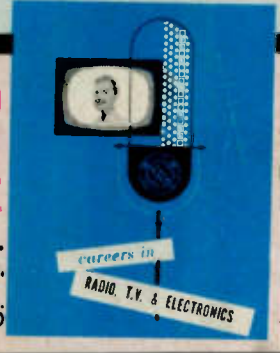

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