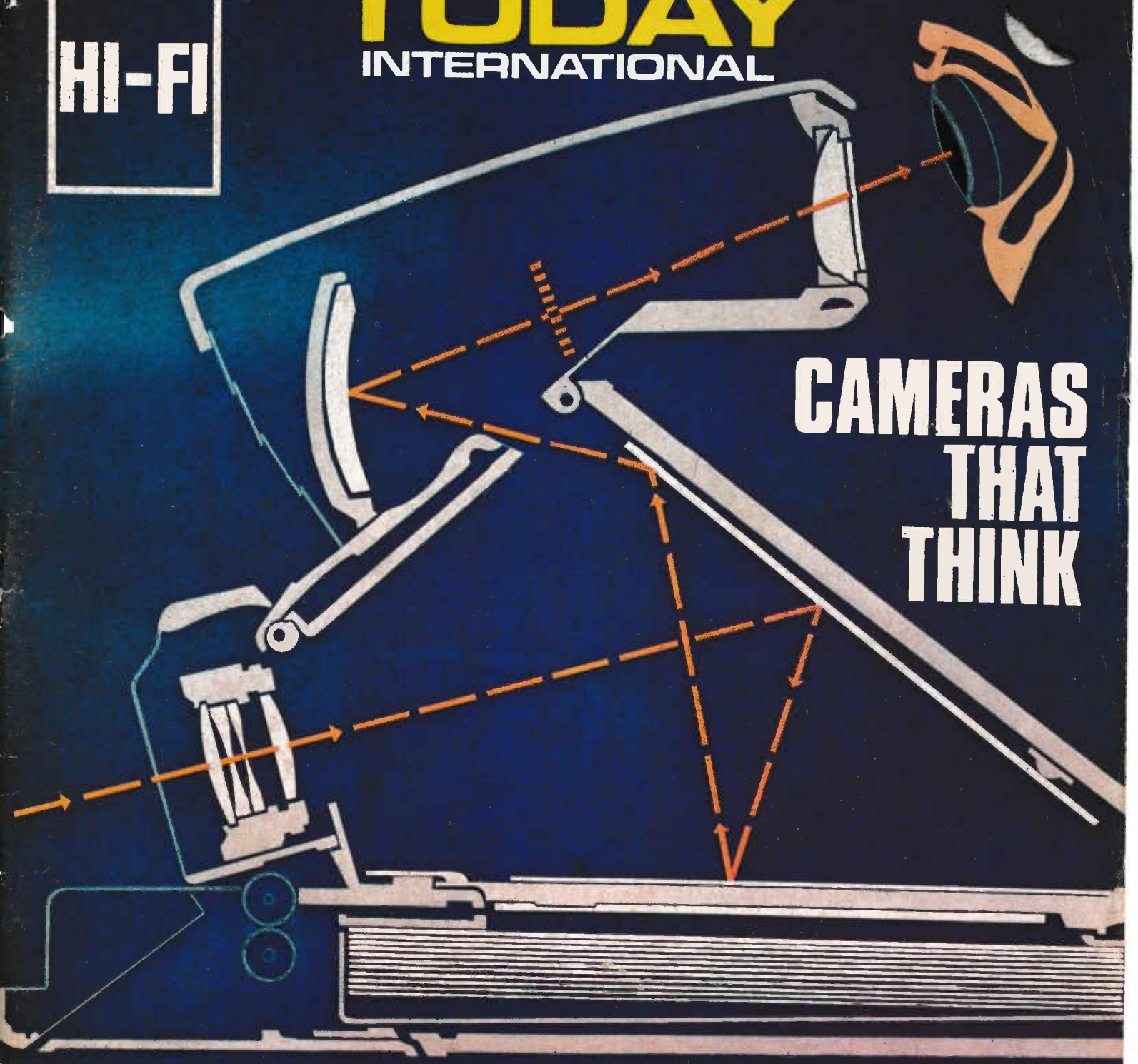
MARCH, 1973
50c*

electronics TODAY INTERNATIONAL

HI-FI



CAMERAS THAT THINK

EXCLUSIVE REPORT: U.S. SUBMARINE RADIO LINK

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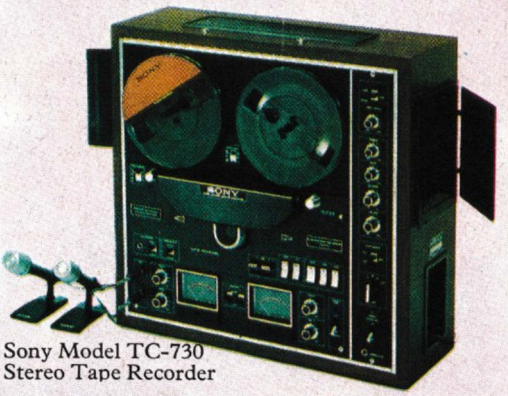
this is SONY

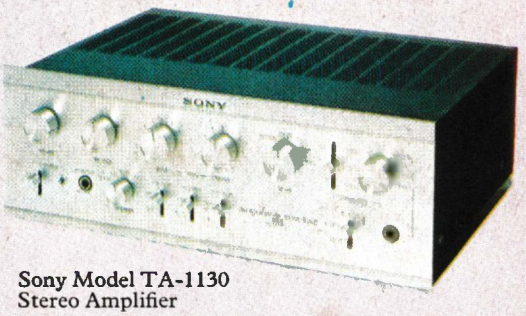
the pathfinder

SONY never intends to follow others. SONY has always been the pathfinder in electronics — discovering new trails where no one has ventured. Out of this philosophy has grown a policy of innovation and development, of improvement and refinement, of absolute quality, resulting in SONY's world-wide reputation for enterprise and excellence. SONY sets the standard. Because SONY is the pathfinder.



Sony Model TC-730
Stereo Tape Recorder

Sony Model SS-7300
Speaker System



Sony Model TA-1130
Stereo Amplifier

Sony Model TC-160
Cassette Tape Deck

Sony Model TS-5520
Hi-Fi Turntable

SONY

JACOBY KEMPTHORNE

SYDNEY: 26-2651, MELBOURNE: 329-6866, ADELAIDE: 93-2388/9, BRISBANE: 44-4488, PERTH: 28-5725, LAUNCESTON: 2-5322, **Agents:** CANBERRA: 47-9010, NEWCASTLE: 61-4991, FAIRY MEADOW: 84-8022.

Models illustrated form only a minute fraction of the vast Sony range. For more information contact any one of the phone numbers listed above.

electronics TODAY INTERNATIONAL

MARCH 1973 Vol. 2 No. 12

main features

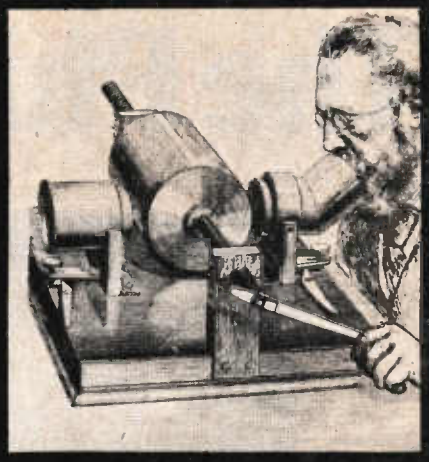
projects

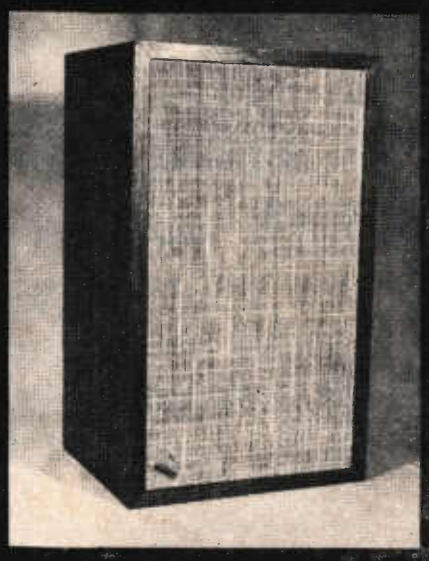
product tests

reviews

news & information

Cover: Dr. Land's amazing new colour camera is shown here in outline — full story this issue starts page 16.





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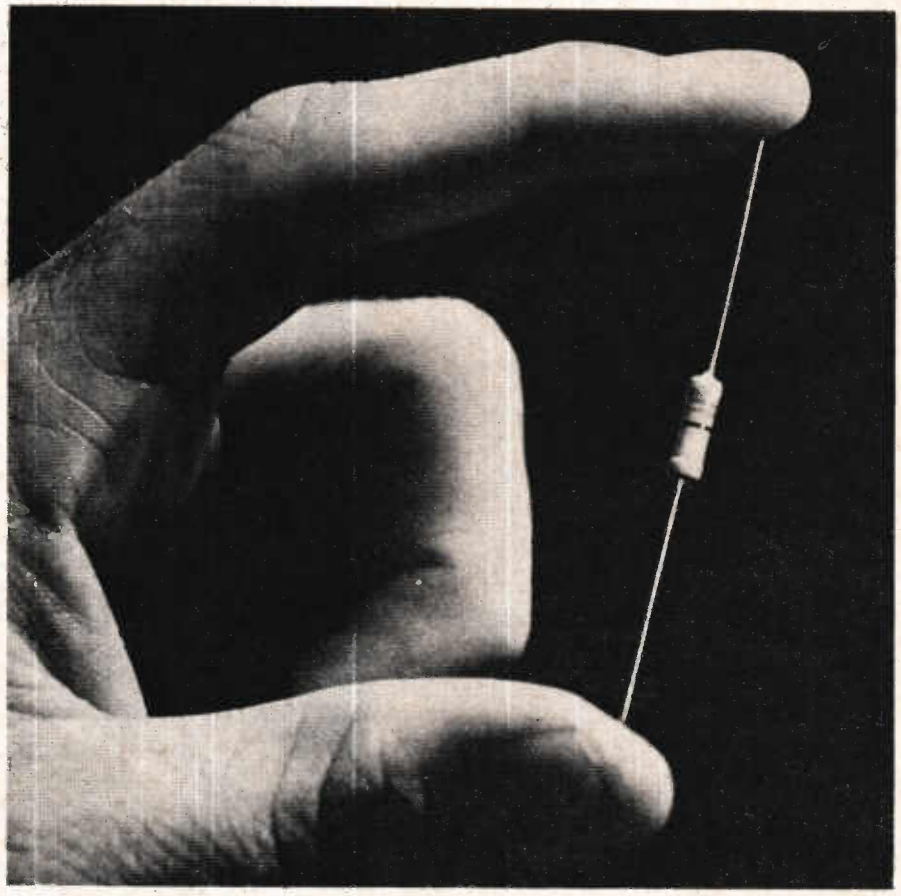
The Philips resistor.



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DIVISION OF PHILIPS INDUSTRIES LIMITED
Sydney Melbourne Brisbane Adelaide Perth Canberra

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PROJECT SANGUINE

Pollution, and its effect on our ecology has captured the imagination of both press and public. People have suddenly become aware of the systematic desecration of our "Spaceship Earth".

Yet despite warnings from many responsible scientists – that at our present increasing rate of power usage – the thermal balance of our planet is at risk, the US Navy has initiated Project Sanguine – see article on page 32 for full details.

Project Sanguine is a brute force method for communicating with submerged submarines. It operates at 45 Hz, and in operation the system will pump energy equivalent to the output of a medium-sized power station into a buried antenna.

Scientists around the world are known to be worried about the possibly deleterious effect that this system may have on the ecology – yet responsible informed comment either from the US Navy or the scientists involved – is virtually unobtainable.

Nowhere is there any evidence that the system's designers have given any consideration to this aspect of Project Sanguine's operation.

The whole project seems to be at variance with the US Government's avowed intention of reducing pollution in all its forms.

We extend a welcome to Mr. Colin Francis who has recently joined our organization as Editor of a number of new publications – details of which we will be announcing soon.

Colin was previously Editor of "Australian Electronics Engineering" and "Australian Chemical Processing and Engineering" over a period of nearly five years.

Prior to entering the publishing field, Mr. Francis held engineering positions in the Components Development Laboratory of Amalgamated Wireless (A/sia) Ltd. and Kriesler (A/Asia) Pty. Ltd.

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X30 a new high in Hi Fi...

The Plessey X30 dome tweeter

This is not just another high frequency speaker. It is a true high fidelity tweeter that can lift the performance of your present speaker system to a new high level. In fact, the Plessey X30 dome tweeter can add new brilliance to any speaker system—old, new or yet-to-be-built.

Here's why:

Superb frequency response. The X30 tweeter has a smooth response to beyond 30 kHz.

Ultra-wide dispersion. The X30 dome configuration provides up to 180° dispersion of the high frequencies.

Optimum clarity and extra brilliance. The excellent transient response of the X30 is due to the very low mass of the moving system—an epoxy impregnated voice-coil on a multiturn polycarbonate former brings its total weight down to the all-time-low of only 0.3 grammes!

PLESSEY
Rola

High power handling. The X30 has excellent performance in systems over a wide variety of power handling capacities.

Non-metallic loading plate—eliminates flux leakage, improves efficiency.

Plessey X30 dome tweeters are available in pairs from all leading Hi Fi stores and come with full instructions, including details of a self contained tweeter array which can be used in conjunction with existing enclosures.

Plessey Rola Pty. Limited The Boulevard, Richmond, Victoria, 3121. Telephone 423921. Telex 30383. N.S.W. P.O. Box 2, Villawood, 2163. Telephone: 720133

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AR48

Select Sansui stereo amplifiers for...

Superior design
Superb engineering
Sparkling performance

When you're considering the purchase of a complete new stereo system, the control amplifier is the key to the whole program. So it's worthy of detailed analysis.

There are six audibly superior control amplifiers in the Sansui range . . . from 30 watts RMS to 100 watts RMS. All feature *all-silicon* transistor design — and distortion is considerably *less* with Sansui control amplifiers, as output stages are semi-complementary Darlington designs without *input* or *output* transformers. Transformers have always caused some distortion problems in amplifier design — but not with Sansui!

The startling difference you will notice with any Sansui stereo amplifier is the *tonal quality* and the obvious *dynamic range*. In every price bracket your new Sansui amplifier sounds like a much more expensive unit. These are not idle words. In the review of the least expensive Sansui amplifier, the AU-101, a leading Australian journal said . . . "*. . . few amplifiers, regardless of price, give an overall test result as good as this*". Another review said . . . "*. . . better than most other amplifiers at twice the price*".

With those comments made about the AU-101 (recommended price $149) can you imagine how effective the other models in the Sansui range are? With more power and, let's face it, higher price tags?

Let's look at the complete Sansui stereo amplifier range:

MODEL	POWER RATING at 8 ohms.	FREQUENCY RESPONSE	REC. PRICE
AU-101	30 watts RMS	20-60,000 Hz. ± 2 dB.	$149
AU-505	50 watts RMS	20-60,000 Hz. ± 2 dB.	$199
AU-555A	50 watts RMS	20-40,000 Hz. ± 1 dB.	$237
AU-666	70 watts RMS	10-40,000 Hz. ± 1 dB.	$325
AU-888	90 watts RMS	10-70,000 Hz. ± 1 dB.	$403
AU-999	100 watts RMS	5-100,000 Hz. ± 1 dB.	$460

IMPORTANT: All prices are recommended prices only. The actual cost can well be less — as trade-in valuations can make a world of difference. See your Bleakley Gray franchised dealer!

Bleakley Gray Corporation Pty. Limited,
28 Elizabeth Street, Melbourne, 3000.
Please send me complete details about the Sansui amplifier Model.....
and the name of my nearest Bleakley Gray dealer.

NAME.....

ADDRESS.....

.....**POSTCODE**.....

Sansui

Sansui Distributors: Australia, excluding W.A.:

Bleakley Gray Corporation Pty. Limited.

Head Office: 28 Elizabeth St., Melbourne, Vic. Tel. 63 8101*. Telex 31904; **Sydney Office:** 177 Salisbury Rd., Camperdown, N.S.W. Tel. 519 5555*; **Canberra Office:** 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 95 2144*; **Adelaide Office:** 301 South Terrace, Adelaide, S.A. Tel. 23 6219; **Brisbane Office:** 3 Prospect St., Bowen Hills, Qld. Tel. 52 7333; **Perth Office:** 27 Oxford St., Leederville, W.A. Tel. 81 4988. **INTERSTATE REPRESENTATIVES: N.T.:** Pfitzner's Music House, Smith Street, Darwin. Tel. 3801. **Tas.:** K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel. 2 5322.

W.A. DISTRIBUTORS:
Atkins Carlyle Limited, 1-9 Milligan St., Perth, 6000. Tel. 22 0191.

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

BG—SA—1272

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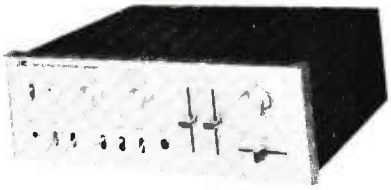
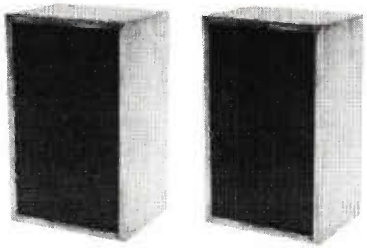


JVC VN300
15 R.M.S. per channel
High/Low filter. All facilities.

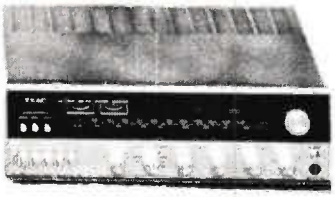
DUAL 1214 TURNTABLE
Manual or Auto.
Complete with
Shure 55E Cartridge.

SYSTEM COMPLETE FOR $339.00



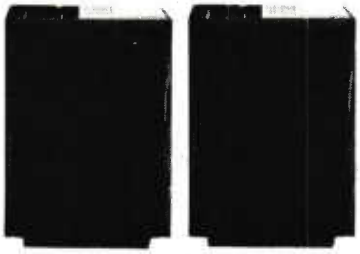
JVC AUTEL SPEAKERS
8" 2 way – 25 watts
R.M.S. 25 – 20 kHz

DUAL 1218, SHURE 91ED
Cartridge. Professional quality making a perfectly matched system.



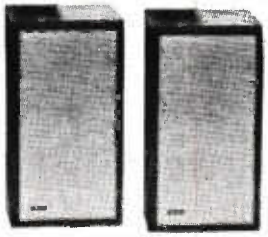
TEAC AG 7000
80 watts R.M.S.
per channel
AM/FM Tuner –
2 tape circuits.

SYSTEM COMPLETE FOR $1195.00



JBL – Exact copies of the famous **L55** speakers using **JBL** 5 + 2 speakers – unbelievable must be heard.

MARANTZ 1060
Tested in excess of 40 watts/channel before clipping. Base, Treble, midrange control, Hi-Filters plus all facilities.



Large **ADVENT** speakers.
Designed by the man who made A.R. speakers famous for reproduction.

SYSTEM COMPLETE FOR $639.00

DUAL 1216 TURNTABLE
Plus Shure 55E
Cartridge.

AUTEL SYSTEMS PTY LTD

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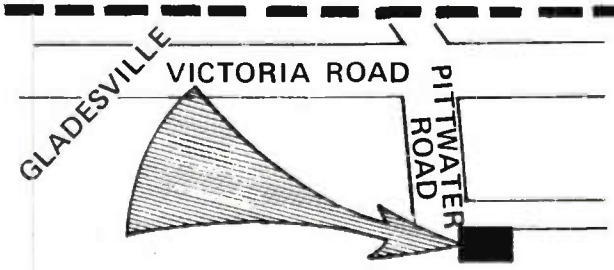
OPEN THURSDAY NIGHT



AUTHORATIVE WORDS ABOUT FROM THE WORLDS EXPERTS...

ADVENT LOUDSPEAKERS

THE ADVENT LOUDSPEAKER

The lows . . . remained strong and clean all the way down to 20Hz with very low distortion . . . Without a doubt, the Advent is one of the smoothest and widest-range speaker systems we have had the pleasure of testing . . .

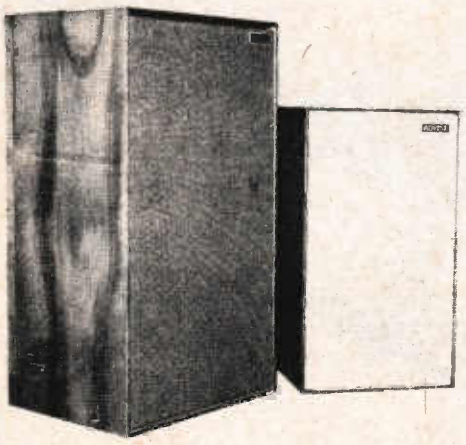
Stereo Review, 1970.

The shape of the curve about 6kHz corresponds almost exactly to the calibration curve of our microphone . . .
We can't recall having heard another speaker in its price class that can match it . . .

Electronics World, 1970.

Particularly noteworthy is the high-frequency dispersion resulting in excellent definition and adding spaciousness to the sound . . . the frequency response was flat, with only + 3dB variations over the major portion of its range.
One could say that at twice the price the Advent speaker would be good value.

Audio, 1970.



They were the least coloured loudspeakers we have ever heard, and this includes the highest priced systems currently available.

Stereophile, 1970.

The measured frequency response was an eye-opener . . . better than most we have tested.
The overall impression of the Advent speaker is that it is an unusually good low cost unit and undoubtedly top of its class in terms of value for money.

Electronics Today, 1971.

Hence Auriema's logical decision to produce Advent loudspeaker systems in Australia by manufacturing the cabinets locally and importing the drive units and crossover networks from the U.S.A.
The revised units are not only as good as the U.S. Built speakers in every respect – but in one or two areas they are actually better.

Electronics Today 1972.

THE SMALLER ADVENT LOUDSPEAKER

Subjective assessment of the speaker's performance was surprising and the little Advent compared very favourably with its big brother "The Advent Loudspeaker".
An excellent bookshelf speaker at a realistic price.

Electronics Today, 1972.

Any preconceived ideas you may have about the limitations of sub-compact speaker systems will, we think, be shattered.

Stereo Review, 1972.

HEAR ADVENT LOUDSPEAKERS AT AUTHORITATIVE DEALERS

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20 Pittwater Rd., Gladesville.
Ph. 89 0663

MIRANDA HI-FI
Shop 67, Upper level, Miranda Fair.
Ph. 525-6745

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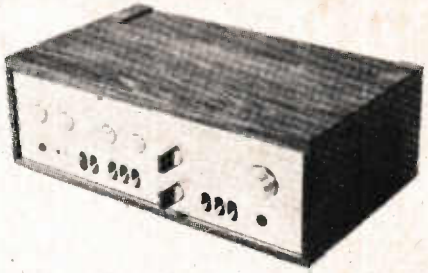
ADVENT

LUX

paramount in amplifiers...

Lux is the world's longest-established manufacturer of amplifiers, being famous for quality since 1921.
The company's manufacturing policy accounts for the quality of sound — they first make the unit to their own standards of quality, then put a price on it.
For sheer professionalism in amplifiers look to Lux — the ultimate in hi-fidelity.

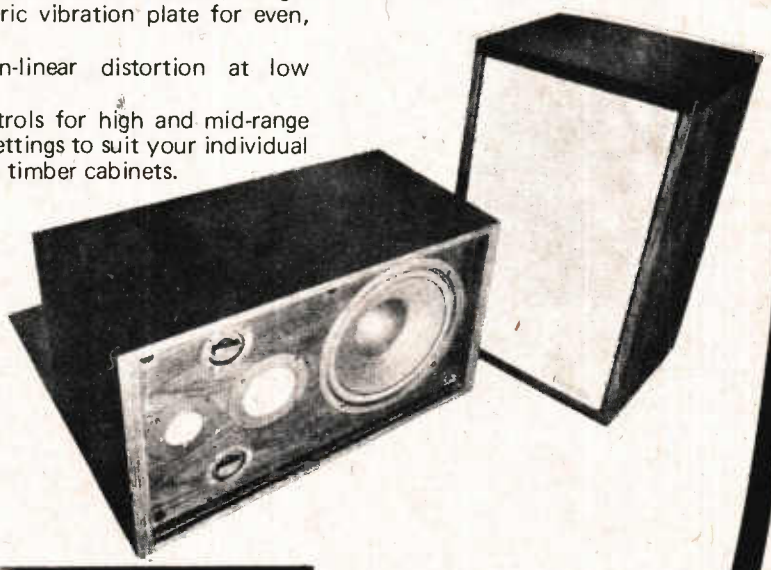


505X Frequency response 10-50,000 Hz, — 1dB. All stage direct coupling in main amp., pure complementary circuit in output stage, and two-stage differential amplification assure distinguished, distortion-free performance. RMS power 30/30 watts, less than 0.04% distortion.
700X 27 transistors, 2 silicone varisters, 4 silicone diodes. Main amp section adopts a fully complementary direct coupled output with differential amplification. RMS power 30/30 watts, distortion less than 0.04%, frequency response 10-80,000 Hz.

Also available: Models 507X, 503X, 708, 202.

... and now HIGH QUALITY SPEAKERS

Finally released after many years of extensive development, the Lux LX77, 3 way speaker system features the exclusive ring diaphragm tweeter which eliminates break-up vibration within the audible range. Dome-type midrange features a hemispheric vibration plate for even, wide range dispersion.
Long voice-coil woofer eliminates non-linear distortion at low frequency range.
Constant impedance attenuator level controls for high and mid-range are fitted on the front panel, permitting settings to suit your individual listening requirements. Beautifully finished timber cabinets.



Speakers: 12" high compliance woofer, 1.6" dome type midrange, 1.3" ring type tweeter. Rated input 30W, frequency response 30Hz to 22,000 Hz. Crossover frequency 700, 8000 Hz, 12dB/oct.

See Lux at Interdyn State agents:

N.S.W.	M & G Hoskins Pty. Ltd., 37 Castle St., Blakehurst, 2221.
Q'LD.	Stereo Supplies, 100 Turbot St., Brisbane, 4000.
S.A.	Challenge Hi-Fi Stereo, 6 Gays Arcade, Adelaide.
TAS.	Audio Services, 72 Wilson St., Burnie, 7320.
VIC.	Encel Electronics Pty. Ltd., 431 Bridge Rd., Richmond, 3121.
W.A.	Albert TV & Hi-Fi, 282 Hay St., Perth, 6000.

INTERDYN

Sole Australian distributors:

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news digest

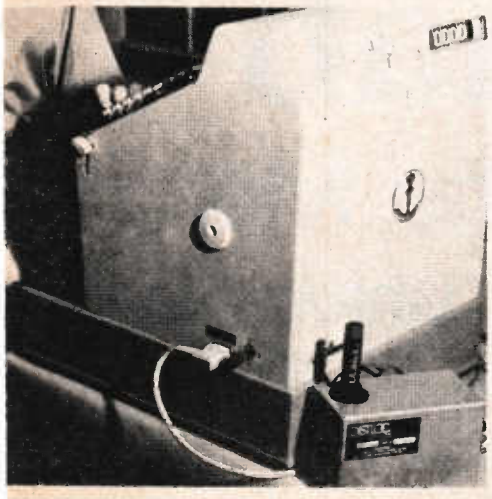
DIGITAL EQUIPMENT'S NEW TECHNICAL CENTRE

With an awareness of the need to develop further local technical resources, Digital Equipment Australia Pty. Ltd. has established a Technical Centre at Crows Nest, N.S.W., where the head office has recently been relocated. The company now occupies over 10,000 square feet of a new three-storied building which is conveniently situated at 123 Willoughby Road, adjacent to the Chandos Street exit of the northern motorway.

Mr. John Allen Jones, General Manager of the company said the DEA Technical Centre offers a complete range of services to customers. These include an engineering group under the direction of Mr. Peter Bennett, which designs and constructs special systems to meet the particular requirements of instrument and control engineers, and scientists who want to link a computer to their own equipment, and the services of a team of programmers, headed by Mr. Alan Williamson, for the development of software.

The Technical Centre also has a large software library and provides extensive facilities for customer training, the repair of DEC equipment, and equipment demonstration.

PROXIMITY ELECTRONIC KEY OPERATES SECURITY LOCKS



A British company, Disloc of 91a High St, Camberley, Surrey, have developed a portable electronic key that gives accredited people access to secure buildings, machinery, safes, filing cabinets, cash registers, vans, data-processing rooms and other restricted enclosures.

All of these enclosures can be protected by solenoids that are normally locked. The action of bringing the key within about one metre of its fixed probe unlocks and operates the solenoid to give free access. Key and probe interact by electro-magnetic induction, without the need to remove the key from the user's pocket, so that both hands are left free. After the door or drawer or till has been reclosed, the removal of the key to a distance greater than one metre automatically ensures re-engagement of the locking solenoid or removal of the power supply.

This is a fail-safe system, so low battery voltage in the key, mains failure in the control-unit supply or tampering with any of the circuits will simply make unlocking impossible. Incorrect signals from a key produce a warning tone that will discourage further attempts to use it.

The standard oscillator key is roughly the size of a ten-cigarette packet, and it contains a PP3-type battery of about six week's life. A rechargeable battery unit is under development. Linking components include the inductive probe that picks up the oscillator's field, a control box to check that the signal's coding is correct, an electric door staple for strong-room and other doors, and a range of solenoids for locking cabinet drawers and immobilising machinery. Machinery, and cash registers, can also be controlled, without modification, by making the unit switch off the electrical supply. On receipt of a correct code the control box generates an ac or dc unlocking signal.

ELECTRONICS CONSULTANT

Mr. S. J. (Sam) Rubenstein has retired after thirty years with the Phillips/E.I.L. group to set up as a consultant, dealing primarily with the commercial aspects of electronics. He will tour Europe for six months from April 1973, visiting technical exhibitions in a number of countries, and will undertake commissions to evaluate new products, technical developments, etc. and to liaise with principals on matters of import/export business.

Mr. Rubenstein is a Fellow of the I.R.E.E. (Aust.) and has served on its Council for many years. He is also an Hon. Life Member of the I.E.E.E. (U.S.A.).

His original training was with the New Zealand Post Office Engineering

Turn to page 14

news digest

Division, specializing in radio communications and equipment. In 1937 he accepted a position as radio engineer with Philips in Sydney, later transferring to Communication Engineering Pty. Ltd. as Commercial Manager. In 1946 he joined Electronic Industries Ltd. in Melbourne and was continuously employed as a senior technical/commercial executive in various divisions of the company, the last eighteen months as General Manager of Astronics Australasia Pty. Ltd.

MINICOMPUTER OF THE FUTURE?

Recently Motorola's European Computer Marketing Group has been taking a long hard look at the computer market with the emphasis on the small machine. They came to the conclusion that the marriage of two separate semi-conductor technologies could lead to some very exciting developments in the small computer field.

For some time now the performance of minicomputers has remained fairly constant while the price has continued to fall steadily, helped by the fall in cost of semiconductors. If Motorola's predictions are correct the performance of small machines will rise dramatically while the cost will continue to fall and, for the first time, cost/performance trends will become divergent.

The way in which this exciting development might be achieved is to use a very high speed e.c.l. central processor coupled to nmos semiconductor stores. Such a computer could be extremely powerful and might have a minimum storage capacity of 32k words (against 4k) rising to a maximum of 256k words. The very high speed of the central processor and the large storage capacity could result in machines whose performance is limited only by software development and which are no larger than the minicomputers of today.

Reloadable control store structure and ambitious architecture will enable the small machine to enter areas previously dominated by other machines. As soon as clock rates up in the 100 MHz region are mentioned, engineers tend to take a deep breath and visualise sophisticated and expensive interconnection techniques. To see how easy, or how difficult, it would be to implement such a computer, Motorola's application laboratories in Geneva designed and built a demonstration model.

It is stressed that Motorola have no intention of manufacturing computers. The exercise being discussed was carried out to assess the feasibility of an idea and to demonstrate to interested parties how a high-speed processor could be constructed with MECL 10,000.

The central processor built at Geneva consists of some 170 MECL 10,000 i.cs which have been connected together on normal double sided printed circuit boards without much regard for the rules of circuit layout at such high frequencies. The demonstration minicomputer stretches most of the basic engineering rules concerning MECL 10,000 layout and termination to their limits and yet still manages to function most successfully.

The demonstration minicomputer employs a 16 bit word length and a microprogramming word length of up to 56 bits. There is no random access memory fitted and control for demonstration purposes is provided by a read only memory or by switches. Arithmetic is carried out in two's complement form, the execution time being typically 100 ns; logical operations are carried out in typically 66 ns. Altogether 68 microinstructions are accommodated.

The combination of e.c.l. and nmos technologies is the most likely trend in the development of the minicomputer.

TELEMETRY SYSTEM CONTRACT

The contract for the Radio-Telemetry system for the Brisbane River and adjacent catchment areas, worth over $173,000, has been awarded to Techdata Australia Pty. Limited.

The system, believed to be the largest of its kind in the world, will provide flood warning and, in conjunction with Somerset Dam, flood mitigation for the Brisbane area.

Techdata will supply addressable gauge stations which will, on command, report rainfall and river height data from various remote locations through addressable U.H.F. radio repeaters to two control stations in Brisbane. The Master Control employs a mini-computer automatically to interrogate all the gauging stations, check the validity of incoming messages and output the results for further analysis.

All the equipment for this system, with the exception of the minicomputer, is developed by Tech Data Australia Pty. Limited.

(Continued on page 125)


When second
best is not quite
good enough....
think of Sweden...and Sonab
SONAB of Sweden Pty. Ltd., 114 Walker Street, North Sydney. N.S.W. 2060. Ph 929-4288/4554.

Fig. 1. Electro-mechanical system of aperture control. Meter controls diaphragm setting by means of a mechanical linkage.

Fig. 2. The Yashica Electro 8 LD6 cine camera has servo motors for aperture control and zooming functions. The zoom motor can be seen at bottom-left of camera body.

Latest cameras incorporate electronic systems to provide previously unmatched operational features — Brian Chapman reports.

AUTOMATIC CAMERAS

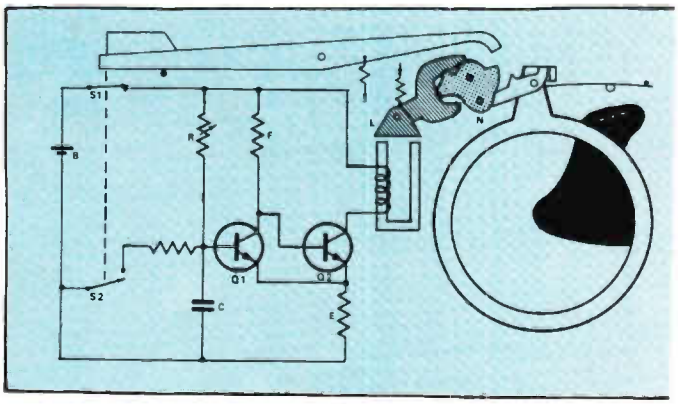


Fig. 3. Typical electronic control system for Compur type shutter uses electromagnet and transistor timing circuit to programme the shutter.

AROUND 10 years ago the first cameras incorporating electronic systems were introduced to the market by companies such as Minolta and Yashica. Unfortunately the use of such terms as "Electronic Brain" and "Computerized Shutter" did not go down well with the public. The buyer felt that all these electronic additions were of dubious value and liable to be expensive to repair. In fact Minolta was forced to withdraw its first electronic model because of sales resistance. When they did re-enter the market, it was with a changed advertising image which played down the electronic features and concentrated on the functional advantages of the new cameras.

Nowadays there is a proliferation of cameras in the $50 to $150 bracket which feature electronic control of shutter, diaphragm or both.

Fully automatic exposure control has been incorporated on cheaper cameras allowing 'point and shoot' photography, but until recently, although cameras in the medium to high price brackets have been fitted with electronic shutters and TTL (through the lens) metering, they have retained semi-automatic operation. This again has been because of buyer resistance amongst advanced amateurs and professionals who, quite rightly, insist on having over-riding control.

Now the last vestiges of such buyer resistance seem to be crumbling and, in the top price bracket, fully automatic cameras with overriding manual control are coming onto the market. Typical amongst these are the Pentax ES and the Yashica Electro AX.

PRACTICAL SYSTEMS

The age of automation in cameras really began when light meters were first built into camera bodies. From this first step it was only logical to develop a method of controlling aperture directly by means of the internal metering system. This method of automation was in fact the subject of patent applications as early as 1902 but a practical system was not developed until the advent of the photo-voltaic cell in 1930, and another 30 years were to elapse before the technique became commercially feasible.

One of the earliest electro-mechanical systems is illustrated in Fig. 1. Here the film-speed setting dial adjusts the position of a stop ratchet and the photocell produces a meter needle deflection which is indicated on a scale visible in the viewfinder. When the shutter release is pressed a stirrup bar closes down until a scanner, driven by the closing diaphragm, hits the meter needle thus stopping the diaphragm from closing further. This action automatically determines the correct aperture to be used for the exposure.

Automatic control of the diaphragm is performed in conjunction with selected film speed and shutter speeds. The shutter speed setting is usually coupled to a potentiometer in series with the photocell circuit, or, to a mechanical means of varying the light entering the photocell, alternatively, the sensitivity of the meter may be varied by a magnetic shunt.

The electromechanical systems as described above, although quite reliable under normal circumstances, are mechanically complex and delicate. One of the most common causes of trouble in such cameras has been failure of the metering system. Unless the camera has manual override such failure makes the camera unusable. Additionally repairs of such systems are invariably quite expensive.

With photo-conductive cells more versatile systems may be used. The cell may be placed in a bridge circuit and, when the bridge is unbalanced, a servo-motor is used to open or close the lens aperture until bridge balance is achieved. Such systems as this are seldom used in still cameras, but are very popular in electronically controlled cine-cameras. The Yashica Electro 8 LD6 is typical of such better quality cine-cameras and includes servo-motors for aperture control and zoom functions (see Fig. 2).

ELECTRONIC SHUTTERS

Aperture control was the easiest to implement in the past but now most new cameras are using electronically controlled shutters to provide automatic exposure. The beauty of using an electronic shutter is that the whole of the aperture setting mechanism is eliminated as well as the light meter of earlier control systems.

A typical electronic shutter control is as shown in Fig. 3. and an actual shutter mechanism from a Yashica Electro 35 is shown in Fig. 4. This Compur type shutter is exactly the same as that used in a manual camera except that the escarpment controlling the exposure time is replaced by an electromagnet. The shutter is held open for a period determined by the associated electronic circuit in the following manner.

When the shutter release is pressed S1 closes and transistor Q2 conducts energizing the solenoid. The armature is attracted to the solenoid, the shutter blades open (one only shown for convenience) and are held open as the pawl, linked to the armature, blocks the movement of the rotating member N. This situation persists as long as the solenoid is energized. Initially

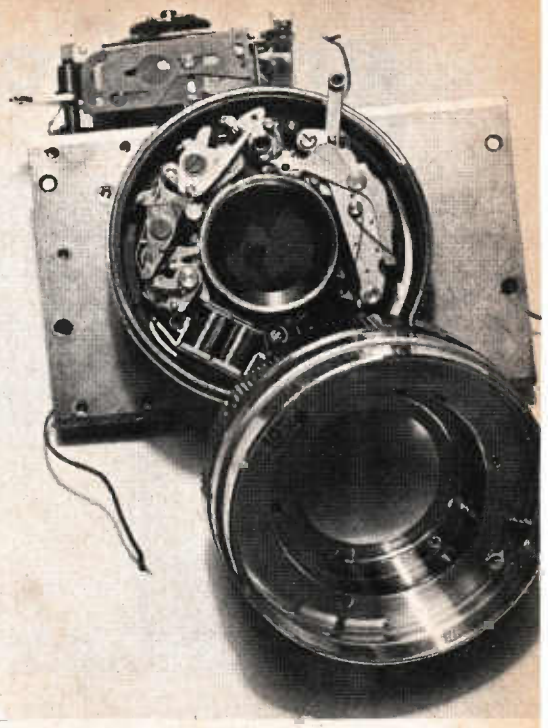


Fig. 4. Shutter assembly of the Yashica Electro 35. The electro-magnet can be clearly seen bottom left.

transistor Q1 is not conducting and capacitor C charges via R. The resistor R is usually a photo cell whose resistance is high with low light levels (hence longer charging time for C) and low for high light levels. When C has charged sufficiently, Q1 conducts shorting out the base/emitter of Q2 which turns off, de-energizing the solenoid and closing the shutter.

A further advantage of shutter control over aperture control is that shutter times may be extended to 30 seconds or more electronically, providing excellent low-light level performance, whereas reliable mechanical shutters with exposure times longer than about 2 seconds cannot be made. Hence low light level performance with aperture control is limited by the maximum aperture available.

The first widely accepted camera to use electronic shutter control was introduced by Polaroid in 1963. The shutter was designed for them by Yashica and is elegantly simple mechanically. Basically the same electronic control circuit as for Compur type shutters is used, a typical configuration being as shown in Fig. 6a and 6b. The mechanical construction of the shutter is shown in Fig. 7a and 7b.

Operation of the circuit is as follows. When the shutter release is pressed TR2 conducts and the solenoid is energized. Both the opening and

AUTOMATIC CAMERAS

Fig. 5. Topping the line of the new "300 series" of Polaroid Colour Pack Cameras, the Model 350 Land Camera features a transistorised electronic shutter and an electronic development timer.
The electronic timer is built into the back of the camera. After loading a film pack into the camera, the user simply dials the recommended development time (60 seconds for colour, 15 seconds for black-and-white) into the timer, which then becomes fully automatic. As the user pulls an exposed film pack from the camera, the timer lights up and begins a silent "countdown". When the picture is fully developed, the timer light goes out and a distinct "beep" signals that the picture is ready.

closing blades are mechanically released but the closing blade is restrained by the solenoid. Light passes from the lens through the aperture wheel and the hole in the opening blade to the negative. At the end of the timing period (as explained before) TR1 conducts, TR2 cuts off, the solenoid releases the closing blade which snaps over, thus terminating the exposure.

In order to control shutter speed over the full range there are several different timing capacitors selected by a switch on the aperture wheel.

Shortly after the release of Polaroid's camera, Yashica introduced their own electronic camera with between-the-lens shutter as shown in Fig. 4. Shutter speeds available are from 1/500sec to a full 30 seconds making photography possible under the most adverse lighting conditions. Unique warning arrows are visible in the finder, 'Yellow' signals a slow shutter speed, and 'Red' warns against over-exposure. The aperture is adjusted until both arrows are extinguished.

ELECTRONIC FOCAL PLANE SHUTTERS

Electronic control may be applied to focal plane shutters as well as between-the-lens shutters and a typical example of this is the Yashica TL Electro-X.

A diagram of the shutter control system is shown in Fig. 8 from which the control circuitry can be seen to be the same as that discussed previously. Adjusting the speed dial varies capacitor charging time as does illumination changes on the cadmium sulphide (CdS) photocell. Thus the metal focal plane is electronically controlled for speeds from 1/1000 sec to 2 seconds. One can preselect either aperture or speed and then vary the other to obtain correct exposure indication by the viewfinder arrows.

The above semi-automatic operation has proved to be very popular and there are many cameras in the middle-price bracket which feature this system. The Canon range has been particularly successful with the QL series. Now that public acceptance of electronic control has increased, several manufacturers are introducing (or already have) fully automatic control on the higher priced cameras in their range. Cameras typical of this trend are, as mentioned before, Pentax ES and the Yashica Electro AX. These cameras have the essential feature of automatic or manual shutter selection which is demanded by serious amateurs and professionals. The Pentax has an interesting feature in a special dial to compensate for problem lighting conditions. It allows preset modification of exposure from half to four times normal whilst still retaining the automatic action.

Both the Pentax ES and the Yashica AX offer an automatic shutter speed range of 8 seconds to 1/1000 seconds, a valuable range previously unobtainable with mechanical systems.

It seems that this is the way all better quality cameras will go. The automatic shutter offers speeds unobtainable by conventional methods and the incorporation of electronics allows a host of other features to be built in at relatively small cost. Facilities such as automatic flash, when fitted, make these cameras ideal for universal, calculation-free, photography. The Minolta Hi-matic F is a typical medium priced camera that features automatic flash exposure control in addition to normal automatic operation, Fig. 10.

INSTANT PHOTOGRAPHY

Ever since the days when they struggled with massive cameras and took shots in broad daylight with the aid of one second exposures and half a pound of magnesium powder, photographers have dreamed of a fully automatic camera where one merely had to press a button and a fully developed perfectly exposed colour photograph emerges from the camera.

Now Polaroid have done just that — they have introduced a new camera, the SX70, which automatically ejects a self developing colour print 1.3 seconds after the exposure button is pressed.

As a young student at Harvard University Edwin H. Land became extremely interested in experiments on polarizing light. He became so involved in these experiments that he abandoned his degree course in order to devote his full time to them. In 1928 at the age of 18 he succeeded in polarizing light with acetate sheet and certain forms of iodine. After a further 9 years spent developing the polarizing process he founded the Polaroid Land company which during the second world war made considerable profit from the sale of anti-glare goggles to the armed forces, and subsequently, polaroid sunglasses to the general public.

Then in 1943 Land conceived the "Instant photography" process and subsequently introduced the first

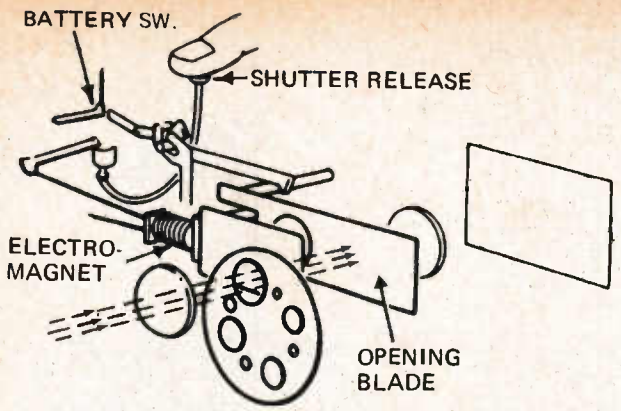


Fig. 6a. The Polaroid Land shutter just prior to release. The opening blade prevents light from reaching the film.

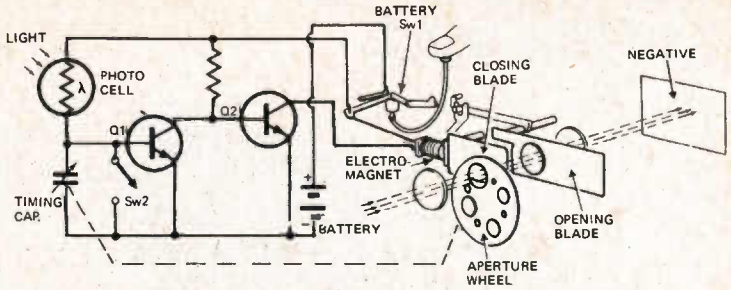


Fig. 6b. The Polaroid land shutter after release. The opening blade now allows light to reach the film via the lens and aperture wheel. At the end of the timing period the closing blade will be released by the electromagnet and terminate the exposure.

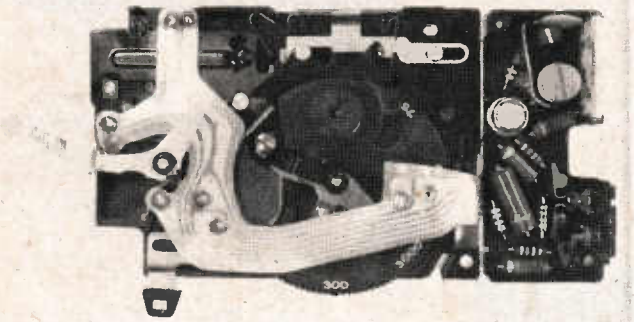


Fig. 7a. The Polaroid Land shutter from the front. The transistor timer is on the right.

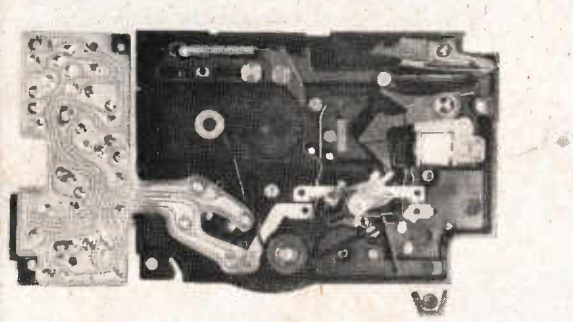


Fig. 7b. Rear view of the Polaroid shutter. The electromagnet can be seen at middle right.

Polaroid-Land model 95 camera in 1947. In this camera the negative is first exposed, and then brought into contact with a positive. Both sheets are drawn through a pair of rollers which rupture a pod attached to the positive and squeeze the jelly-like substance from it across the sheet. After 10 seconds development, the sheets are separated, the negative discarded, and the fully developed print treated with a fixing chemical.

Although many improvements have been made to both camera and film in the ensuing years, the basic process remains the same for all cameras in the range till now. Polaroid has marketed some 26 million cameras and it is claimed that they sell more cameras in the $50 and over class than all other companies in the world combined.

THE SX70 CAMERA

And now another breakthrough – a revolutionary new camera and film have been introduced by Polaroid. The new system produces a developing picture, hard, dry and sheathed in unscratchable plastic, just 1.3 seconds after the user touches the red electric shutter button. The pictures develop outside the camera even in the brightest sunlight. They are of much

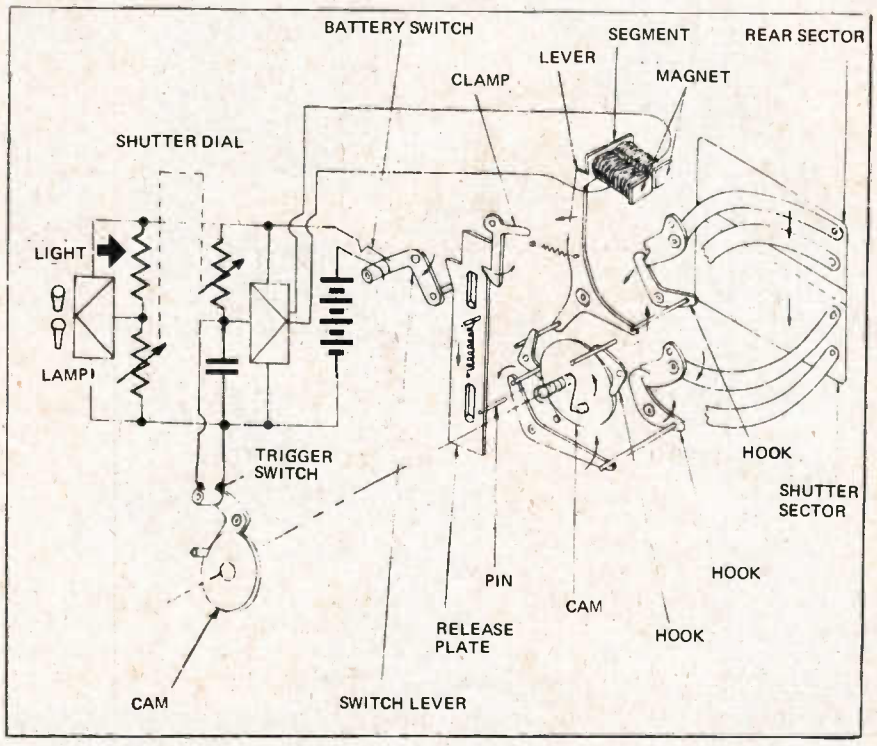


Fig. 8. The metal focal-plane shutter and electronic control of the Yashica TL Electro X.

AUTOMATIC CAMERAS

Fig. 9. The Yashica Electro AX is a fully automatic SLR with manual override. The camera has a flexible printed circuit wiring harness which can be seen at top.

Fig. 11. The Polaroid SX 70 camera in use showing how the film is automatically ejected from the camera.

Fig. 10. The Minolta Hi-Matic F is a medium priced automatic with electronic flash control.

better quality than offered by the older Polacolor film, have better colour saturation and no perceptible grain structure.

The camera retails for $US180 and is a unique folding single lens reflex which when closed, measures 7 x 4 x 1 inches. It weighs only 24 ounces, less than the lens alone on many conventional 35mm single lens reflex cameras. It is opened to its operating position by simply pulling the viewfinder housing upward (Fig. 12). When opened, the camera's profile is roughly triangular, with the viewfinder a smaller triangle above.

The film pack, costing about $US6.90 for 10 colour shots, is inserted from the front of the camera (Fig. 14). When the pack is inserted the camera automatically ejects the top dark-slide cover of the film pack which is then ready for the first exposure.

The lens of the SX70 camera is capable of an extremely broad range of focus. It will in fact focus down to 10.2 inches to give a 1:2 magnification. This is achieved by moving only the front element of the lens, which travels less than one-quarter of an inch. The lens is therefore so compact that even with the front element fully extended for close ups, the camera may be folded shut.

The reflex view system employs a mirror-folded light path through the camera, rather than the bulky penta-prism of a conventional single lens reflex. For many years the usefulness of folding the light path between lens and film has been recognised but not considered practical.

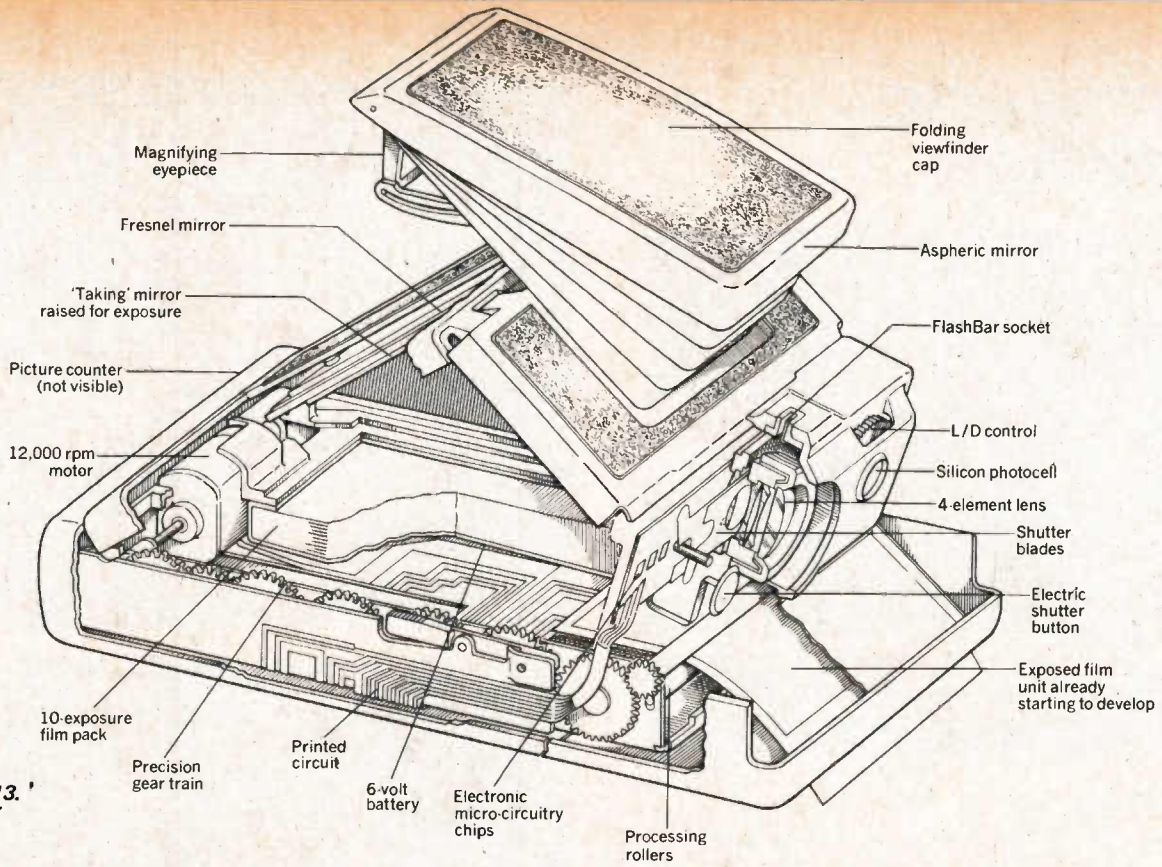


Fig. 13.

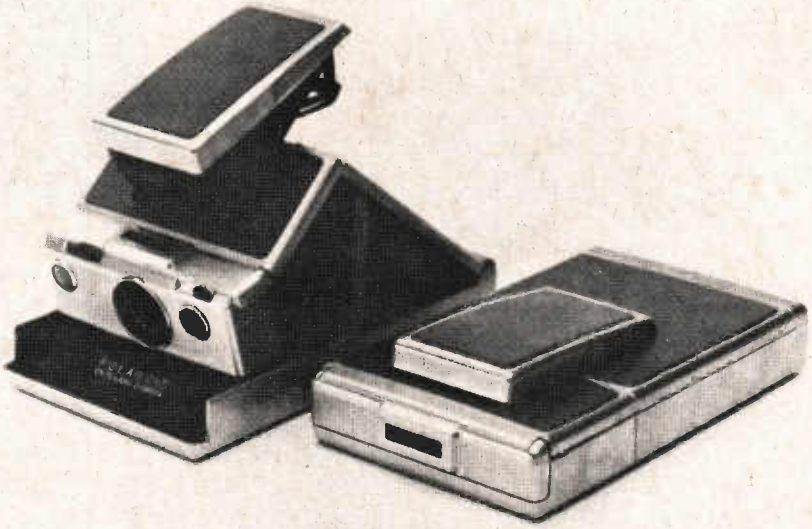
A mirror permits a longer focal length lens for a given film size, and a more compact camera. There are two principle objections to using such a mirror. Firstly it provides a reversed image, and secondly, using conventional lens, shutter and control mechanisms a compact camera could not be built. The first of these objections was invalidated by the requirement of the new film pack for a reversed image. The second objection was overcome by designing special lens, shutter diaphragm, control mechanism and solid-state electronic control for the new camera.

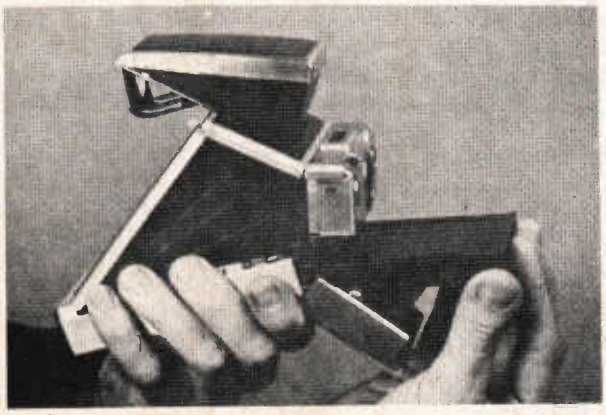
Fig. 13. Cutaway drawing shows location of principle components of the Polaroid SX 70 land camera.

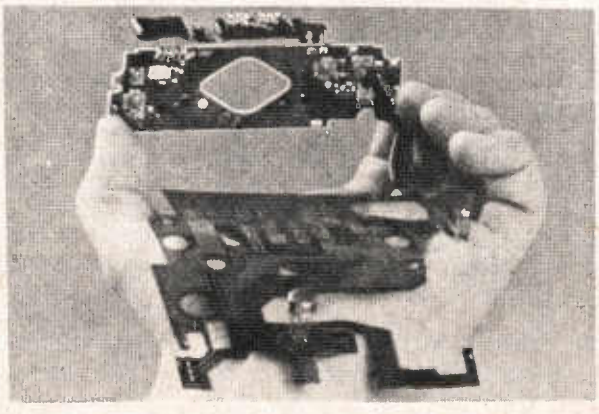
Fig. 14. The camera is loaded by inserting the film pack from the front. Film-pack dark slide is automatically ejected.

Fig. 15. The solid state module and the printed circuit card shown in the relative positions they occupy in the camera.

Fig. 12. The Polaroid SX 70 camera shown here in both open and closed positions, snaps open when the viewfinder housing is lifted.







AUTOMATIC CAMERAS

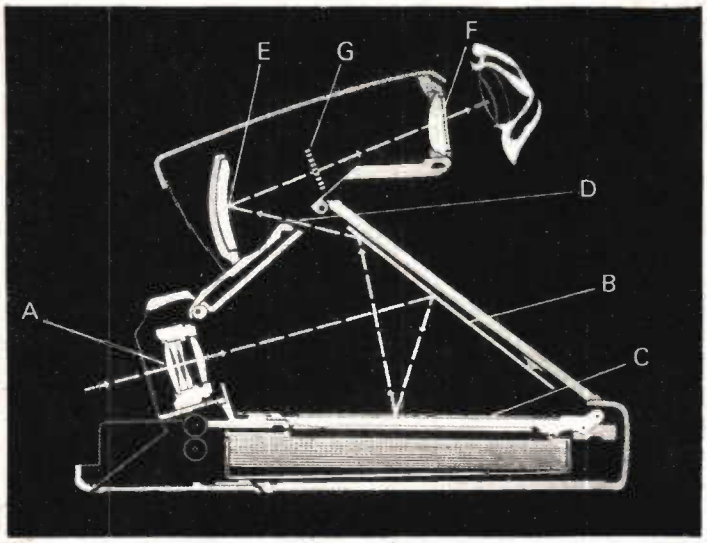


Fig. 16a.

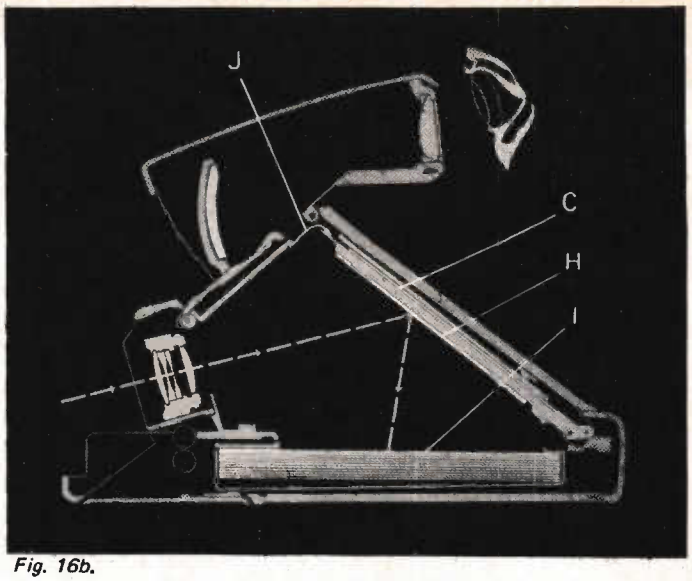


Fig. 16b.

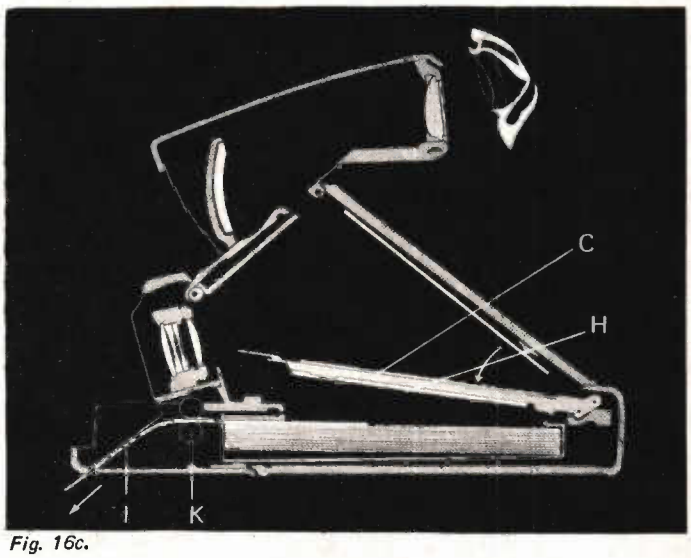


Fig. 16c.

Fig. 16a. Camera in the viewing mode.
Fig. 16b. Arrangement at instant of film exposure.
Fig. 16c. Operation after exposure.

CAMERA OPERATION

Light enters the camera through a four-element glass lens (refer to Fig. 16a) at (A) strikes a permanent viewing mirror of aluminized glass (B) and reflects down onto a special, plastic, 200 groove per inch Fresnell mirror (C), the surface of which is roughened to provide a ground glass screen effect. The mirror gathers all light, incident on it, into an off-centre beam and projects it out of the camera through a one-tenth inch diameter exit-hole. The emergent light beam strikes a concave, aluminized, aspheric (not spherical) mirror (E). As the light rays strike this mirror from below its centre line, a special shape is required to correct image distortion. The actual shape is a section of an ellipsoid and its design is said to have consumed a full 2½ years of computer time. The aerial image formed by this mirror at (G) is viewed by means of a magnifying aspheric eyepiece at (F) and comes to focus again just behind the pupil of the viewer's eye. The scene is presented right side up and correctly positioned left to right. Focus is easily achieved as the image is very bright despite the maximum aperture available of f8.

To make an exposure, the photographer simply touches a red electric shutter button whence the following sequence is initiated (refer Fig. 16b). The shutter closes and an electric motor drives the Fresnel mirror (C) up against the back of the camera bringing a trapezoidal 'taking' mirror on its under surface into the light path.

This mirror reverses the image into the correct left-to-right orientation as it reflects it down onto the now uncovered negative (I) in the film pack. A small rubber flap (J), attached to the pivoting carrier which holds the Fresnel mirror and 'taking' mirror, seals the exit hole at the top of the camera to prevent a light leak during exposure. The required exposure is determined by a sensitive silicon photo cell the output of which controls, by means of logic circuitry, the combination of shutter speed and aperture to be used. The aperture is variable from F8 to F90 and the shutter from 1/100th of a second to about 20 seconds. A total of five integrated circuits containing 260 transistor functions are used to control exposure and the sequential camera operations.

Operation of the SX70 shutter is basically similar to that of earlier models. The same blade type shutter blades are mounted between the 3rd and 4th elements of the lens. The new shutter incorporates wider speed range than previous models and integrated, rather than discrete, control circuitry.

After exposure the film unit (I, Fig. 16c), is automatically driven through two small rollers (K) which rupture a pod of reagent and spread it between the film unit's positive and negative sheets to begin the developing process. Simultaneously, the pivoting Fresnel and 'taking' mirror assembly swings down to cover the film pack and the camera returns to the viewing mode for the next picture.

It takes a mere 1.3 seconds from pressing the red electric button till the emergence of the turquoise-green exposed film from the front of the camera. Power for the camera logic circuits and drive motor is derived from a battery built into the film pack. Thus the photographer need never be concerned about flat batteries, the battery is renewed each time a new film pack is inserted and has sufficient reserve power to handle 150 shots even though there are only 10 per pack.

THE FILM

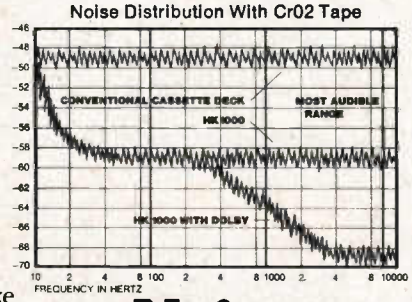
Although the camera itself is remarkable and revolutionary, the film is even more so and represents a daring

Turn to page 75

Never before has this little noise accompanied this much music.

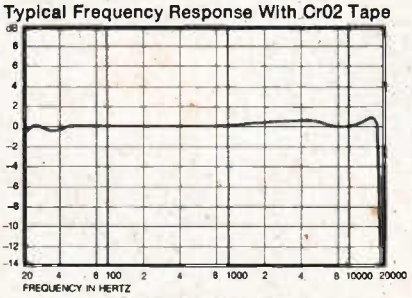
If you're sophisticated enough to be reading this magazine, you're probably familiar with the two main characteristics of cassette decks: hiss and nonlinear frequency response.

Noise Distribution With Cr02 Tape



Noise.

Typical Frequency Response With Cr02 Tape



Music.

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

Signal-to-noise (unweighted) is −58 dB with Dolby and −70 dB in the audible hiss level above 4,000 Hz. The frequency response curve is essentially flat from less than 30 to beyond 15 kHz, ±1.5 dB, with CrO_2 tape. (This curve is due largely to the way we drive our heads. Instead of the conventional constant *voltage* drive to the head, the HK-1000 is designed for constant *current* drive. Many studio model reel-to-reel decks are designed the same way.)

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

Ours is the first cassette deck designed for maximum phase linearity. Square wave response is better than every other cassette deck and even some expensive reel-to-reel decks. And the better the square waves, the cleaner and more transparent the music.

Discriminating audiophiles will also appreciate the wide selection of controls to take control of. There are two "peak-reading" VU meters; automatic shut-off in all transport modes; separate controls for recording playback and microphone levels; a "memory" rewind feature that lets you key a selection to the exact start location; a Dolby test oscillator; both record and Dolby playback calibration adjustments on the top panel; and so on.

The HK-1000 is also designed so you can use it often without endangering it. Plug-in printed circuit boards are used for simplicity and reliability of operation. Heads are easy to reach and clean. And the transport is the most reliable we've ever tested; it even closes with the sort of reassuring "thunk" you normally hear only by closing the doors of expensive hand-built cars.

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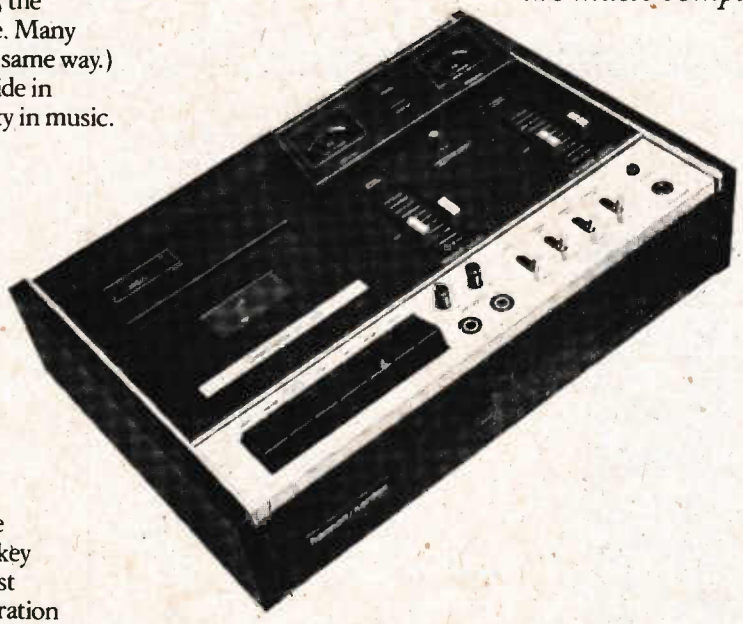

Deitron

PICTURE SHOWS MR LEN DEITCH AND MR PETER LONDON, BOTH DIRECTORS OF DEITRON INTERNATIONAL PTY LTD., STANDING BEHIND SOME OF THE RANGE OF 78 DIFFERENT ELECTRONIC PRODUCTS THAT THEIR NEWLY FORMED COMPANY WILL BE MARKETING IN THE FUTURE.

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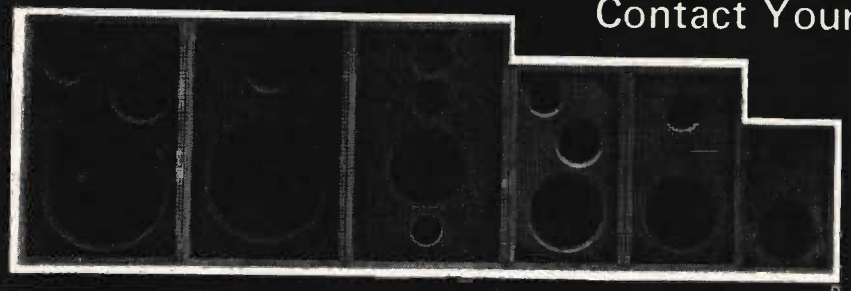
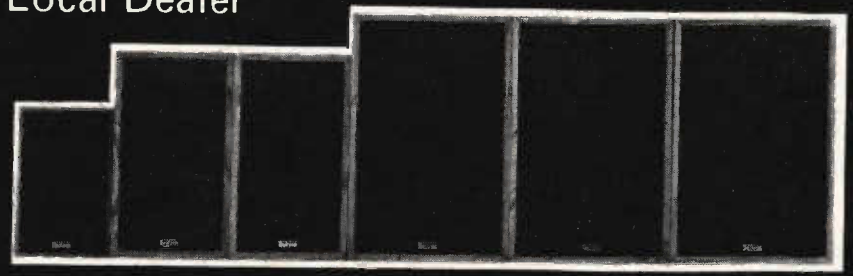
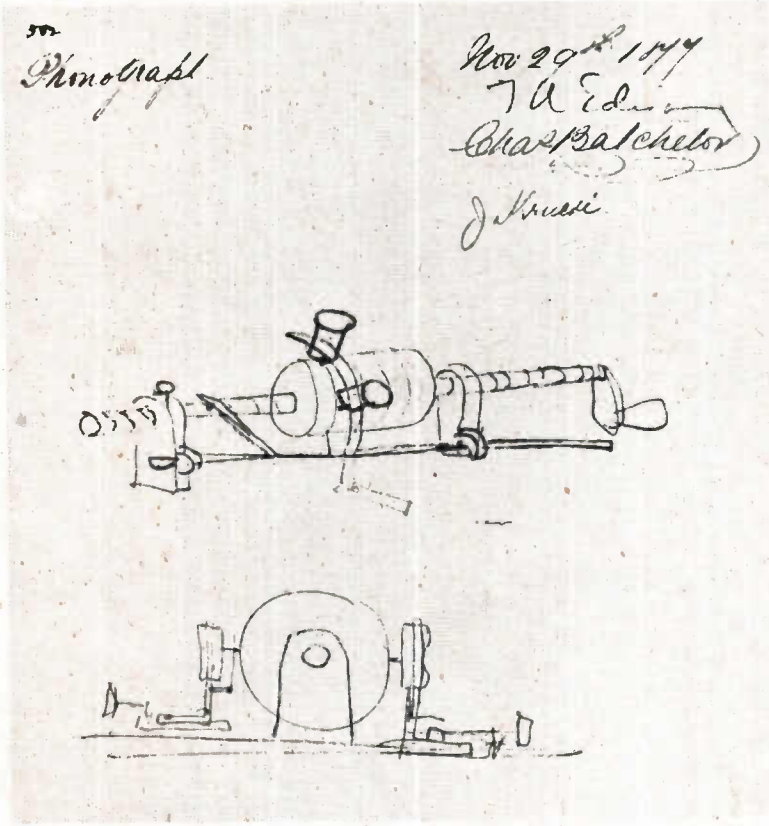




Manufacturer	Model	Handling Max. Power Watts rms.	Frequency Response Hz	Speaker			Impedance ohms			Dimension Inches H x W x D	Weight lbs.	Price $A
				Woofer	Mid	Tweeter	4	8	16			
Deitron	DSS-63	8	55-18,000	6	–	3		x		–	–	30.00
	DSS-83	10	55-18,000	8	–	3		x		–	–	45.00
	DSS-853	15	35-20,000	8	5	3		x		–	–	55.00
	DSS-833	30	25-20,000	8	–	3x2		x		–	–	70.00
	DSS-125	20	25-20,000	12	–	5		x		–	–	85.00
	DSS-1265	25	25-20,000	12	6	5		x		–	–	95.00

THE PHONOGRAPH

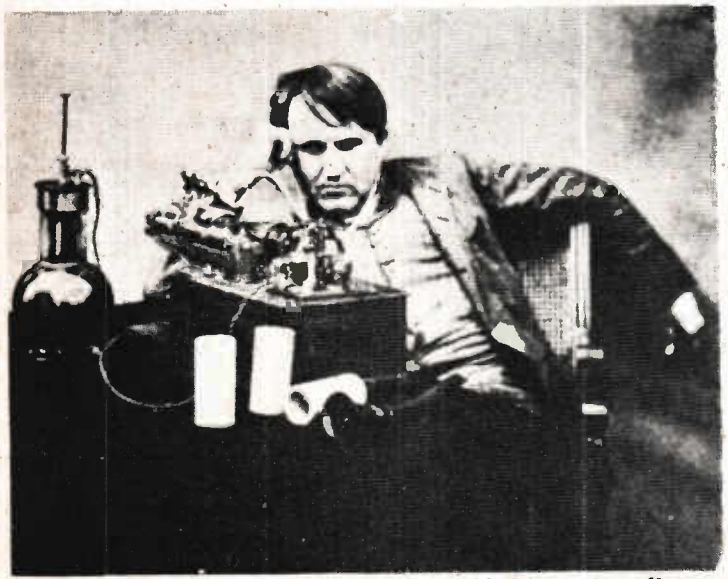


Edison's first sketch of the Phonograph, recently discovered. Another "first sketch" incorrectly dated "August 1877" has since been found to be a copy, drawn from memory by Edison in 1894.

IN 1877, Thomas Edison was working on a telegraph repeater when the idea occurred to him that it might be feasible to record, not only dots and dashes of the Morse Code, but the actual sound of a human voice.

During previous experiments with the telegraph headphones he had observed, that when in operation, the receiver diaphram vibrated with sufficient energy to be felt quite easily with the finger tips. He reasoned that if a sharp point was attached to the center of a voice actuated diaphram and allowed to emboss a moving surface it would create a varying pattern which would be, in fact, a record of the original sounds.

The material eventually chosen for a recording surface was a sheet of tin foil. Edison had his chief mechanic make up a machine which consisted of a brass drum, 3½ inches in diameter mounted on a threaded axle, with a hand crank to revolve it. Each turn of the crank caused the drum to revolve, and move laterally one tenth of an inch. A recorder, consisting of a diaphram mounted in a mouthpiece with a stylus attached to the center of the diaphram was on one side of the drum. Opposite was the playback reproducer, similar to the recorder but with a more flexible diaphram.



Edison listening to his wax-cylinder phonograph after a marathon effort to improve its mechanism.

Famous opera singer recording on a tin foil Phonograph, 1878.

— a short history by Charles Slater

The world's first sound recording was produced on Dec. 6th 1877 when Edison wrapped a sheet of tin foil around the drum of this strange little machine, turned the handle and recited 'Mary had a little lamb'. The playback reproducer was then substituted for the recording mouthpiece and the machine cranked again. To the amazement of everybody present — including Edison himself — a recognisable reproduction of his voice spluttered forth.

The name Edison gave to this invention was 'The Phonograph'. (Those who know their Greek derivations will easily see why, the word means 'sound writer'.)

The Phonograph caused a sensation wherever it was demonstrated. It is difficult for us today, living as we do in a world of television, piped music and quadraphonic sound to imagine the impact that a 'talking machine' had on 19th century ears. Many at first thought it some kind of ventriloquist trick or a device of the devil, but before long it was being unanimously acclaimed as the 'wonder of the age'. To hear a machine reproducing the human voice, even very poorly, seemed nothing short of a miracle. The device however, was rather imperfect and its primary role was that of an amusing novelty. Hundreds were manufactured for use by showmen who were able to make a good living out of them during the early months of 1878.

As the novelty wore off, the crowds of spectators grew less and less and the tin foil phonograph gradually went into retirement eventually to become little but a scientific toy. In retrospect the reasons are obvious. Firstly, the quality was extremely poor, so much so that, unless one was present when a record was made, it was often impossible to recognise exactly what was being played back. Playing time was barely half a minute and each recording could only be played about five times before wearing out. Of what practical use could such an instrument be? Before long the phonograph went into eclipse, abandoned by all including its inventor, who by this time was busy perfecting the electric lamp.

No further phonographic progress was made for almost a decade. Then, in 1889, a new talking machine was exhibited before the public.

It was developed by two men, Chichester Bell — a cousin of the famous telephone pioneer — and an associate, Charles Tainter. Together they produced a machine which had far better performance than the Edison design. The new machine recorded on wax coated cardboard cylinders instead of tin foil, had an improved stylus arrangement, and could be operated by either electric motor or a foot treadle — instead of being hand cranked. Bell and Tainter named their instrument the Graphophone.

Upon hearing of the success of Bell and Tainter's efforts, Edison decided it was time to have another look at what he later called his favourite invention. In typical fashion he immersed himself in the project until, after a five day stint, he was able to announce his 'Improved Phonograph'.

The new machine was indeed an improvement over the Graphophone, using solid wax cylinders which could be shaved for re-use; a precision battery powered motor plus a more efficient recorder and reproducer.

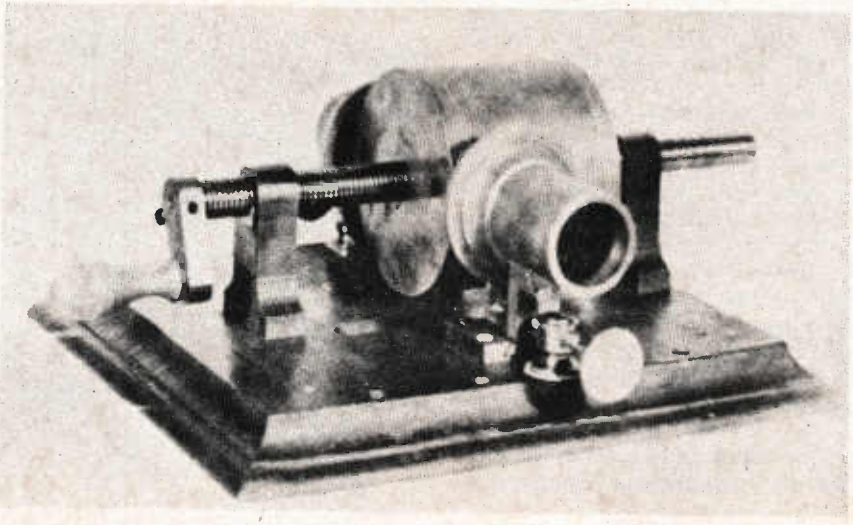
At this stage a complex legal battle between the Graphophone and the Phonograph interests flared up over patent rights. Eventually the two factions decided to pool their patents and started to sell their products. Their initial idea was to install them in offices as dictating machines but it was soon discovered, that there was more profit in setting up the machines as coin-in-the-slot entertainment devices.

So it was that 1890 saw the birth of the first juke boxes. By inserting a nickel, and donning stethoscope type ear tubes, it was possible for people to hear a popular song, a brass band selection or a humourous anecdote reproduced from a beeswax cylinder which played a little over two minutes.

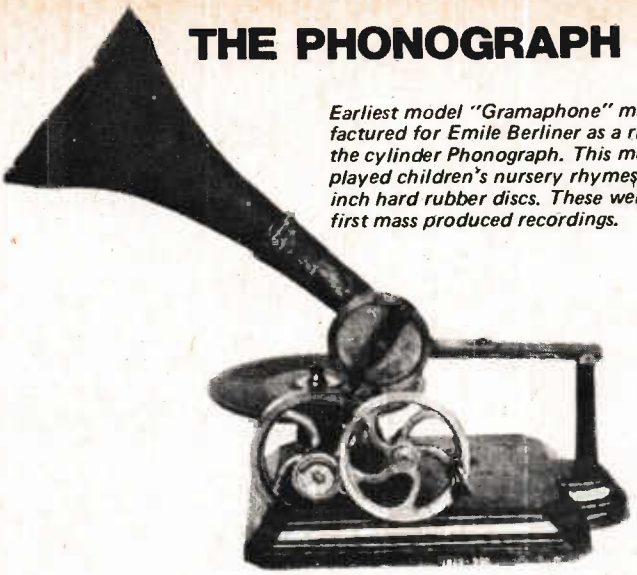
But the demand for recorded entertainment became so persistent that it soon appeared obvious that the most viable role for the Phonograph was not at the office but in the home and so domestic machines were developed employing a cheap and reliable spring motor to eliminate the cumbersome and messy batteries used in the dictating machines. By 1886 one could purchase either a Phonograph or Graphophone, suitable for home use, for about $50; still rather expensive but only a third of the price of the cheapest model of 1893. By this time the Graphophone was owned by the Columbia Phonograph Co. whose genealogy can be traced to the modern CBS Corporation. The infant record industry began to boom, and as sales improved, prices became lower. Just when the Phonograph and the Graphophone looked like becoming firmly established as the number one household entertainer, a third competitor appeared which was destined to relegate the cylinder to obscurity; this was the Gramophone.

Developed by Emile Berliner, a

Edison original tinfoil phonograph, the first recorder of sound.



THE PHONOGRAPH



Earliest model "Gramaphone" manufactured for Emile Berliner as a rival to the cylinder Phonograph. This model played children's nursery rhymes on five inch hard rubber discs. These were the first mass produced recordings.

Edison "Standard" Phonograph, one of the most popular record players of early times. This 1909 model featured a turnover stylus for playing either normal two minute or the finer grooved "Amberol" 4 minute cylinders.

young inventor who had emigrated to the U.S.A. from Hanover, the Gramophone struck right at the Achilles heel of the Phonograph. This was its inability to mass produce recordings cheaply, for at that time each Phonograph cylinder sold was an original! If an artist wanted to sell a thousand recordings of a song, he had to sing it that many times. Brass bands were slightly more fortunate as, due to their greater volume, a dozen or so cylinders could be cut at once, but it still made for a slow and costly recording procedure.

Berliner's Gramophone utilised a flat disc instead of a cylinder, and a method was evolved whereby these discs could be stamped out in almost unlimited numbers. Although Berliner first began experiments in 1887 it was not until 1894 that he had sufficient knowhow and financial backing to produce a commercially viable product.

The very first disc records appeared around November of that year pressed in hard rubber, they were seven inches in diameter and single-sided, with the title scratched in the centre (no paper label). They played for two minutes and were recorded at 70 r.p.m.

Another major difference was the use of laterally modulated grooves, that is the stylus vibrated from side to side while playing, as opposed to the hill and dale (or vertical modulation) movement employed for cylinders. Another significant improvement was that whilst with the Phonograph a feedscrew was required to enable the reproducer to reliably traverse the shallower grooves of the cylinder the soundbox of the Gramophone was propelled across the disc solely by the grooves in the record. Hence a machine to play disc records could be made more simply and cheaply than its cylinder counterpart. At this time most people could afford a 'talking machine', for the simplest Gramophone, admittedly hand cranked, sold for about $12. This was far lower than any cylinder machine, while records could be bought for 50 cents.

The Gramophone could not be used to make home recordings, (as was possible with the Phonograph) but this proved to be only a minor drawback as the public had already shown a preference for professionally 'pre-recorded cylinders', rather than their own inconsistent efforts.

More important was the fact that Gramophones were hand cranked and this invariably produced erratic speed. This drawback prejudiced the progress of the disc player for a while until a mechanical engineer, Eldridge Johnston, was given the task of designing a suitable spring motor to drive it.

Johnston not only succeeded with this project but soon found himself improving the fledgeling machine.

By 1897 he developed the 'Improved Gramophone' with a stronger motor and a revised soundbox. This model was to become the most famous talking machine in history. It is the one being listened to by Nipper the fox terrier in the well known 'His Masters Voice' trademark. It is interesting to note that the artist, an Englishman named Francis Barraud, originally painted a dog listening to 'his masters voice' at the horn of an Edison cylinder machine. A few years later a visitor noticed the painting and suggested it might look better if he painted a gleaming brass horn as used with the latest machines. Barraud approached the manager of the recently formed Gramophone Co., William Owen, for a loan of such a horn as a model. Upon seeing the painting Owen offered to buy it if the original phonograph was painted out and an 'Improved Gramophone'

THE PHONOGRAPH SOCIETY OF AUSTRALIA

For anyone interested in collecting, restoring or just plain reading about vintage Phonographs, records and similar items, we would like to mention the existance of the Phonograph Society of Australia.

This club was formed in Melbourne several years ago as a branch of the London Phonograph Society and has members throughout Australia — each of who receives a bi-monthly magazine "The Phonogram" featuring articles by members on various aspects of their own particular field. These range from music boxes to player pianos, clocks to vintage radios as well as all types of talking machines and records. Collections of associated items such as old theatre programs, record catalogues etc. are also catered for.

The next phase of expansion will include vintage television, associate editor of the 'Phonogram', Chris Long, has recently completed experiments with a mechanical Baird T.V. system. The honary secretary, Tony Savery, can supply many spare phonograph parts, springs, stylii etc. as well as reprints of early record and machine catalogues to members. From time to time exhibitions of machines are given by members, while the Victorian branch holds meetings each month. Readers interested in joining the society may obtain further information by writing to Mr. Colin Gracie, C/- Post Office Cavendish Victoria. 3408.

The "Graphophone" cylinder player made by Columbia Co. around 1899.

substituted. This was agreed to and before long Nipper replaced the 'Angel with a quill' trademark hitherto employed. In America he appeared on records produced by the Victor Co. which was formed as a breakaway from the Berliner group by Eldridge Johnston in 1901.

By now the disc record was providing healthy competition for the cylinder manufacturers who decided that something had to be done to improve their product. After much experimenting a method was evolved whereby cylinders could be mass moulded. A microscopic layer of gold was deposited on the master cylinder to make it electrically conductive. The record was next copper plated and then melted out, leaving a copper mould, the counterpart of the negative stamper used for disc pressings. Molten wax was then poured into the mould to create the copy which was kept hollow by means of a tapered cylindrical form inserted inside the mould. Upon cooling, the wax would harden and contract sufficiently to be withdrawn from the mould. It was then ready for use. The correct speed for cylinders was standardised at 160 rpm (it was previously around 120 to 144 rpm), thereby improving the sound quality – but limiting the playing time to a maximum of two minutes. The first of these improved 'Gold Moulded' cylinders appeared in 1901, but it was then already too late to win the battle against the disc manufacturers.

By the following year (1902), Enrico Caruso had recorded ten discs for the Gramophone Co. of England and these created something of a sensation among music lovers the world over. The Columbia Co, seeing the writing on the wall, also began the manufacture of discs although the company continued to market cylinders until 1912. A further blow descended on the cylinder trade in 1904 when somebody realized that a disc had two sides. It seems extraordinary that this had not occurred sooner, but until then all discs were recorded on one side only, the other being blank or inscribed with trademarks, patent dates etc.

By 1908 most discs were double sided which implied that the average 10" record could provide up to six minutes of program material, whilst a similarly priced cylinder was still limited to two minutes only; moreoever the cylinder was more fragile and harder to store. All these facts resulted in a swing by the record-buying public to the disc system. (If this hadn't occurred, instead of radio disc jockeys 'spinning' a record, we would have perhaps cylinder jockeys 'revolving' them. If nothing else this would have made a request 'to play the flip side' rather difficult).

But despite this, Edison was still convinced that the cylinder was technically superior and, up to a point, he was correct. When playing a disc, the circumference of the grooves becomes progressively smaller as the pickup moves toward the label and the effective surface speed decreases accordingly. This causes a restriction of the available treble response towards the end of a disc.

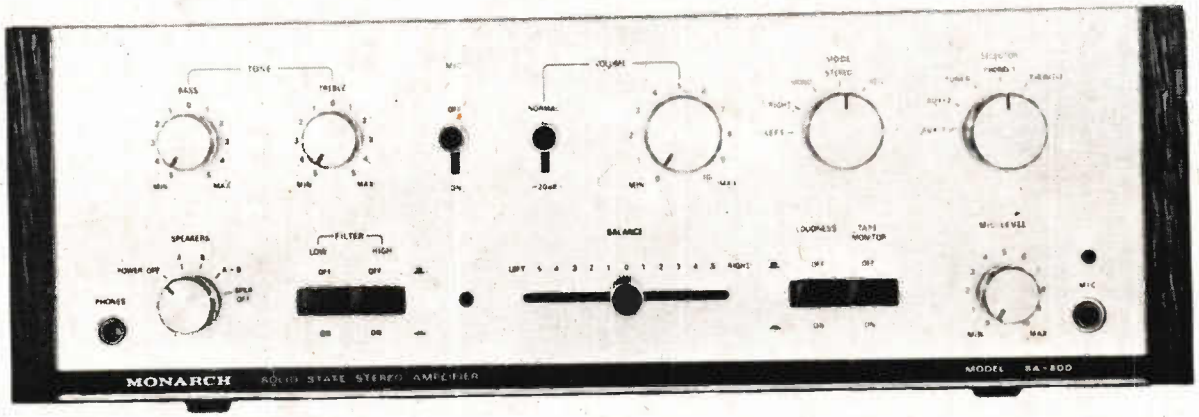
Cylinder recordings do not have this limitation as the stylus tracks the groove at a speed that remains constant throughout the record.

Cylinder records also had the advantage of being played with an accurately ground elliptical sapphire, which caused less wear and lower surface noise than the expendable steel needles used for discs. Moreover the 'hill and dale', or vertical modulation method, referred to earlier, was in many ways more suitable for the acoustic recording methods then employed.

It was with these facts in mind that Edison decided to have another try at converting the wayward record buyer back to his beloved cylinder. A new four minute wax cylinder was introduced in November 1908 which Edison called the Amberol. The extra playing time was achieved by doubling the groove pitch from 100 to 200 per inch – about the same as the average microgroove LP of today.

A special phonograph called the Amberola was produced to play these new cylinders. It was equipped with a suitable feedscrew and finer stylus. The Amberola was the first Edison machine to be fitted with an internal horn, rather than the flamboyant external type which had often

Three Kings



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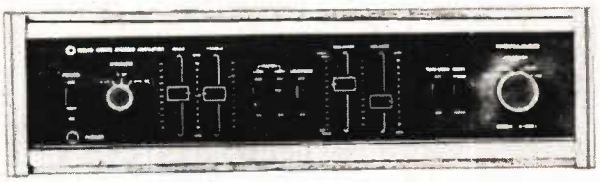

MONARCH SA 5001 (60 watts RMS)
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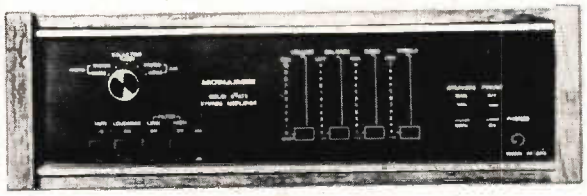

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THE PHONOGRAPH

predjuced its appearance in the well furnished home.

To keep faith with past customers, ingenious conversion kits were supplied at low cost to owners of two-minute machines to allow them to play both standard and four-minute types. New machines were also supplied with a gear change to alter the feed screw speed to suit either type, and a turn-over stylus arrangement similar to that used nowdays for 78's and LP's, was featured.

An unbreakable celluloid four minute cylinder was marketed in 1912. This was known as the Blue Amberol but, although acoustically superior to its competitors, it failed to influence to any extent the buying habits of the average record collector.

In the same year that the Blue Amberol was introduced, Edison conceeded to public taste and marketed his first disc records. However both Edison's records, and the diamond disc machines produced to play them, were completely incompatible with the standard gramophone type discs. For Edison had retained the 'hill and dale' modulation and shallow groove concept as used with his cylinders.

To overcome tracking problems, the players were fitted with a feedscrew device to guide the soundbox over the record, while the records themselves were made a quarter of an inch thick in order to minimise any warpage which might tend to throw the stylus out of the groove. These records were finely grooved — 150 to the inch — giving a playing time of up to four minutes per 10" side. The stylus itself was diamond tipped hence the designation 'Diamond Disc Records.'

This was not the first attempt to produce a 'hill and dale' cut disc. Six years earlier the French Pathe Co. began marketing discs using vertical modulation with very broad grooves and meant to be played with a sapphire 'ball' stylus of some 13 mils radius. To minimise treble losses due to this large stylus, discs were recorded at about 95 rpm. These Pathe discs were manufactured up until 1932, while the production of Edison Diamond Discs and Blue Amberol cylinders ceased in 1929, two years before the inventor's death.

Before leaving the Diamond Disc it is worth noting that in 1927 a long playing version of this system was marketed. The record played at the normal (80 rpm), but the groove density was increased to an amazing 450 grooves per inch enabling a 12" record to play 20 minutes per side. Unfortunately the public were not yet ready for LP records and the venture was a commercial failure.

Probably the greatest breakthrough in recording history came in 1925 when a system of electrical recording, using microphones and valve amplifiers instead of tin horns, was perfected. Until then singers and musicians had to record 'double forte' in order to register on the insensitive diaphrams. There was no room for subtleties, and some voices and instruments would not record at all.

Suddenly thanks to research at the Bell laboratories, a new sonic world was available to the record industry. Suprisingly enough the public was slow to appreciate the new electrical techniques — many disclaiming it openly — for by capturing a greater range of tones, they were hearing sounds to which they were unaccustomed. They were rather like someone who, having been short sighted all his life, tries wearing spectacles and claims that everything looks strange.

Similar sentiments were later to be expressed by many upon the arrival of the microgroove LP, the stereo disc and more recently, quadraphonic sound.

Nevertheless, eventually, most people began to appreciate the advantages of electrical recording and reproduction.

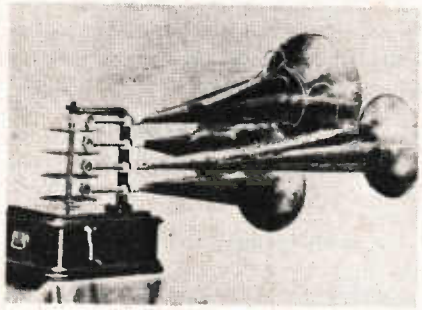
By 1927 the system was being put to use by the movie industry. The soundtrack used for early talkies consisted of a 16" disc record revolving at 33-1/3 rpm and mechanically coupled to the film projector. However an attempt in 1931 by RCA Victor to market a 12" 33-1/3 rpm record failed, just as Edison's earlier LP venture had. The 78 rpm record had become standard and remained so until 1948 when Columbia first introduced its microgroove system. RCA countered with the 7" 45 rpm disc and for a while the two systems battled it out for supremacy. Finally they settled down to a peaceful co-existance, and by 1955 the 78 rpm shellac record was extinct.

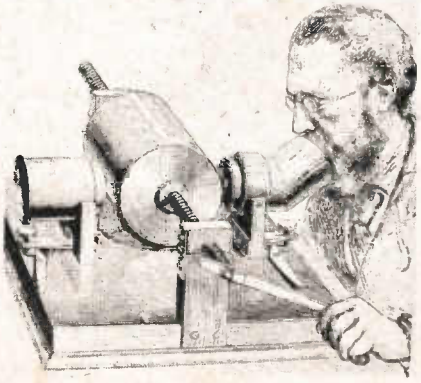
In tracing the fortunes of Thomas Edisons brainchild it is interesting to note how many 'modern' innovations had distant ancestors. For example we have the elliptical stylus developed for cylinder machines and the LP fine groove records of the 20's. A three channel cylinder machine was exhibited by Columbia around 1900 and although it wasn't labeled stereophonic its makers termed it the 'Multiplex' Graphophone Grand.

The straightline tracking arm was in commercial use in over 65 years ago, and eight years before this an alternate method of recording was being demonstrated, using reels of steel wire and electro-magnetic recording heads. The 'tape' recorder was first developed in 1900, although its inventor, a Danish telephone mechanic by the name of Vladmir Poulson, was hampered by the lack of a suitable amplifier to make his invention practicable. The first stereo disc using the same 45/45 modulation method employed today was produced in 1933 by A.D. Blumlein, an engineer working for EMI in England. It was 24 years before its time. Perhaps a look back through the history of the gramophone record might enable us to foretell developments in the audio world that are still yet to come. ●

ABOVE: A three-channel cylinder machine exhibited by Columbia in 1899.

Above right: Quadraphonic sound, 1904 style.





RIGHT: Large, demonstration tin foil Phonograph built by British engineer William Preece in 1878. (From a contemporary newspaper account).

Project SANGUINE

Submarine communications link will operate at 45Hz! Collyn Rivers reports.

THE US Dept. of Navy is actively planning an ultra-low-frequency communications system for transmitting command and control messages to submerged submarines.

Code-named 'Project Sanguine' the system will provide world-wide coverage from a single transmitting location in the United States.

The system has been designed to operate at the ultra-low frequency of 45 Hz (although an alternative frequency of 75 Hz is also under consideration). The reason for choosing such a low frequency is simply that in sea water the attenuation of radio waves is related to the frequency used. For example at 2 MHz the attenuation is 15 dB/ft, at 40 kHz it has fallen to 2.2 dB/ft and at 10 kHz it is a mere 1.1 dB/ft. Down at 75 Hz the attentuation has fallen to less than 0.1 dB/ft. No figures are available for 45 Hz but it is certain that the attenuation will be even lower than at 75 Hz.

The choice of such a low frequency has complicated antenna design – for to achieve reasonable efficiency – the antenna used must be a small multiple of one wavelength. When one wavelength is over six and a half thousand kilometres (6666 km to be reasonably precise), clearly there are geographic limitations to the length of antenna used!

Information about the actual length chosen is classified and cannot therefore be published, but unofficial reports say that a length of 22.5km will almost certainly be used. As a result, the antenna system will be extremely inefficient and nearly all the energy input will be dissipated as heat into the surrounding earth.

A very small portion will be radiated into the 'duct' between the earth's surface and the ionosphere, and, due to the wave 'tilt' of the propagated energy at the surface of the earth, some of this energy will penetrate beneath the earth's surface and be attenuated in accordance with the normal exponential laws of decay.

Unlike conventional radio transmission techniques, the Project Sanguine antenna cannot be regarded as radiating directly. At 45 Hz the distance between the earth's surface and the ionosphere is a mere 1/80th of the wavelength and because of this the jonosphere above the transmitter acts as a conductor that is coupled inductively to the antenna in the same way that the secondary winding of a transformer is coupled to the primary winding.

A GIGANTIC TRANSFORMER

In fact the whole Project Sanguine antenna and the space above it can be seen as a gigantic transformer in which the transformation ratio becomes an essential feature in coupling the 45 Hz power generator to the earth-ionosphere duct. In other words the antenna, together with the return circuit through the earth, is simply the primary winding of a matching transformer which induces current in the ionosphere above the antenna site, and it is this current that in effect launches the energy wave in the earth/ionosphere duct.

Information concerning the level of power to be transmitted has not been released, but some indication can be obtained from experiments undertaken at the US Navy's Project Sanguine test facility sited in the Chequamegon National Forest in Northern Wisconsin.

In this installation an antenna input power level of 600 kW is used to generate a current of 300 A into an orthogonal antenna (oriented North-South and East-West) mounted on poles 10 m above the ground. Each antenna arm is 22.5 km long and has extensive earthing arrangements at the ends.

Received power measurements were taken from this transmitter at field sites at Utah, Hawaii and Alberta. These sites are approximately two Mm, 6.5 Mm and 1.5 Mm (respectively) from the transmitter location in Northern Wisconsin.

Official reports state that the signal level received was extremely low and from this it is reasonable to assume that very much higher power levels will be used. Figures as high as 30 MW are being spoken of – if one authority is correct it could be as high as 3000 MW!

There is some controversy as to whether burying the transmitting antenna will attenuate the signal to any marked degree – the concensus of informed opinion is that it will not. However, one well known authority, Dr. C. W. Harrison Jr. in his 'Note relating to Project Sanguine Antenna for Communication with Submarines at Operational Depth' questions this and suggests that the power input to a buried antenna might have to be 100 times that of an above ground antenna.

At frequencies as low as those to be used, the dominant source of noise for a fixed antenna at surface level is atmospheric. Hence a receiver aboard a submarine will receive the atmospheric noise as well as the Sanguine signal.

The sea is a conducting medium and therefore has an attenuation for any given frequency that is exponential with the product of antenna depth and the square root of the frequency. Thus the sea above the antenna acts as a low-pass filter attenuating and linearly distorting both the Sanguine signal and the atmospheric noise.

Apart from the selectively attenuated Sanguine signal plus atmospheric noise, there will also be noise associated with the flow of the sea water over the antenna electrodes plus a noise component caused by the variability of motion of the antenna through the earth's magnetic field. On top of all this there will be internal noise generated by the receiver itself.

Thus the relative levels and characteristics of the Project Sanguine signal and the inevitable noise will determine the quality of reception, and ultimately it will be the speed and depth of operation of the submarine (or at least the sunmarine's antenna)

that will determine whether a signal can or cannot be usefully received.

From the facts currently available it is obvious that the received signal/noise ratio will be extraordinarily low — far less than unity — and because of this a very complex message coding and decoding technique will be employed.

THE CODING TECHNIQUES

The technique to be used requires that the receiver knows the exact phase of the transmitter at all times — whether a signal can be received or not. This will be done by using a stable crystal controlled oscillator (or possibly an atomic clock). Using such techniques, any limitations on timing are principally due to keeping track of the changing propagation delay due to day/night transition and of course changes in geographical position of the submarine. These delays are predictable from the navigation system of the submarine — or can be measured from the Sanguine transmissions, using very long integration times.

Thus by using these methods it will be possible to 'lock' the receiver in phase with the transmitted signal even though the signal is deeply burried in noise or not receivable at all. To decrease the risk of an enemy decoding the signals it is probably that the phase of the signal will be changed at predetermined times).

The transmitted 45 Hz carrier wave will be amplitude modulated, and at the receiving end, complex signal correlation techniques will be used to extract the signal from the accompanying noise. This recently developed coding/decoding technique enables the signal power needed to convey a message (with low probability of error) to be substantially reduced.

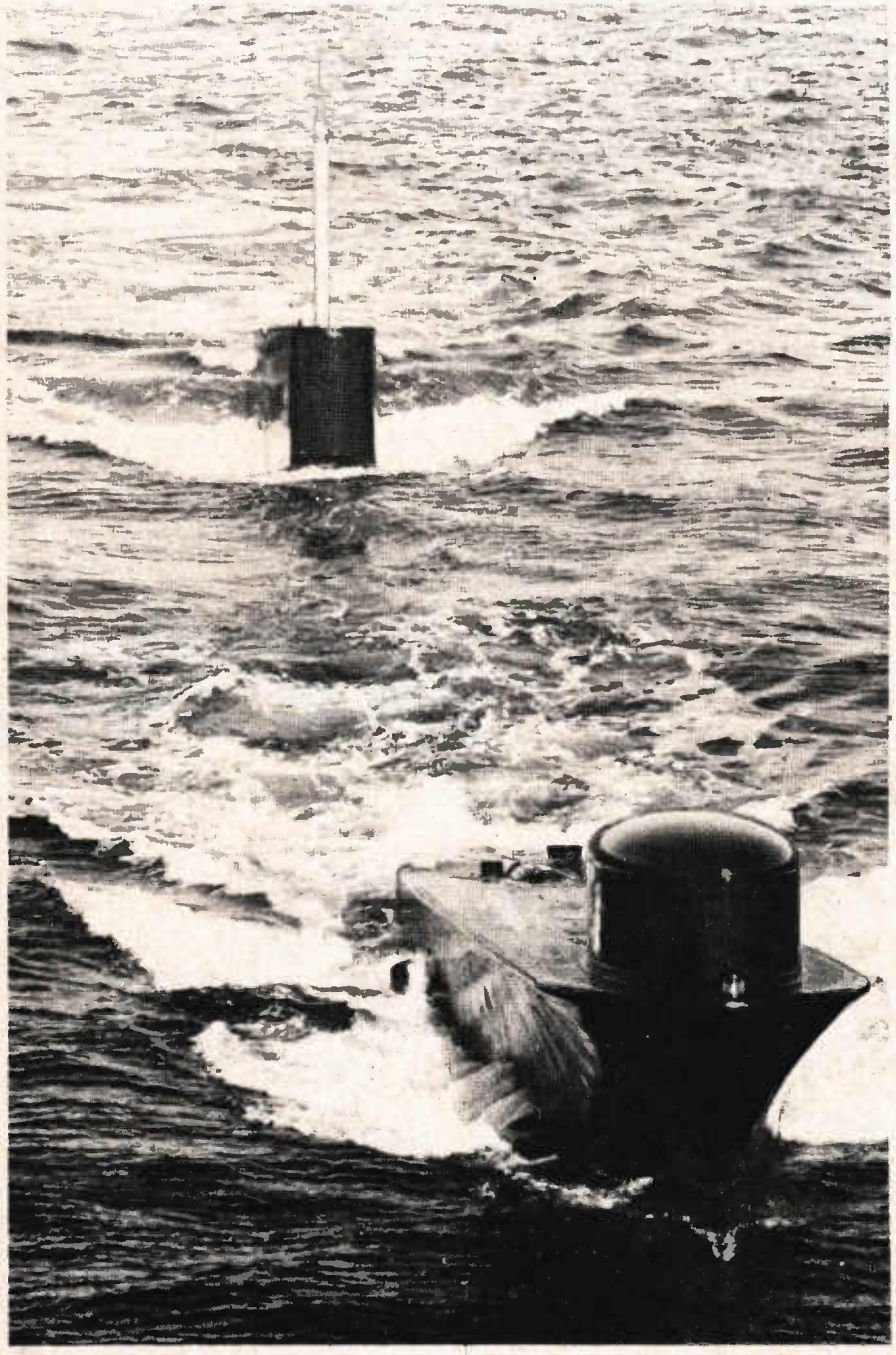
Data to be transmitted by Project Sanguine will be of a digital (binary) nature. The delivery times will be very long by normal communications standards due to the need for very long integration times per bit. In fact estimates of the time required to transmit one bit of information vary from one bit per second (Ad Hoc Panel on Sanguine — National Research Council 1972) to 1000 seconds per bit (McClintock et al, A Report on the Technical Feasibility of Project Sanguine).

Whilst these transmission times may seem very long it should be borne in mind that the messages will be in cipher form, hence complex messages can be sent using relatively few bits.

Like any other communications system, Project Sanguine is designed to operate in a specified maximum noise level and may fail if natural noise, or accidental or deliberate interference, raises the noise level substantially. Consequently, the Sanguine system can be overpowered by brute force noise, and the design of an effective communication system to resist enemy countermeasures will be aimed at forcing the interfering power to be widely dispersed. In this way only a very small fraction of the total interfering power can be effective in disturbing the communications system.

However the characteristics of the Sanguine system are such that for most forms of jamming to be effective, the radiated power of the jammer must be considerably more than ten times that of the radiated Sanguine signal in order to raise the effective noise level by a significant amount. Thus the effectiveness of the jamming transmitter depends largely on the resources devoted to it, and whilst practically any communications system can be jammed by a sufficiently determined enemy, the Project Sanguine system is not an easy mark.

One big question remains — and this is worrying quite a lot of Americans:— What are the ecological effects of dissipating such enormous quantities of electromagnetic energy into the earth? ●



electronics TODAY INTERNATIONAL
product test

APAN

THE Apan BRU 121 is the semi-automatic version of the basic Apan turntable. The manufacturers produce three models of this unit, a fully automatic unit, a semi-automatic unit and a manual unit. Their basic aim is to produce a belt drive turntable that will retail in Australia for less than $100 (less cartridge). To do this Apan have had to eliminate a number of refinements seen on more expensive units. No graduated tracking weight adjustment is provided, nor is there any anti-skating force adjustment or compensation. A fixed headshell is also used to accommodate the cartridge.

The external appearance is plain and uncluttered, with the main base finished in charcoal grey. A lever switch, with a very positive action, is located in the front left-hand corner. This switch, which is for 33-1/3 rpm or 45 rpm record speed selection, has a raised rectangular black surround. This matches the larger raised surround on the play reject lever which is at the right-hand end.

The tubular tone arm, tone arm pedestal and counterweight are all chrome plated. A 45 rpm disc adaptor is located on a pin mounted in the left-hand rear corner of the pressed steel base.

The turntable is a zinc-alloy diecasting with a polished outer rim, chamfered on the top edge and covered with a rubber mat approximately 2mm thick. The turntable and mat weigh 1.4 kilograms.

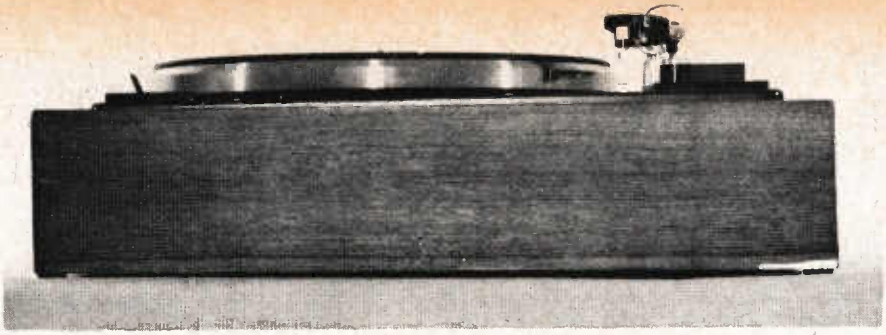
THE UNIT IN USE

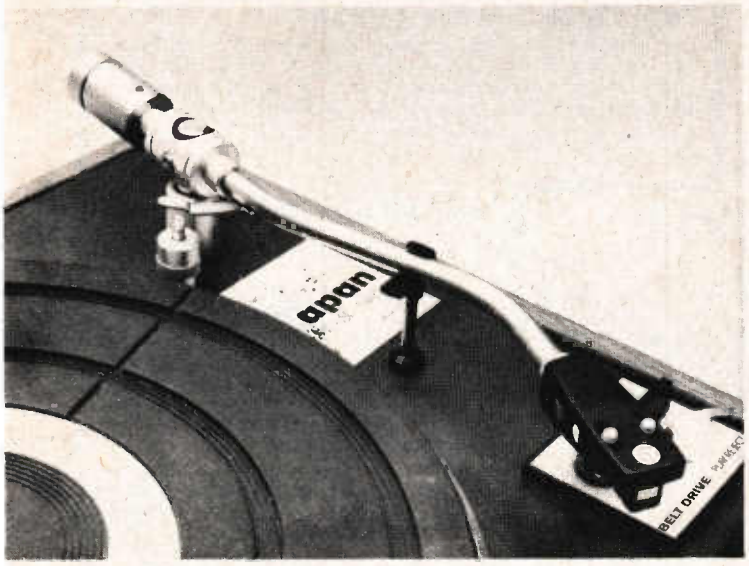
In operation, the unit is very simple and easy to use. To play a record only requires the following steps:—

1. Select record speed.
2. Place the record on the turntable and position the tone arm over the lead-in grooves on the record (this operation also starts the turntable).
3. Operate the start lever in the front right-hand corner of the player.

Once the start lever has been operated, the arm is automatically lowered onto the record. At the end of the record the arm is automatically lifted and returned to the rest, and the motor stopped.

Low priced Japanese turntable is simple yet functional.





MEASURED PERFORMANCE OF APAN TURNTABLE MODEL BRU 121 S/N 20515023

Hum & Rumble Equalised
(re 1kHz at 5cm/sec)
unweighted = 20dB
weighted = 45dBA
hum = 40dB

Wow and Flutter
0.25% rms

Speed Error
+0.7%

Transverse Friction
600mg.

Vertical Friction
5mg.

Recommended Selling Price
$100.00 approximately

TURNTABLE

The (unbranded) cartridge supplied with the turntable was of a moving magnet type fitted with a 0.6 mil diameter diamond stylus. The tracking weight as received was set at 5.4 grams.

Measurements conducted at both three grams and at the factory setting showed no significant change in performance either subjectively or by measurement. (The importers of the turntable recommend fitting a similar cartridge but with a spherical stylus).

The turntable is driven by a four pole synchronous motor via a neoprene belt. This belt exhibited some stretching and this was the primary cause of the rather high wow and flutter figures that we measured. A different composition belt with better internal damping characteristics would result in a significant improvement.

The automatic playing mechanism whilst very simple is more than adequate to perform the task required. It consists of a number of pressed metal components and a number of moulded plastic components, carefully designed to eliminate any metal to metal contact in the automatic control system.

Our initial measurements and subjective evaluation indicated that the cartridge produced noticable distortion around 10kHz. This was primarily a design feature of the cartridge and partly due to the conical stylus fitted. Some evidence of possible tone arm resonance was also apparent, with artificial emphasis of the bass response being exhibited on one or two records. Even though no anti-skating device is included, the transverse friction was very high (600 mg). Whilst this partly compensates for the lack of anti-skating it is not an entirely satisfactory substitute.

This distortion was very noticeable on the R.C.A. Victor Record titled Nilson Schmilsson, particularly the track "Jump into the Fire" which has some very low frequency drum work and some very high frequency symbol and lead guitar passages.

Despite some minor criticisms we liked the turntable, which whilst being simple is none the less very functional. It certainly is of sufficiently good quality to justify installing a magnetic cartridge in the $20 to $30 range ●

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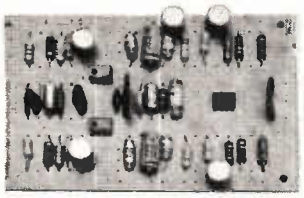
MUSICOLOUR COLOUR ORGAN (MK11) KIT

A pleasing colour-visual demonstration of sound for Discotheques, Parties, etc. Easily operated from any radio or stereo amplifier. The kit is supplied as described in Electronics Australia and will control 3KW of power. Instructions for assembly are supplied. Price without chassis **$38.00** Post 50c Price (with chassis) **$45.00.** Post $1.00.

"E.T." HIGH POWER STROBE

This project is a 'winner' at parties and theatrical productions and may be calibrated for checking speed of motors, etc. Light output is both high and intense, and, as an added attraction it will drive other slave units for even greater light output. The kit includes all parts, reflector and instructions. Price **$19.50.** Post 60c.

4 CHANNEL QUADRAPHONIC SYNTHESIZER KIT



Another 1st for PRE-PAK! This is your opportunity to build a high-quality, low-cost I.C. Synthesizer that uses active circuit elements and that, when used with a second stereo amplifier and speakers, will do an impressive job in converting 2 channels to 4. The Synthesizer also includes individual level controls and a set of phasing switches for the new channels so that the sound quality can be "tailored" to suit almost any listening environment and musical taste.

Specifications: Noise level — 92dB below 1V on any channel. Distortion — 0.05% or less at 1V rms output. Gain of +6dB on the two front channels, controllable from −7 to +6dB on the two new channels, and frequency response of +0.5dB from 20Hz to 20kHz at 1V RMS output. It may be connected to any 2 Stereo Amplifiers and may be fed from a Magnetic Cartridge or other similar source.

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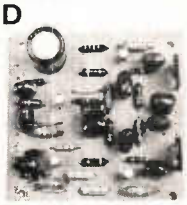

This simple Decoder Unit, which appeared in the November issue of "Electronics Australia", will allow you to go 4 Channel without going broke. Simply connect the input terminals to your present stereo amplifier speaker terminals and the output to a second stereo amplifier or tape recorder amplifier and the decoder will then synthesize rear channel signals either from existing records or the new quadraphonic pressings. A simple kit and very easy to assemble, it is complete with P.C. Board and all components. Requires 20V supply. Price **$5.90** post 30c.

P.C. BOARDS FOR "E.T." AND "E.A." PROJECTS

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ET003B Elec. Thief Trap	$1.40
71/C12 Mjsicolour 11	$2.25
71/SA4A Playmaster 132	$1.45
71 SA4B Playmaster 132	$1.45
71/SA4C Playmaster 132	$2.50
72/10 I.C. Probe	75c

All boards are supplied with component layout diagrams. Post 20c.

SCR DRILL SPEED CONTROL KIT

This project appeared in Electronics Australia in May '71 and has proved very reliable. It is suitable for household electric drills and small motors to 3 amp rating. The unit is housed in a sturdy plastic case and is fuse protected. Instruction diagrams are provided. Price **$9.50.** Post 40c.

7 TRANSISTOR RADIO KIT

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VICTORIAN AGENT: Geo Hawthorn Electronics, 966-968 High St., Armadale, Vic. 3143. Ph. 509-0374.

STH. AUST. AGENT: Revolver Electronics (mail order only) 20 Essex St, Goodwood S.A. 5034.

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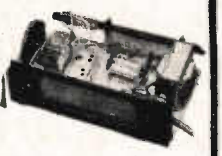
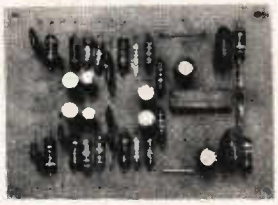


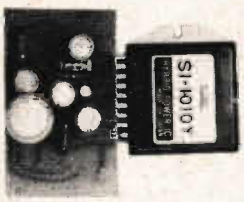
NEW! IMPROVED MODEL — Now with plug and sockets for changeover to standard ignition

PRE-PAK MOD '73 STEREO AMPLIFIER KIT.



STEREO PRE-AMPLIFIER — a superior low noise design featuring I.C. circuitry. Frequency Response 10Hz — 100kHZ. Total Harmonic Distortion — 0.1% at 1KHz. Channel Separation 60dB. Noise — less than 0.5uV total input noise. Operating voltage Range — 9 to 40 V.D.C. Supply Current — Approx. 10mA. Input Sensitivity — 3mV for 2V out. Input Impedance — 100K. Complete Pre-Amp Kit with conventional Round or Slider Controls (VOL, BASS, TREBLE, BALANCE). PRICE: KIT FORM — **$19.90.**, post 40c.

I.C. POWER AMPLIFIERS



SANKEN HYBRID MODEL S1-1010Y, 10W

SANKEN HYBRID IC. Power Amps, Type S1-1010Y, 10W R.M.S. output into 8 Ohms with 34V supply. Kit includes I.C., P.C. Board and all external components, (including output capacitors) (two required for stereo). PRICE' **$11.95.**, post 30c.

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BC107
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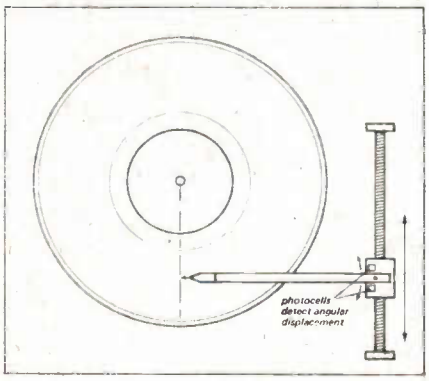
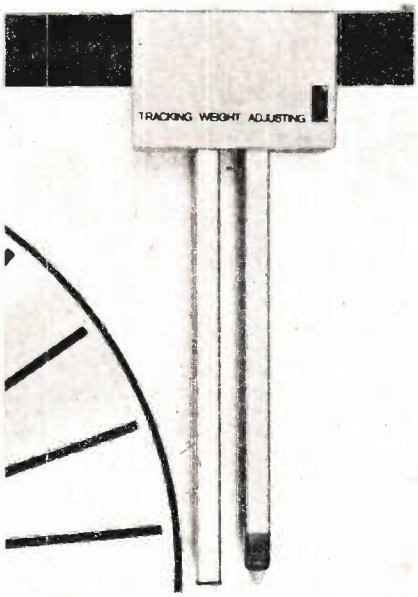
BEOGRAM 4000 TURNTABLE

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





Electronically controlled turntable from Bang and Olufsen combines ingenious engineering with elegant appearance.

DEVELOPMENT of most audio equipment is done on a 'vertical' basis — each step being predicated on the rightness or otherwise of what went before. This is a very common engineering approach and leads to competent if sometimes dull results.

It is rare for any organisation to take a 'horizontal' approach, starting as it were with a fresh sheet of paper and not too many preconceived ideas of how things should be.

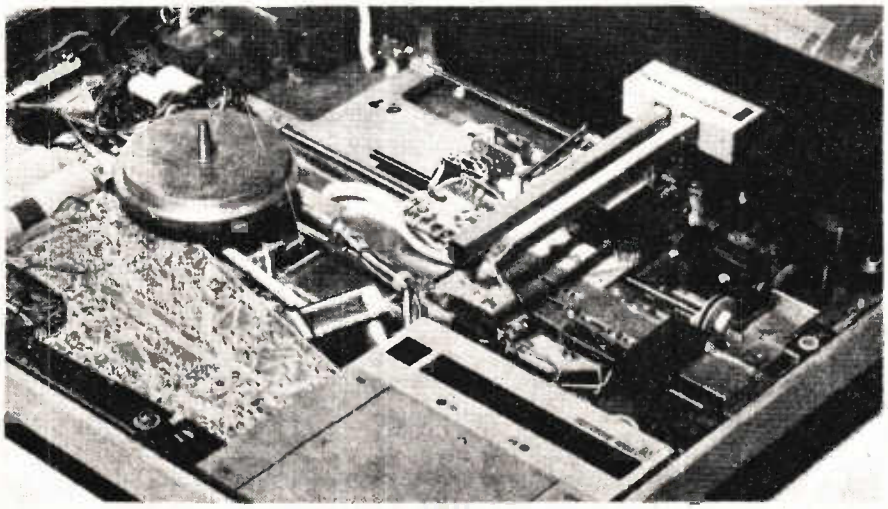
But this is what Danish hi-fi manufacturers Bang and Olufsen have done, and their new Beogram 4000 turntable is the result.

The unit virtually bristles with new solutions to old problems — from the use of a powered and tangentially moving arm — to an automatic system that senses record size and selects the correct playing speed.

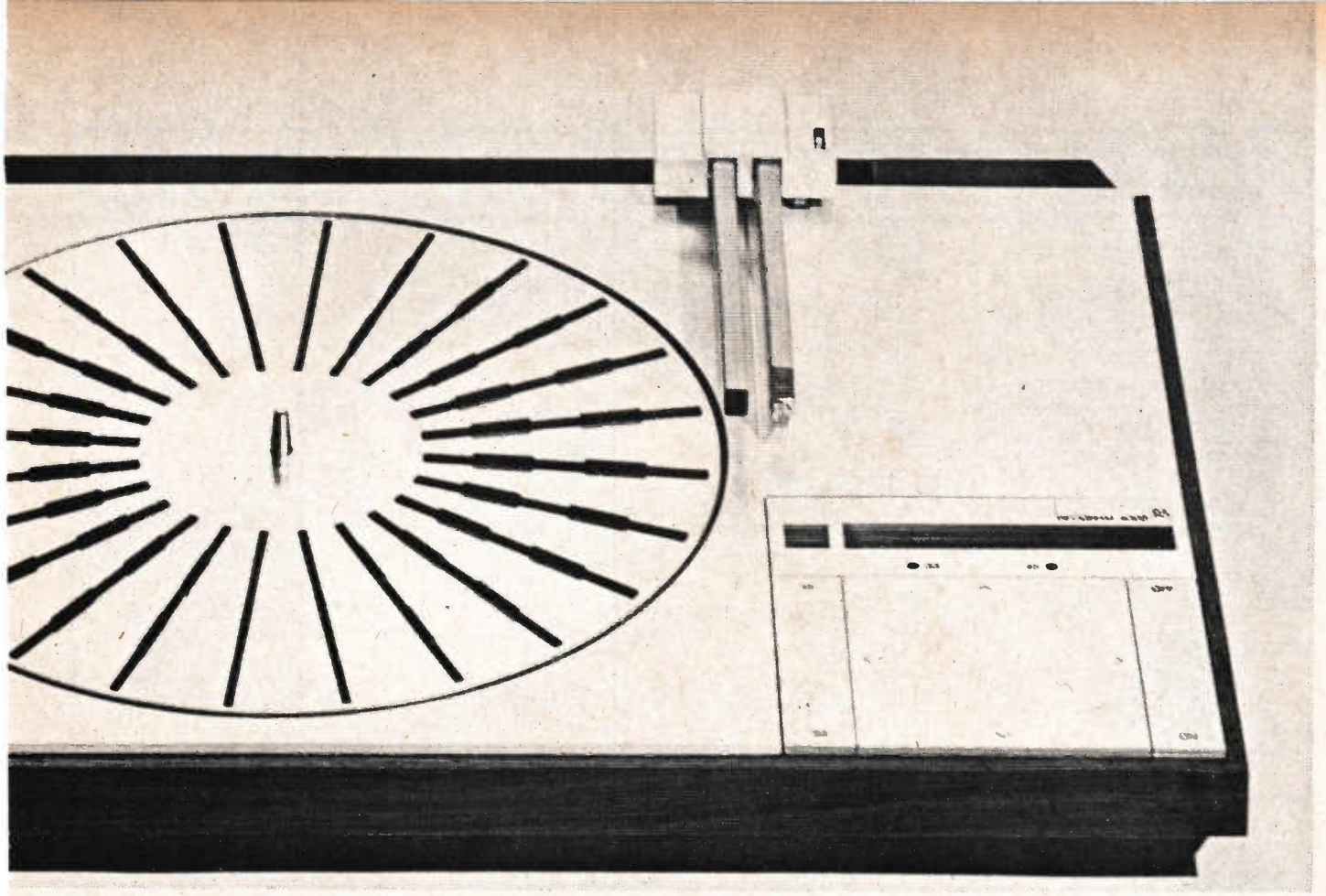
The most obvious difference between this and other turntables is the tangential arm which ensures that the pick-up cartridge moves in a straight line across the full playing width of the record. The purpose of this is to ensure that the cartridge tracks the record groove at the same angle as that of the original recording stylus.

This does not happen with conventional turntables — and in theory at least — distortion is introduced due to the stylus tracking the groove at a continually changing angle.

Manufacturers of conventional tone arms attempt to reduce this so-called tracking error by bending the arm at an angle. Although this reduces tracking errors, it does so at the



This interior shot of the Beogram 4000 turntable shows the two guide rails and drive shaft of the sliding arm assembly.



expense of introducing a force which causes the stylus to be pressed against the inner face of the record groove.

This force – commonly known as 'skating' is counteracted in good quality turntables by some form of mechanical or magnetic compensation, although in practice it is virtually impossible to provide precisely the right amount of 'anti-skating' bias across the full width of the record.

Bang and Olufsen's solution to the problem is ingenious and elegant. The tone arm, plus a second 'sensing' arm is cantilevered out from a rectangular slide which in turn is positively located – but free to move longitudinally – along a pair of 'rails'. The complete slide assembly is driven through worm gearing by a small servomotor.

Apart from the 'sensing arm' the function of which will be described later, the tone arm also carries a sensing system the purpose of which is to provide the servomotor with positional information.

The tone arm is pivoted in both vertical and horizontal planes, and the horizontal movement is monitored by a small lamp and shutter assembly in conjunction with a pair of photocells. These photocells sense any deviation of the arm away from a true tangential position, and by producing outputs proportional to the deviation, cause the servo motor driving the arm assembly to take up the 'correct' position. The system is remarkably sensitive – to the extent that tracking angle error is contained to within 0.04°.

The servo mechanism can cope with both eccentric and warped records. A very eccentric record may on occasion cause the servomotor to go into reverse – but the mechanism will ensure that tracking error is kept to a minimum. Warped records will simply cause the pick-up arm to rise and fall as with a conventional arm.

Figure 1 shows a simplified version of the system. A block schematic diagram of the servo-control system is shown in Fig. 2.

Circuitry associated with the servo mechanism is used to sense when the stylus reaches the 'run-out' grooves at the end of the record. Figure 3 shows how this part of the circuit operates. As the stylus approaches the last grooves of the record, a mechanical contact (SW) is closed by the moving slide. This contact connects the servomotor to the base-emitter circuit of transistor Q11. As soon as the stylus actually runs onto the run-out grooves, the increased lateral velocity the tone arm causes a sudden increase in voltage to the servomotor. This suddenly increased voltage is sensed and amplified by Q11 which in turn causes Q10 to conduct. Transistor Q10 switching to conduction causes Q9 to conduct – and point A (which was previously at +6V) falls to virtually zero potential. This latter action is used to operate the 'tone-arm raise' mechanism and subsequently, to initiate a fast return and and switch-off sequence.

A further logic system, operating via Q12, enables the user to override the automatic mechanism.

The purpose of the main sensing arm briefly described at the beginning of this article, is to detect the presence or absence of a record on the turntable platter, and then to ensure that the stylus is lowered onto the edge of the record – no matter what size record is used. It also automatically switches the main drive from 33-1/3 rpm to 45 rpm whenever a seven inch record is sensed.

As with practically every part of this turntable, the mechanism and circuitry used for the sensing functions are ingenious in the extreme.

The turntable platter has a reflective metal surface onto which are mounted a number of radial black plastic 'spokes'.

A small lamp and photocell housed in the tip of the sensing arm detect the

DICK SMITH'S ELECTRONIC CENTRE

PLESSEY 3 & 3 AMPLIFIER KIT

Thoroughly recommended, this high quality stereo amplifier utilises the well known Plessey SL.403D IC's. It is supplied complete in an attractive display pack and includes all components other than the power transformer. The instructions supplied are very explicit, in fact, a person who can solder but has had no previous electronic experience could easily build this amp. Our staff member, Ian Smith (age 16) built his in less than two hours. The complete unit is now operating in our Sound Room for all to see and listen to.
Also included are full details of a suitable speaker enclosure, a silk screened board, and all controls. The cost of the separate parts are a lot more than the total kit price —
Plessey AT 102 amp $27.50 $1.00 p&p
Transformer to suit $6.66 .75 p&p.
BSR fully automatic
G11-105 Turntable (ceramic cartridge) $29.64 $1.50 p&p.

TANGENT KITSETS

2 Transistor Radio kit. A most popular kit at a most reasonable price — requires no aerial, complete with "easy to build" instructions — all you require is a soldering iron. Ours took only 30 mins to build. Pre-wound aerial coil and crystal earpiece supplied or can be used with any small amplifier (such as below) to operate a speaker — $5.70 plus battery 53c.

AMPLIFIER KIT

A 4.5 watt RMS (6 watts peak) amplifier, features excellent fidelity and extremely low distortion (less than .5% at 1 watt), easy to build. Supplied complete with comprehensive instructions. Suggested uses are—
(1) Stereo amp
(2) Baby alarm
(3) Amp for 2 tran. radio
(4) Intercom
(5) Thing-a-me-bob.
Requires approx. 12 to 18 volts DC.
AMP KIT — $8.70 incl. P.&P.
Fully built & tested: $9.50.

Power supply for above — pre-built, will operate two of above amplifiers or useful for many other things, 240v to 13.8 volt D.C. at 1 amp — $9.00
CALL IN AND SEE THESE UNITS OPERATING.

CIRCUIT BOARDS — pre-tinned

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

71/ C12	Musicolor Mark 2	3.00
72/ SA1	Economical Amplifier	3.00
72/ R2	Crystal Locked Receiver	1.60
72/ P3	Microphone Pre-Amp	.90
72/ T3	EA130 Tuneable I.F.	3.20
72/ PS6	Reg. power supply	.98
72/ C2	Sync. & pattern gen.	4.75
72/ A6	P.A. Amp	1.50
72/ MX6	P.A. Amp	2.70
72/ P2	Mic. preamp.	1.60
72/ C8	6 Metre Converter	1.30
72/ G7	Guitar Amp.	1.50
72/ SA9	Amplifier	1.50
72/ S10	Scaler	1.60
72/ 10	IC Probe	.95
72/ S11	4 Channel Converter	1.50
72/ SA10	Playmaster 136	1.90
ET025	Super Stereo	1.90
ET026	Tape Slide Sync.	1.50
ET029	Tuner	1.45
	IC Power Supply	2.50
ET033	Int. audio system	2.60
ET034	Int. audio system	2.60
ET111	Power Supply	1.50
ET1413	100W AMP	2.20

LIGHT EMITTING DIODE

Miniature M50 Red — the same price as miniature filiament bulbs — at this price wire them into logic circuits as status indicators, build low cost counters or use them as panel lights.

—75c each or 10 for $6.50

SUPER KITS

Dick Smith "Super Kits" are very special as they have been selected by him for "V.I.P." treatment. At least one of each kit has been built by Dick Smith or his staff and is on display at the electronics centre. Other features are:
1. Expensive pre-tinned "silver" boards.
2. Full copies of constructional articles included.
3. Any changes in circuits, addendums etc are included — saves checking following issues.
4. Most kits contain "extras" at no cost. These extras have been added where Dick Smith thinks they may be more reliable or where he feels the constructor may have difficulty in purchasing them.

REMEMBER if Dick Smith can build it — anyone can! ! !

MUSICOLOUR MK II (E.A. DEC. '71). Build this exciting colour organ unit. It may be driven from any low level output from your amplifier or radio unit and will operate up to 1000 watts per channel. Complete kit including full instructions and heavy duty (10amp) triacs $49.50 P&P $1.00.

CDI KIT (E.A. AUG. '70)
Want to improve the performance of your car? Then make up this well proven capacitor discharge ignition unit. Supplied complete with instructions. Extra at no cost: Pre-wound secondary coil and special silicon grease $21.00 P&P $1.00

100 Watt AMP (E.T. DEC. '72)
The complete kit to build this enormously powerful quality amp. Extras include deluxe pre-tinned circuit board, silicon grease, a can of heat absorbing spray paint and full construction details. New Low price $65.00 p&p $1.00.

SEPARATE PARTS FOR ABOVE KIT:
Metalwork including pre-drilled heat sinks $14.50 P&P 50c
PF 3577 transformer $10.60 P&P $1.50
ET.1413 circuit board $2.20

STEREO 24 ADAPTOR (E.A. Nov. '72)
We have recently built this inexpensive unit and find it quite amazing (call in and have a listen if you can). Complete kit including special board and instructions $5.75 P&P 50c.

PLAYMASTER 136 AMP (E.A. DEC '72)
Good value for money with special transistor offer from Fairchild. Complete kit (less "special offer" transistors) including attractive front panel, pre-tinned boards and silicon grease for transistor mounting. 26 watts RMS Output $55.60 P&P $1.00
Metalwork only $8.00 P&P 50c
Panel only $2.50
Board 72/ SA10 $1.90
BC108B 55c
BC109C 55c
Call in and see these completed "Super kits" and always remember if Dick Smith can build it — ANYONE CAN! !

SOLAR CELL KIT

From International Rectifier
We have sold a huge quantity of this popular kit — our second shipment is arriving from the U.S.A. this month. Seven cells are supplied, valued at over $24.00. Supplied complete with instruction book.
Yes! these cells actually generate power from the sun.

$10.35
P & P 30c

SOLDERING SPECIAL

Multicore "Savbit" solder
This solder contains five separate cores of flux as well as a small percentage of copper to help prevent tip erosion.
16 gauge 60 40 $2.65 per lb P & P 30c.
5 YARD "Experimenters Coil" 60c
DESOLDERING BRAID
Five foot length of flux impregnated braid in container. $1.35.

MOLEX I.C. SOCKET PINS

With these you can build economical I.C. sockets (approx 1/3 price) by simply cutting off the number of connections required (i.e. two strips of seven for 14 pin socket) and soldering on to P.C. Board.
50 Pins $1.00

TANTALUM CAPACITORS

Special
Extremely small and reliable units from Plessey — use them in place of Electrolytics — ideal for all low voltage transistor circuits.

Value		Voltage
4.7 uf	at	35
22 uf	at	16
33 uf	at	10
47 uf	at	6.3

10 for $2.50 P & P 30c
Values may be mixed

RESISTOR SPECIAL

Top quality, thermally stable Philips resistors 1/4 and 1/2 watt. All values, 1 ohm to 4.7 meg ohm
All 4c each
Special servicemans pack — full assortment of values — over 150 resistors (1/2 watt) $4.30

SPECIALS
Build yourself a motor speed controller for bench drills, electric motors etc, full 750 watt rating.

KIT D.S.E. 1 includes 10 amp S.C.R., Pot, Diodes and simple circuit $5.75.

KIT DSE-12 includes above and hardware (metal box, power connectors etc) to make complete drill speed controller $9.75 (P&P 30c)

GO SOLID STATE

VHF POWER TRANSISTORS 30 watts at 12.6 volts — FANTASTIC OFFER TO AMATEURS — $9.85.
These transistors manufactured by "Solid State Scientific" are exactly as currently being used by Australia's largest VHF mobile radio manufacturers. They are virtually indestructible (they withstand severe V.S.W.R.) and are guaranteed to give in excess of 30 watts at 144 mcs on 12.6 volts (more at 13.8 volts!) Supplied complete with data sheet, test, circuit and layout diagram.

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

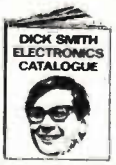
TYPE 2N 5591-$9.85 plus 50c p&p.

DRIVER TRANSISTORS AVAILABLE.
Complete with data sheet and suggested circuit and layout diagram.
2N 5590 (15 watts) $7.75
2N 5589 (7 watts) $6.50 p&p 50c
The complete set of three transistors are available as a special package offer for $22.50 plus p&p 50c.
Data sheets available separately 10c plus 20c p&p.

AUDIO SPECIALS

B.A.S.F. TAPE—SPECIAL PURCHASE
We have recently made a bulk purchase of B.A.S.F. "LH" tape and can offer this at amazingly low prices.
7" x 1800' L.H. $6.90 or 10 for $6.50
7" x 2400' L.H. $8.74 or 10 for $8.24
P & P 50c per tape or $1.00 per order
C60 L.H. Cassette $1.80 or 10 for $16.00
C90 L.H. Cassette $2.55 or 10 for $23.00
C120 L.H. Cassette $3.50 or 10 for $31.00
P & P 30c per order
C60 Chromium Dioxide $2.95
C90 Chromium Dioxide $3.60
P & P 30c per order

INCREDIBLE NEW CATALOGUE — 1973 EDITION



We have sold over 3,000 copies of our new 1973 catalogues. This greatly improved larger 2nd edition is fast becoming the hobbyist's reference book because of its pages of information, prices, formulae etc. We now include parameters on every transistor we sell, thus making the job of finding equivalents much easier. Our instrument section is greatly enlarged and the catalogue also features a new section on high quality McMurdo and Utilux connectors. Yes — we still include our popular 50c vouchers

Dick Smith Electronics Pty Ltd., 162 Pacific Highway, Gore Hill, 2065 (near Channel 2) 439-5311 (5 lines)

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Please send me your catalogue. I enclose 50c towards the cost plus 25c to cover p&p knowing that it contains special 50c discount vouchers.

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BEOGRAM 4000 TURNTABLE

presence or otherwise of a record on the revolving platter.

If a record is on the platter the light reflected back to the photocell from the lamp will be fairly steady – hence a constant dc level indicates the presence of a record. But if the matter is uncovered, the reflected light from the polished metal turntable will be regularly interrupted by the radial black strips, and a chopped dc voltage will be produced by the photocell.

When the turntable is switched on and the record playing sequence initiated, the sensing arm and the tone arm move steadily along their track until the sensing arm detects the edge of a record. At this point the tracking servomotor is de-energized and the tone arm automatically lowered.

The sensing arm's photocell is sensitive to the strobe effect when the turntable is in motion. Hence if the sensing arm reaches the point where the edge of a 12" record should be, and still detects the signal from the moving ribs, it deduces that there is no 12" record on the platter. Similarly if it passes the 10" point and still detects rib movement it knows that there is no 10" record there either. It then continues inward seeking the possible presence of a 7" record. If it finds one, the turntable speed, which always starts off at 33-1/3 rpm, is automatically switched to 45 rpm. The pick-up is then lowered and the record played in the normal way.

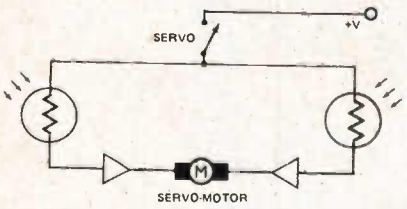


Fig. 2. Block schematic drawing of servo system used to sense angular errors in tone arm.

Fig. 3. This logic circuit detects the voltage increase as the tone arm drive motor compensates for the increased lateral velocity of the stylus running onto the run-out grooves at the end of a record. This sudden increase in voltage is used to actuate the arm return and 'switch off' mechanism.

If there is no record on the platter at all, then the sensor detects the moving ribs until the centre of the record is reached. At that point the arm is returned automatically to the rest position.

Although manual overrriding controls are provided to enable the user to lower the tone arm onto any required part of a record, these manual controls are interlocked with the rib sensing circuitry – thus ensuring that the arm can only be lowered if a disc is on the turntable platter.

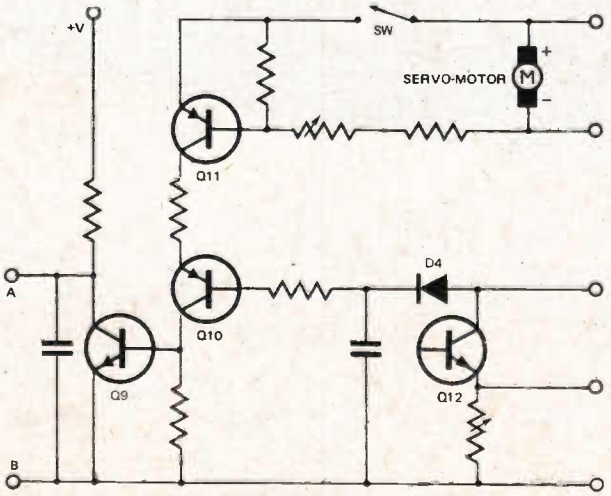
Additional logic circuitry is used to monitor continuity of the lamp filament in the sensing system. If this lamp becomes open circuit, the control logic prevents the arm being lowered.

In common with an increasing number of high performance turntables, the main drive motor is powered by a stabilised oscillator and power amplifier. Thus turntable speed is virtually independent of mains supply voltage and frequency. Fine speed adjustment is provided – independently for both 33-1/3 rpm and 45 rpm – by varying oscillator frequency. No provision has been made for operation at 78 rpm.

A totally new cartridge has been developed by Bang and Olufsen for the Beogram 4000 unit. Although basically conventional in design, the stylus fitted to the new SP 15 cartridge is an integral part of the unit. The whole cartridge is manufactured as a sealed unit and is not repairable. In the event of damage Bang and Olufsen supply a new replacement cartridge for half the cost of the original. Recommended tracking weight is a mere 0.8 gram.

Just how successful the unit will be commercially is difficult to tell. The Bang and Olufsen organisation seem reluctant to release any of these units to the technical press for critical evaluation – although they have been demonstrated to a number of groups.

Electronics Today International is currently trying to obtain a review unit and if successful we will be running a full review shortly. ●



THE JAM SESSION IS DEAD.

The compact tape cassette has always had its obvious advantages.

Unfortunately, it's always had one not-so-very-obvious disadvantage.

Jamming.

After all, what good is a super sensitive tape, and super faithful reproduction, if it's going to get stuck on you when you need it most!

We introduce the BASF jam proof cassette.

The first cassette actually guaranteed against jamming or we'll replace it at any time, free of charge.

Every BASF Cassette is fitted with a special kind of tape transport system that guides the tape through the cassette without it ever snagging or sticking. It's called "Special Mechanics" and only BASF Cassettes have it.

Variable tension is practically non-existent—which means you can also forget about things like wow and flutter.

Special Mechanics tape transport makes the super sensitivity and super faithful reproduction of our tapes all worthwhile. Choose BASF LH (Low Noise, High Output)—the finest ferric oxide cassette tape on the market. Or pay a little more for the ultimate—BASF Chromium Dioxide—its extended dynamic range, highest output and lowest noise level, plus the additional reward of minimal headware are the qualities you'll appreciate.

Hearing is believing!

Buy BASF jam proof cassettes. And record a jam session without missing a single mind blowing never-to-be-repeated improvisation.

Distributors: Sydney (Head Office): Maurice Chapman & Co. Pty. Ltd., 276 Castlereagh St., 2000. **Newcastle:** W. L. Redman Agencies, 11 Hall St., N.S.W., 2300. **Canberra:** Sonny Cohen & Sons, 20 Isa St., A.C.T., 2600. **Melbourne:** Maurice Chapman & Co. Pty. Ltd., 146-150 Burwood Rd., Hawthorn, Vic., 3122. **Brisbane:** Chandlers Pty. Ltd., 399 Montague Rd., West End, Qld., 4101. **Adelaide:** Neil Muller Pty. Ltd., 8 Arthur St., Unley, S.A., 5061. **Perth:** Anderson-Tedco, 11-13B Belmont Ave., Belmont, W.A., 6104. **Launceston:** P. & M. Distributors, 87A Brisbane St., Tas., 7250. **Darwin:** Plitzners Music House, 2 Darwin Arcade, Smith St., N.T., 5790.

BA2279

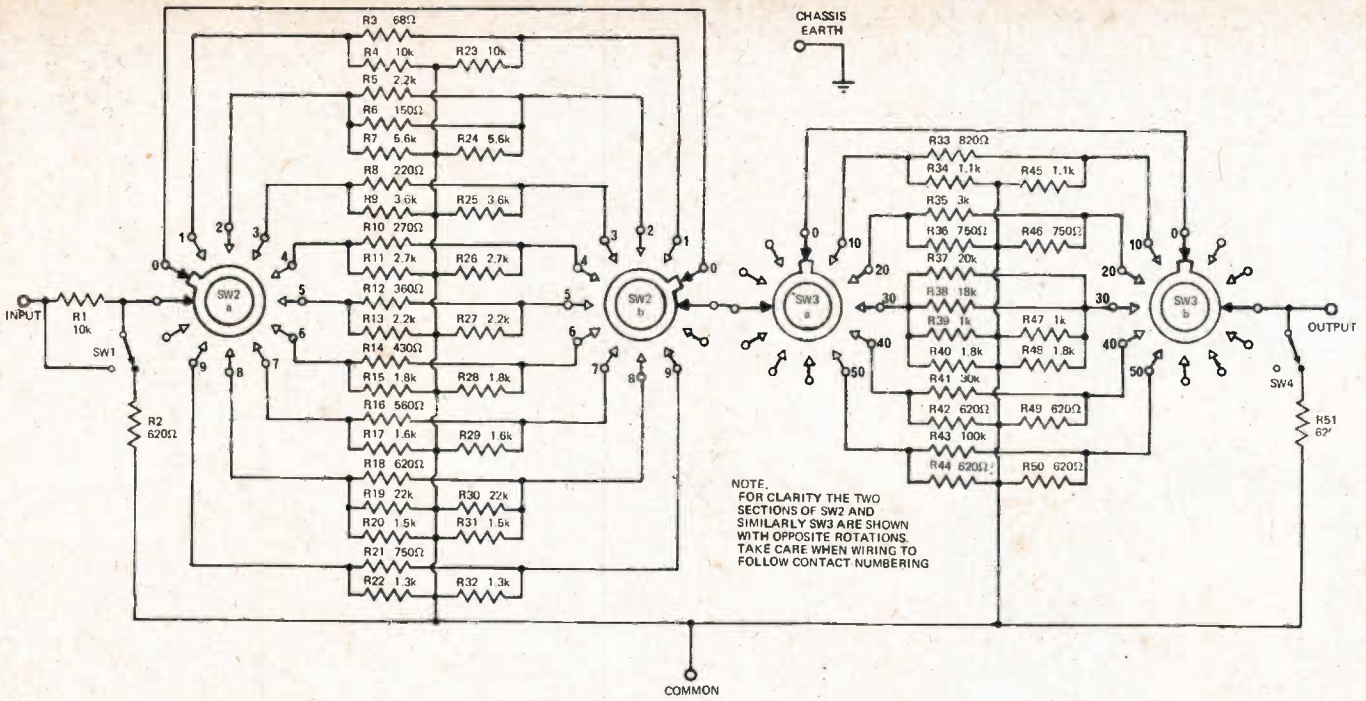
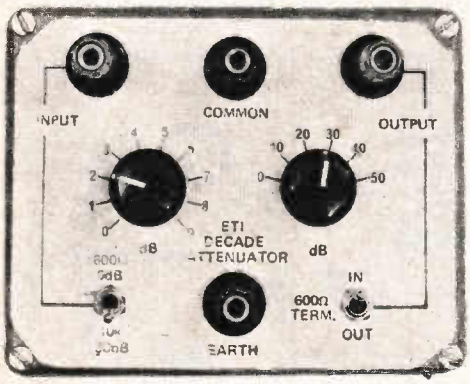


Fig. 1. Circuit diagram of the attenuator.

This useful audio attenuator project for the experimenter provides 0-59dB attenuation in one dB steps.

AUDIO ATTENUATOR



ACCURATE attenuators are required in a multitude of design, service, testing and measuring situations. These units are designed with varying degrees of accuracy and as many steps of attenuation as the designer feels necessary. They may be balanced or unbalanced and have whatever input and output or impedances the designer requires.

There are three common types of attenuator configuration, Pi, T or L. The latter is mainly employed where the output impedance is not required to be constant.

ETI PROJECT 112

We have chosen Pi type sections for our unit. We could have connected the various sections in tandem to form a ladder attenuator, but this would have made more complex rotary switches necessary. Instead, we chose to employ a separate section for each step of attenuation, making only simple rotary switches necessary.

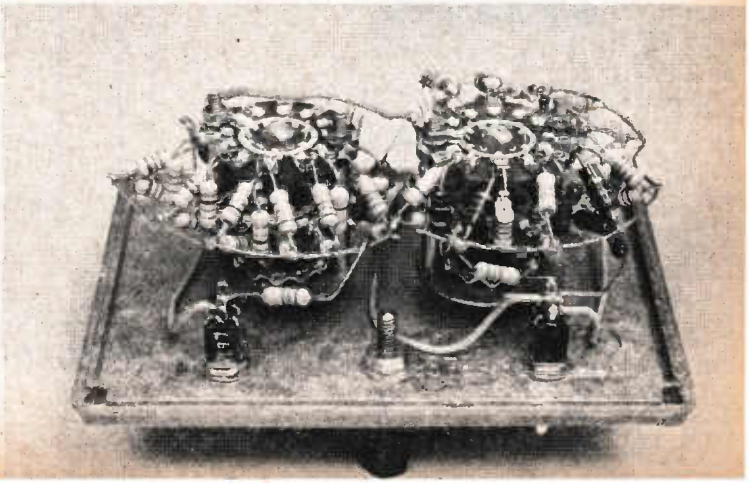
The input and output resistances of the unit remain relatively constant at 600 ohms over the full attenuation range. The input impedance can be changed to 10k by SW1 but an additional 30dB of attenuation is added. The output can also be terminated internally by SW4 when using a high impedance load such as a meter.

The maximum attenuation when the input and output resistances are set at 600 ohms is 59dB. There are ten 1dB steps from 0dB to 9dB, via a 10 position rotary switch, and a further six 10dB steps from 0dB to 50dB via a six position rotary switch, giving a

SPECIFICATION

Max attenuation	59dB
Resolution	1dB
Accuracy	±0.3dB
Frequency range	dc to 100kHz
Input impedance	600 Ω nominal
	10k switched (+30dB attenuation)
Output impedance	600 Ω nominal
Max input voltage	15 volt

Internal switched termination resistor for use with high impedance loads.



PARTS LIST ETI 112

R1	Resistor	10k	2% ½W
R2	"	620Ω	" "
R3	"	68Ω	" "
R4	"	10k	" "
R5	"	2.2k	" "
R6	"	150Ω	" "
R7	"	5.6k	" "
R8	"	220Ω	" "
R9	"	3.6k	" "
R10	"	270Ω	" "
R11	"	2.7k	" "
R12	"	360Ω	" "
R13	"	2.2k	" "
R14	"	430Ω	" "
R15	"	1.8k	" "
R16	"	560Ω	" "
R17	"	1.6k	" "
R18	"	620Ω	" "
R19	"	22k	" "
R20	"	1.5k	" "
R21	"	750Ω	" "
R22	"	1.3k	" "
R23	"	10k	" "
R24	"	5.6k	" "
R25	"	3.6k	" "
R26	"	2.7k	" "
R27	"	2.2k	" "
R28	"	1.8k	" "
R29	"	1.6k	" "
R30	"	22k	" "
R31	"	1.5k	" "
R32	"	1.3k	" "
R33	"	820Ω	" "
R34	"	1.1k	" "
R35	"	3k	" "
R36	"	750Ω	" "
R37	"	20k	" "
R38	"	18k	" "
R39	"	1k	" "
R40	"	1.8k	" "
R41	"	30k	" "
R42	"	620Ω	" "
R43	"	100k	" "
R44	"	620Ω	" "
R45	"	1.1k	" "
R46	"	750Ω	" "
R47	"	1k	" "
R48	"	1.8k	" "
R49	"	620Ω	" "
R50	"	620Ω	" "
R51	"	620Ω	" "

SW1	Single pole change over minature toggle switch
SW2	2 pole 11 position rotary switch
SW3	2 pole 11 position rotary switch
SW4	Single pole change over minature toggle switch
Diecast box 4¾ x 3¾ x 2	
4	Terminals type L1568/1S or similar
2	Knobs

total of 60 steps from 0dB to 59dB. This range of attenuation is adequate for most purposes. Although further sections could be added, noise becomes a limiting factor in a simple attenuator such as this.

CONSTRUCTION

It is advisable to employ separate wafers for each switch pole. If the type of switch that has two poles on one wafer is employed, there may be problems at the high frequency end due to stray capacitance. This would be evident as spikes on the leading edges of high frequency square waves.

The common rail for each switch is a length of 18 gauge tinned copper wire formed into a ring to allow termination of the shunt resistors (R4, R23, R7 and so on). The series resistors are connected directly between the relevant switch contacts. Layout of the unit may be seen by the accompanying photographs. ●

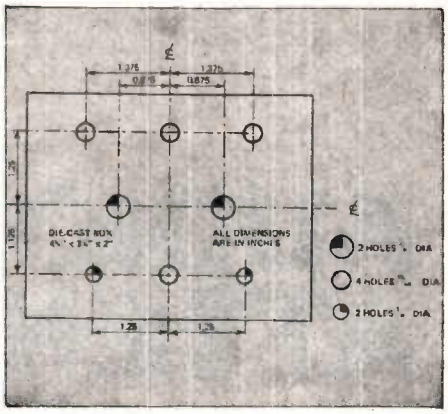


Fig. 2. Drilling details for the die cast box.

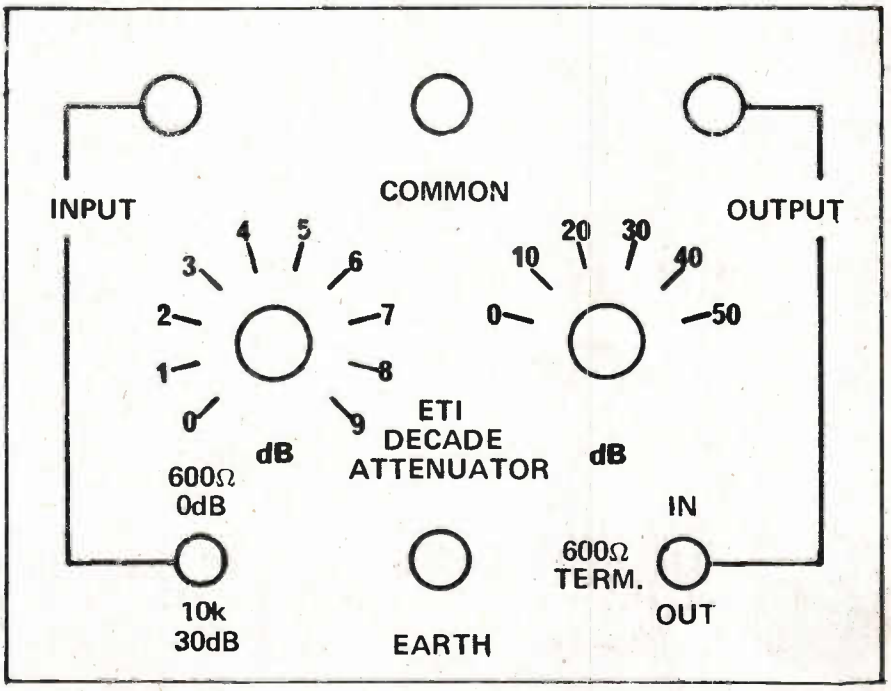
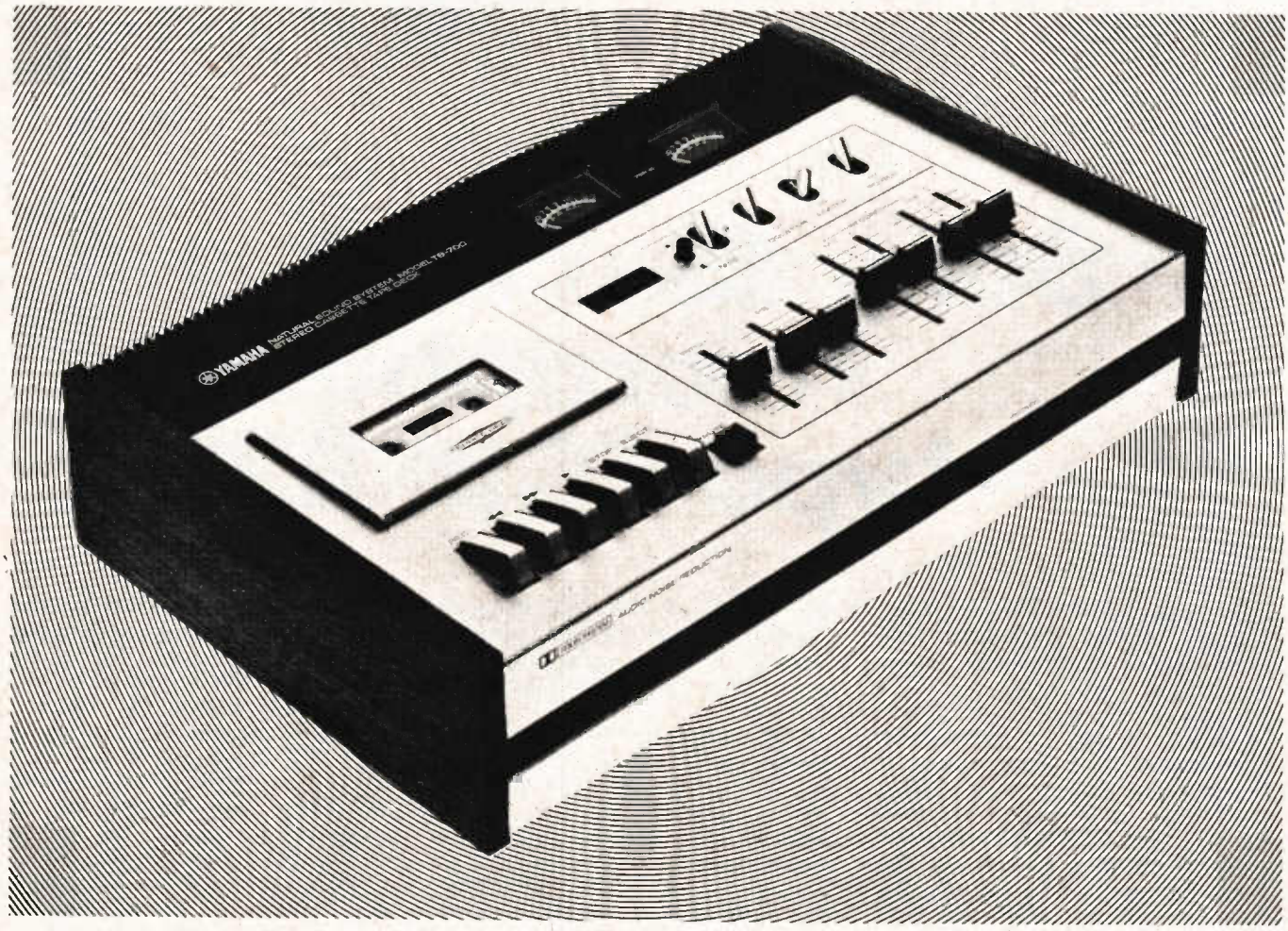


Fig. 3. Lettering and front panel artwork — full size.

Yamaha Natural Sound the music of the *Maestro* not the *Mechanic*



Yamaha Dolby System TB 700

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

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

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

Specifications:

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

SUGGESTED RETAIL PRICE — $299.00.

ET 73/4

To Rose Music Pty. Ltd.,
17-33 Market Street,
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(TICK APPROPRIATE SQUARE)

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

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Sony Electret microphone -type ECM 22P

FOR many, EXPO '70 in Japan, provided the first demonstration of Sony Electret Microphones. These were used extensively for the functions in the main arena, and in particular, as pick up microphones mounted directly on to the horns of the brass instruments in the orchestra.

Australian entertainers — John Hawker, Athol Guy and Don Burrows were particularly impressed with the clarity and reproduction and following their return from EXPO '70 they arranged to purchase some of these microphones for their own use. Now three years later, a large proportion of Australian entertainers are using Sony Electret microphones. In addition, it is interesting to note that top U.K. pop group Manfred Mann, who toured Australia in 1972 used the Sony Electret microphones exclusively — both for vocals and for pick-up microphones on the guitars and drums.

This new generation of microphones makes use of the 'electret' principle. While the electret principle is not new, it is only in recent years that it has become sufficiently developed to become a commercial proposition.

Electret microphones are a development of capacitor microphones. Capacitor microphones use the sound vibrations to move a thin metallic diaphragm which forms one plate of a parallel plate capacitor. The other plate is fixed to the body of the microphone. This capacitance is inversely related to the distance between the plates so, as the plates move closer together, the capacitance increases.

There are two ways commonly used to convert this change in capacitance into an electrical signal. The first uses the microphone as the tuning capacitor in an oscillator circuit. The second method uses a constant charge placed upon the capacitor (microphone). The voltage across a capacitor is inversely proportional to capacitance and therefore proportional to the displacement of the diaphragm. This is the system used in most precision microphones.

With this latter technique, a difficulty arises in providing the charge upon the microphone. This is usually achieved by a very stable dc power supply, delivering about 200 volts, connected to the microphone elements through a very high value resistor (200 megohms or greater).

The electret concept is to place a permanent charge on a dielectric material and this has an equivalent effect to a voltage of between 50 and 200 volts on the plates of a normal capacitor. Using this technique, the electronic circuitry associated with the microphone is vastly simplified.

The method that Sony used to form electrets is to place a piece of plastic, which has been coated with a metal film between the plates of a capacitor. The capacitor is charged up to a high voltage, and the plastic film is then heated and allowed to cool. This causes the plastic to retain a permanent polarisation — except for the effects of leakage from one face to the other. With modern electret technology this leakage can be controlled to give a half life of between 100 years and 1000 years.

With normal capacitor microphones the stiffness of the diaphragm is controlled by an air cushion between the diaphragm and the back plate. This controls the many modes which would otherwise be set up in the diaphragm thus degrading the smooth performance for which a capacitor microphone is renowned. The spacing between the diaphragm and the back plate together with the geometry of the back plate is critical and expensive to achieve. Sony abandoned this technique and used a radical but ingenious departure in design. The back plate in their electret microphone is roughened aluminium, the plastic film is then stretched over this, giving random contact between the film and the high points of the aluminium backing plate. This provides the same effect as the air space in the conventional microphone, and is not only simple to make but provides maximum capacitance (because of the lowest possible spacing between the

Lightweight microphone has excellent frequency response.

MEASURED PERFORMANCE OF SONY ELECTRET MICROPHONE TYPE ECM22P

Frequency Response	
Music Mode	50Hz to 20kHz ±5dB
Voice Mode (filter)	6dB/Octave Corner Point 200Hz.
Sensitivity	−54.6dB re 1V/Pascal into 600 Ω LOAD
Output Impedance	250 Ω or 600 Ω balanced
Front to Back Ratio at 1kHz	28dB.

metal film on the diaphragm and the backing plate). The only trade-off is in the maximum sound level which the microphone can handle. This is typically 10 dB lower than a comparable conventional capacitor microphone.

The electronics associated with the microphone are contained in a single integrated circuit. The circuit is basically an impedance convertor transforming the very high output impedance of the microphone capsule down to a more useful impedance for driving the matching transformer. The sensitivity of the Sony ECM 22P microphone is comparable with most dynamic microphones, allowing interchangability.

The microphone tested was supplied in an attractive and compact black plastic case. Supplied with the microphone and fitted into compartments in the case, was a 20ft. long microphone cable with Cannon connector, a wind-screen, a microphone holder, a stand adapter and an instruction manual. In addition, a plastic cover incorporating silica gel crystals was provided to cover the microphone when not in use (to minimize the retention of moisture).

In appearance the microphone is very

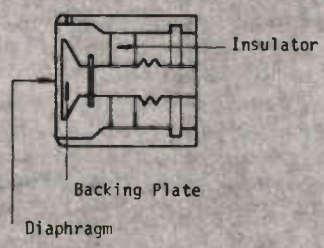


Fig. 1. Construction of typical conventional capacitor microphone.

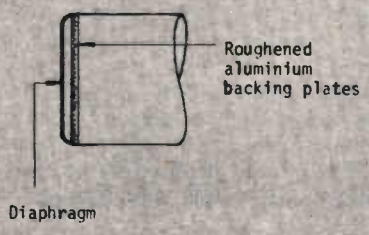


Fig. 2. Construction of Sony electret microphone.

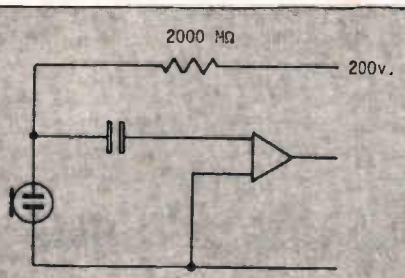


Fig. 3. Schematic of constant charge type capacitor microphone amplifier.

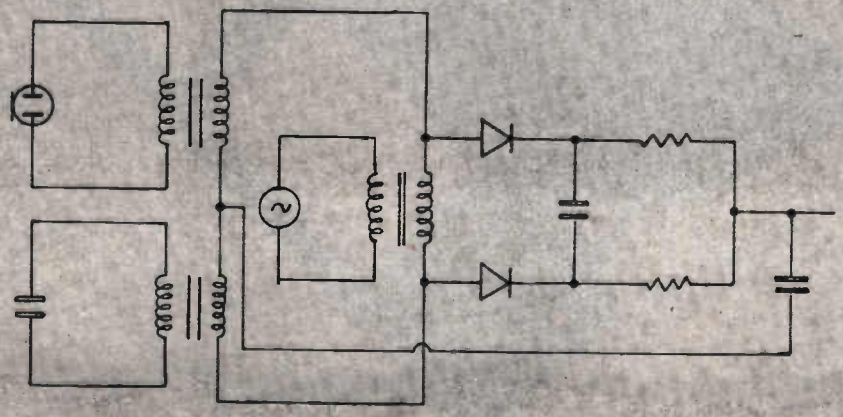


Fig. 4. Schematic of FM type capacitor microphone amplifier

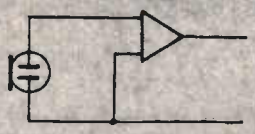
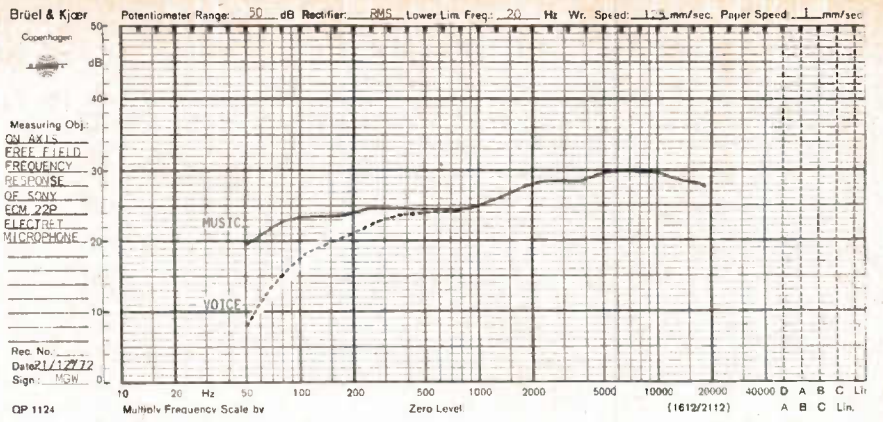


Fig. 5. Schematic of electret microphone amplifier

Sony Electret microphone -type ECM 22P



plain. It is basically a straight tube with the top 1½" perforated to accommodate the capsule.

The unit unscrews at the centre to allow battery replacement and selection of output impedance. Above the central joint is a switch which provides response shaping, in addition to turning the microphone off when not in use.

The microphone cable supplied provides a balanced line to ground and extension cables up to 200 feet long may be used without affecting the performance. The wind-screen is recommended to be used at all times, as it acts not only as a 'pop' screen for vocal work, but also protects the capsule from shock, moisture and dust. The fifteen-page instruction manual is quite comprehensive and gives brief details of the electret principle as well as listing a complete specification, wiring details and instructions on the features and accessories provided. A separate section on the installation of the battery is included.

As supplied for testing, this microphone, and others seen elsewhere, have all been fitted with the incorrect battery – a 4.5V battery instead of the suggested 9V battery.

Provision is also made for phantom powering as well as the internal battery power and, in view of the high quality microphone mixers available with this supply, it is a worthwhile feature. The microphone itself is fitted with a three-way switch mounted mid-way along the tube and enables the user to select:– OFF, MUSIC or VOICE. The "Music" position provides a linear response, whilst the "Voice" position incorporates attenuation of the bass, to assist in areas where low-frequency ambients are encountered. This switch is extremely valuable and enables the vocalist to switch from the "Off" position to the "vocal" position without the necessity to look carefully to see the switch is in the right position – good ergonomic design.

Naturally, users have found it necessary carefully to evaluate their requirements and select the most appropriate model from the range. For pure pop group use, the cheaper ECM 21 is extensively used whereas the ECM 22P has found applications in the semi-professional field of cabaret artists and has been recently used to videotape large concerts for TV specials.

From the practical point of view, the performance of the ECM 22P is excellent except when used at levels greater than 120dB. At these levels the cardiod pattern is not sufficiently narrow thus resulting in pick-up of the background noise, rather than the desired signal. For every day use, the microphone requires care in its handling (as do all precision microphones) as ruggedness is not one of its major assets. A recent pop festival found that the maximum lifetime of this microphone, when used for 14 hours a day was only around 1 – 1½ days. As you may imagine, this application is even worse for microphones than the Bathurst 500 is for motor vehicles!

In all, this microphone provides an exciting yet economical alternative to conventional capacitor and dynamic microphones, in the semi-professional field. ●

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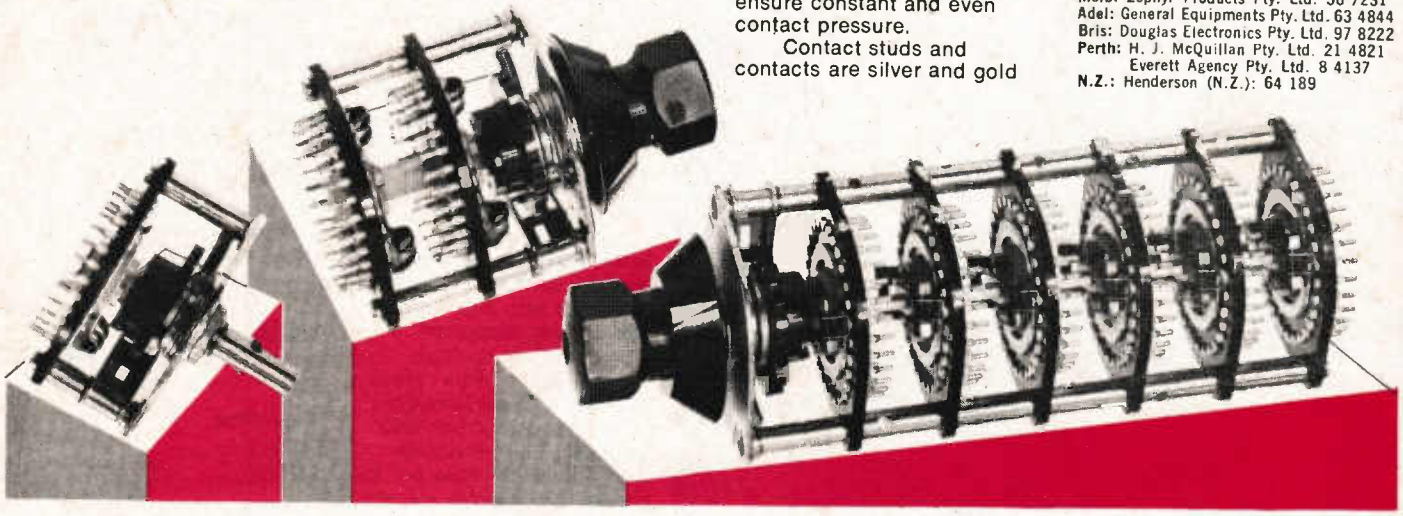

AC 65

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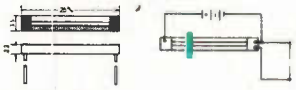
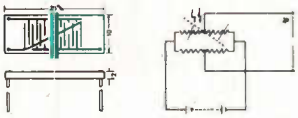
Photentiomatic



Photobridge



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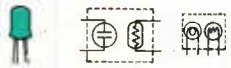

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AD56

PERFECTION MASS PRODUCED

Elac cartridges used for quality control in EMI's factories.

ABOVE: Checking "a mother" for imperfections. BELOW: Checking a random sample record.

YEAR by succeeding year, hi-fi equipment has an ever-increasing ability to reproduce exactly what is on a gramophone record.

Whether it is high quality music — or surface defects introduced during the manufacturing process — today's hi-fi equipment will reproduce it with equal fidelity.

Thus, improvements in equipment design present equal challenges to manufacturers of gramophone records — and indeed all other sources of programme material.

But today's technology is equal to this challenge, and a very great deal of effort is expended in ensuring that the final product is of a standard commensurate with the equipment with which it will be played.

Quality control standards in the record industry are extraordinarily high — for deceptively simple though record manufacture may be at first sight appear — it is nevertheless a process in which even minor lapses of attention to detail can irretrievably ruin the final product.

In Australia, EMI at their Homebush NSW factory, illustrate just how seriously quality control is regarded. Here throughout the day a long row of machines automatically check samples taken at random from the production line. The machine are checking for those infuriating clicks and pops that can totally ruin a musical performance for the sensitive ear.

To the uninitiated it might seem incredible that a machine can detect clicks and other surface defects that may be actually quieter than the programme material itself. Nevertheless these machines do just that.

They do it by playing the record backwards! (that's why the tone arm is on the 'wrong' side of the record in our picture on the right). It works like this — practically every musical instrument generates sounds which rise quickly from zero level but fall off very gradually. For the technically minded, the waveform looks like that shown in Fig 1a. Surface defects, on the other hand, are characterised by a very sharp rise and fall (Fig 2b).

By playing the record through backwards, any sharply rising signal can only be caused by a surface defect. Simple yet effective!

EMI's automatic machines are backed up by a number of highly trained listeners who have an almost uncanny ability to detect quite minor defects that you or I would almost certainly never even hear.

For this most exacting of record playing applications, EMI use a variety of equipment. But there is one item that their multiplicity of record players have in common —

ELAC cartridges.

Why?

Syd Firth, Record Production Engineer of EMI explains. "EMI have chosen ELAC cartridges for use in their record factories for product control and evaluation of record quality. We found ELAC cartridges consistently outperformed the others and we rely on them exclusively".

Fig. 1a

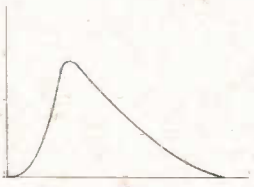
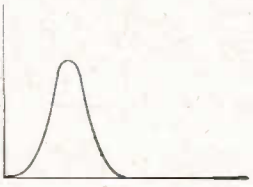


Fig. 2b



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PIÈCE de RÉSISTANCE No.2—results

ENTRY FROM MR. H. J. HYDE

METHOD I (quick, but makes unjustified assumptions)

If we assume that the addition of one more section to the front of an 'infinite' chain of such sections will make no change.

It follows that: $x = R + \frac{Rx}{R+x}$, $R_x + x^2 = R^2 + Rx + Rx$, $x^2 - Rx = R^2$,

$x^2 - Rx + \frac{1}{4}R^2 = \frac{5R^2}{4}$, $(x - \frac{R}{2})^2 = \frac{5R^2}{4}$ $x = \frac{R}{2} \pm \frac{R\sqrt{5}}{2}$

i.e. the positive solution is: $x = (1 + \sqrt{5}) \times \frac{R}{2}$ which is approximately: R x 1.618

Unfortunately, such an intuitive approach is not justified and the reasoning used would give an incorrect answer in many similar problems.

METHOD II

What is meant by an infinite number of sections? One valid interpretation is to consider exactly n sections, where n is an arbitrarily large number. For completeness, I have included an error term 'E', which although not strictly necessary, could be construed as the "resistance of the rest of the circuit." The Arithmetic can be simplified considerably by taking out a scale factor R and performing all calculations as shown:—

Since E can be considered as a network in parallel with a 1Ω resistor and then in series with a 1Ω resistor, it follows the E must have a value somewhere between 1Ω and 2Ω.

We can now construct a sequence of values corresponding to the maximum (x_n') and minimum (x_n) values of an n section network.

MINIMUM	MAXIMUM
$x_0 = 1$	$x_0' = 2$
$x_1 = 1 + \frac{1 \times 1}{1+1} = \frac{3}{2} = 1.5$	$x_1' = 1 + \frac{1 \times 2}{1+2} = \frac{5}{3} = 1.666$
$x_2 = 1 + \frac{1 \times 3/2}{1+3/2} = \frac{8}{5} = 1.6$	$x_2' = 1 + \frac{1 \times 5/3}{1+5/3} = \frac{13}{8} = 1.625$
$x_3 = \frac{21}{13} = 1.615\ldots$	$x_3' = \frac{34}{21} = 1.619\ldots$
$x_4 = \frac{55}{34} = 1.6176\ldots$	$x_4' = \frac{89}{55} = 1.6182\ldots$
$x_5 = \frac{144}{89} = 1.61798\ldots$	$x_5' = \frac{233}{144} = 1.61806\ldots$
$x_{17} = 1.618\ 033\ 988\ 749\ 889\ldots$	$x_{17}' = 1.618\ 033\ 988\ 749\ 896\ldots$
$x_{18} = 1.618\ 033\ 988\ 749\ 894\ldots$	$x_{18}' = 1.618\ 033\ 988\ 749\ 895\ldots$

We can notice three things about these sequences:

1. An obvious relationship to the famous sequence of Fibonacci numbers. i.e. 0,1,1,2,3,5,8,13,21, . . . which can be used to formally establish that:—
2. They are both converging to a common limit x with approximate value 1.618
3. The simple arithmetic relationship: $x_n' = 1 + \frac{1}{x_n}$ for n = 1,2,3, . . .

Since the sequences are converging to a common limit we can make the difference between x_n' and x_n as small as we like by choosing n large enough. In the limiting case,

$x_n = 1 + \frac{1}{x_n}$, $x_n^2 = x_n + 1$ $x_n = \frac{1}{2} \pm \sqrt{\frac{5}{2}}$

and after replacing scale factor R

$x = (1 + \sqrt{5}) \times \frac{R}{2} = R_x\ 1.618\ 033\ 988\ 749\ 894\ldots$

METHOD III (I consider this to be the most plausible)

Using the formulae for series and parallel networks we can establish the following continuing fractional expression.

$$x = R_1 + \cfrac{1}{\frac{1}{R_2} + \cfrac{1}{R_3 + \cfrac{1}{\frac{1}{R_4} + \cfrac{1}{R_5 + \cfrac{1}{\frac{1}{R_6} + \cfrac{1}{R_7 + \ldots}}}}}}$$

Continued overleaf

It is impossible to join two things in a beautiful manner without a third being present, for a bond must exist to unite them, and this is best achieved by a proportion. For, if of three magnitudes the mean is to the least as the greatest is to the mean, and, conversely, the least is to the mean as the mean is to the greatest — then is the last the first and the mean, and the mean the first and the last. Thus are all by necessity the same, and since they are the same, they are but one.

Timaeus,
a student of Pythagoras according to Plato.

OUR PROBLEM, page 71 of January 1973 edition, asked for the input resistance of an infinite series of "L" pads where the value of each resistor is "R" ohms.

"Too Easy" — said some of our readers, but the vast majority agreed that the problem is an interesting one and asked for more.

Judging of the entries was based entirely on the mathematical plausibility of the entries and not on the problem's relationship to the Fibonacci series and the Golden Section. This relationship, however, is one of the most interesting features of the problem and was spotted by 22 people out of the almost 300 who submitted entries.

Fibonacci, sometimes known as Leonardo of Pisa, was the author of a celebrated mathematical treatize, published in 1202, which was called *Liber Abaci*. Unfortunately it makes very dull reading, but one problem included has inspired many later mathematicians. This was:

How many pairs of rabbits will be produced in a year, beginning with a single pair, if in every month each pair bears a new pair which becomes productive from the second month on?

This most celebrated problem gave rise to what is now known as the Fibonacci series namely,

1, 1, 2, 3, 5, 8, 13, 21, 34 . . . , U_n

Where $U_n = U_{n-1} + U_{n-2}$. That is each term, after the first two, is the sum of the two terms immediately preceding it. This sequence has many beautiful properties and is applicable to questions in phyllotaxy (get your dictionaries out!) and organic growth.

It can be shown that in the limit the ratio of any term to the following term is equal to $(\sqrt{5}-1)/2$, the "Golden Section".

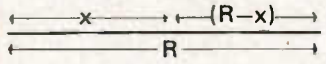
Before discussing the "Golden

Section" further it is worthy of note that Fibonacci travelled extensively in North Africa and was one of the people most responsible for introducing Arabic numerical notation, including the concept of zero, to the Western world.

In a separate panel we have included a quote from Plato which specifically alludes to a ratio discovered by the Greeks in about the fifth century, probably from the regular pentagon. The ratio became known as the "Golden Section" and was commonly applied to the shape of buildings, windows etc, as its proportions are most pleasing to the eye.

So many examples of this ratio were found in nature, that the term "Divine Section" was introduced by Kepler as he thought it indicated the Creator's intention to create "like from like". For example the diagonals of the regular pentagon form what is known as a pentagram which contains 200 "Golden Ratios", hence its mystical significance.

The "Golden Section" may be represented by a line divided as shown.



where $x : R = (R-x) : x$

which leads to the quadratic:

$$x^2 + Rx - R^2 = 0$$

Continued on page 55

Continued from previous page

We can simplify this expression by taking out the scale factor R and we find that:

$$y = \frac{x}{R} = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \ldots}}}}$$

The generator of this continuing fraction is:

$$y = 1 + \frac{1}{y} \quad \left[= 1 + \cfrac{1}{1 + \frac{1}{y}} = 1 + \cfrac{1}{1 + \cfrac{1}{1 + y}} = \ldots \right.$$

$$\Rightarrow y^2 = y + 1$$

$$\Rightarrow y^2 - y = 1$$

$$\Rightarrow y^2 - y + \frac{1}{4} = \frac{5}{4}$$

$$\Rightarrow (y - \frac{1}{2})^2 = \frac{5}{4}$$

$$\Rightarrow y = \frac{1}{2} \pm \frac{\sqrt{5}}{2} \quad \left. \right]$$

$$\Rightarrow x = (1 + \sqrt{5}) \times \frac{R}{2}$$

$$= R \times 1.618033988749894\ldots$$

ENTRY FROM MR. ALAN M. FOWLER

The resistance across points A & B of the network shown on page 71 of your January issue is ØR where Ø the "Golden Ratio" is defined as the positive number whose value is the same as its reciprocal plus one.

i.e. $\emptyset = 1 + 1/\emptyset$

$= 1.61803398.....$

Phi can also be expressed as a continued fraction:

$$\emptyset = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \ldots\ldots\ldots}}}}$$

which is, if you look at it carefully, the expression you would obtain for the input resistance of an infinite ladder of "L" sections with 1 ohm series and shunt arms.

It is interesting to note that the successive terms that appear when the above expression is evaluated form the Fibonacci series 1, 1, 2, 3, 5, 8, 13, 21, 34 . . . where every term is the sum of the preceding two terms. Note also that the ratio of any two consecutive terms approach the value of Phi as the series increases.

Like π, the Golden Ratio Ø crops up in the most unexpected places. It was once thought to be the most pleasing ratio for the sides of a rectangle — such as window or door — and has been known and used since antiquity. Greek sculptors and architects used it frequently for their work — most notably in the construction of the Parthenon. Early mathematicians often became so intrigued with its properties that they devoted much of their work to it. Adolph Zeising published his classic 457 page treatise 'Der goldene Schnitt' in 1884. The German psychologist Gustav Fechner measured thousands of windows, picture frames, books and other rectangles and found the average ratio of their sides close to Phi.

Kepler almost became obsessed with Phi and its properties, and Salvador Dali used it in the framing and composition of his painting "The Sacrament of the Last Supper". Frank A. Lonc of New York measured many women, and found that the ratio of their average heights to the average height of their navels from the ground was close to the value of Phi, confirming one of Zeising's pet theories.

While this may not be the best way to work out the exact answer to your piece de resistance — some of the "pieces" or their boy-friends may offer too much resistance — it could be more interesting than using an ohmmeter and a handful of resistors.

Shortage of space prevents our inclusion of Mr. Fowler's solution which is similar to Mr. Hyde's Method I.

EXTRACTS FROM READERS' LETTERS

Your problem has caused me half a night's loss of sleep, a great deal of re-reading earlier texts and a complete re-thinking.

Nevertheless, prompted by the challenge, loss of prestige before my students, and, the lure of a year's free subscription I have submitted my entry.

J.A.B. Berkeley N.S.W.

I found this problem a little easier than that in your June '72 issue, but perhaps this is because I benefited from your solution in the July issue.

S.F. Mitcham, Vic.

Curse you for your wretched brain-teasers, but since I've spent so much time on it, at least my solution should be worth a year's subscription. See what you can find wrong with it.

C.C.G. Rankin Park, N.S.W.

If by some strange coincidence I happen to be correct, please start my free subscription from the end of my current paid one, in September 1973.

P.B. Collaroy Plateau, N.S.W.

Too easy!

M.B. Sydney University.

I hope you continue to include puzzles of this nature in your magazine, as I think there is a great lack of recreational mathematics in Australian magazines.

R.D. Gordon, N.S.W.

Being a full flooded Frenchman I was naturally attracted to your "Piece De Resistance".

Jean-Joseph Jacq, Burwood, N.S.W.

I have no doubt that my approach is almost certainly the most tedious and least elegant possible, but unless I have made some serious algebraic blunders, the answer should be the correct one!

H.M. Gilles Plains, S.A.

I believe this problem can be solved very simply, it is more an exercise in logic than mathematics.

G.W.B. Melbourne, Vic.

I hope my verbosity hasn't overwhelmed you.

J.McK. Copuna, Vic.

After having struggled with this problem for a whole evening I can only believe that I had probably missed some point and that there is a simple solution which does not require the degree of complexity involved in my solution.

A.C. Pascoe Vale, Vic.

It goes without saying that the network has obvious applications for use in conjunction with the Signetics WOM reported exclusively in your last issue.

K.MCL. Canley Heights, N.S.W.

I normally shun problems with more than two resistors in parallel as one might shun encyclopaedia salesmen . . .

B.M. East Hawthorn, Vic.

Even though I am only 13 years old, the answer to your Piece de Resistance No. 2 is simple.

G.S. Lucindale, Vic.

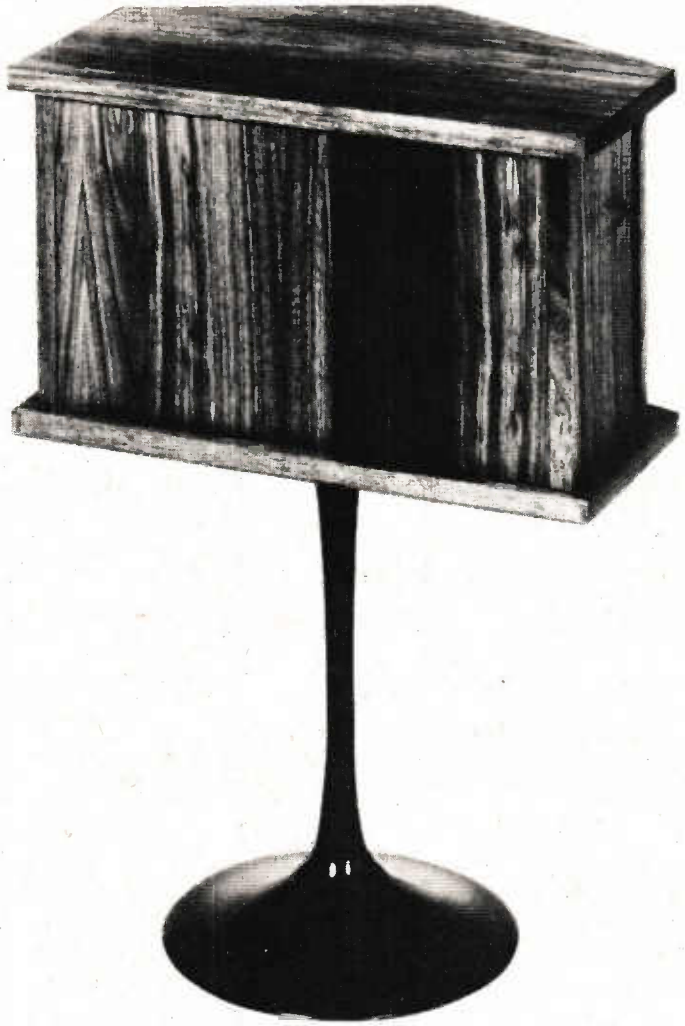
I have no complaints at all. I don't care if you put a nude on the front cover, or if your staff go round without their shirts.

J.B. Nth. Caulfield, Vic.

The rave reviews keep coming...

"The Bose 901 is, indeed, one of the finest speaker systems it has ever been my pleasure to hear. I have lived with it now for several months, so that I am quite sure of what I say . . . it is the sound itself that remains paramount. The 901 is characteristically smooth. Everything is simply **there** . . . I urge that you listen for yourself. I think you will have to agree that Bose has, in a single giant step, produced one of the finest speaker systems ever made."

Larry Zide—American Record Guide—December 1969.



1. Norman Eisenberg—High Fidelity
"you feel you've made some sort of stereo discovery . . . if your own response to it is like ours, you'll be reluctant to turn it off and go to bed."

2. Julian Hirsch—Stereo Review
"all the room-filling potency of the best acoustic-suspension systems, combined with the tautness and clarity of a full-range electrostatic speaker . . . I have never heard a speaker system in my own home which could surpass, or even equal the BOSE 901 for over-all 'realism' of sound."

3. Bert Whyte—Audio
"the illusion of an orchestra spread across the wall is uncanny . . . To hear a thunderous low 'C' organ pedal . . . or a clean weighty impact of a large bass drum is truly impressive . . . There is no doubt that the much-abused term, 'breakthrough', applies to the BOSE 901 and its bold new concepts."

4. Hi-Fi Buyers Guide
". . . its over-all sound quality so clean that the listener is almost unaware of the electronics between him and the instruments . . . The sound? The 901 is very possibly the only speaker to date to pour forth in true concert hall fashion."

5. Stereo & Hi-Fi Times
"but the proof of the pudding inevitably is sound. And it is here that the BOSE 901 stands clearly away from the crowd . . . What a lovely sound those speakers produce! . . . Listen to Columbia's 'Carmina Burana' on this speaker and hear what a chorus should sound like! . . . these speakers provide a quality that is not to be matched."

6. Elementary Electronics
"conclusion. The BOSE 901 speaker system delivers the most natural stereo sound, creating the illusion of being in a concert hall, with a uniformity of frequency response and freedom from distortion that is unbelievable, particularly if the listener takes into account the physical size. It is our opinion that this is the speaker system to own, regardless of price, if one wants the ultimate in listening pleasure."

Your inquiry will bring you complete reprints of these unprecedented reviews and a list of franchised BOSE dealers in your area. Ask your dealer for an A-B comparison of the BOSE 901 with the best conventional speakers—**regardless of their size or price.** Then, go back to your present speakers—if you can.

You can hear the difference now.

BOSE

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193 Clarence Street Sydney 29 6681

Bose systems may be purchased from the following Australian dealers:

NSW: Sydney Hi-Fi Centre, 83 York Street, Sydney. 2000
ACT: Homecrafts, Petrie Street, Canberra. 2600
WA: Leslie Leonard, London Court, Perth. 6000
VIC: Douglas Trading, 191 Bourke Street, Melb. 3000
TAS: P. & M. Distributors, 87 Brisbane Street, Launceston. 7250
QLD: Stereo Supplies, 100 Turbot Street, Brisbane. 4000
SA: Sound Spectrum, 33 Regents Arcade, Adelaide. 5000

PIÈCE de RÉSISTANCE No.2–results

The positive root of which is:

$x = \frac{1}{2}R(\sqrt{5} - 1)$ i.e. if R = 1

x = .6180339 . . . .

If on the other hand x = 1, R will equal 1.6180339 . . . . . .

Most readers who submitted answers will recognize the similarity to the formula they derived by various means for PIECE de RESISTANCE No 2. To which the solution as A.J. Brown of North Ryde, NSW informed us is'–

1.61803 39887 49894 84820 45868 34365 63811 77203 09179 80576 28621 35448 62270 52604 62818 90244 97072 07204 18939 11374 84754 TIMES R. (ETC ETC).

Whilst we commend Mr Brown's effort, the number of decimal places is not important, it's the method that counts. And although the use of a computer makes calculation easier, we prefer to judge on the thinking process rather than the mechanistic computation process.

For the above reason we have chosen Mr Hyde's entry as being the most plausible mathematically. It points out, that although the correct answer may be arrived at by various methods, (three given) there are logical reasons for choosing a pure mathematical method above an intuitive one. So congratulations Mr Hyde you now have a free one year subscription to ETI.

Mr Alan Fowler submitted an entry which makes most interesting reading and we have decided that it too is worthy of a year's free subscription – congratulations.

Many thanks to all who submitted entries and keep watching for another PIECE de RESISTANCE shortly. ●

INSTROL

SLASHES A.D.C. PRICES

ADC STEREO CARTRIDGES — AMERICA'S QUALITY CARTRIDGE

ADC 220X . . $17.00

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

ADC 10E mk4 . . . $51.00

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

ADC 220XE . . . $22.00

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

ADC 550XE . . . $30.00

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

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J. H. TURNTABLE (complete) This outstanding turntable value consists of:–

(A) J.H. TURNTABLE — Belt drive, synchronous motor, unmeasurably small rumble, wow and flutter of better than 0.04%, negligible hum radiation, with 12" diameter of platter.

(B) SANSUI TA1050 ARM — A high precision universal arm. Oil damped cueing lift is fitted. Anti skate. Separate stylus pressure gauge.

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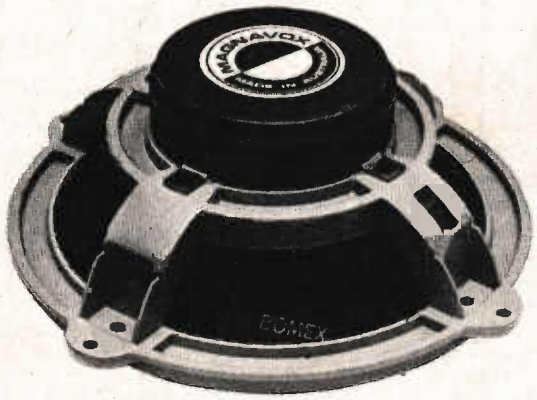
T303

INSTROL SPEAKER SYSTEMS KITS

All the systems below are available in kit form. The cabinet kits come in either unpolished walnut veneer or unpolished teak veneer. All kits are complete, and include speakers, crossover networks (where applicable), cabinet kits, grill cloth and innerbond.

MAGNAVOX 8-30 SYSTEM

at reduced prices.



Featured in "Electronics Today". It handles 30 watts RMS, features a new high performance 8" speaker, two 3" tweeters, and is available in cabinet 20 7/8" x 12 7/8" x 8 7/8" (1 cu. ft.) or 23 7/8" x 15½" x 10 7/8" (1.6 cu.ft.). Available in teak or walnut veneer.

COMPLETE SYSTEM

Kit of Parts	$42.00 (1cu ft) $52.00 (1.6 cu ft)
Built and Tested	$55.00 (1 cu ft), $65.00 (1.6 cu ft)

SEPARATE COMPONENTS

Enclosure kit (1 cu ft)	$17.00
Enclosure kit (1.6 cu ft)	$27.00
Built Enclosure (1 cu ft)	$30.00
Built Enclosure (1.6 cu ft)	$39.00
speakers & crossover only	$26.00 (one side only)

NEW E.T. MAGNAVOX 8-30 DESIGN

A revised version of the popular Magnavox system was featured in July 1972 edition of Electronics Today. It featured a Philips tweeter and improved crossover

COMPLETE SYSTEM

Kit of Parts	$62.00 (1 cu. ft.) $72.00 (1.6 cu. ft.)
Built and Tested	$75.00 (1 cu. ft.) $85.00 (1.6 cu. ft.)

SEPARATE COMPONENTS

Speakers and crossover only	$45.00 (one side only)

WHARFEDALE AND KEF KITS

The Wharfedale Super Linton, Melton and Dovedale 3 are now available as build-yourself kits, featuring INSTROL quality cabinet kits in choice of walnut or teak veneer.
Similarly the KEF range of speaker systems are now available as build-yourself kits, the Concerto, Concorde and Chorale all being available complete with INSTROL cabinet kits (teak only)

The Super Linton kit employs an 8" bass and 3" tweeter.
The Melton kit employs a 12" bass and tweeter.
The Dovedale 3 kit employs a 12" bass, 5" mid-range and 1" tweeter.
The Chorale kit employs the B8200 bass and T27 tweeter
The Concorde kit employs the B139 bass unit and T15 tweeter.
The Concerto kit employs B139 bass, B110 mid-range and T27 tweeter.

COMPLETE SYSTEMS

Wharfedale Super Linton kit (Unit 3)	$52.00
Wharfedale Melton kit (Unit 4)	$93.00
Wharfedale Dovedale 3 kit (Unit 5)	$128.00
KEF Chorale kit	$79.90
KEF Concorde kit	$99.90
KEF Concerto kit	$169.00

INSTROL and SEAS COMBINE

to present 2 NEW speaker systems
the BROADWAY 201
and BROADWAY 251

BROADWAY 201 — This system features the SEAS wide range 8" speaker, 21TV.GD, in your choice of teak or walnut enclosure. The attractive cabinets, which feature bevilled fronts, measure 16-7/8" x 11" x 9".

BROADWAY 251 — This system uses the 25 TV.ED, a 10" wide range speaker by SEAS, in teak or walnut cabinets. Featuring bevilled fronts, the enclosures measure 21" x 12" z 11½".

COMPLETE SYSTEM

Kit of Parts (Broadway 201)	$26.00
Kit of Parts (Broadway 251)	$33.00
Built and Tested (Broadway 201)	$36.00
Built and Tested (Broadway 251)	$46.00

SEPARATE COMPONENTS

BROADWAY 201 encl. kit only	$14.50
Broadway 251 encl. kit only	$19.00
8" SEAS (21 T.V.GD) speaker only	$12.50
10" SEAS (25 TV.ED)speaker only	$14.50

INSTROL
HI-FI & ELECTRONICS CENTRE

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

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

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

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

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

NAME . . . . . .

ADDRESS . . . . . .

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

T303

ETI MASTER MIXER

Part 2 of the series gives constructional details and circuit descriptions of the preamplifiers and mixer/equalizer boards.

IN OUR introductory article to this project last month the design philosophy and overall circuit description of the 8-channel master-mixer were provided. This month we commence construction of the preamplifiers and the mixer/equalizer boards.

There are four preamplifier boards each having two channels. Assemble the components to each board in accordance with the circuit diagram and component overlay provided. Take care not to damage the ICs with excessive heat (use a lightweight iron, and solder quickly) and pay particular attention to the orientation of the TAG tantalum capacitors.

Printed circuit boards will be available from kitset suppliers. However for those who prefer to etch their own boards, a full size pattern is provided. Details of the connections between the preamplifier boards and their associated controls are given in Fig 1. It is suggested that leads of adequate length are connected to the boards first. The boards may then be fixed in position and the leads routed to their respective controls.

After the preamplifier boards are assembled, we can assemble the main mixer – equalizer boards of which there are two. The winding data for the inductors associated with this section is given in Table 1.

The coils must be layer wound with care. Jumble winding will almost certainly prevent the full number of turns fitting on the bobbin.

The only remaining printed circuit board accommodates the power supply – echo mixer, overload and meter circuitry, The construction of this board will be covered next month, together with full details of the wood and metalwork required.

HOW IT WORKS MAIN MIXERS – EQUALIZERS

As indicated last month, there are nine inputs to each main mixer IC. This IC is connected in an inverting amplifier configuration, with the gain controlled by varying the negative feedback. This gives a control range from zero output to about 30dB gain.

The output from the main mixer is direct coupled to the input of the equalizer stage. This stage is a little unusual, since the equalizing networks are arranged to vary the negative feedback. If we consider one section with the others disconnected, at the resonant frequency of the series LCR combination the impedance of the entire network will be equal to 680 ohms. Either side of resonance the impedance of the network will increase (with a slope dependent on the Q of the network), due to uncancelled inductive reactance above resonance and uncancelled capacitive reactance below resonance. We can therefore represent the equalizer stage with equivalent circuits as reproduced below. These circuits consider only one network is in circuit, the input signal frequency is the resonant frequency of the network, and the resistance of the inductor is negligible.

With the slider of the potentiometer at the top end (Fig. 2a) we have 680 ohms to the zero volt line from pin 2 of IC2, and a 1k ohm between pin 3 and pin 2. The IC will act due to the feedback to keep the potential between pins 2 and 3 virtually zero, thus there is zero current through

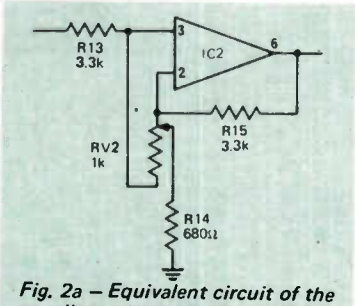


Fig. 2a – Equivalent circuit of the equalizer with potentiometer set for maximum boost at the resonant frequency of the network.

RV2. The voltage on pin 3 (IC2) is therefore equal to the output of the mixer since there is virtually no current through and no voltage drop across R13.

The output of IC2 in this case is approximately the input signal times (R15 + 680)/680 ohms, indicating a gain of about 15dB. If the slider is at the other end of the potentiometer (Fig 2b) the signal appearing at pin 3 and thus also at pin 2 is about 0.2 of the output of the previous stage due to the voltage division of R13 and the 680Ω. There is still zero current through RV2 and also zero current through R15 since there is no path. The output voltage is therefore the same as that at pin 2, which happens to be about 0.2 times the output of the previous stage. The gain is therefore 0.2 or –13dB.

With all networks in circuit, the maximum boost and cut will be reduced, but a range of ±10dB is still available. With the wiper of the potentiometers set midway – Fig 2c, the gain will be unity regardless of frequency, due to the symmetry of the entire network.

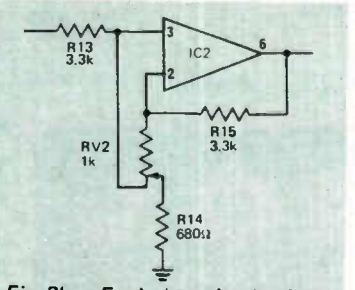


Fig. 2b – Equivalent circuit of the equalizer with the potentiometer set for maximum cut at the resonant frequency of the network.

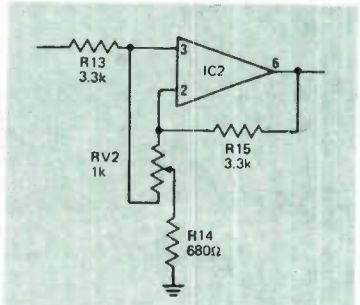
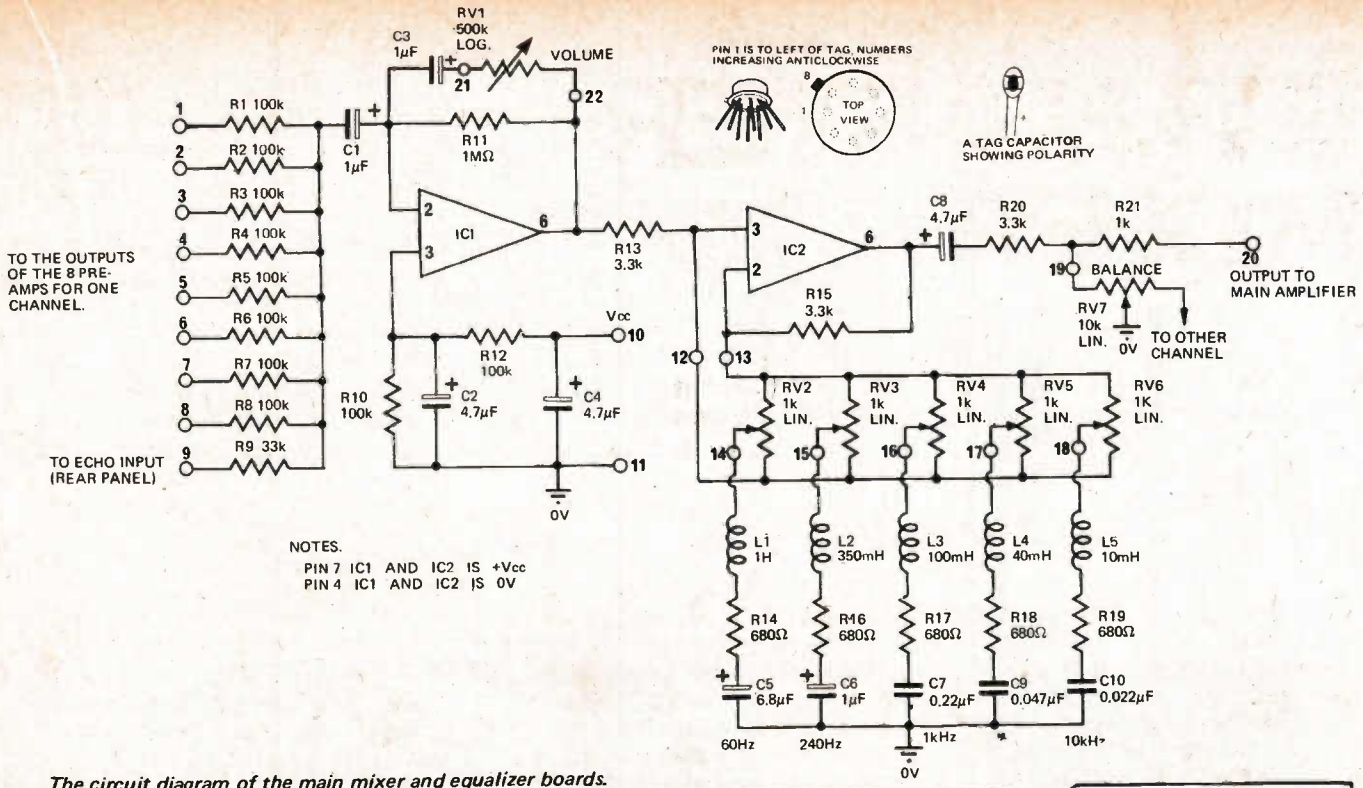
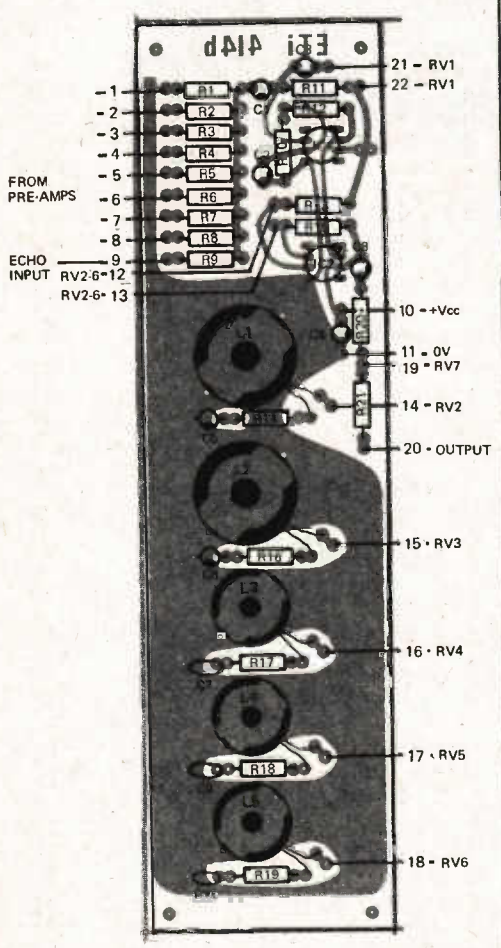


Fig 2c – Equivalent circuit of the equalizer with the potentiometer set for unity gain regardless of frequency.



The circuit diagram of the main mixer and equalizer boards.



Component overlay for main mixer and equalizer.

THIS LIST CONTAINS ALL THE PARTS FOR ONE MIXER-EQUALIZER. (TWO SETS REQUIRED)

R1	resistor	100 k	5%	½ watt
R2	"	100 k	"	"
R3	"	100 k	"	"
R4	"	100 k	"	"
R5	"	100 k	"	"
R6	"	100 k	"	"
R7	"	100 k	"	"
R8	"	100 k	"	"
R9	"	33 k	"	"
R10	"	100 k	"	"
R11	"	1 M	"	"
R12		100 k	"	"
R13	"	3.3 k	"	"
R14	"	680 ohm	"	"
R15	"	3.3 k	"	"
R16	"	680 ohm	"	"
R17	"	680 ohm	"	"
R18	"	680 ohm	"	"
R19	"	680 ohm	"	"
R20	"	3.3 k	"	"
R21	"	1 k	"	"

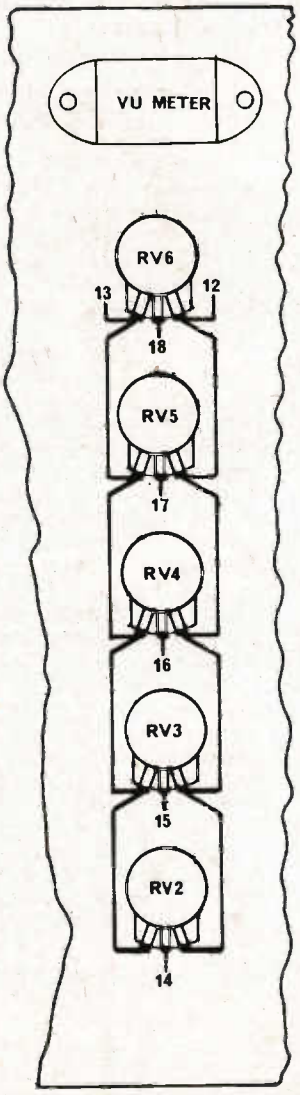
C1	capacitor	1µF	35V	TAG	tantalum
C2	"	4.7µF	35V	"	"
C3	"	1µF	35V	"	"
C4	"	4.7µF	35V	"	"
C5	"	6.8µF	25V	"	"
C6	"	1µF	35V	"	"
C7	"	0.22µF	polyester		
C8	"	4.7µF	35V	TAG	tantalum
C9	"	0.047µF	polyester		
C1	"	0.022µF	polyester		

L1	audio choke	1H	(see winding data table 1)
L2	" "	350 mH	"
L3	" "	100 mH	"
L4	" "	40 mH	"
L5	" "	10 mH	"

IC1 integrated circuit uA741.LM307 (metal can or mini dip only)
IC2 " " uA741,LM307 (metal can or mini dip only)

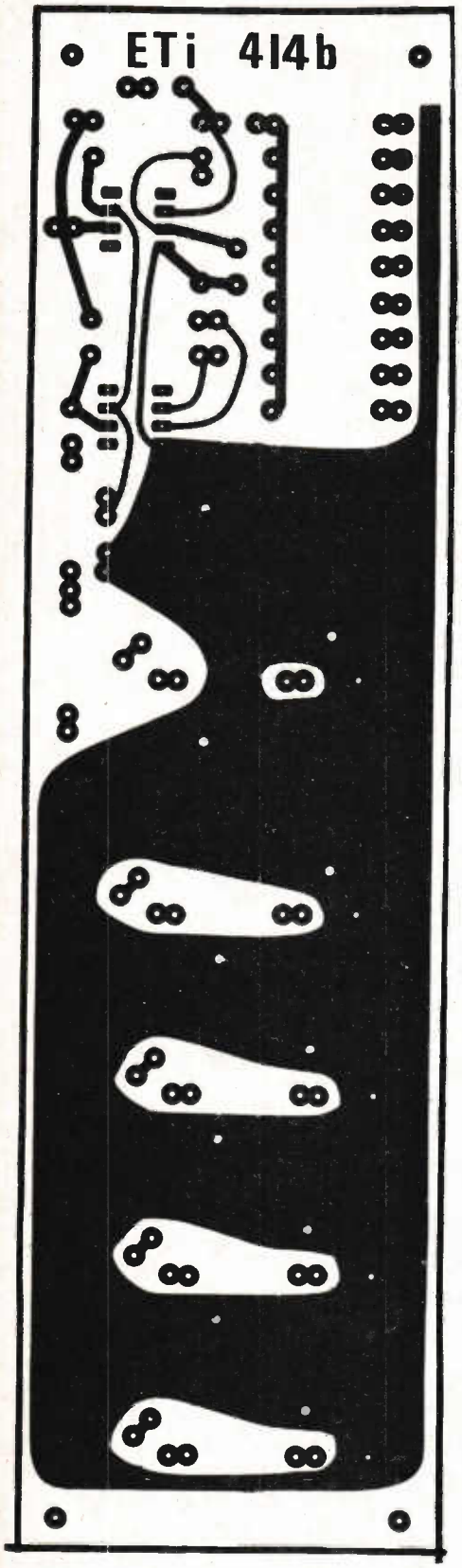
*RV1	potentiometer	500 k ohm LOG dual
RV2	"	1 k LIN
RV3	"	1 k LIN
RV4	"	1 k LIN
RV5	"	1 k LIN
RV6	"	1 k LIN
*RV7	"	10 k LIN

*ONE ONLY REQUIRED FOR COMPLETE UNIT
PC Board ETI 414B
5 knobs
4 1" spacers



This diagram shows the connections to the potentiometers associated with the equalizers. The numbers correspond one-to-one, to those on the main mixer – equalizer circuit and overlay diagrams.

ETI MASTER MIXER



The main mixer and equaliser printed circuit board pattern – shown full size.

TABLE 1:– WINDING DETAILS EQUALIZER COILS

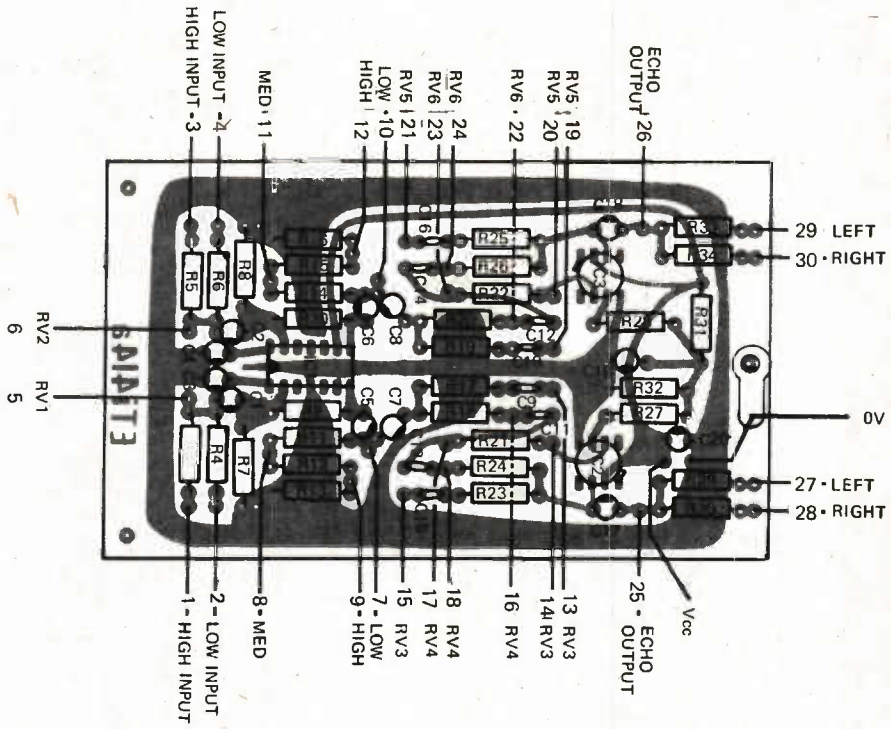
L1 100 Turns 34 B&S wire
Core Philips 4322 022 28290
Former Philips 4322 021 30330
Clip Philips 4302 021 20020

L2 585 Turns 32 B&S wire Core, former and clip same as L1

L3 460 Turns 34 B&S wire
Core Philips 4322 022 24280
Former Philips 4322 021 30270
Clip Philips 4302 021 20000

L4 300 Turns 34 B&S wire Core, former and clip same as L3

L5 150 Turns 32 B&S wire Core, former and clip same as L3



Preamplifier component overlay

HOW IT WORKS – PREAMPLIFIERS

Considering channel 1 of the board only, IC1 is wired as an inverting amplifier. The gain of this amplifier is varied by RV1 – the volume control, and set at high, medium or low by SW1 – the sensitivity switch. These controls vary the gain of the amplifier by adjusting the negative feedback. More feedback, less gain, and vice-versa.

SW1 changes the range of RV1 for maximum gains of 20dB, 40dB and 55dB when the low impedance input is employed. With the sensitivity switch at low the minimum output of this stage is virtually zero, while a minimum gain of 6dB is realised when the sensitivity is set at either medium or high. Gains when the high impedance input is employed are all 20dB lower than those given above.

The input impedance to the IC is virtually zero, when used as an inverting amplifier. Therefore the input impedance to the preamplifier is determined by R3 for the high impedance input, and by R1 in parallel with R4 for the low impedance input. R9 and R7 set the bias of the IC. The tone control stage is a conventional feedback type.

Note that where different input impedances from those specified are required, the values of R1 (or R2) required may be calculated by the following formula

$R = (4700 \times Zin)/(4700 - Zin)$

where Zin is the desired input impedance.

THIS LIST CONTAINS ALL PARTS EXCEPT METAL WORK, FOR A COMPLETE PREAMP-LIFIER AND TONE CONTROLS. FOR AN 8 CHANNEL MIXER FOUR SETS OF COMPONENTS ARE REQUIRED

PARTS LIST (PREAMP)

R1*	RESISTOR	200 ohm	5%		½W
R2*	"	200 ohm	"		"
R3	"	47k	"		"
R4	"	4.7k	"		"
R5	"	47k	"		"
R6	"	4.7k	"		"
R7	"	390k	"		"
R8	"	390k	"		"
R9	"	4.7M	"		"
R10	"	4.7M	"		"
R11	"	10k	"		"
R12	"	1k	"		"
R13	"	100ohm	"		"
R14	"	10k	"		"
R15	"	1k	"		"
R16	"	100ohm	"		"
R17	"	2.2k	"		"
R18	"	15k	"		"
R19	"	2.2k	"		"
R20	"	15k	"		"
R21	"	47k	"		"
R22	"	47k	"		"
R23	"	2.2k	"		"
R24	"	15k	"		"
R25	"	2.2k	"		"
R26	"	15k	"		"
R27	"	10k	"		"
R28	"	10k	"		"
R29	"	10k	"		"
R30	"	10k	"		"
R31	"	100k	"		"
R32	"	100k	"		"
R33	"	10k	"		"
R34	"	10k	"		"
C1	CAPACITOR	1μF	35V	TAG	tant.
C2	"	1μF	35V	"	"
C3	"	1μF	35V	"	"
C4	"	1μF	35V	"	"
C5	"	4.7μF	35V	"	"
C6	"	4.7μF	35V	"	"
C7	"	4.7μF	35V	"	"
C8	"	4.7μF	35V	"	"
C9	"	0.0047μF	35V	polyester	
C10	"	0.0047μF		"	
C11	"	0.01μF		"	
C12	"	0.01μF		"	
C13	"	0.01μF		"	
C14	"	0.01μF		"	
C15	"	0.0047μF		"	
C16	"	0.0047μF		"	
C17	"	4.7μF	35V	TAG	tantalum
C18	"	4.7μF	35V	"	"
C19	"	4.7μF	35V	"	"
C20	"	4.7μF	35V	"	"

RV1	potentiometer	50 k LOG	45mm slide (Soanar)
RV2	"	50 k LOG	" " "
RV3	"	25 k LIN	
RV4	"	100 k LIN	
RV5	"	25 k LIN	
RV6	"	100 k LIN	
RV7	"	10 k LOG	
RV8	"	10 k LOG	
RV9	"	50 k LIN	
RV10	"	50 k LIN	

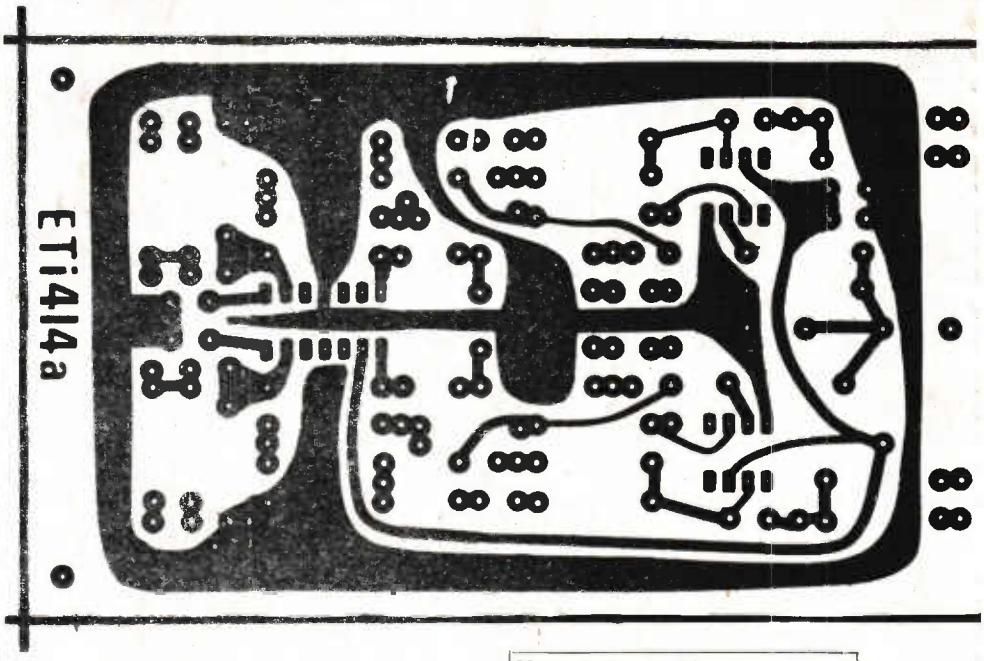
IC1 integrated circuit LM381
IC2 " " uA741, LM307 (metal can or mini dip only)
IC3 " " uA741, LM307 (metal can or mini dip only)

PC board ETI 414A
8 knobs for rotary potentiometers
2 knobs for slide potentiometers Soanar type K100
2 3P-3T slide switches (John Carr or McMurdo)
3 1" spacers
4 6.5 mm phone sockets

* see text.

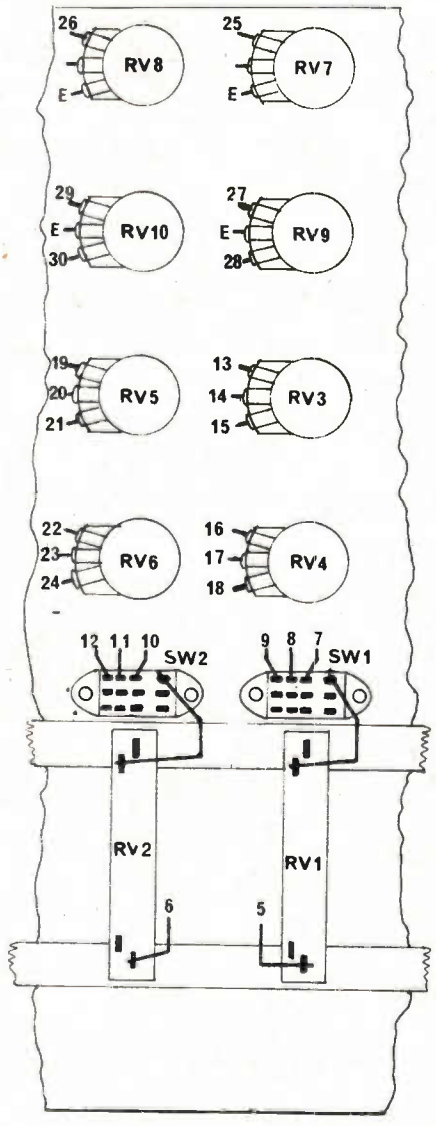
DUE TO LACK OF SPACE THE "MICRO-ADS" AND "CAREER OPPORTUNITIES" HAD TO BE OMITTED FROM THIS ISSUE. BOTH WILL APPEAR AGAIN NEXT MONTH AS USUAL.

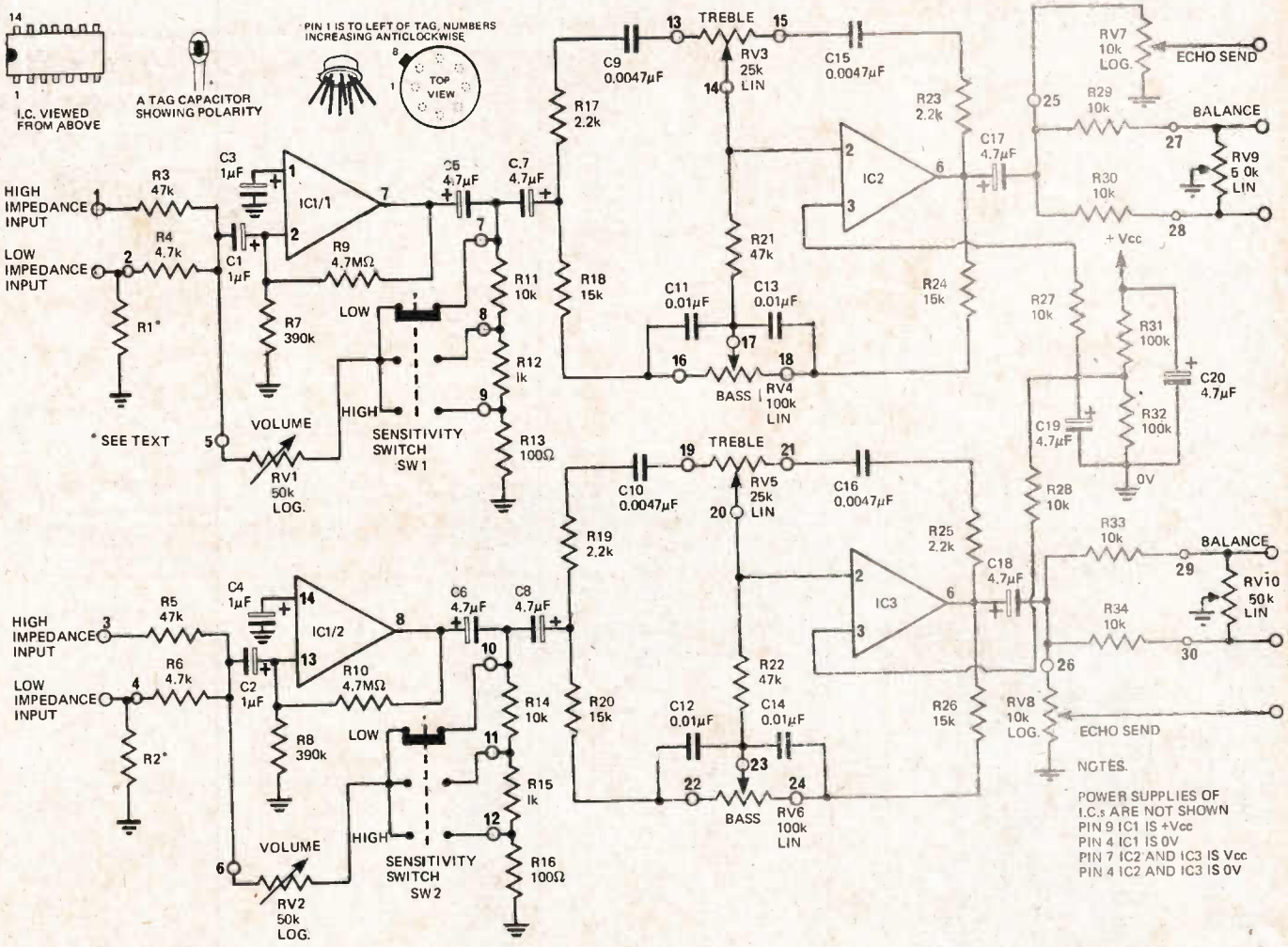
ETI MASTER MIXER



The printed circuit board pattern for the pre-amplifier sections — shown full size.

Fig. 1. This diagram shows connections to the potentiometers and sensitivity switches associated with the preamplifier boards. The numbers corresponds to those on the pre-amplifier circuit and overlay diagrams.





The circuit diagram of one of four identical preamplifier boards. I.C. 1/1 and I.C. 1/2 are in the same package.

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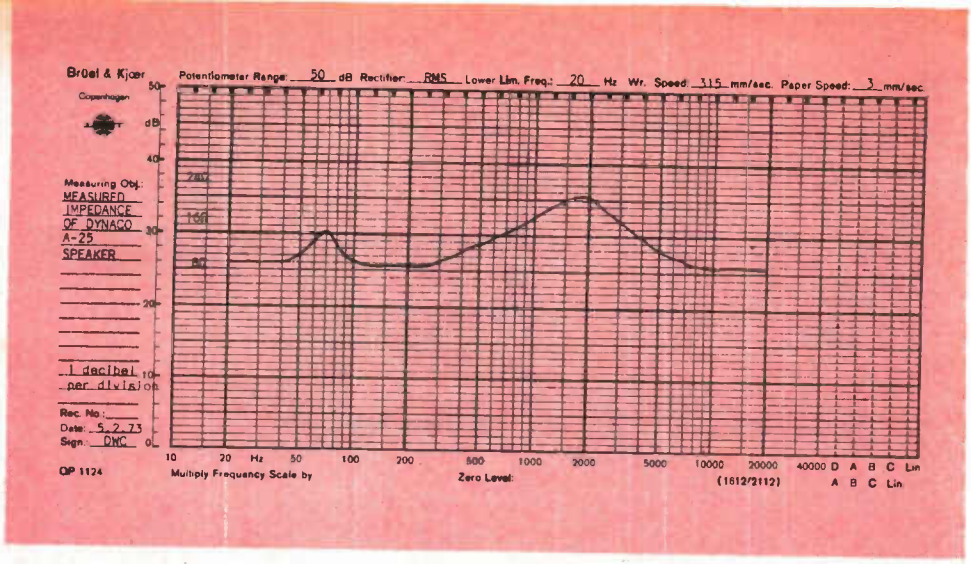
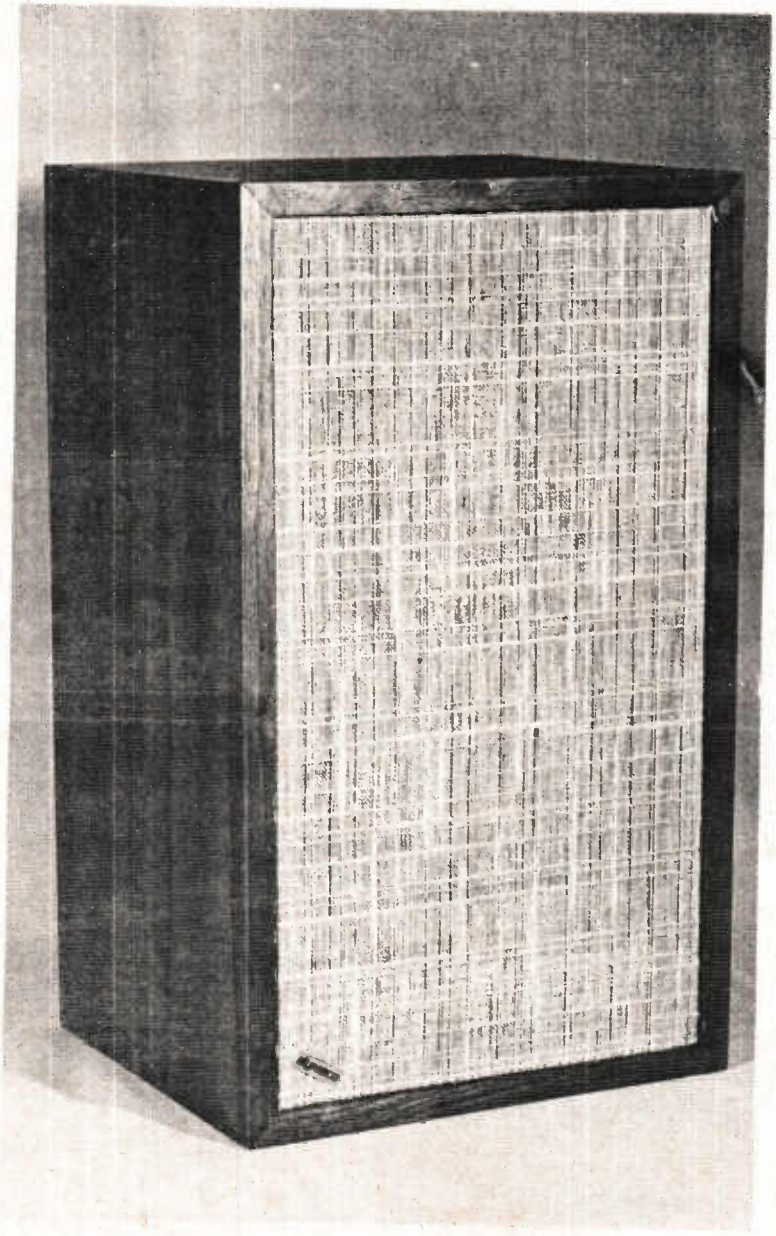


DYNACO A-25 SPEAKER



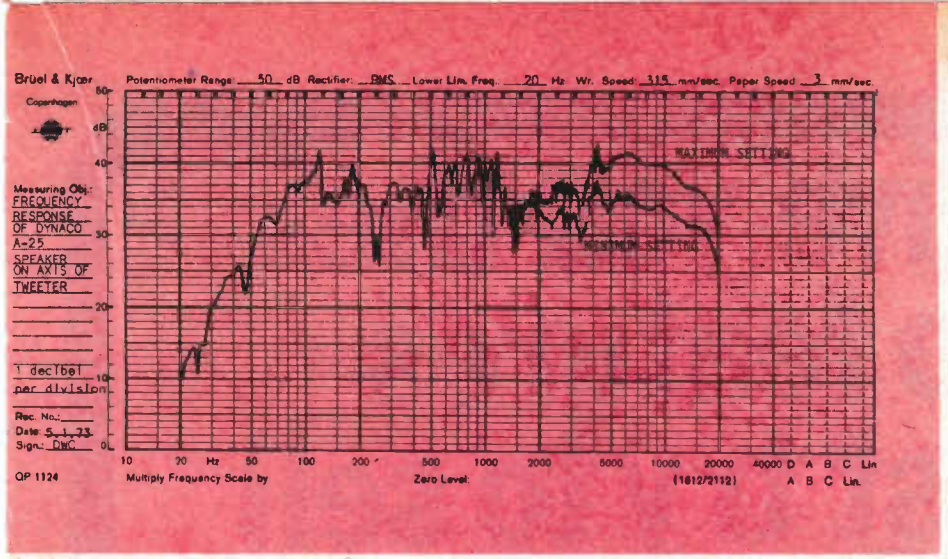
THE Dynaco A 25 is an interesting loudspeaker — firstly because it is different from its competitors in a number of technical features, and secondly because it is lower in price than most other speakers imported from the USA.

Dynaco claim that this is an "aperiodic" system i.e. that its frequency response and acoustic impedance is flatter than the normal system. They also claim that the "Q" of the system is reduced by resistively loading the port. This approach was used extensively by Goodmans in the 1950's with their small volume enclosures, and their Acoustical Resistance Units which could be fitted in lieu of a tuned port on enclosures which used large speakers. The results that they achieved were satisfactory and comparable with the results that Dynaco have achieved.

The external appearance of the Dynaco A 25 speakers is plain and unpretentious. The enclosure is oiled walnut with a flecked beige grill cloth. The grill cloth is flush mounted in the timber enclosure with a two centimetre wide timber edging surrounding it. The speaker compliment consists of a 25 centimetre diameter (10") woofer and a 3.8 centimetre (1½") domed tweeter, with a capacitive crossover at approximately 1500Hz. The enclosure has a large single elongated rectangular port at the bottom of the face of the enclosure. This is damped by low density fibreglass protected by plastic mesh, rather than being tuned by a port in the conventional manner.

When the frequency response is measured right on axis the tweeter shows a marked improvement in its high frequency response. This was particularly noticeable with piccolos and violins which generate significant harmonic content in the 10-15kHz region.

With speech and singing, the



"A good speaker at a low price" — says our acoustical consultant Louis Challis.

Recommended retail price $129 each

performance of the Dynaco A 25 is exceptionally good and equal to any other speaker system that we have ever heard. This is primarily the result of first class linearity between 80Hz and 1kHz.

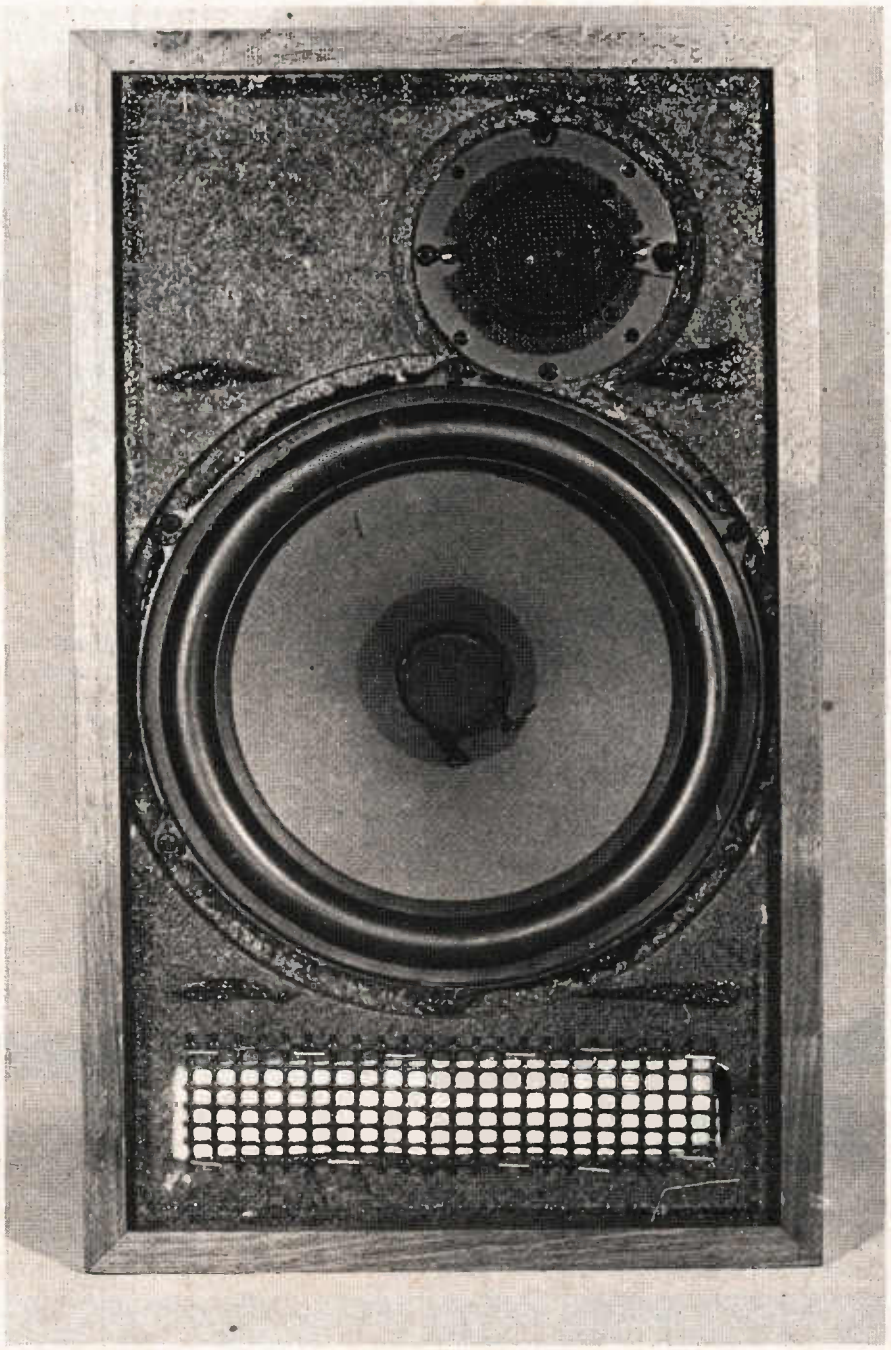
The 25 centimetre diameter low frequency driver is a conventional low efficiency speaker with a flexible roll surround and a 3.8 centimetre (1½") diameter copper voice coil. The unit has been efficiently designed to cope with normal transient signals and it is stated by the manufacturers that each speaker is tested and adjusted to cope with a 5Hz square wave so as to provide the minimum distortion in the back emf voltage across the voice coil. The woofer is well designed and is very similar to many European units that we have tested.

The domed tweeter is not quite of such a high standard. It offers reasonable performance, but because of its size (3.8 cm), and its configuration, there is some non-linearity in frequency response and excessive directionality at the top end of the spectrum. This tweeter is used to cover the spectrum from 1.5kHz to 15kHz.

We tried some of the latest records produced specifically for evaluating speakers and found that, apart from high level organ pieces and drum beats on which the A-25's woofer cone could be readily induced to break up, the overall performance was good. On classical guitar and flamenco pieces the performance was exemplary and every bit as good as speakers way out of their class.

The transient response of the A-25 below 1500Hz is excellent (accounting for the exemplary reproduction of the guitar, which does not have much high frequency content). Above 1500Hz the transient response is comparable with other speakers in the same price category.

(Continued on page 67)



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BFU-121

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

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

Manual and semi-auto models also available.

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MEASURED PERFORMANCE OF DYNACO A-25 SPEAKER SERIAL NO. 19-242036

Frequency Response
50Hz to 18kHz ± 7dB

Total Harmonic Distortion

	100Hz	1kHz	6.3kHz
1 Watt Input	0.6%	0.4%	0.5%
5 Watts Input	0.8%	0.8%	1.5%
10 Watts Input	1.5%		

Electro-Acoustic Efficiency at 1kHz 0.4%

Cross-over Frequency 1700Hz

Woofer Resonance
in free air 19Hz
in enclosure 62Hz

Measured Impedance
100Hz 9 ohms
1kHz 18 ohms
6kHz 10 ohms

Enclosure Volume
24 x 10^3 cubic cm.

Dimensions
Height 50 cm
Width 29 cm
Depth 25 cm

Weight 8.5k kilograms

MEASURED PERFORMANCE

The measured performance of the A-25 was quite good, the frequency response being ± 7dB from 50Hz to 18kHz. Distortion, at a realistic listening level of 5 watts, was very good — being below 1.5%. More detailed measurements between 1000Hz and 3000Hz showed a threefold increase in harmonic distortion compared with the rest of the spectrum.

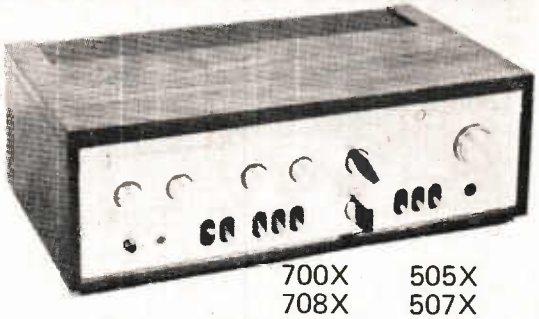
This was also noticeable in the subjective assessment when very loud orchestral passages were played. The electro-acoustic efficiency of these speakers was lower than for a normal vented enclosure, for usually they have an efficiency in excess of 0.6% to 0.8% at 1000Hz.

The enclosure is not a truly aperiodic design, it has a measurable resonance at 62Hz due to the physical characteristics of the enclosure and its resistive vent.

The clarity of program content produced by the Dynaco A-25 speakers was equal to the best we have heard, but this is offset in part by poor off-axis high frequency response.

The design is interesting, and should create a lot of interest amongst hi-fi enthusiasts seeking a good speaker at a low price. ●

LUX AMPLIFIERS



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MICRO 311
MICRO 611 Professional 8 Pole
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KITS –
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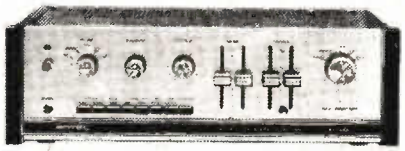
ROTEL AMPLIFIERS



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310 – 34 watts R.M.S.
610 – 64 watts R.M.S.

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AMATEUR RADIO

Roger Harrison VK2ZTB

THE STATE OF THE ART

THE performance of A06 Oscar satellite has exceeded expectations and many Australian and New Zealand stations have worked through the translator. One of the most notable stations to appear on A06 recently is a young New Zealand girl, Joy, ZL2TOJ, She uses SSB and has worked quite a few Australian amateurs in the eastern states and can be heard quite regularly.

A number of amateurs in Queensland, NSW and Victoria have heard a station signing KX6HK, from the Marshall Ils. in the mid-North Pacific. A number of Qld and NSW amateurs have also heard Japanese stations on some passes but, as yet, no contacts have been made.

Regretfully, the 435.1MHz beacon failed in mid-December. The emitter of the final amplifier went open circuit — according to housekeeping data received from the satellite by AMSAT members. This could have been due to thermal runaway caused by excessive harmful solar radiation.

The Australian-designed translator scheduled for launch in A07 later this year will undergo prototype testing in a balloon flight scheduled for mid-March (listen to WIA Sunday morning broadcasts for exact dates/times). This translator will have four input channels centred on 145.8, 145.85, 145.9 & 145.9MHz and corresponding output channels centred on 435.1, 435.15, 435.2 and 435.25 MHz. The input receiver will be a hard-limiting FM design and will only accept FM modulation input with 15kHz deviation. The power output of each of the 435 MHz channels will be 1 watt. It will also carry a low power RTTY telemetry beacon transmitting on 436.00 MHz.

The balloon launch will be code-named "Highball" as previous ones have been. Expected maximum height of the flight is 120,000ft and the balloon will be launched from Mildura in N.W. Victoria. Mean communications range is expected to be 1000 miles, centred on Mildura.

ATV

I attended the January meeting of the WIA Victorian Division VHF Group and saw an excellent lecture/demonstration of ATV given by Peter Wolfendon, VK3ZPA. Peter transmitted the lecture from his home location at Sunbury, some 20 miles from the Victorian Division's rooms where the meeting was held. The system employed a modified commercial camera, the rest of the system being home-made. The transmitter was on 430MHz and the receiving system employed a solid-state converter ahead of a portable TV set.

It is of interest that Peter worked Bill Nichols, VK7EM at Penguin in Northern Tasmania on December 13th 1972 on 430MHz ATV. Noisy but perfectly copyable pictures were exchanged both ways. The distance between the two stations is 240 miles. Twenty watt transmitters were used at both ends. This is an Australian record for ATV.

Currently active on ATV in Victoria are Geoff, VK3AUX (an ATV pioneer); Peter, VK3ZPA; Greg VK3YGB; Peter VK3BFG; Barry VK3ZUN and VK3ZYD.

MOONBOUNCE

A patient worker on 144MHz moonbounce is Chris Skeer, VK5MC at Hatherleigh S.A. Chris first obtained his own echoes from the moon on 24th October 1972 after nine months of work. He was unable to tape his

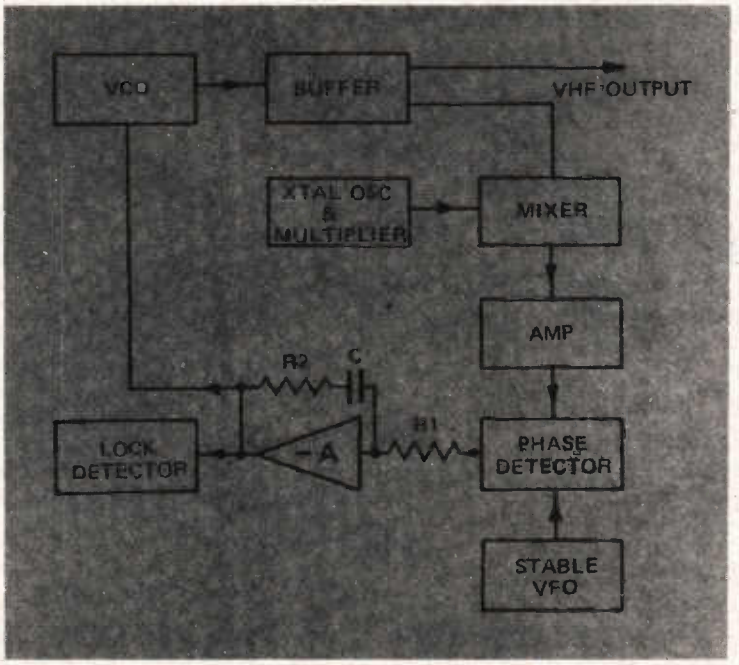

Fig. 1. Phase-locked oscillator designed by Hamish Kellock VK3ZMZ

STATE OF THE ART

echoes on the 24th of October due to interference from his recorder but successful tapes were made on 28th October with a different recorder.

Equipment consists of a 100 watt CW transmitter with a 4X150A in the final stage feeding a stacked rhombic antenna array of 50 wavelengths per leg. The converter is home made using TIS88s in the front-end, followed by an FR100 receiver. An active audio filter using ICs, having a bandpass probably less than 200Hz is used for audio signal processing.

This is the first successful attempt from a South Australian amateur.

Chris finds it necessary to work on his rhombic array before further tests as it was found to be nearly one degree out of alignment. Assistance was given by a number of Mt. Gambier amateurs, particularly Trevor, VK5TN. A very fine effort.

Ron Wilkinson, VK3AKC (Geelong, Victoria), continues to progress with work on his 1296MHz equipment for moonbounce. He has a pair of 3CPX 100A5 planar triodes operational as a P.A. for his transmitter. He is also reported to be able to receive greater than 12dB of sun noise at this frequency. It appears to be only a matter of time before Ron is ultimately successful.

The Illawarra (NSW) Moonbounce Group has made some improvements to their receiving system.

A post amplifier stage has been included ahead of the 432 MHz converter. They are now obtaining 14dB of sun noise which is 3dB better than previously obtained.

CIRCUITRY

Hamish Kellock, VK3ZMV has developed a phase-locked oscillator for VHF. It can be used for a receive system local oscillator or transmitter VFO and employs discrete components. Details were published in the "Victorian VHFer", October 1972.

A block diagram is shown in Fig. 1.

Variations on an original theme... with Silcron!

Although it's only two years since the very first Silcron turntable was released, this economical and noise-free belt driven turntable has captured a substantial percentage of the Australian hi-fi market. The original Silcron Mk. III appeals to the hi-fi enthusiast who demands perfection yet is cost-conscious; without doubt it is the finest turntable available at the price.

Like all engineers who are also perfectionists, the designers of the original Silcron turntable have recognised the need for a deluxe model. And so we release the new Silcron Mk. IV "Isophonic" Series. It combines all the proven attributes of the Mk. III with new design and engineering features which make it the most outstanding turntable available in Australia today . . . no other turntable offers as much performance for relatively low cost.

FEATURES OF THE SILCRON TURNTABLES:—

SILCRON MK. III.

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- Wow and flutter — less than 0.04%.
- Lightning fast speed change.
- Two speeds — 33⅓ and 45 r.p.m.
- Dynamically balanced cast aluminium turntable platter.
- Only 3 moving parts.
- Anti-static mat at no extra cost.
- Height above motor board — 2".
- Precision engineering throughout.

SILCRON MK. IV "ISOPHONIC" SERIES.

- New sealed 8 pole 750 r.p.m. synchronous motor.
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- Wow and flutter — less than 0.04%.
- Lightning fast speed change.
- Two speeds — 33⅓ and 45 r.p.m.
- Dynamically balanced cast aluminium turntable platter.
- Four times the power of the Mk. III.
- New centre bearing shaft assembly.
- Acoustically insulated turntable platter and pick-up assembly which eliminates acoustic feedback.
- Tone arm tracking is constant.
- New vibration absorbent anti-static mat.

CHOICE OF MODELS — SILCRON MK. III.

- Basic turntable only, unmounted.
- With motor board and timber base.
- With independently sprung motor board, dustproof perspex cover, professional tone arm and magnetic stereo cartridge.

CHOICE OF MODELS — SILCRON MK. IV

- Basic turntable, unmounted.
- With professional quality tone arm.
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Note: Dustproof perspex covers and spring mounted timber bases are available for both Silcron models.

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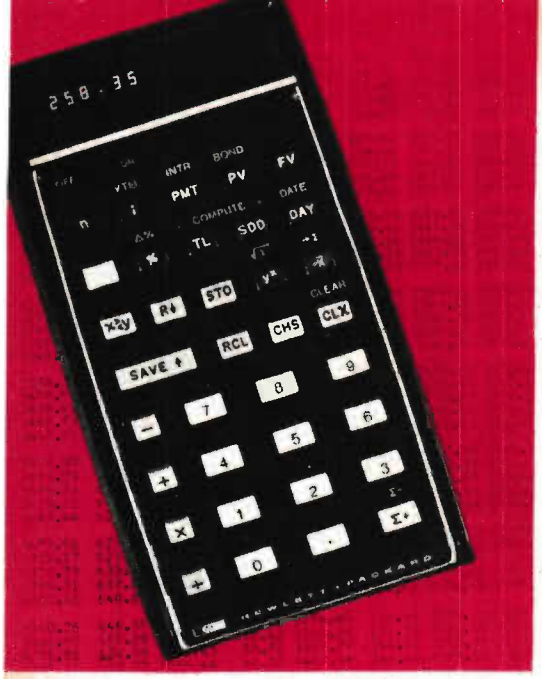

Computer in your pocket?

A powerful electronic calculator, small enough to fit into a shirt pocket, yet capable of performing the most complex business and financial calculations, has been introduced by Hewlett Packard.

THE NEW HP-80 Calculator, weighing only nine ounces, has a solid-state memory similar to that used in computers. Thus, its capability extends far beyond simple addition, substraction, multiplication and division.

With the HP-80, virtually all financial calculations involving the relationship between money and time can be done quickly and easily, according to John A. Warmington, Managing Director of Hewlett-Packard Australia Pty. Ltd.

For example, in less than a minute, the user can determine the bond yield between any two dates. There is no need to consult cumbersome financial tables, since the necessary data, including a 200-year calendar, are already stored in the calculator's memory.

Similar problem-solving capability is provided in such areas as compound interest, sinking fund, loan repayment, depreciation and amortisation, truth-in-lending calculations and investment analysis.

For most problems, the actual time of calculation by the user is less than 10 seconds. In more complex calculations, such as determining discounted cash flow, the HP-80 can save the user as much as 10 minutes. Although its calculating speed rivals that of a computer, the user need know nothing about computers to operate the machine effectively. A handy reference guide enables him quickly to put the machine to work.

The new calculator, with its 10-digit display, is accurate to within a cent in a million dollar transaction. Like larger, more expensive machines, it also has the capability to handle numbers as large as a 1 followed by 99 zeroes.

Although Hewlett-Packard is known widely as a manufacturer of electronic test equipment, in recent years the company has diversified into the computer and calculator fields.

Just a year ago, the company introduced its first pocket-sized calculator. Known as the HP-35, it is a machine designed for engineers and scientists.

While the HP-35 was designed to solve equations commonly used by engineers and scientists, the new HP-80 is aimed at providing the same problem-solving service for the financial community. It is an entirely new approach to handling financial calculations.

Among the unique features of the HP-80 is the 200-year calendar stored in the machine's memory. This is particularly valuable in projecting cost, interest, future value and other financial data. By pressing appropriate keys, the user can determine quickly the number of days between any two dates from January 1st, 1900 to December 31st, 2099. Or, given a date and a number of days, he can determine a past or future date.

HOW IT WORKS

The HP-80 is a pocket-sized business calculator. It differs from the HP-35 (Hewlett-Packard's original pocket-size scientific calculator) in its built-in programming. The HP-35 solves *functions* with a single keystroke: The HP-80 solves *equations* with a single keystroke. Typical of the functions solved by the HP-35 with one keystroke are: Log, Ln, SIN, COS, TAN and X^Y. Some of these functions are hard-wired into the HP-80 as subroutines within the single keystroke programs. In other words, the HP-35 has one level of programming, while the HP-80 has two levels. The most important equations used in banking, finance, accounting and real estate have been programmed into the HP-80. Data is entered, then a key is pressed for the unknown. The HP-80 executes the appropriate program, calling upon all the required functions, each of which is wired into the calculator as a subroutine. Thus, the HP-80 executes the entire program needed to solve an equation, including the necessary subroutines, all with one keystroke.

In a way, the operation of the HP-80 can be compared to that of a computer. A computer program stored on magnetic tape, discs, etc., is called by the operator when it is to be executed. But in the HP-80 each program is part of the hardware built into the calculator and called with one key press.

Four temporary memory registers used in the HP-80 are arranged in a stack, in the same way as in the HP-35 scientific calculator. Like the HP-35, the HP-80 also uses reverse Polish notation as the most efficient way known to computer science for evaluating mathematical expressions. This scheme helps achieve the goal of packing a great deal of calculator power into a very small space.

The operational stack consists of four registers, X, Y, Z and t. The stack stores intermediate results and the calculator automatically recalls them from the stack when required for further processing. This eliminates the need for manual intermediate notes or re-entry of intermediate answers. Only the contents of the X register is displayed on the solid-state display.

Numbers are entered into the stack from the bottom on a first in, last out basis. When a number is keyed in, it goes into the X register and is displayed. When "SAVE" is pressed, the number is repeated in the Y register. At the same time, any number

in Y moves up to Z, any number in Z moves up to t, and t is lost. When an operation is performed on data in the X and Y registers, the answer automatically appears on the display, and the entire stack drops.

Both the HP-80 and the HP-35 use specially-designed MOS/LSI circuits using a low-power, high performance ION-implantation process. The HP-80 uses seven read-only-memories versus three for the HP-35. The four additional ROMS handle logic needed to solve these complex equations.

Answers appear on a 15-character solid-state display. Each digit of the light-emitting diode (LED) display is of passivated monolithic construction made up of seven segments. The inherent ruggedness and long life of these monolithic solid-state devices contribute to the reliability of the HP-80. Use of one digit for the decimal point results in excellent legibility.

An unusual feature of the calculator is the "golden key". This key, immediately above the exchange X and Y key, operates like the shift key of a typewriter and allows eleven of the keys to perform a dual function. For example, pressing it before pressing the "%" key allows instant computation of the percentage difference between two numbers.

COMPLETE LIST OF THE HP-80'S CAPABILITIES

Beyond the basic four functions (+ – X ÷), the HP-80 is pre-programmed with 36 separate financial capabilities.

Constant storage
Selective round-off
Percentage calculation
Percent difference
Square root
Powers (exponentiation)
Running total (summation)
Mean (arithmetic average)
Standard deviation
Number of days between two dates
Future date given number of days
Future value of an amount compounded
Present value of an amount compounded
Effective rate of return for compounded amounts
Number of periods for an amount compounded
Future value of an annuity
Present value of an annuity
Effective rate of a sinking fund
Effective rate of a mortgage
Installment of an annuity given future value
Installment of an annuity given present value
Number of periods for a sinking fund
Number of periods for a mortgage
Add-on to effective annual rate conversion
True equivalent annual rate
Linear regression (trend line) analysis
Sum-of-the-years'-digits depreciation amortization
Rule of 78's finance charge amortization
Discounted cash flow analysis
Accumulated mortgage interest calculation
Remaining principal on a mortgage
Accrued interest (360 and 365-day year)
Discounted notes (360 and 365-day year)
Discounted note yields (360 and 365-day year)
Bond price*
Yield-to-maturity of a bond*

*Corresponds exactly to standard bond yield tables used in investment industry.

Each key has a touch similar to the action of an electric typewriter. A vapour barrier used between the keys and their contacts reduces environmental effects on the machine.

Rechargeable nickel-cadmium batteries with about five hours of operating time and an ac adapter-recharger are provided.

We were extremely impressed with the HP-35 when it came out 12 months ago and at that time thought that it was just about the ultimate in pocket calculators. We were wrong — it seems that with ingenuity such as that used in the design of this calculator, we soon *will* be able to carry a computer in our pocket. ●

MATCHING COMPATIBLE STEREO... THANKS TO WHARFEDALE

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AUTOMATIC CAMERAS

Continued from page 22

and costly gamble on the part of Dr. Land — for the film and camera were seven years and 250 million dollars in the making. Pollution conscious Land was determined to reduce the garbage and sticky fixing chemicals associated with previous film and the only way around the problem seemed to be to have the film self-developing outside the camera in ordinary lighting.

Land is never one to think small and he merely ordered his chemists to come up with an opacifier which would block out light rays until the development process was complete. A team of 25 chemists worked for 4 years before a successful opacifier was developed.

Well now how does this chemical marvel operate? The film card contains no less than 17 chemical layers. The negative, a mere three-hundredth of an inch thick, contains eight such layers, some of them are only as thick as a red-light wavelength, i.e. one fifty-thousandth of an inch. These layers are covered by a tough transparent-mylar film on front and an opaque, acetate backing-card.

After exposure the film card is fed automatically to processing rollers which rupture a pod containing three separate chemicals which are spread between the positive and negative layers as the film card is ejected from the camera. Most of the chemical contained in the pod is titanium dioxide, (about 50%) an intensely white pigment, which forms a background for the colour dyes which would otherwise form a transparency under the clear mylar film.

The characteristically turquoise colour of the freshly ejected print is due to the presence of an alkaline opacifier which together with the titanium dioxide, shields the development process now under way. It in fact shields the negative from light millions of times brighter than that required to expose it. The third constituent of the pod is a developing agent which oxidizes light-exposed dye layers. Unoxidized dyes diffuse upward towards the positive film layer and the colour image starts forming almost immediately. Development is complete in about 10 minutes, but a useful image is visible after only one or two minutes.

Whilst development and dye migration is in progress the alkaline opacifier gradually dissolves a plastic layer between itself and another acidic layer. When the two encounter, the opacifier immediately becomes transparent and the full colour image is revealed. At this stage development is also complete and we now have a very colour-stable print which requires no further treatment and is impervious to rough handling — even during the development process. Film speed is approximately 100 ASA and the resolution approximately 40 lines. There is in fact no perceptible grain structure.

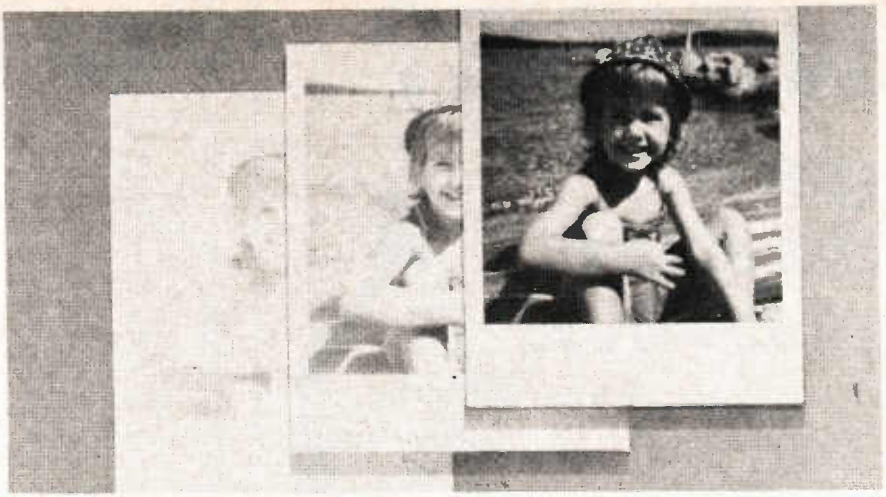


Fig. 17. A print from the SX 70 as it appears during the development phase which takes 10 minutes.

FLASH PHOTOS

General Electric in co-operation with Polaroid, have developed a special plug-in flash bulb unit for the SX70. The unit is called the Flashbar 10 and has 10 bulbs in all, five on each side. Flashbar operation is controlled by part of the camera logic circuitry which selects the next good bulb and skips over bad or previously exposed bulbs. Operation is also inhibited when the camera is empty or being loaded.

The Flashbar 10 clips into the top of the camera's shutter mechanism and automatically engages the follow-focus mechanism, thus there is no need to calculate enposure with distance.

The new SX70 provides far better colour prints than the old Polaroid system but they are more expensive than those produced by conventional colour photography. It is still difficult to duplicate prints and to make enlargements, and further, the new Polaroid film does not have the exposure latitude of Kodacolor. However, no-one can deny that the new camera/film technology goes a long way towards answering photographers dreams.

One sad note — the camera is as yet on limited sale in the US and will not be available in this country for some time. ●

Radio astronomy for amateurs

PART XIII in this, the penultimate article in the series. Roger Harrison gives a number of valuable hints and tips on antenna construction.

PRACTICAL ANTENNA CONSTRUCTION TIPS

There are quite a variety of materials from which antennae can be constructed. Wood and wire arrays are popular for HF antennas. Wood is cheap, easy to work and suitable pieces are often available from the local hardware store. However, wood is nowhere near as weather resistant as metal.

All-metal construction antennae are usually employed in the VHF range. Constructing antennae using all metal assembly is a little more difficult but ingenuity overcomes most problems.

A number of antennae are designed in such a way that elements must be supported on a main boom. The Yagi is a prime example.

Four methods of attaching elements to booms are shown in Figs. 1, 2, 3 and 4. A square section, wood or aluminium tubing boom will support elements very easily (Fig. 1). The elements may simply be drilled, or screwed, or bolted on to the boom although this reduces the strength of the element. Two screws are necessary to keep the element at 90° to the boom.

Alternatively, electrical cable 'saddles' or clamps of the appropriate size, are used to clamp the element to the boom. A simpler way, but often disastrous if you make a slip or measurement error, is to drill a hole slightly smaller than the element diameter, through the wooden boom and force the element through. It works, but we don't recommend it!

If a round section wooden or aluminium tube is used for the boom, (as shown in Fig. 2) then TV antenna hardware is excellent. Usually, the boom diameter is limited to 7/8" or 1" O.D. and the element diameter to 3/8" O.D. as these are standard sizes for TV antenna elements.

Suitable insulator/element-clamp assemblies are available for folded dipoles in the TV antenna hardware range. It is a very convenient form of construction and has much to recommend it. I have found that, using this type of construction, antennae go together much quicker, almost BOAC style (with a minimum of fuss).

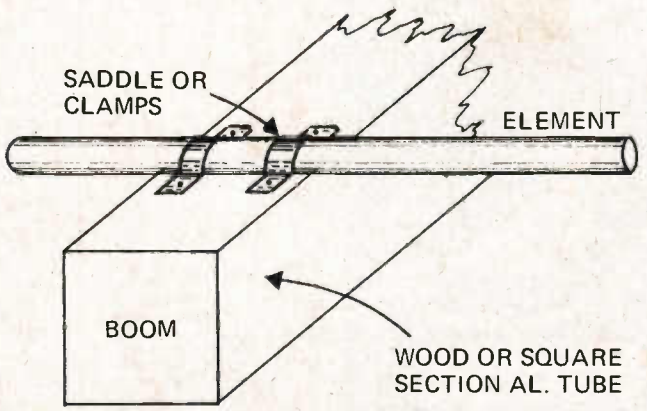


Fig. 1. Clamping an element to a square section boom.

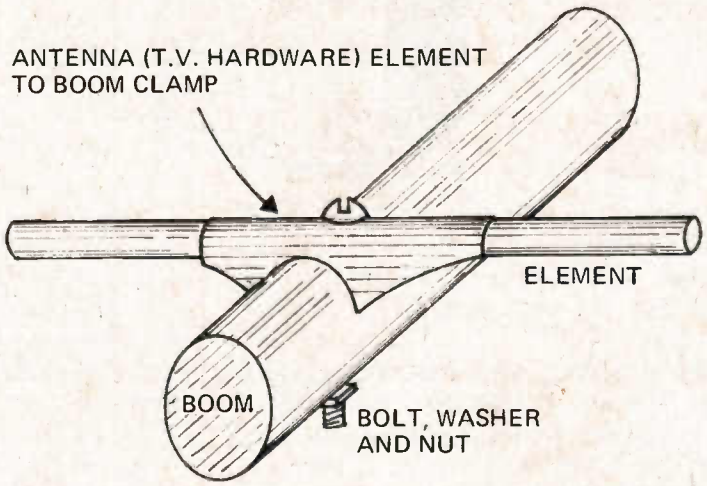


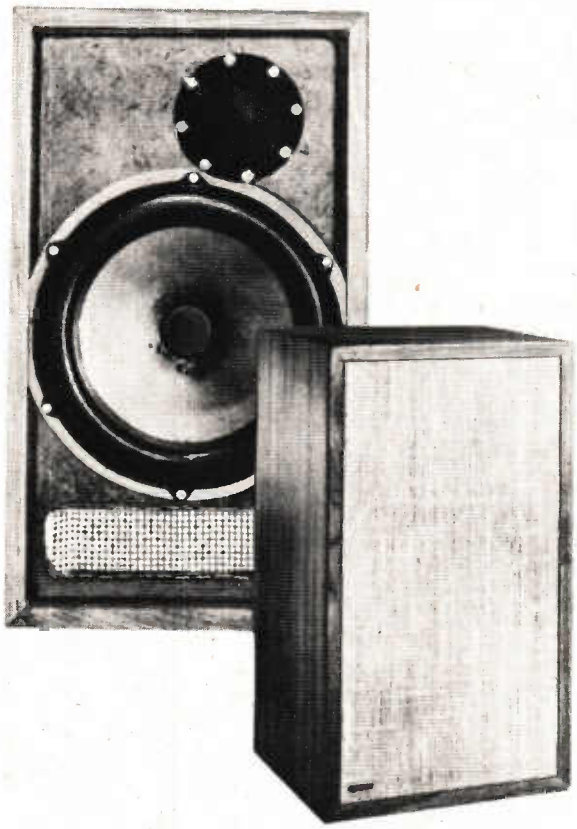
Fig. 2. Using TV antenna hardware.

A simple clamp arrangement as shown in Fig. 3 is readily made up where an element passes through the boom. The clamp is made from a scrap of metal similar to that used for the element (and boom if a metal boom is used). It should be somewhat larger than half the circumference of the boom and drilled at each end so that the element passes through it. The centre of the clamp is drilled to take a suitable size self-tapping screw which should have a blunted point. This is not the most robust arrangement for clamping an element to a boom but is good where only a short life is required from an antenna.

Turn to page 79

"...(The Dynaco A-25) has established a new standard of performance in uncolored, natural sound."

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



"...you'll have a hard time buying more musical naturalness at any price."

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

The critiques from these hobbyist magazines have unusual merit as these publications accept no advertising. Their comparative evaluations are funded solely by the subscriptions of ardent audiophiles.

The A-25's sound quality is a direct consequence of its smooth frequency response, outstanding transient characteristics, and very low distortion. Its aperiodic design (virtually constant impedance over its range) provides an ideal load so any amplifier can deliver more undistorted power (and thus higher sound levels) for a given speaker efficiency.

Uniformity of impedance also makes the A-25 the best choice for adding two new speakers to an existing stereo setup using the Dynaco system* for four-dimensional reproduction. In this way, true "concert hall sound" can be enjoyed with a standard stereo amplifier.

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Radio astronomy for amateurs

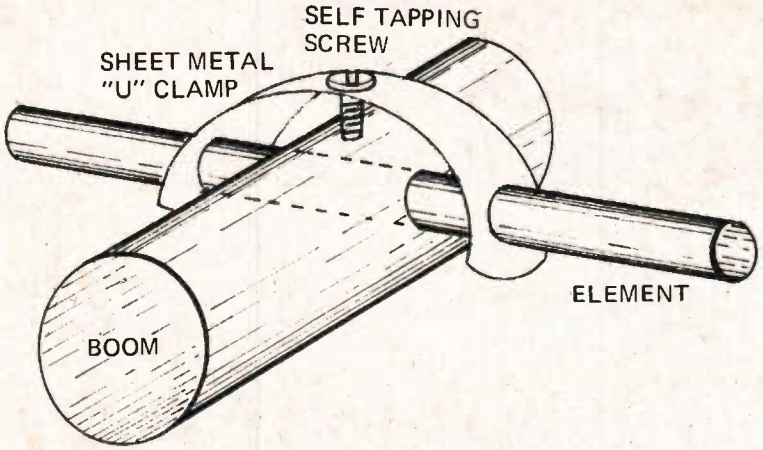

Fig. 3. Simple clamp arrangement.

Drilling the boom to pass the element, and then passing a bolt through the element and boom, as shown in Fig. 4, ensures a very robust assembly. Care must be taken to mark and drill the element and boom correctly. There are many other possible methods, but those discussed above we believe to be the simplest.

Where elements pass *through* a metal boom, they must be lengthened to account for the effect of the boom on the resonant frequency of the element. A good rule of thumb is to add an amount equal to two thirds of the boom diameter to the length of each element.

Folded dipoles can be readily designed so that their mechanical assembly becomes quite easy. Choose the spacing for the folded section to be equal to the boom diameter where the elements are mounted *above* the boom and design the element diameters accordingly for the impedance transformation desired. Where the driven element passes *through* the boom make the spacing half the boom diameter.

ATTACHING BOOMS TO SUPPORTS & MASTS

There is one simple rule for making good mechanical joints where booms cross supports at right angles – or any angle for that matter. That is . . . use your head! Not physically, just THINK. A bit of thought will save your 356 element, high gain masterpiece from crashing down around your ears the first time that its pointed at Orion! And it won't be Orion's fault.

Several tried-and-true methods are available. Again – use can be made of

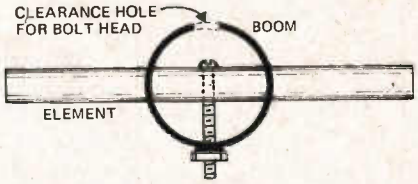

Fig. 4. Element bolted through boom.

standard TV antenna TV antenna fittings and hardware. U-bolts and brackets are readily available for assemblies that range from light, thin-walled tubing to heavy gauge pipe. Don't skimp, it could cost you your life – a complex array is a heavy animal indeed.

Gussett plates can be constructed at home in the workshop from a square of heavy gauge sheet metal.

The antenna boom can be bolted to the gusset plate which is subsequently either bolted to the support or mast for a light weight array, or attached, using U-bolts, for a heavy array. This method is illustrated in Fig. 5.

For booms 1½" diameter or less, the gusset plate should be 6" per side. For 1½" to 2½" diameter booms it should be 8" to 10" per side. The thickness of the gusset plate depends on the length of the boom. Booms around 10' to 12' long, lightweight and less than 1½" diameter will require a gusset plate about 1/8" to 3/16" thick. Heavier and longer booms will require a plate ¼" to ½" thick. Extra bracing is generally required between boom and mast for longer and/or heavier booms.

USEFUL TIPS

Smear vaseline on the threads of bolts and nuts before and after

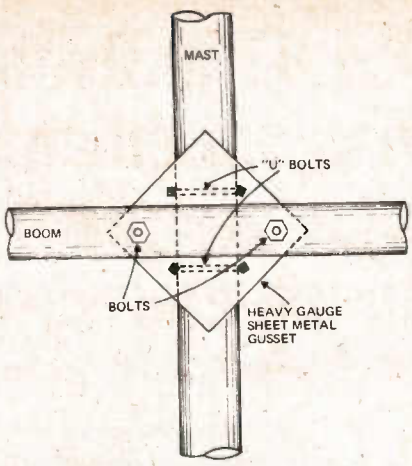

Fig. 5. Gusset-plate boom to mast mount.

tightening. This delays the effects of weathering and makes later dismantling much easier.

Spraying elements and transmission line connections and fittings with plastic or lacquer also delays the effects of weathering.

Always support coaxial cable at frequent intervals. Do not put sharp bends in it as this causes a sudden impedance "bump" often resulting in difficulties in matching, balancing etc.

Use the best coaxial cable you can afford and avoid long lengths.

Mount a preamplifier at the antenna – performance is considerably improved in most cases if these simple measures are taken.

When using open-wire transmission line, support it only sufficiently to prevent it moving very much in the wind. Keep it tight. Straight runs are preferable. Any bends should be obtuse or over a large radius. If using home constructed open wire line, use only sufficient insulators to keep the lines parallel and supported.

Avoid running open-wire line parallel to metal structures – if necessary, make a parallel run very short. Twist the line several times to help preserve balance.

When joining coaxial cable together or to a piece of equipment, use good quality, constant impedance connector such as BNC for ¼" diameter coaxial cable or type N or C for 3/8" or ½" diameter coaxial cable. Always use low-loss coaxial cable, the ½" or 3/8" diameter variety is better than the smaller type. There is less loss. Types ET13M and UR67 are excellent and not expensive. They are useful into the VHF region.

The final article in this series – to be published next month – describes a number of techniques that may be used to extend the usefulness of various systems, and covers in some detail the methods used to make observations. ●

Transducers in measurement and control

In Part 11 of this continuing series, Dr Sydenham discusses the measurement of force and related topics.

Physical objects have a property of mass as well as size. This is a fixed value for an object (provided time has no influence). It is the magnitude of the gravitational attractions upon it that decides its weight (weight = mass gravity). An object exerts a force upon its support due to the gravitational attractions. When zero gravity exists there is no such force — articles float in outer space because the gravitational pull of the heavenly bodies is negligible. A force can also be exerted by an accelerating mass (as Newton realised with his force = mass x acceleration equation) in the absence of gravity. Gravity is but one form of acceleration. A force can also be created by devices such as springs or magnetic attractions which do not rely on acceleration or gravity.

Basically then, the weight of an object is decided by our knowledge of the gravitational pull acting on it. Fortunately, variations in gravity with time and place (on the Earth at least) are small compared with the precision needed in most commercial applications and a fixed value, or even a total disregard for it, suffices. (For example the roughly 12 hr period gravity variations due to the effect of the changing orbit of the Moon are roughly one part in 10^7.) The standard value of gravitational acceleration is 9.80665 m/s^2.

Units of mass, weight and force in existence are varied. The Imperial systems' pound and slug (an engineering term used for mass as opposed to weight) have been confusing to the uninitiated. The distinction between mass and weight is often not made.

Metrication now dictates the use of the kilogram kg as the mass unit and the Newton N as the force unit. As force and weight are often synonomous it has been usual practice to qualify force by the use of the letter f as in lbf but now only Newtons N and kilonewtons KN are to be used for force with the gram g, kilogram kg and tonne t being reserved for mass.

Not always is it the total force of a system that is of interest. Instead it may be a derived quantity. Pressure is the force exerted by a distributed force on a unit area of surface. Torque is variable acting about a pivot joint that is created by a force effectively acting at the end of a lever arm.

Common Imperial pressure units are pounds per square inch, psi, or inches of mercury Hg or water H_2O. (A column of liquid exerts an absolute pressure at the bottom depending on its density and the height of the column). In the new metric system the unit of pressure is the pascal Pa (Pa = $N.m^{-2}$). Older units were kilograms per square centimetre or metre and centimetre height of water or mercury. In meterological measurements of atmospheric pressure the millibar mb is commonly used — weather charts express pressures of highs and lows in hundreds of millibars mb. A standard atmosphere is now exactly defined as 101.325 kPa, but millibar units will still be used in weather records. A pound per square inch equals 6.89kPa.

To further confuse the issue, vacuum pressures (those less than atmospheric in general) often use a unit 'torr' that is the pressure exerted by 1 mm of Hg at 0°C. In this range it is also acceptable to use mm Hg and uHg units. Specific mention is made of vacuum gauges for they measure low pressures by quite different methods to the above atmospheric pressure devices.

To conclude this brief resume of units there are three forms of pressure definition. Firstly it can be expressed in an absolute sense, pure vacuum being zero pressure. In absolute terms atmospheric pressure is the familiar 14.7 psia or the 101 KPa mentioned above. (Note the use of 'a' to denote absolute). Secondly, a gauge pressure can be used, psig for instance, where atmospheric pressure is used as a reference datum of zero pressure. Thirdly, pressure might be the difference between the unknown and a convenient datum pressure other than atmosphere. This is the differential pressure — psid is how it is denoted. If the pressure is stated in the column height form it could be designated as in.wg (water gauge) or inH_2O

measuring inches of water.

Torque is now correctly expressed as newton metres N-m but the many older units such as pounds force-inches, ounce-inches, dyne-centimetres, kilogram-metres and others will be in use for a considerable time to come. They should not, however, be used in newly-prepared documents describing new products.

THE STANDARD OF MASS AND CALIBRATION OF FORCE

As force, weight, pressure and torque depend on mass it is appropriate to discuss the means by which the unit of mass is standardised.

Like all standards, that of mass is man-made – there is nothing about our everyday experience of nature that is regular enough to suggest its use as a standard. The aim, therefore, has been to provide commerce and science with a certain piece of substance that is the sole mass standard. The earliest mass standard seems to be the beqa used by the Egyptians around 3 800 BC. it was a cylindrical object with rounded ends (perhaps to ensure no corners could be knocked off?) that weighed around 0.2 kg. It is said our Troy weight system developed from this. As civilisations flourished independantly in those times there were also other standards. Today the standard is universal and is a lump of platinium-iridium that is held by the International Bureau of Weights and Measures (BIPM) in Paris. This object defines the prototype kilogram – all others are substandards and are calibrated by comparison with this.

Many modern standards are now based on atomic phenomena (a verbal definition of an apparatus enables any group to construct its own standard to the same precision without need to actually inter-compare the two – atomic phenomena give excellent results) but to date it is not possible to relate the prototype kilo with the fundamental mass unit ($1.66\ 10^{-27}$kg) to a precision equal to the current arrangements of merely weighing the unknown and the standard. Even a comparatively simple beam-balance can be used to compare similar masses to within parts in 10^9 when used with adequate precautions. If the masses are of different material the task is not so simple. Firstly, the bouyancy of each in a fluid will be different due to their different volumes, and secondly they each will have a different quantity of absorbed gas. The use of vacuum weighing to avoid the bouyancy problem only introduces a problem by removing the absorbed gas that is regained when the vacuum is released. The practical solution (standards must be a practically useful arrangement) is to compare different masses in a standard air pressure.

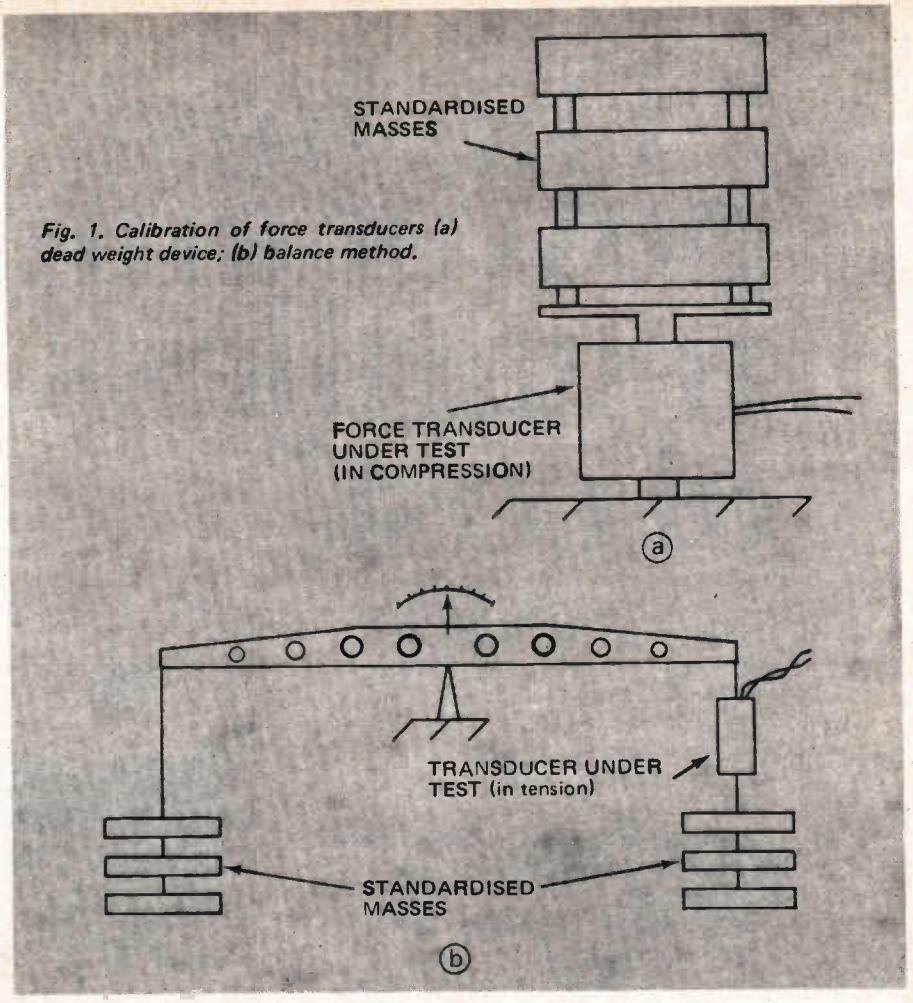

Fig. 1. Calibration of force transducers (a) dead weight device; (b) balance method.

In use, a standardised mass will exert a defined force due to gravity. Force transducers are therefore calibrated by putting them in series in a force loop. The two ways of doing this are shown in Fig. 1. Deadweight testing rigs go as high in capability as 100 000 000 N. Balances usually are used to calibrate to 10 000 N.

FORCE TRANSDUCERS

The need to determine the force acting in a mechanical loop arises in the calibration of pressure transducers, in the testing of civil structures where stress levels must be known, for weighing both static and moving loads, in the testing of automatic machine-tool structures, as the basis of accurate electric current determination and in force-balance devices mentioned earlier.

Unlike other variables there are comparatively few forms of force measuring transducer. The main principle employed makes use of an elastic mechanical member that deforms proportionately with loading. A secondary output transducer monitors the resultant displacement.

The design-aims for the elastic member are to achieve a linear movement of adequate magnitude that suits the available microdisplacement sensors. It must also have low mechanical hysteresis, a long fatigue life and be minimally influenced by environmental factors such as temperature. A few of the force sensing elements in common use are shown in Fig. 2. In each arrangement the sensor is usually placed at the position of maximum stress. Resistive strain gauges, inductive and capacitive sensors are generally used. The complete device is termed a load-cell. In some designs a solid-block is machined out to produce areas of considerably high stress to enhance the sensitivity. In the measurement of dynamic force systems a compromise must be made between the load cell spring rate (a more elastic cell gives a larger strain signal) and the sensitivity obtained (a less elastic cell results in higher resonant frequencies but gives a smaller output signal).

Piezo-electric ceramics provide an electrical output directly from the application of force across the device. During the initial period of force variation, charge will flow to balance the energy but as there is only a fixed amount of energy available for a given force distance product the

"The best power amplifier regardless of cost."

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Our philosophy at Amcron is that there's no such thing as good-better-best. Variations in product scope and function, yes, but deviation from the highest degree of perfection attainable — no! Our dedicated aim is to continue to produce audio equipment which sets the ultimate standard of reference. We cannot apologise for our prices. Because every item of equipment that carries our name has been designed by our engineers to be measurably and audibly superior to anything else available — regardless of cost.

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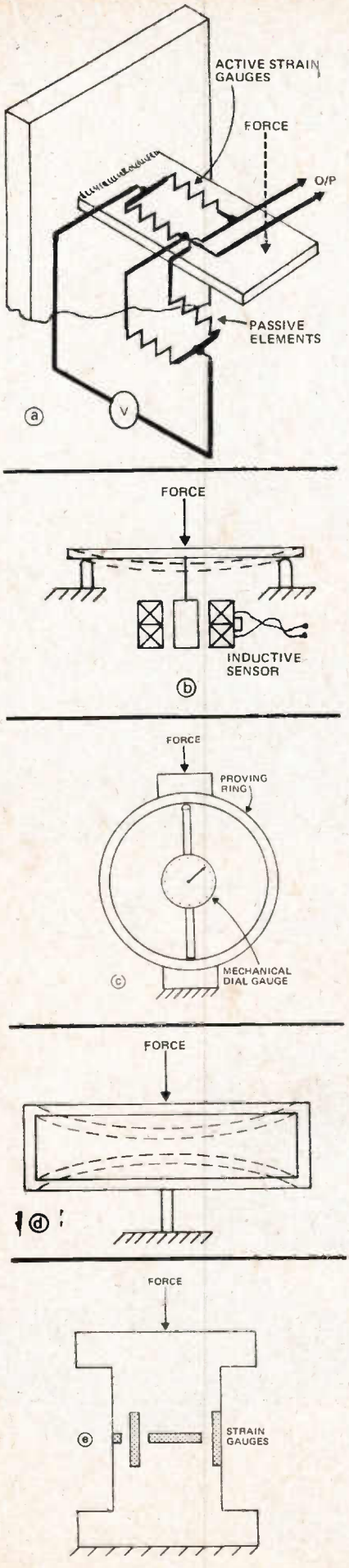


Fig. 2. Elastic elements used in force transducers. (a) cantilever; (b) simply supported beam; (c) proving ring; (d) disk cell; (e) solid or tube column.

signal eventually drops to zero. To extend the duration of the signals (to give the piezo device quasi-static performance) an extremely low-leakage amplifier is used to read the charge flow. When measuring rapidly varying alternating forces, as for instance in machine-tool vibration analysis, there is a continual energy supply and the high input impedance amplifier is not as vital. The force transducers are extremely stiff so little deflection occurs across them.

Many instruments rely on springs to provide a calibrated balancing force that can be used to measure an unknown force. There is a basic difference between such dynametric devices and force assessment by the use of weights.

The weight of an object determined by the absolute method using a beam-balance will be the same regardless of the value of gravity for both masses are equally attracted. A spring devised determination, however, will vary with gravitational changes, for the spring provides a constant force distance relationship. (This is the basis of many sensitive gravity-meters)

CHEMICAL BALANCES

Beam balances have been in use since the earliest times and even a crude arrangement can be used to compare weights to high precision. In the 18th century the rise of research interest in chemistry created a continual need for better balances. Joseph Black reported results of a chemical weighing to the nearest grain (0.065 gm). By the 19th century Handolt was weighing 500 gm loads to several micrograms.

The simple beam balance has been continually developped to reduce the errors in knowledge of the length of the arms, to increase the sensitivity by reducing frictional errors and to simplify the balance adjustment and reading arrangement. Modern balances often make allowance for bouyancy effects and are quite different in appearance from the traditional beam balance. Counterbalancing loads are sometimes applied by front mounted knobs and this provides for simple use and direct readout of value.

Microbalances measure small loads to micrograms resolution, (they are, however, not often small in size). Most make use of a fine torsion-fibre or ribbon suspension that is twisted by the load. To determine the exact load, a counter-torque is applied to rezero the beam. Figure 3 is schematic of a commercial electro-balance. The sample is placed in one pan and a roughly equal weight in the other. To achieve balance the current in the coil is varied until the photocell displacement detector receives a standard illumination level. The process is easily automated to follow changing weights. A recently developed microbalance makes use of a magnetic field suspension system to support the load without mechanical restraint. The field-coil current needed to establish position balance is a measure of load. Modern microbalances can resolve weights of less than a microgram.

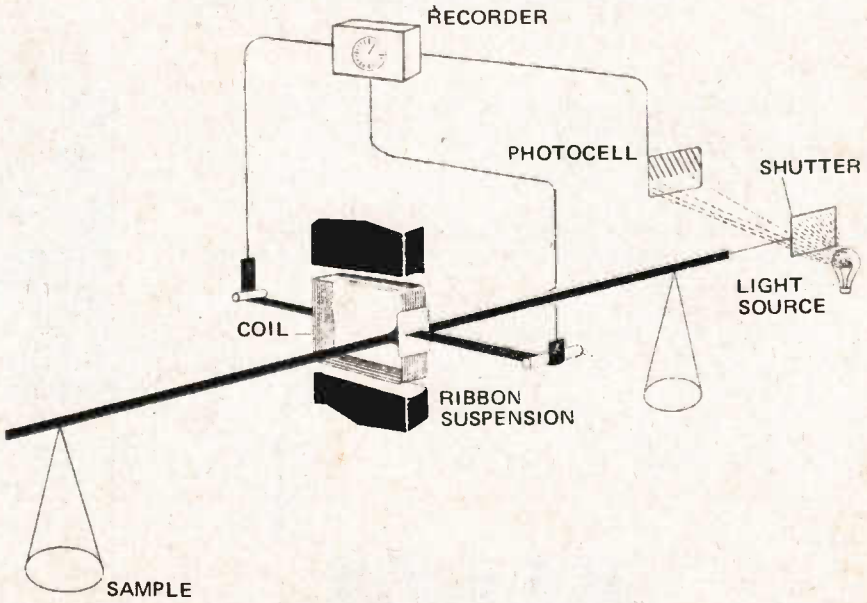
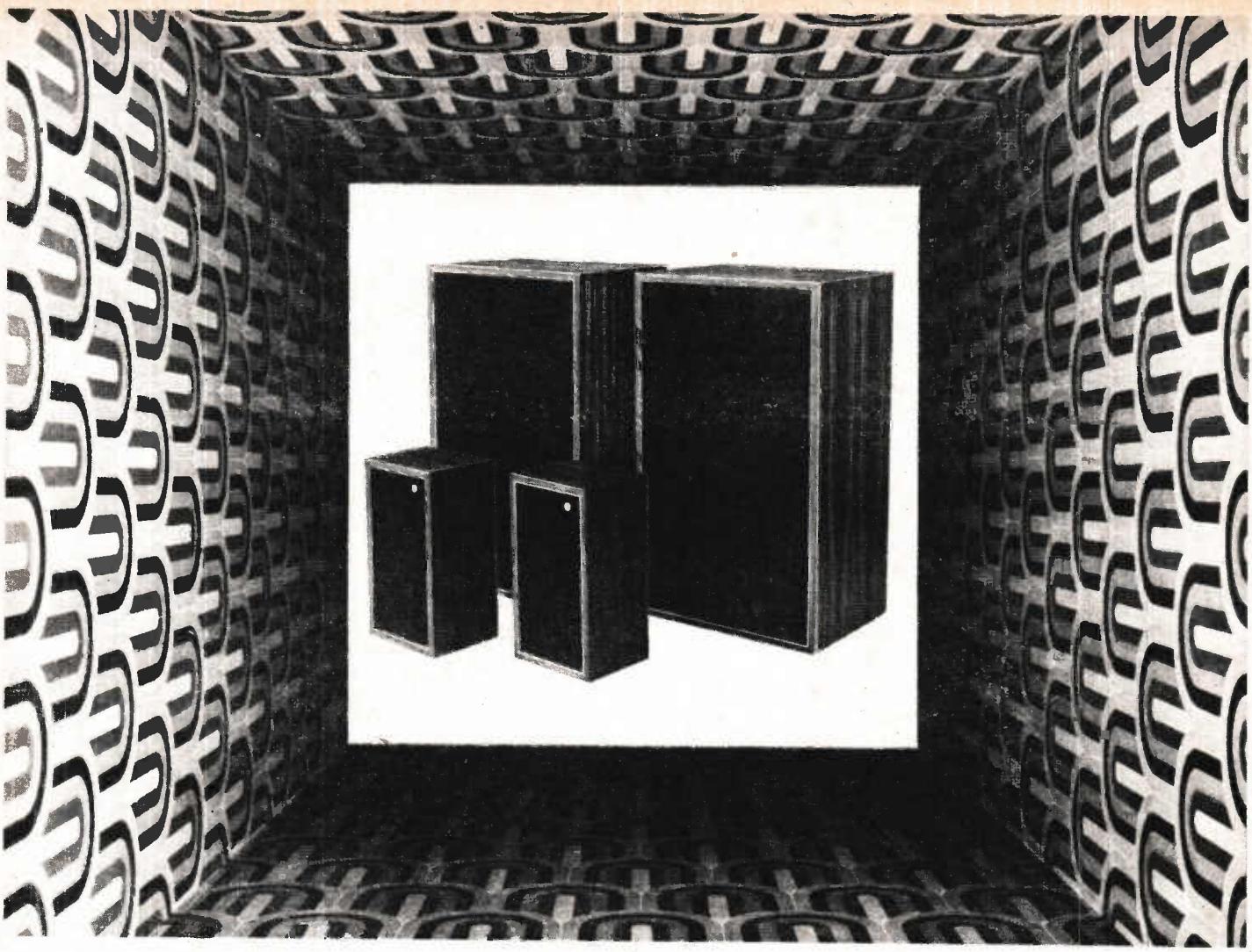


Fig. 3. Schematic of the Cahn electro- balance.



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AWA ...leaders in audio

Transducers in measurement and control

DYNAMIC WEIGHING

An automatic readout weighing machine consists of a platform operating on effectively frictionless pivots that bears down upon a load-cell. Details of a commercial unit are shown in Fig. 4. If the load is stationary, the reading is reliable, but a moving load, such as an animal or a travelling string of goods wagons on a railway or material on a conveyor belt, will produce a more complex signal such as that shown in Fig. 5. Averaging the value eliminates the fluctuations about the true mean but to obtain a fast response more sophisticated adaptable filtering is used. The power of such methods is shown by stating that a simple R-C low pass filter gives 200 times greater error than a weighted averaging method (patented by Avery) when used in an equal, short-time period.

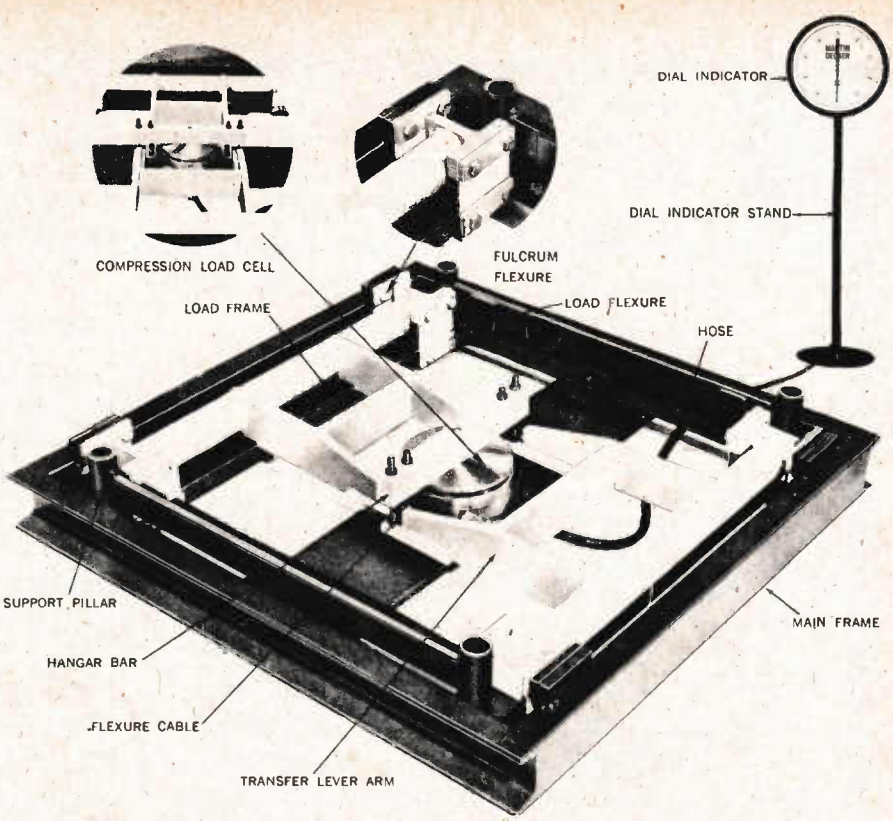


Fig. 4. Inside details of a Martin Decker deck scale.

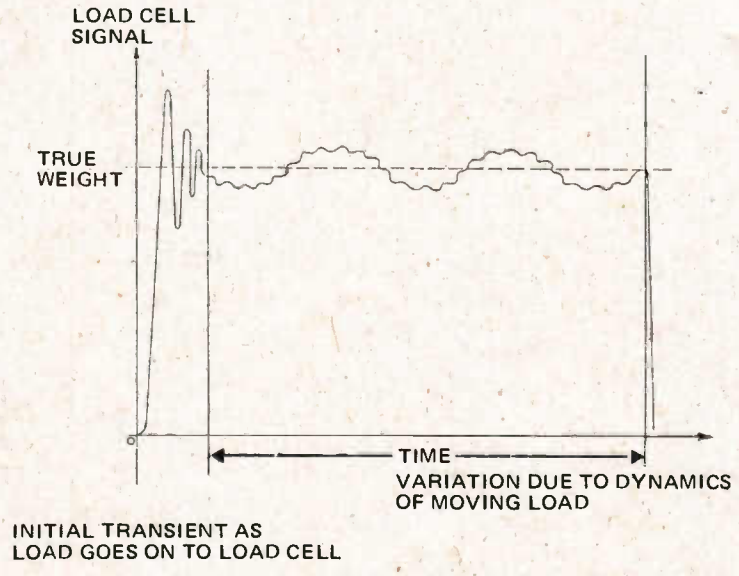


Fig. 5. Typical weighing signal produced by rolling stock passing over a battery of load cells.

PRESSURE SENSORS

The range of pressures that exist is vast and ranges from tens of megabars (10^8 atmospheres) down to inter-stellar space pressure (10^{-19} atmospheres). Consequently many techniques are used to suit the range.

As with force transducers the commonest procedure uses a mechanical elastic element coupled to a microdisplacement transducer. The main difference is that pressure transducers usually do not need the stiffness essential in force sensors.

Commonly used sensing elements are shown in Fig. 6. The limiting factor is usually the magnitude of mechanical hysteresis and perhaps bearing friction in the simpler devices.

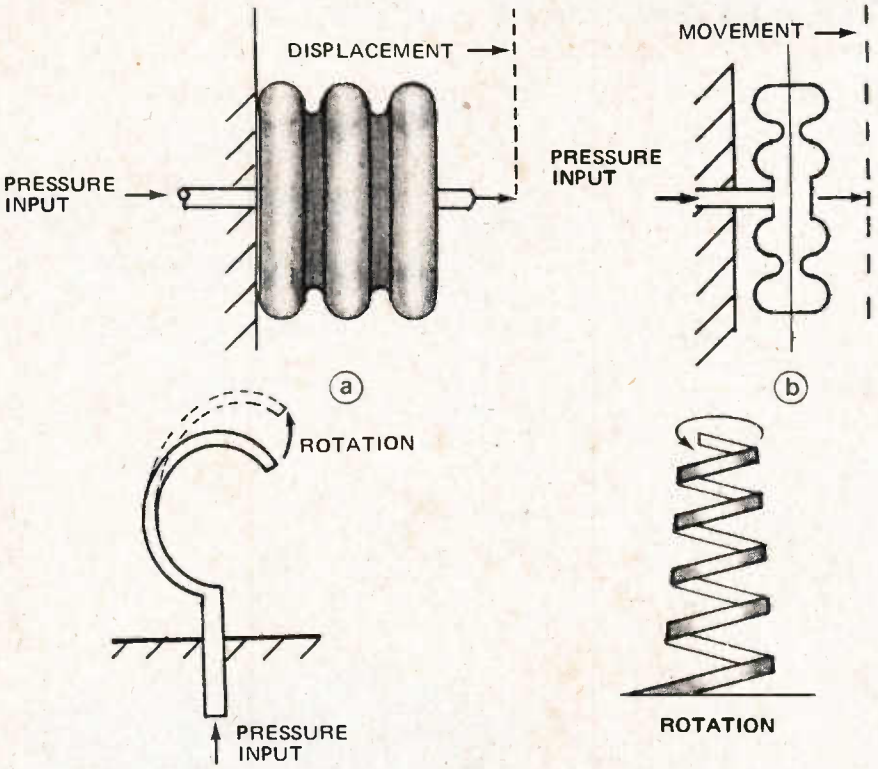
The most general need for accurate pressure measurement around an atmosphere is for weather mapping and for elevation determination (barometric levelling). The aneroid barometer uses a stack of bellows to drive a pen or transducer. The best resolution instruments are termed microbarometers. The schematic of an advanced instrument is given in Fig. 7. Note the quartz helical bourdon tube that is used because of the excellence of its stability and spring-rate. Microbarometers have been used to detect the pressure surges caused by nuclear test explosions on the opposite side of the globe.

Pressure sensors using an elastic element are not absolute and must be calibrated against those using a head of liquid as a reference, or by the use of dead weights driving a piston filled with liquid.

The standard mercurial barometers, of the Kew or Fortin pattern, are devices in which the height of a mercury column is measured against a mounted scale. If the column is coupled to the pressure within a closed system via a pipe it is termed a manometer. These are used in abundance in hydraulic research as readouts for pressure difference flow meters and in aerofoil section investigation. Chemical reactions often must be monitored under precisely known pressure conditions. Manometers used in this work are often made more precise by electrically sensing the position of the top surface of the column. Auto tracking inductive sensors, such as that given in Fig. 8, and capacitive or optical sensing have been employed to resolve to micrometers. One micromanometer measures the surface height with an optical interferometer that looks at the mercury surface from above.

An analog output signal may be undesirable from a pressure sensor. A

Transducers in measurement and control



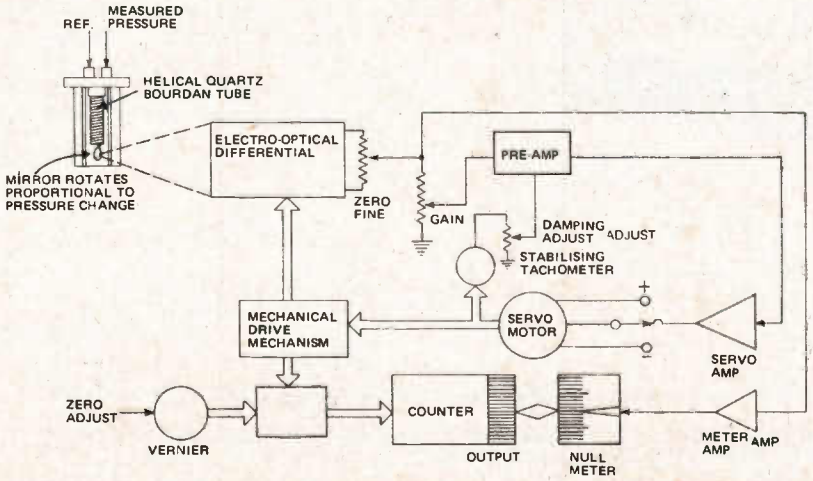


Fig. 7. Block diagram of the Mensor helical quartz pressure sensor having digital readout to 0.0005% of full scale.

sensor developed at the Royal Aircraft Establishment uses the force-balance technique in an oscillatory mode. From the schematic of Fig. 9 it can be seen that the driving coil forces the diaphragm against the pressure, opening the contact. This in turn de-energises the electrodrive, setting the system into vibration. The average duration of the contact dwell is the measure of pressure. This form of transducer can provide a time-duration modulated signal that is easy to transmit due to its binary nature.

Another transducer derives a frequency modulated output by monitoring the natural resonance of the sensing diaphragm. An electromagnetic excites the diaphragm. A capacitive sensor monitoring the displacement is coupled to the excitation driver and the two oscillate at the resonant frequency. As pressure changes so does the frequency.

VACUUM PRESSURES

From 1 mm Hg (1 torr) to an atmosphere is low vacuum, from 10^{-3} mm to 1 mm is medium vacuum. High vacuum extends from here down to

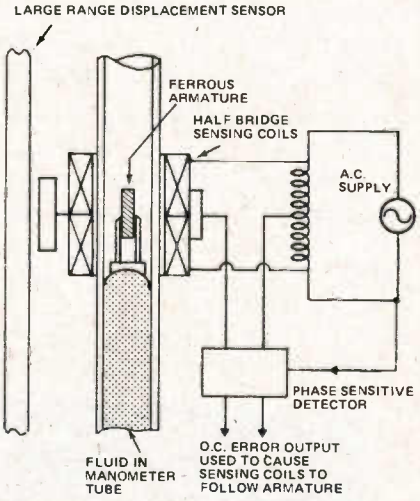


Fig. 8. The height of the liquid column is measured by slaving the detecting coils to follow the armature in this servo-manometer.

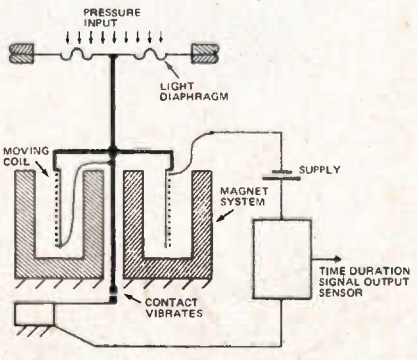


Fig. 9. Schematic of the RAE vibrating-contact, pressure transducer.

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It's actually a simultaneous record-playback control center with its own record and playback amps. It has built-in mike and line preamps that maintain mixing capability, or add this capability to recorders not so endowed.

TEAC
AN-180

It has large professional-type VU meters for Dolby level setting as well as record/playback level indicators. AN-180 also incorporates such features as an internal 400 Hz, 100 Mv oscillator level controls, source/tape monitoring and a multiplex interference filter.

Even without Rossini to write a setting for the AN-180 specs, they make such beautiful music.

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- Harmonic Distortion, below 0.3%
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Transducers in measurement and control

10^{-6} mm, very high from 10^{-9} to 10^{-6} mm. Ultra-high vacuum is a pressure less than 10^{-9} mm of Hg. Mechanical pressure gauges are often capable of measuring to 10^{-3} mm Hg but for better than low vacuum it has been necessary to employ quite different methods.

For the pressures of 10^{-4} mm Hg upward, the simplest vacuum gauge is the thermo-conductivity unit. The heat transfer from a heated sensor depends upon the mass of gas thermally coupling it to the container heat sink. The lower the vacuum the less the transfer. Earlier designs used a purely resistive sensor connected to a Wheatstone bridge to monitor its temperature via its resistance change — see Fig. 10, and this is commonly called the Pirani gauge. Another variation uses a thermocouple to measure the temperature. The most recently introduced models make use of a thermistor sensor instead. In this range the McLeod gauge — a type of manometer, provides an absolute method.

Below 10^{-3} torr, ionization gauges are used that rely on the ionization of the gas molecules to determine pressure. In the hot filament kind a heated cathode provides electrons that are accelerated by a grid to make impact on an anode, providing ions in the process. (The design is similar to a triode valve.) Positive ions are collected by an electrode and the ratio of ion to electron current is a measure of gas pressure. The Bayard-Alpert configuration, shown in Fig. 11a, has a small collector to reduce errors from unwanted soft X-ray generation. The anode collector can be replaced by an electron multiplier and versions using this can detect 10^{-18} torr pressure changes.

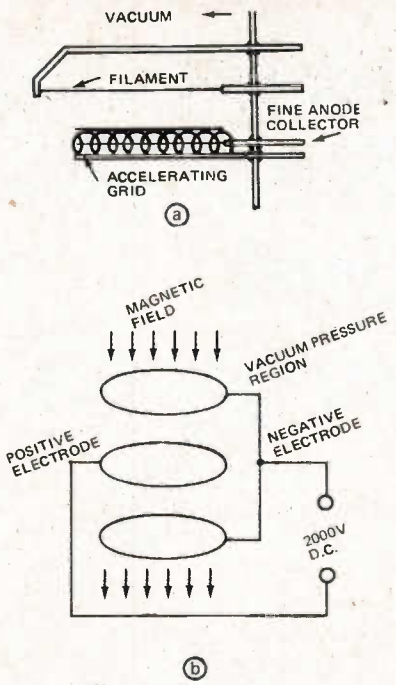

Fig. 11. Ionization gauges used to determine vacuum pressures. (a) This Bayard-Alpert sensor uses a hot filament; (b) In the Penning gauge a cold cathode is used.

The Penning, or Philips gauge, shown in Fig. 11b, is a cold-cathode, magnetic field, ionization pressure sensor. A discharge current is established by the application of 2000 Vdc between the anode and cathodes. The purpose of the magnetic field is considerably to lengthen the electron path (it makes them travel in a helical locus) enhancing the chance to form ions. The current drawn is the sum of electron and ion currents and is, therefore, not a linear measure of pressure. These are useful in the range 10^{-7} to 10^{-3} torr. The cold cathode is often preferred, for an unintentional vacuum loss will not destroy the cathode as would the heated version.

For pressures below 10^{-7} torr there are other methods. The Redhead gauge is also a cold cathode, magnetic, instrument but the internal layout is different being based upon the Magnetron. It has the advantage of giving a linear ion-current to pressure relationship down to at least 10^{-10} torr.

The Knudsen radiometer gauge is occasionally used and is the only absolute method for the range 10^{-8} to 10^{-2} torr. A small mirror is suspended in the vacuum by a torsional filament that also supports a moving paddle-vane. Fixed close to the moving vane ends are two others that are heated. The momentum of the gas molecules passing near the heated plates causes them to bombard the unheated vane deflecting it in proportion to the gas mass present. The mirror forms part of an optical level readout.

SOUND MEASUREMENTS

Acoustic propagation involves pressure wave travel. The above mentioned pressure gauges are of little value for sound pressure measurement due to the high frequency low pressure characteristics of sound waves. The detector, therefore, (the microphone) is designed to have a bandpass response including the frequencies of interest. Generally microphones have to couple an air medium so a comparatively compliant diaphragm is used to obtain an efficient acoustic match. Motion is transduced with a displacement sensor. Microphones in use use piezo-electric crystal, capacitance and moving-coil principles.

When making sound-level measurements it is necessary to use specially designed meters, Fig. 12. In these a stable characteristic microphone produces a basic pressure

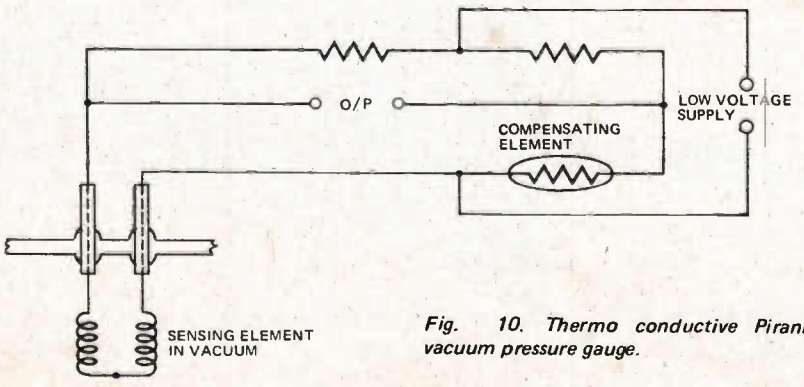

Fig. 10. Thermo conductive Pirani vacuum pressure gauge.

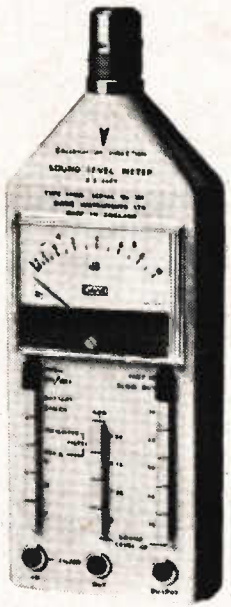

Fig. 12. The Dawe Sound level meter.

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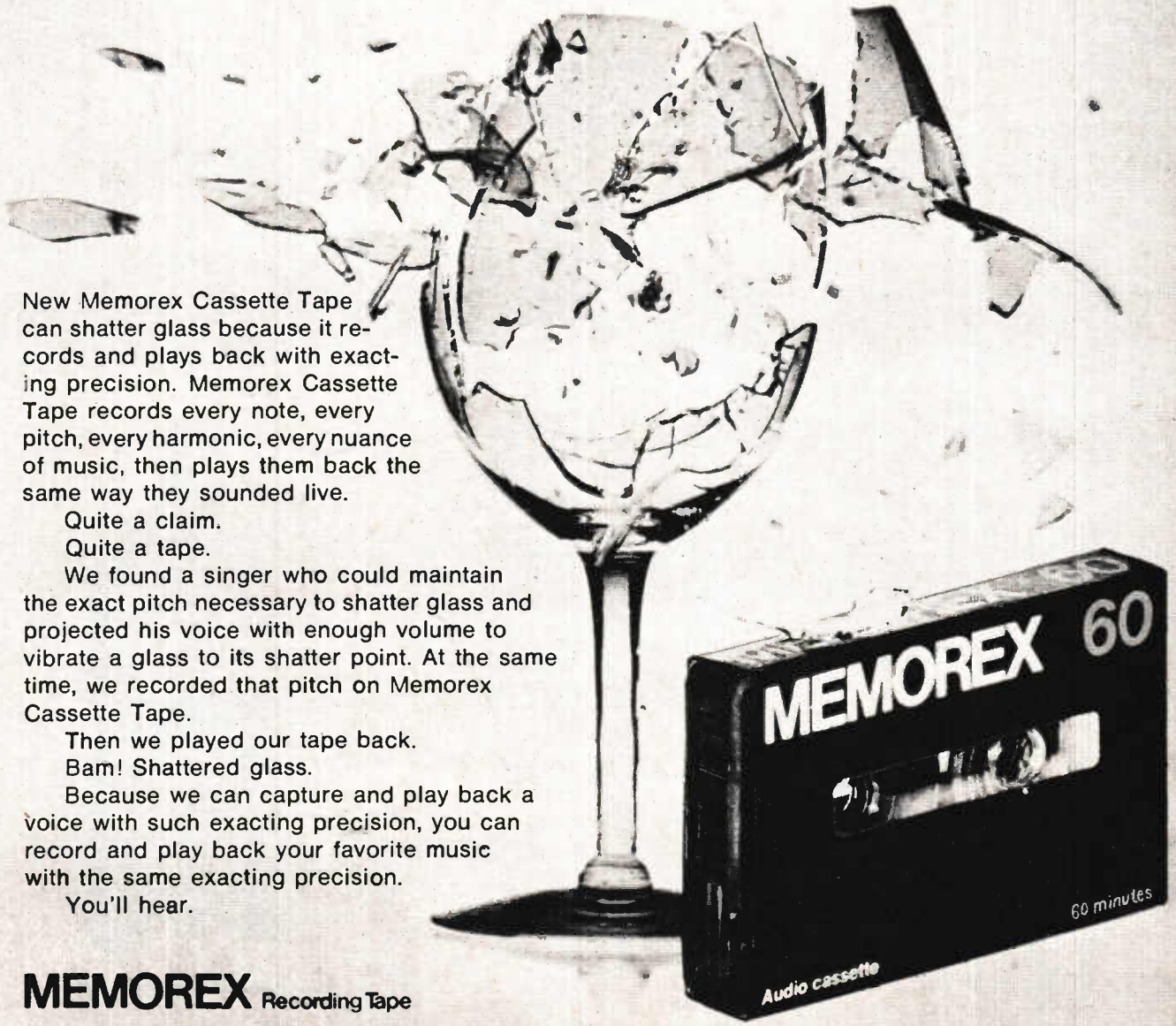

New Memorex Cassette Tape can shatter glass because it records and plays back with exacting precision. Memorex Cassette Tape records every note, every pitch, every harmonic, every nuance of music, then plays them back the same way they sounded live.

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Transducers in measurement and control

signal. This is processed to allow for the random-like nature of sounds and for the frequency characteristics of the human ear.

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TRANSDUCING TORQUE

Torque is the product of a force acting at a distance, so for static shaft measurements a torque transducer is little more than a load cell driven via an arm (as shown in Fig. 13a). As the shaft is constrained it is not of any value for measuring rotating shaft torques.

A simple way to monitor the rotating shaft is to fix a strain rosette at 45 degrees to the axis (for this is the maximum stress direction) and connect the gauge to the bridge via slip rings as shown in Fig. 13b. Mercury-wetted rings have been used for extreme rotational rates; monitoring at 30,000 r.p.m. is quite feasible. A more sophisticated arrangement is shown in Fig. 14. Power to excite the bridge is induced by magnetic means, thus avoiding the problems associated with sliprings. A similar approach is to mount the power supply on the shaft along with the circuits and radio-telemeter the output. This has the advantage that the sending receiver and transducer needs no rigid position tolerance. It has been used in the measurement of tail-shaft torque in automobile research.

When the rotation is constrained, as with bearings at each end, a phase difference method can be employed. Detectable 'marks' (for inductive, capacitive or optical sensing) are mounted around the shaft at two points as shown in Fig. 15. Fixed proximity sensors generate two alternating waveforms which will have the same frequency but a varying phase-difference depending upon the amount of twist in the shaft. (This method is similar to a shaft encoder principle described in the earlier discussion on angle transducers). The major disadvantages are that there is no output when the shaft is stationary and that the frequency at which the phase comparison must be made varies with speed.

FURTHER READING

"Handbook of Transducers for Electronic Measuring Systems" H.N. Norton, Prentice Hall, 1969.

"Measurement Systems: Application and Design" E.O. Doebelin, McGraw Hill, 1966.

"Weighing Vehicles in Motion" A.C. Fergusen, Trans Inst. M.C. 1969, 2, 12, 214-222.

"Development of the Chemical Balance" J. T. Stock, Her Majesty's Stationery Office, 1969 (A Science Museum Surrey booklet). ●

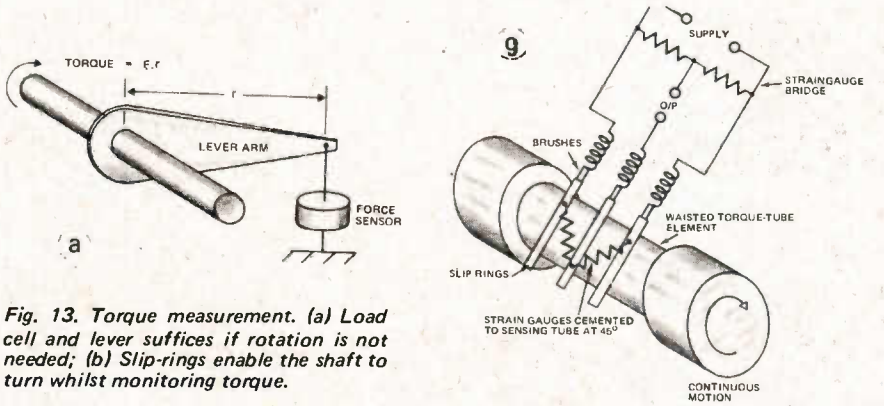

Fig. 13. Torque measurement. (a) Load cell and lever suffices if rotation is not needed; (b) Slip-rings enable the shaft to turn whilst monitoring torque.

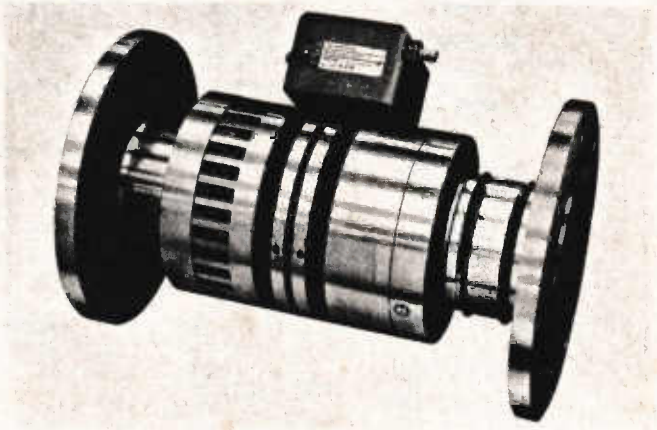

Fig. 14. This Philips torque transducer supplies power and monitors the output of a strain gauge bridge via a new contact inductive coupling head.

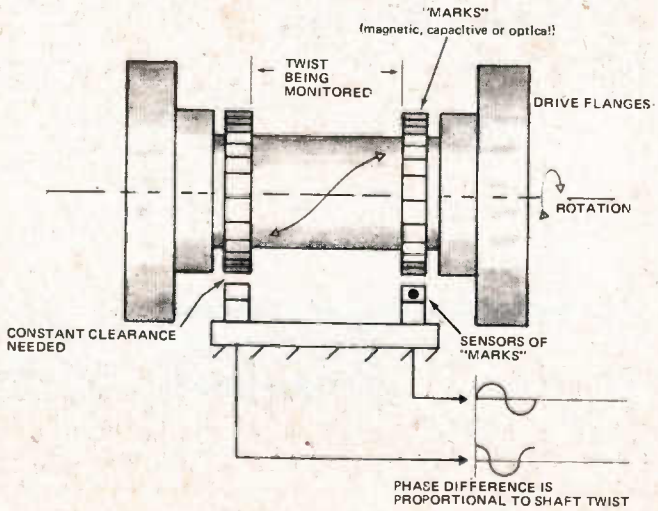

Fig. 15. Measuring the torque of a rotating shaft by the phase difference method.

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

CERMET — ADJUSTMENT POTENTIOMETERS

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

RESISTON CARBON — ADJUSTMENT POTENTIOMETERS

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

VARIABLE RESISTORS

3359P	3/8" Single-Turn Cermet Element	Standard Resistance Range ..... 100 to 2,000,000 ohms Power Rating ..... ½ watt at 70°C, ¼ watt at 40°C Humidity ..... Less than 1% change in total resistance after 500 hours
3359W	3/8" Single-Turn Cermet Element	Resistance Change After Solvent Bath in FREON T.F. or Trichloroethane ..... Less than 1% Operating Temperature Range ..... −65°C to +125°C

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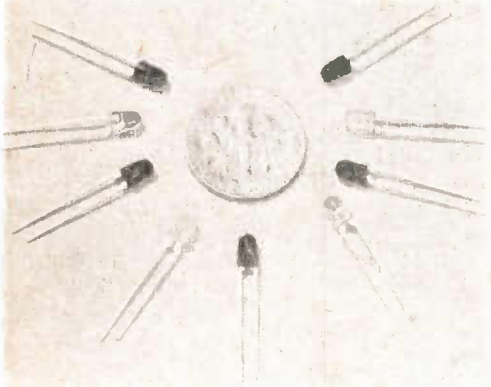
COMPONENT NEWS

NEW, LOW-COST SUBMINIATURE LED's



Only 0.125-inches in diameter, a new series of LEDs is introduced by Hewlett-Packard. These HP Model 5082-4480 Solid State Lamps conform to the Class T-1 bulb outline and are appropriately called mini-LEDS. Because they mount on 0.1-inch centres, they are especially suited to large scale X-Y addressable arrays. Their low cost makes them particularly attractive for use in cost-sensitive devices.

These mini-LEDS can be flush mounted in 0.045-inch diameter holes on printed circuit boards. Light output level is typically 0.8 millicandelas.

Three lens configurations are available – red diffused, white diffused and white clear. Red diffused is best for good on/off contrast; clear diffused masks the red colour when the lamp is off; clear provides a point source for illuminating external lenses, annunciators or photo detectors.

High visibility over a wide viewing range, and long life makes these gallium arsenide phosphide LEDs suitable for permanent installation.

With low voltage and low current requirements and with freedom from turn-on transients, the mini-LEDs are compatible with most integrated circuits without additional drive circuits. Rugged construction makes them suitable for use where equipment is subject to shock, vibration and repeated switching.

Further details from: Hewlett Packard Australia Pty. Ltd. 22-26 Weir Street, Glen Iris, Vic. 3146.

NEW DEC TAPE CASSETTE

After an 18-month evaluation of tape cassette units, the Digital Equipment Corporation found none that was, in their opinion, sufficiently reliable and decided to design a tape transport with direct reel-to-reel drive.

The new dual TU60 DECcassette has no belts, capstans, pulleys and clutches, and is guaranteed to operate for 1,000 passes without tape failure. Normally, up to 6,000 passes can be expected, compared with up to only 100 for other cassette units. Basically a modification of the Philips design, the TU60 uses double thickness tape specially coated for long life, and full-width track, phase-encoded to minimize the effects of dirt and wear.

The system transfer rate averages 487 bytes per second for 256-byte blocks, and the capacity is 87K bytes. Tape speed is nine inches per second for reading and writing, and 21 and 100 inches per second for search and rewind, respectively. The control circuits include logic to prevent tape injury by arbitrary commands, and features bit-to-byte conversion.

The TU60 with dual transports and power supply occupies only 5¼ inches of height in a standard 19 inch rack.

Further details from: Digital Equipment Australia Pty. Ltd., 75 Alexander Street, Crows Nest, NSW 2060.

TOOL FOR INSERTING I.C.'s

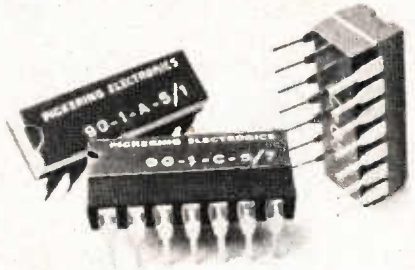
A simple tool has been developed in Australia for inserting dual-in-line integrated circuit devices into P.C. boards or dual-in-line sockets.

The two piece fully insulated tool speeds the insertion of 14 and 16 lead devices. (Integrated circuits, when made, have their leads splayed out, making assembly difficult).

The tools enable the user to pick the I.C. device from a smooth surface. This action automatically sets the pitch of the pins at the correct .3" spacing. Then, by simply depressing the plunger, the I.C. device may be quickly and easily mounted into the P.C. board or socket.

Further details from: McMurdo (Australia) Pty. Limited, 17-21 Carinish Road, Clayton, Vic. 3168.

NEW REED RELAYS



Two new reed relays designed and manufactured by a well known English electronic engineering company will shortly be available in Australia.

The products of Pickering Electronics Ltd., Colchester, U.K., the reed relays will be distributed by Maddrell Bros. (Vic) Pty. Ltd.

The first is a new changeover reed relay additional to the Pickering Series 80 miniature range. Listed as model 80-1-C-5/7 it can be driven directly from TTL logic, having a coil voltage of 5 volts with a current of only 10mA.

It has a break before make changeover action, and will switch 3 watts with a maximum voltage of 28 volts and a maximum current of .250mA, the manufacturers state.

Measuring only 29mm x 9.9mm x 8.9mm, it is intended for a simple P.C. board mounting and includes magnetic screening.

The unit is fully encapsulated with connections on a 0.1 inch matrix.

The secod new unit is a dual-in-line reed relay, an addition to Pickering's series 90. These relays are of 14 pin DIL construction with a wide selection of coil voltages including a 5 volt unit which operates directly from integrated circuits.

When fitted with a single make the unit will switch 10 watts with a maximum voltage of 100 volts. Fitted with a change-over contact it will switch 3 watts at 28 volts. It also is completely encapsulated.

CSMOS RATE MULTIPLIER PERFORMS ARITHMETIC FUNCTIONS

The MC14527 Binary-Coded-Decimal (BCD) Rate Multipler can be used to perform arithmetic, algebraic, and differential equation functions. The output of this McMOS, Motorola CMOS, BCD rate multiplier consists of an output pulse rate based upon a BCD input number.

The MC14527 rate multiplier has two inputs; one a pulse frequency, and the other

...and a wide range of "Specials" for every application

Whether your need is for standard styles or a "special" we know we can help you—30 years of making wire wound resistors has built in this confidence.

IRH Components Pty. Limited

Wholly Australian owned and the largest manufacturer of resistive components in the Southern Hemisphere.

THE CRESCENT, KINGSGROVE, N.S.W. 2208. PHONE: 50-0111 74 RAGLAN ST., PRESTON, VIC. 3072. PHONE: 44-5021

INTERSTATE DISTRIBUTORS

S.A. Collet & Cant Pty.Ltd. **Telephone 23-1971.**

W.A. Simon Holman & Co.Pty.Ltd. **Telephone 8-2271.**

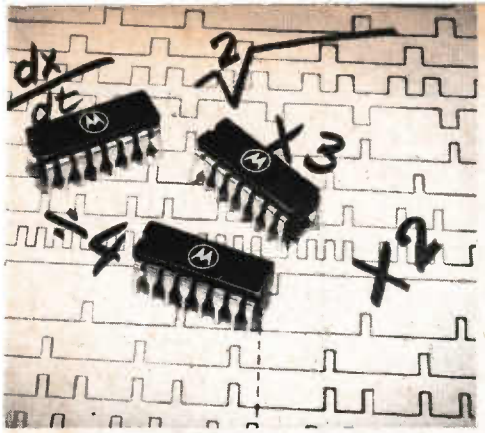
Tas. W.P.Martin Pty.Ltd. (Launceston). **Telephone 2-2844.**

Q'land. K.H.Dore and Sons. **Telephone 21-1933.**

Tas. W.P.Martin Pty.Ltd. (Hobart). **Telephone 34-2811.**

IRH THE COMPONENT DIVISION OF IRH INDUSTRIES LIMITED

WW72



a BCD number. The output of the device is the product of the frequency and the BCD number. In other words, if six is the BCD number used, there will be six output pulses for every ten input pulses.

This is the first truly low power (0.25 μW (quiescent)/Package @ 5 Vdc) high noise immunity (45% of V_{DD} typ) BCD rate multiplier device. Previous digital rate multiplier functions have been available only in TTL devices.

Both MC14527 Multipliers are internally synchronous for high speed operation up to 5.0 MHz, typical. A strobe function is available to inhibit or enable the complementary outputs. The Multiplier can operate in fixed-rate or variable-rate mode, and two, or more, devices can be cascaded for higher resolutions. The MC14527 BCD Multiplier finds application in digital filtering, frequency synthesis, and motor speed controls.

Further details from: Motorola Semiconductor Products, Suite 204, Regent House, 37-43 Alexander Street, Crows Nest, NSW 2065.

EQUIPMENT NEWS

FULLY PROGRAMMABLE DISTORTION ANALYZER

A new distortion analyzer/ac voltmeter, the Hewlett-Packard Model 334A-H25, has all the capabilities of the standard Model 334 plus complete programmability of all functions, ranges and settings. Remote control is by parallel BCD TTL logic. A dc output and an interrogation circuit have been added so that an external controller can determine the status of the instrument during measurements. The instrument can be manually controlled with back-lighted front panel pushbuttons.

As a distortion analyzer, the instrument is said to measure total harmonic distortion from 0.1% to 100% full scale in seven ranges. The fundamental frequency range for distortion measurements is from 10Hz to 100Hz; harmonics are indicated up to 1MHz. Frequency resolution is 3 digits over the full frequency range.

As an RMS calibrated voltmeter, the analyzer measures input levels from 0.3mV to 300V RMS full scale in thirteen meter ranges. The frequency range for voltage measurements is from 10Hz to 1MHz.

Local or remote operation can be selected. In the LOCAL mode, the analyzer is operated as a bench instrument using front-panel pushbutton switches.

In REMOTE, it accepts parallel 8-4-2-1 BCD coded instructions applied to the remote control lines. Internal storage is not provided. Remote control lines use standard TTL logic levels. Provision is made for changing from high to low assertion states. A total of 34 lines are required for complete remote control.

Further details from Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146.

OPTICAL INSTRUMENTS FOR LASER WORK

Three high-quality instruments – a photon drag detector, a crystal detector and a pulsed holography meter – have been developed by a specialist British firm to measure laser power.

The photon drag detector is a powerful tool for users of high power pulsed or 'Q' switched CO_2 lasers. The radiation enters and passes through the detector instrument which incorporates a doped germanium crystal bar. Photons in the beam transfer their momentum to free carriers in the germanium which are physically driven down the bar by the energy loss from the photons. This creates a voltage gradient which is then either amplified or fed directly to the output socket. Several models are available, including a straight-through beam monitor.

The basic detector has an inherent rise time of less than one nanosecond. In most models a choice of built-in amplifiers is available to boost sensitivity of response. They are highly insensitive to electrical interference and will withstand massive overloading without damage. They are ruggedly made and suitable for optical bench rod mounting. The units with amplifiers are powered by their own batteries for maximum freedom from interference.

The photon drag beam monitors pass a 10.6 micron beam straight through the instrument. Approximately 25 per cent of the beam is absorbed and the remainder is transmitted undisturbed. As the beam passes through the crystal a voltage is generated which is amplified internally and the output fed to a 50 ohm BNC socket.

The crystal detector is polished flat and parallel and is anti-reflection coated on both sides, giving no polarising effects. This instrument is designed for maximum shielding and protection against noise.

The pulsed holography meter is used for measuring the energy density from pulsed laser in a well defined plane which would be later occupied by a photographic plate. The energy density is displayed directly on a meter. Wavelength and temperature compensation are incorporated to give high over-all accuracy.

The instrument can also be used for measuring cw power densities. The ranges have been chosen to correspond to those of interest in safety measurements for pulsed and cw lasers as well as pulsed holography. The detector is mounted in a head with a 6ft (2m) cable leading to the display unit.

Further details from Roffin Limited Windmill, Bishops Stortford, Hertfordshire, England. Australian Agents: Rofin (Australia), 649 St. Kilda Road, Melbourne, Vic. 3004.

NEW ELECTRON MICROSCOPE

Siemens have developed a new high-performance electron microscope, the Elmiskop 102, a considerably advanced transmission electron microscope said to be capable of line resolution down to 0.2nm. Image brightness and definition are automatically adjusted. The maximum accelerating voltage for generating the electron beam is 125kV, with an adjustable final magnification of 500 000:1.

The new Electron Microscope is an advanced development of the Elmiskop 101, differing from the latter by a number of important improvements, electrical aids for adjustment and other additional features. Operation of the equipment is said to be particularly simple due to self-adjusting image brightness and definition, and the automatic high vacuum system. There is a choice of six accelerating voltages between 20kV and 125kV, which can be wobbled for fine adjustment.

Specimens for examination are prepared in the usual way on apertures or grids, then irradiated by fast-moving electrons in the evacuated microscope column and finally imaged on a fluorescent screen by electromagnetic lenses with different focal lengths. The magnification of the final image appearing on this projection screen can be varied in 33 calibrated steps ranging from 200x to 500 000x. The image remains in focus throughout the magnification range. Within the magnification range from 3 000:1 to 100 000:1 the image brightness

also remains constant. By using special apertures, irradiation in the form of a hollow cone is produced for high-intensity dark-field microscopy.

An optical binocular magnifier with 9x magnification is used for accurate observation of image detail, thus giving a total magnification of over 4 000 000x for visual observation. The images are photographically recorded by directly exposing plates or films from which enlargements can be made.

The performance of an electron microscope is not, as is often assumed, determined by its magnification, but by its resolving power. In the Elmiskop 102 the guaranteed resolution of two adjacent image points, known as point resolution, is 0.3nm or 3 Angstroms. A "line resolution" of 0.2nm (2 A) can be achieved when observing lattice planes of crystalline structures. This more or less corresponds to the distance between two adjacent atoms in a crystal lattice. If the micrographs are too greatly magnified, which is technically quite feasible, or photographically enlarged (worthwhile up to about 20 000 000x) no further specimen details will become visible.

As well as bright-field and dark-field transmission micrographs, diffraction micrographs can also be produced. Six calibrated steps with diffraction lengths between 300mm and 3 000mm are available for selected-area diffraction. The diffracting specimen area can be chosen in 18 magnification steps by using various selector apertures. Small-angle diffraction with maximum angular resolution, diffraction in the converging beam, and diffraction without image-forming lenses are also possible.

Especially notable features are the statically well-balanced, stable mechanical construction of the stage and column, and the electrical system for the voltage and current supplies. Extensive use of integrated circuits and silicon semi-conductors in the electronics, it is claimed, have resulted in objective lens current and high voltage stabilities of better than 2.10^{-6}/min after a short running-in time. The digitally programmed current values for the four image-forming lenses, and for focusing and illumination are self-adjusting, and the desired magnification is set with one knob and displayed in digital form.

The high-vacuum system consisting of a three-stage pump system (oil diffusion pump, mercury jet pump, rotary backing pump) functions automatically at the touch of a single button. Specimen contamination is said to be largely avoided by intensive cooling of the specimen area.

Numerous additional pieces of equipment are available, e.g. image amplifiers with image-storing facility, equipment for wavelength dispersive and energy dispersive X-ray microanalysis, cooling and heating cartridges with or without specimen tilt, also a large-angle double-tilt cartridge for specimen tilts of $\pm 45^{o}$ around two mutually perpendicular axes in conjunction with an axially adjustable specimen stage. Additional equipment for scanning-transmission electron microscopy (STEM) with a resolution of 3nm (30 A) is also worthy of mention.

Further details from Siemens Aktiengesellschaft, Presseabteilung, D-8520 Erlangen 2, Postfach 325, Federal Republic of Germany.

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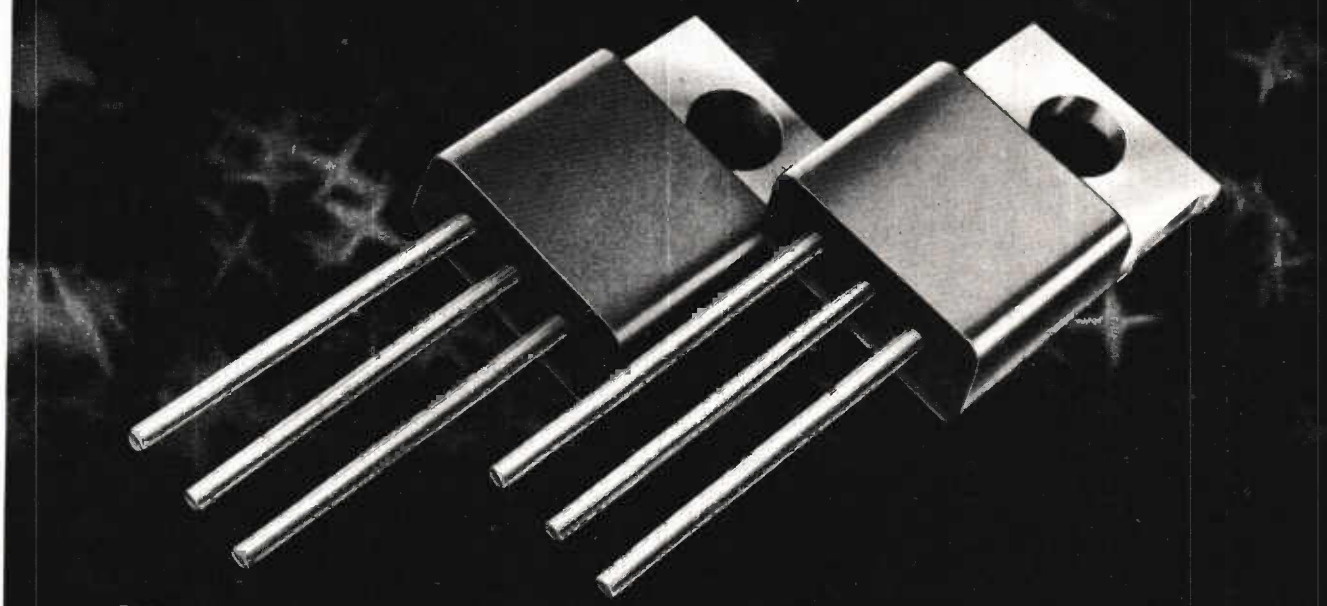
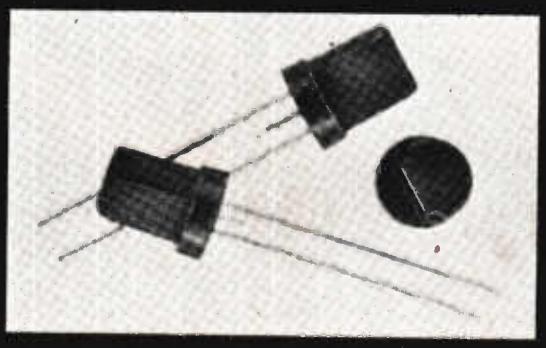
GE DESIGNED THESE TRIACS FOR YOU



GE originated the triac in 1963 and now offers new standards of performance and reliability. Silicone encapsulated SC141 and SC146 triacs, up to 500 volts, and 6 and 10 amps respectively, feature the new proprietary ***POWER-GLAS***™ passivation process which creates a void free bond between the silicon chip and the matched glass. This results in low "off-state" currents of typically 10μA. The SC141 and SC146, like all GE triacs, have inherent immunity from transient voltage damage and improved commutating dv/dt. Additionally these rugged packages incorporate a stress-free assembly system, which offers you torque limit-free tab mounting and easily formed round leads. For your convenience, GE offers 6 standard lead configurations. These features make the SC141 and SC146 your best value in 6 and 10 amp triacs.



Another GE creative design, the ST4 asymmetrical trigger, is an ideal trigger for light dimmer applications. It features performance comparable to triggering circuits using at least 3 additional passive components and greatly reduces hysteresis effects by means of a single RC time constant. It is truly an economical companion to GE ***POWER-GLAS***™ passivated triacs.

AUSTRALIAN GENERAL ELECTRIC LIMITED

DISTRIBUTORS: Fairchild Australia Pty Ltd, Melbourne, Tel 723 4131. Sydney, Tel 439 4355.
GEC-Elliott Automation, Sydney, Tel 439 1922. Adelaide, Tel 71 7971. Brisbane, Tel 32 0441. Melbourne, Tel 387 2811.
PB Components, Melbourne, Tel 53 2766.
Watkin Wynne Pty Ltd, 32 Falcon Street, Crows Nest, Tel 43 2107.
H. Rowe & Co Pty Ltd, Perth, Tel 28 5444.
The National Electrical & Engineering Co Ltd, Wellington, Tel 553 709. Auckland, Tel 599 089.

EQUIPMENT NEWS

NEW DIGITAL MULTIMETER

The Schlumberger/SIS model VB 6701 measures dc, ac Volts and Ohms and offers a resolution of 1 part in 50 000 and 10mV sensitivity on the 500mV range.

The instruments uses dual slope integration and have Auto ranging for all measurement functions combined with fast settling time of less than 50mS.

The Ohms range is protected against accidental overload from mains voltage.

The instrument is of particularly rugged lightweight construction.

A programmable version, VB 6600 series, is available for data logging application and includes, programmable function, range and reading rate plus Auto range and BCD output.

Further details from Schlumberger Instrumentation Australia Pty. Ltd., 112 High Street South, Kew, Victoria, 3101.

71 MICROFICHE DUPLICATOR

DC Datagraphix has recently released a new Microfiche Duplicator.

The Datagraphix Model 71 is a completely dry process card-to-card (silver-to-copy film) duplicator. It provides rapid, single copy microfiche duplicates every 10 seconds without chemicals or film holding tanks.

The compact, tabletop Model 71 contains two stations, the first for ultra-violet light exposure and the second for heat development. Two simple switches control the operation, one for power and turning on the ultra-violet light, the other for stand-by or print operator mode, which turns on the drive system and heat lamp for development.

The duplicator eliminates the need for special darkroom facilities, venting and complicated permanently installed plumbing systems.

No special training is required as most semi-skilled office personnel can operate Datagraphix film duplicators.

Further details from DC Datagraphix, A Division of DC Industries Pty. Ltd., 32 Smith Street, Collingwood, Victoria. 3066, and 19 Berry Street, North Sydney, NSW. 2060.

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EQUIPMENT NEWS

ELECTRONICS TEACHING AIDS

A series of eight experiments has been developed for students by a British company as an introductory laboratory of electronic devices and circuits. The aim is to provide a stimulating approach to teaching electronics by involving students in the subject practically, while keeping operations relatively simple to avoid confusion.

The experiments cover characteristics display, class efficiency, biasing and thermal effects, relaxation oscillators, negative feedback ac amplifier, positive feedback ac amplifier, dc amplifier and dc stabilisation.

Each experiment is fitted in a self-contained worktop unit, and printed circuit boards, transistors and thermistors are provided. Some of the experiments require oscilloscopes, signal generators, multimeters and variable attenuators, all of which can be supplied by the manufacturer if not readily available within a laboratory.

The characteristics display experiment shows, in conjunction with an oscilloscope, the characteristic dynamic waveforms of diodes, zener diodes, and bipolar and field effect transistors.

A low-frequency sine-wave generator is included with the class efficiency unit, which demonstrates the biasing of a transistor in classes A, B, C and calculates the practical efficiency of each class type.

The biasing and thermal effects experiment has been developed to show the effects of temperature on silicon or germanium transistors. A small oven quickly heats the transistor to over 100° and the appropriate junction temperature is indicated on a meter. The transistor under test is switched into various biasing arrangements to show the effect of feedback biasing, and the transistor leakage characteristics can be plotted.

In a relaxation oscillator experiment the student builds a circuit on a plug-in printed circuit board. In this case the board layout provides an easy progression through astable, monostable and bistable multivibrators.

The student constructs an ac amplifier on a plug-in board for an experiment to demonstrate the parameters affected by negative feedback such as input and output impedances, bandwidth and gain. This amplifier can also be used to demonstrate positive feedback when fitted to a different control unit.

Another experiment, in which the student builds a dc amplifier, is used to demonstrate the inherent problems of dc amplification and the effects of feedback. This unit can also be used to solve simple problems in analog form since it illustrates the principles of analog computation.

Four stabilisation networks in natural progression – zener, series, stabilised and higher quality series stablished with or without current limiting – can be constructed by the student to demonstrate ripple factor, regulation and stabilisation ratio.

Equipment can be supplied to operate from all voltages. Each unit is 15 in wide x 8.5 in deep x 4.8 in high (382 mm x 210

mm x 115 mm) and weighs about 3 lb (1,4 kg). The complete set occupies 4.6ft^3 (0,13 m^3) and weighs 30 lb (14 kg).

Further details H.B. Selby & Co Pty. Ltd., 352-368 Ferntree Gully Road, Notting Hill, Victoria. 3168.

TRANSDUCER AMPLIFIER/CONVERTER

The K-tran V converter is used to amplify low-level signals from thermocouples, resistance thermometers, gas analysers, emf or current-sources and to provide an accurate proportional 4 to 20mA or 0 to 10mA output signal. The output may be transmitted to remotely mounted recorders, indicators, computers or data loggers or may be used to actuate regulating or control equipment.

The converter is said to feature calibrated accuracy of better than ±0.1% span; plug-in range cards; isolated or non-isolated output; mains – or dc operation and back-of-panel or weatherproof on-site mounting.

Further details from Kent Instruments (Australia) Pty. Ltd., 61 Betuld Ave., Vermont, Victoria, 3133.

GENERAL PURPOSE MICROSCOPES

The Meopta AZ2 Microscope is particularly suitable for general purpose workshop use. While robust and reasonable in price, it is claimed to have superb optics giving magnifications between 50 and 300 times, reducing to 20 times with an additional eyepiece.

The objective lenses are fixed and cannot be lost, and a calibrated eyepiece is available

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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

DIGITAL INTEGRATED CIRCUITS (dual in line package)

Signetic TTL (5 volt operation)

8440	Dual 2/2 and or invert gate	$0.40
8455	Dual 4 input buffer	0.40
8480	Quad 2 input NAND gate	0.40
8H16	Dual 4 input NAND (high speed)	0.40
8H70	Triple 3 input NAND (HS)	0.40
8H80	Quad 2 input NAND (HS)	0.40
8H90	Hex inverter (HS)	0.40
8H21	Dual JK flip flop (HS 60MC)	1.25
8290	Decade counter (HS 60 MC)	3.50
8292	Decade counter (low power)	1.40
8251	BCD to decimal decoder	1.75
7480	Gated full adder	0.80
7413	Dual 4 input NAND Schmidt triggers	1.75
74181	Arithmetic logic unit	5.00
8260	Arithmetic logic unit	3.50
8261	Fast carry for above	1.40

Send for free brochure listing hundreds of bargains.

Signetic DTL (5 volt operation) dual in line

SP629	Flip flop	$0.40
SP659	Dual 4 input buffer	0.35
SP670	Triple 3 input NAND gate	0.35
SP680	Quad 2 input NAND gate	0.35
SP690	Hex inverter	0.35

Signetic "Utilogic"

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

"Utilogic" dual in line package

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

LINEAR INTEGRATED CIRCUITS

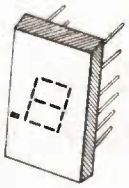
Fairchild and Signetic devices (no choice). Some of this line is not marked but it is fully tested and sold on a money-back guarantee. State first choice on package (TO-5, 8-pin dual in line, or 14-pin DIP—we will not ship flat packs).

NE526	High speed comparator	$1.00
NE565	Phase lock loop	4.25
NE566	Function generator	4.25
NE567	Tone decoder	4.25
709	Popular operational amplifier	0.40
5558	Dual 741 op amp (compensated)	1.25
747	Dual 741 op amp	1.10

LED DISPLAY

The MAN1 is a seven segment diffused planar GaAsP light emitting diode array. It is mounted on a dual in line 14-pin substrate and then encapsulated in clear epoxy for protection. It is capable of displaying all digits and nine distinct letters.

FEATURES:



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

ONLY $4.25

"UTILOGIC" SPECIAL

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

Complete package only $4.00

LINEAR SPECIAL

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

EACH $0.65 PACKAGE $6.00

Please specify first and second choice of: TO-5, 8-pin MINI DIP, 14-pin DIP.

LM309K—5 volt regulator

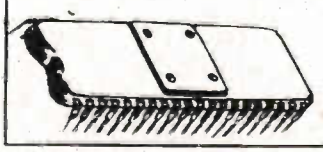
This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof, it is designed to shut itself off with overload of current drain or over temperature operation. Input voltage (DC) can range from 10 to 30 volts and the output will be five volts (tolerance is worst case TTL requirement) at current of up to one ampere.

EACH $2.50
FIVE for $10.00

LSI—CALCULATOR ON A CHIP

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

Complete with data, $14.95



Data only $1.00

COUNTER DISPLAY KIT—CD-2

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

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

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

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

Circuit board is .8" wide and 4¾" 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

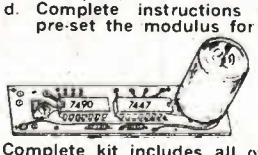
RCA DR2010 Numitron digital display tube. This incandescent five volt seven segment device provides a .6" high numeral which can be seen at a distance of 30 feet. The tube has a standard nine pin base (solderable) and a left-hand decimal point. Each $5.00

SPECIAL 5 for $20

UNIVERSAL COUNTER DISPLAY KIT CD-3

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

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



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

Complete kit includes all of the above plus 5 programming parts, instructions and Molex pins for IC's. Only $9.25

256 BIT BI-POLAR FIELD PROGRAMMABLE READ ONLY MEMORY

This Signetic No. 8223 IC operates at 5 volts and contains 32 x 8 bit wide ROM which can be field programmed.

Each $10.00

We can provide these devices programmed to your specifications @ $5.00 for the first one and $2.00 each additional one. Please allow one week for programmed units.

Babylon Electronics Inc.

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EQUIPMENT NEWS

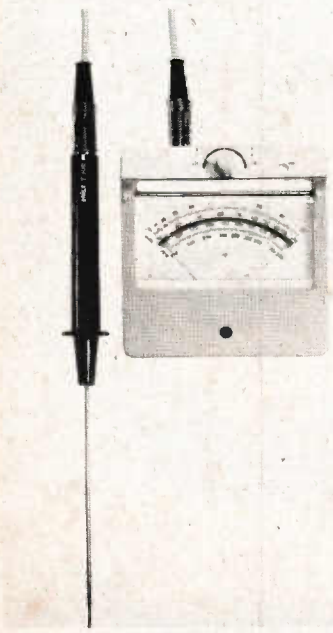
From page 101

for measurements. For storage the eyepiece tube screws off and mounts in the base and the microscope is protected by a dustproof metal cover.

The G.11P Stereo Microscope is also available where profiles and surfaces need to be examined.

Further details from Technical & Scientific Equipment Co. Pty. Ltd., GPO Box 241E, Melbourne 3001.

NEW TEMPERATURE PROBE



A new range of instruments for automatic temperature measuring and recording is now available. The new instruments have a temperature measuring range of -60° to +400°C, (-76° to +752°F), and features a new type of metal probe tip, thermally optimal with an extremely short response time and a minimum of heat absorption capacity.

The thermistor probes have also been standardised by computer-devised balancing networks giving unlimited interchangeability. Accuracy is better than 1% with the selection of different measuring probes done by switching.

Both mains voltage and portable models are available with adaptors switchable to 220 or 110 volts ac, single phase, or by an external 6V dc battery.

Features of the Braun Tastotherm range include exact transistorised electronic control of the voltage supply for the measuring bridge and disconnection of the battery when exhausted. Plug-in connecting cables and combined battery and mains operation are other features of the new Tastotherm range.

Further details from DC Electronics Pty. Ltd., 32 Smith Street, Collingwood, Victoria, and 19 Berry Street, North Sydney, NSW, 2060.

AUDIO NEWS

TDK ENDLESS CASSETTE TAPES

TDK now offer a range of endless cassettes which give cassette recorders the same facilities as the endless cartridge without any modification of the recorder. The cassette looks the same as any normal cassette except there is no centre window and it has a specific top and a bottom; i.e. it is not reversable. The immediate difference is a plastic section which is visible through the left hand capstan drive aperture when looking down on the cassette. The plastic plate in the capstan aperture is in fact a locking device which locks the whole cassette to its normal state of tension as it is removed from the tape recorder, thus overcoming the tendency for the tape to lose its tension when not in use.

There are many uses for an endless cassette, particularly for recording emergency situations, for instance, a telephone monitor can be run with say a 12 minute back lag meaning that the moment an emergency occurs on a radio-telephone system, which is on continuous record, the cassette can be removed and all conversation for the past 12 minutes are permanently recorded. It only takes a second to replace this vital cassette with a fresh one for the next emergency.

Most monitoring tape recorders suffer from the inability to quickly recover vital information and exclude extraneous information. Cassettes may be obtained with times varying from 30 seconds to 12 minutes. Tapes may be shortened to exact timings.

Although TDK endless cassettes will play in almost all portable type cassette recorders, some tape decks with an automatic cut-off will not play these tapes without a small modification, as there is no left hand capstan drive from the tape feed and this sometimes operates the tape stop mechanism. In most cases there will be no problem in using this cassette on any standard compact cassette recorder. Supplies are available from TDK's sole Australian agents, Convoy International Pty. Ltd., Imports Division, 1 Maclean Street, Woolloomooloo, or their agents throughout Australia.

NEW FROM SONY LOW-PRICED CASSETTE RECORDER

A new cassette recorder from Sony has an electret condenser microphone inbuilt for ease and convenience of recording. Other features of the new TC-66 unit are : Automatic Shut-off Mechanism – shuts off transport and power after cassette playing. Sony-o-Matic recording system – completely automatic recording volume level control. Convenient, lockable fast-forward and rewind buttons. AC/DC operation. Continuous tone control and jacks for external microphone, remote control, auxiliary input and earphone monitoring.

The unit is supplied with a leatherette carrying case with carrying strap. An additional external microphone with protective case is also included.

NEW NATIONAL 'DOLBY' DECKS RELEASED

Haco Distributing Agencies Pty. Ltd., Australian distributors of NATIONAL products, have announced the release of 3 new cassette decks with 'Dolby' system.

The units are:–

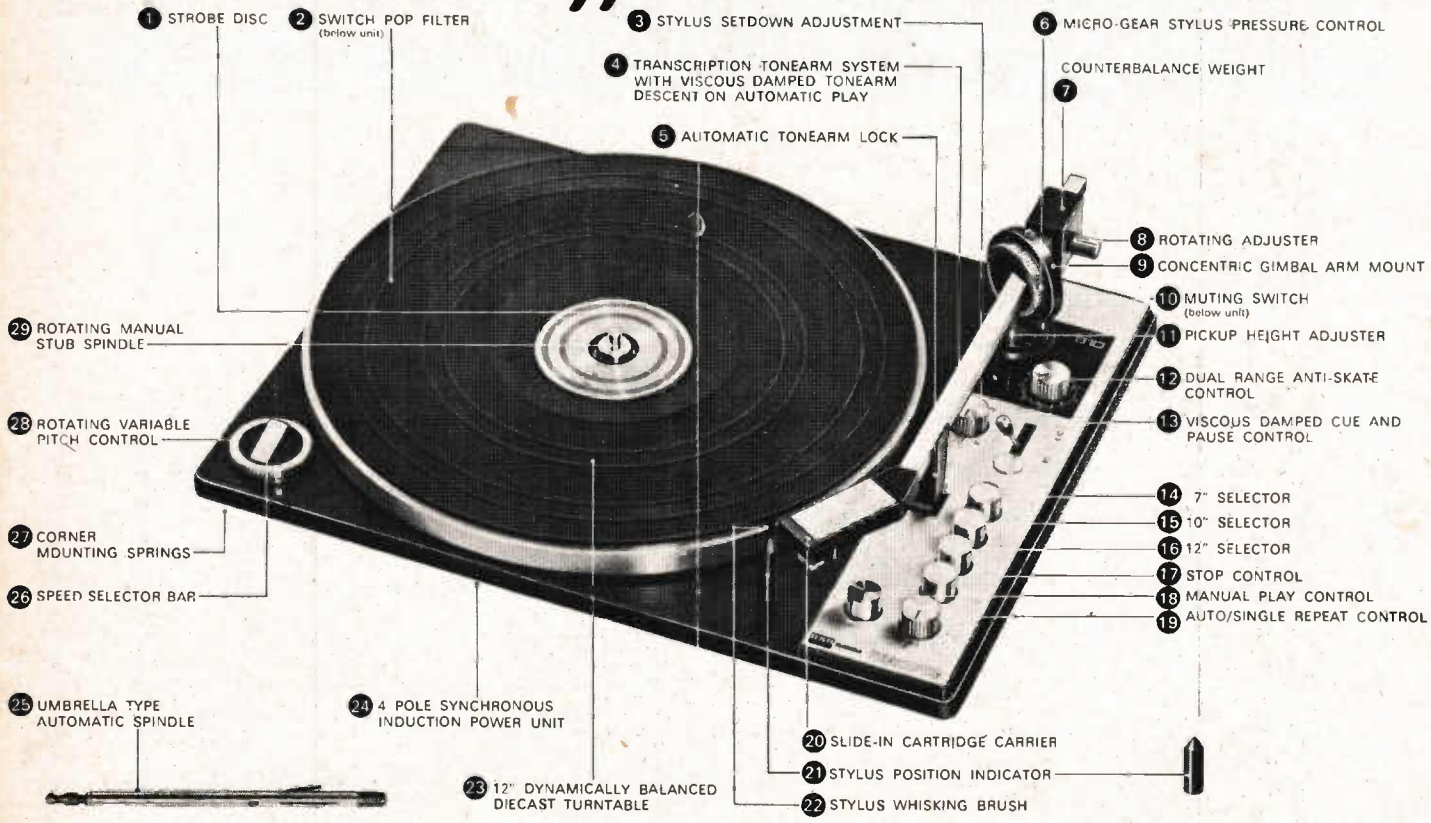
RS263US – with memory rewind, tape switch, claimed frequency response 20-15 000 Hz.

RS271US – with H.P.F. Head, memory rewind, separate input/output controls.

RS276US – direct drive motor, H.P.F. head, frequency response on chrome tape is claimed to be 20-18 000 Hz.

Almost a pity to cover it up with a grill – Pioneer's new CS 3000 enclosure.

"Taking it all together — performance, features, styling — the BSR 810 moves into ranking place among the best automatics we know of. And at its price, the others may well be in for a real contest." Hi-Fidelity Magazine, May 1972.



At $149* for the kit, the brilliant BSR/810 transcription turntable is hardly cheap. But your ears will tell you it's a bargain.

BSR, manufacturers of most of the world's turntables, have now turned the tables on expensive units.

And here are the features that make the 810 such an attractive proposition: the unit weighs 17 lbs — the diecast turntable alone is a solid, dynamically balanced 7¼ lbs. A 4-pole beautifully balanced synchronous motor automatically compensates for any fluctuation in voltage input, or for any record load. A pitch control gives absolute accuracy of speed, utilising a stroboscopic centre plate.

The low mass pick-up arm gyroscopically pivots in a concentric gimbal mount producing virtually friction free movement in both horizontal and vertical planes. It also has a slide-in cartridge carrier, decoupled one piece counterbalance for a minimum tracking pressure of ½ gramme with suitable cartridge. And the arm length is over 8½ inches to reduce tracking error to less than 0.5° per inch.

Viscous cueing is also standard on automatic as well as manual operation, and a unique anti-skate device is also featured for elliptical and standard styli. Speeds are 33⅓ rpm and 45 rpm. (Which are all you need today.)

Single to automatic play conversion is achieved with the interchangeable umbrella centre spindle.

Start-stop, record size control and auto repeat and manual conversion are actuated by push button controls set in a handsome brushed aluminium panel.

Of course there is much more you'll want to know about the BSR 810. Write to BSR and we'll send you a colour brochure.

BSR (A'asia) Pty. Ltd. Southern Section
Industrial Estate St. Marys New South Wales
Telephone 623.0375 and 623.0376

*At recommended retail price.

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New South Wales: 26-28 Ricketty Street, Mascot. 2020. Telephone: 669 6088
Victoria: 162 Pelham Street, Carlton. 3053. Telephone: 347 5177
Queensland: 35 Balaclava Street, Woollongabba. 4102. Telephone: 91 4972
Western Australia: 32 Northwood Street, Leederville. 6007. Telephone: 84 988
South Australia: 207 Flinders Street, Adelaide. 5000. Telephone: 233 488
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BSR McDONALD

810

BSR:117R

HIGH FIDELITY LOUDSPEAKERS by Richard Allan

YORKS ENGLAND

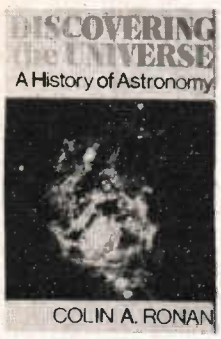
CONSERVATIVELY RATED, in the best British tradition, Richard Allan loudspeakers incorporate massive ceramic magnets, long voice coil assemblies and a corrugated cambric suspension that ensures linear performance at high power. Magnetic flux is unusually high, being 105,000 maxwells for the 10in units, 186,000 maxwells for the 12in Super models and 220,000 maxwells for the 15in bass speaker . . . you'll be agreeably impressed with their outstanding performance.

SPECIFICATIONS

Size	Type	Function	Freq. Range (Hz.)	Power (Watts) rms (Peak)	Flux Density (Gauss)	Total Flux (Maxwells)	Baffle Hole Dia. in. (mm)	Fixing cts. (p.c.d.) in. (mm)	Overall Depth in. (mm)
15" 2" pole (53mm) 25Hz.	CG15	Bass	20/5,000	20 (40)	17,000	220,000	13¾ (350)	14⅝ (370)	6¼ (159)
HEAVY DUTY 2" POLE (53mm) 15" (381mm) 70-80 HZ 8 ohm	CG15HD	Guitar	60/4,000	30 (60)	17,000	220,000	13¾ (350)	14⅝ (370)	6¼ (159)
12" (305mm)	CG12HD super	Guitar	60/5,000	25 (50)	14,000	186,000	10¾ (273)	11⅝ (294)	4½ (114)
12" (305 mm) 2" pole (53mm) 30Hz. 8 ohm	CG12 Super	Bass	25/5,000	15 (30)	14,000	186,000	10¾ (273	11⅝ (294)	4½ (114)
12" (305 mm) 1½" Pole (38 mm) 30Hz. 8 ohm	CG12	Bass/Mid.	25/9,000	10 (20)	14,000	105,000	10¾ (273	11⅝ (294)	4½ (114)
12" (305 mm) 1½" Pole (38 mm) 30Hz. 8 ohm	CG12T	Full	25/15,000	10 (20)	14,000	105,000	10¾ (273	11⅝ (294)	4½ (114)
10" (254 mm) 1½" Pole (38 mm) 45 Hz. 8 ohm	CG10	Bass/Mid.	40/10,000	10 (20)	14,000	105,000	9¼ (232)	9¾ (245)	3⅝ (92)
10" (254 mm) 1½" Pole (38 mm) 45 Hz. 8 ohm	CG10T	Full	40/15,000	10 (20)	14,000	105,000	9¼ (232)	9¾ (245)	3⅝ (92)
8" (203 mm) 1" Pole (25.4 mm) 55Hz. 8 ohm	CG8	Bass/Mid.	45/10,000	6 (12)	14,000	56,000	7 (178)	7¾ (194)	3⅝ (92)
8" (203 mm) 1" Pole (25.4 mm) 55Hz. 8 ohm	CG8T	Full	45/17,000	6 (12)	14,000	56,000	7 (178)	7¾ (194)	3⅝ (92)
8" (203 mm) 1" Pole (25.4 mm) 55Hz. 8 ohm	CB8	Bass/Mid.	45/10,000	5 (10)	12,000	48,000	7 (178)	7¾ (194)	3⅛ (80)
8" (203 mm) 1" Pole (25.4 mm) 55Hz. 8 ohm	CB8T	Full	45/15,000	5 (10)	12,000	48,000	7 (178)	7¾ (194)	3⅛ (80)
8" 1" Pole	CF8	Bass/Mid.	20/8,000	6 (12)	14,000	56,000	7 (178)	7¾ (194)	4" (107)
4" (107 mm) ¼" Pole (114.3mm) 8 ohm	CB4	Treble	2,500	3(6)	10,000	15,000	3⅝ (92)	4¾ (121)	1⅞ (48)
4" (107 mm) ¼" Pole (114.3mm) 8 ohm	460TC	Treble	17,000	3(6)	6,000	9,000	3⅝ (92)	4¾ (121)	2⅛ (54)
CROSSOVER NETWORKS	CN1284	3-woy constont resistance, ½ section, crossover frequencies 1100 Hz, and 5,000 Hz.							
	CN104	2-woy constont resistance, ½ section, crossover frequencies 5,000 Hz.							
	CN54	2-way constant resistance, ¼ section, crossover frequencies 5,000 Hz.							

BOOK REVIEWS

REVIEWER: Brian Chapman



DISCOVERING THE UNIVERSE – A History of Astronomy by Colin A. Ronan. Published by Heinemann Educational Books Ltd 1972. Review copy supplied by publisher. Hard covers, 248 pages 8½" x 5½". Australian price $4.90.

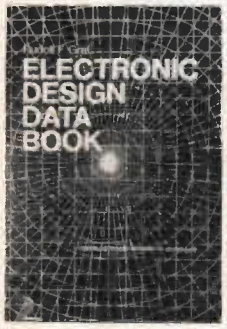
Colin Ronan, the author of numerous books on astronomy including such works as 'Man Probes the Universe' and 'Optical Astronomy' has produced this up-to-date and comprehensive history of astronomy for the student or layman.

It is written in a lucid and entertaining manner. Indeed it makes enthralling reading and is a difficult book to put down once commenced.

To aid clarity, and to point up the sequential effort in particular fields, the book has been organized on a topic by topic basis rather than as a strict chronology. There are 15 chapters in all, progressing from Early Beliefs, through The Planets and Their Motions, Measurement of Position, The Nature and Ages of Stars, The Red Shift, Space Probes and Astronomy and Looking to the Future – just to mention a few.

A historical treatment of astronomy highlights the patience of astronomers in the tedium of planned observation, and at the same time their theoretical brilliance and persistance in seeking new methods and equipment to ever refine their measurements and increase their observational power.

A very interesting book at a very reasonable price. – B.C.



ELECTRONIC DESIGN DATA BOOK By Rudolf F. Graf. Published by Van Nostrand Reinhold Company Ltd 1971. Review copy supplied supplied by publisher. Hard cover, 312 pages 11" x 8½". Australian price $15.05.

In the world of electronic circuitry the amount of data, formulae and tables required by the practising designer is truly staggering. Indeed it is no longer a question of the designer knowing all the relevant data and formulae – but of his knowing where to find them.

Mr. Graf, in his dual role as distinguished engineer and writer, has seen the need for a collation of available design data in the form of nomograms, tables etc and has produced this book as a result.

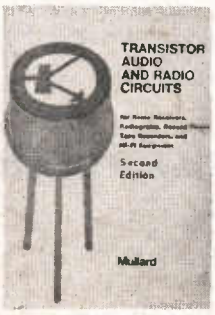
Unquestionably the author's aim has been achieved and the work surpasses anything previously available for similar purposes. Naturally individuals will find things missing that should be included, and things included which in their opinion should be left out. But no-one could say that it is not an extremely useful book.

To assist the reader find the data he seeks, the book has been divided into six functional sections which are organized and indexed in such a fashion that any specific information required is quickly located. The sections are:–

1. Frequency data
2. Communications
3. Passive components and circuits
4. Active components and circuits
5. Mathematical data, formulae, symbols
6. Physical data.

As an example of the treatment, the section on high pass filter design begins with a brief summary of factors affecting choice of type and methods of reading the nomograms. Diagrams of the various filter types are given together with their relevant design equations and four pages of nomograms cover all possible requirements.

An essential purchase for designers whether amateur or professional. – B.C.

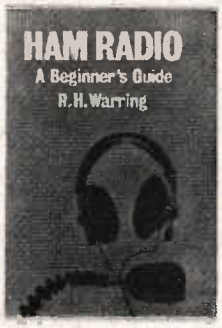


TRANSISTOR AUDIO AND RADIO CIRCUITS – SECOND EDITION. Published by Mullard Limited 1972. Review copy supplied by the publisher. Hard covers, 285 pages 8" x 5¾". Australian price $3.75.

The first edition of this book was very popular amongst amateur constructors and this new edition will certainly be no less so.

It is a manual of established and practical circuits for a wide range of audio equipment and includes portable radios, fm tuners, audio amplifiers from one watt to 50 watts, loud speaker systems and test equipment plus a useful amount of theory, charts and nomograms. Many new circuits have been added for which full details and parts lists are supplied. No details are given of actual construction so the book would not be suitable in this respect for beginners wishing to obtain a source of projects. They would, however, definitely find the book a good source of knowledge about audio circuits.

Excellent value for the home constructor. – B.C.



HAM RADIO – A BEGINNER'S GUIDE. By R.H. Waring. Published by Lutterworth Press 1972. Review copy supplied by publishers. Hard cover, 152 pages 8" x 5¾". Australian price $3.25.

Any book intended for beginners in electronics should be checked and proof read until it is certain that all errors, inconsistences and misleading phraseology have been eliminated as far as reasonably possible. This does not appear to have been applied at all in the production of this book – although Mr. Warring would certainly seem to know what he is talking about, he does not seem to have done much checking.

For example we quote (in slightly paraphrased form):– "The primary requirements (for good Morse transmission) remain:–

1. Accuracy
2. A steady and uniform rate of sending
3. Even spacing
4. Poor technique in use of codes

Even the experienced operator can be guilty of one or more of these faults . . .". Just what are we talking about – faults or requirements?

Again – "Thus sensitivity (of a radio receiver) can be expressed directly in terms of signal-to-noise ratio. the higher this ratio the better the selectivity possible." – Selectivity?

Errors such as those above are coupled with numerous incidences of poor phraseology which could only lead a beginner into the utmost confusion. In addition there are errors such as that on page 53, where in three separate instances we have the micro symbol, μ, in place of the mega symbol, M.

Thus we have this pearl:–

"When used in conjunction with a general coverage receiver, a100μHz crystal is usually adequate for checking frequencies up to 4μHz." Some crystal – it would vibrate at one cycle every 12 days and at a wavelength exceeding 10 miles! Perhaps he means a 4MHz crystal can be used up to 100MHz

One wonders whether we should review a book such as this at all, as any review, good or bad, seems to encourage sales. We can only hope that those seeking to learn amateur radio theory will choose some other source. – B.C. ●

Woody Herman chose AR-2ax speaker systems for his listening at home. The sound of live music, be it rock or big band, is reproduced accurately on AR equipment.

The accuracy with which AR speaker systems reproduce music serves as a valuable tool for many notable musicians. Among the most notable is Woody Herman, whose big bands have long enjoyed great success. His secret seems to be an ability to stay in tune with the evolution of musical styles, as is documented by the Herd's latest recordings. In spite of a schedule of more than 200 concerts every year, Mr. Herman can sometimes relax in the seclusion of his Hollywood home. Here, he listens to a high fidelity system consisting of an AR receiver, AR turntable with Shure V-15 type II cartridge, and a pair of AR-2ax speaker systems.

The low frequency speaker cone of the AR-2ax uses a newly developed material and process of manufacture which makes its absorption of high frequencies very high, suppressing a form of colouration frequently found in conventional cones its size. The circular suspension ring around the cone is also of a new material, silent and highly stable. The voice coil is a new high temperature design, triple insulated and wound on a former of Du Pont Nomex. The mid range speaker is a small, high dispersion cone type.

The high frequency unit is the same miniature hemispherical device as is used in the AR5 and AR3a and is the best high frequency speaker we know how to make.

The workmanship and performance in normal use of AR products are guaranteed from the date of purchase; 5 years for speaker systems, 3 years for turntables, 2 years for electronics. These guarantees cover parts, repair labour and freight costs to and from the factory or nearest authorised service station. New packaging if needed is also free.

The AR catalogue and complete technical data on any AR product are available free upon request.

AR-2ax recommended retail price $285

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Australian Distributors

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AR sound equipment may be purchased from the following Australian Dealers:

N.S.W.: Magnetic Sound, Sydney. 29-3371. Sydney Hi-Fi, Sydney. 29-1082. **VIC.:** Brasch's, Melbourne; Douglas Trading, Melbourne. 63-9321. **S.A.:** Sound Spectrum, Adelaide. 23-2181. **A.C.T.:** Homecrafts, Canberra. 47-9624. **W.A.:** Leslie Leonard, Perth. 21-5067. Alberts T.V. & Hi-Fi Centre, Perth. 21-5004. **QLD.:** Brisbane Agencies, Brisbane. 2-6931.

RECORDINGS... CLASSICAL

REVIEWERS: John Araneta
Tanya Buchdahl, Christopher Wagstaff.

MOZART – Cosi Fan Tutti. Margaret Price, Lucia Popp, Yvonne Minton, Luigi Alva, Hans Sotin, Geraint Evans, New Philharmonia Orchestra, John Aldiss Choir, Otto Freudenthal (Harpsichord), Klemperer (cond.). 4–HMV SLS 961.

It seems common these days to forget that Mozart's operas are always artificial, and by that I do not mean a work like Cosi is mere surface but that it is primarily stylization. Cosi is likewise Mozart's most intricately varied and always delicately tasteful work.

This new recording is to my mind very wrong-headed indeed for a number of reasons. First, it is severely cut. True, there is no completely complete Cosi on records, and there never has been one, but a work that is almost neurasthenically interrelated as this one deserves to be recorded complete someday. Second, this performance is certainly humourless, except obviously at times and this just does not suit the work. It is also graceless and I cannot mean it is rough or careless; there is plenty of fine playing, phrasing, singing but once again not the sort appropriate to the work. Without being facetious, perhaps I culd make things clearer by saying there is hardly any Kultur in this performance. Nor is there any attempt to approach the various sections in Cosi with any real variety.

The basic problem lies I think in Klemperer's refusal to see this work as an extravagant artifice, a stylization. The tendency here is not towards an ultra-realistic production as is so common these days, that would be just as wrong headed as that which we get here. The tempos are not what I object to, although I do think a greater distinction must be made between recitatives and concerted numbers. Why aren't the comic aspects of the marches brought out? Why does everyone sing almost always at the same level especially in ensembles? Like Klemperer's Sauberflote, this Cosi is a concert performance and Cosi can only be dramatic. The singers always act their singing when it should be vice-versa. To be sure there is no Cosi currently on records which can be singled out as a justifiable interpretation of the opera. The one is too realistic, even vulgar, most adopt an essentially romantic approach similar to Klemperer's though never it seems to me as non-dramatic as the present one.

Perhaps someday EMI can re-release the old Schwarzkopf-Karajan performance. That recording was heavily cut, singing was not always ideal from everyone concerned but it still is to my mind the only recording which accepted Cosi as stylization without neglecting the psychological implications of the work. If anyone has an opportunity of hearing this set, he should compare at least the ensembles of ACT 1 with any other performance currently on record. Not only do voices blend, they are also always differentiated and there is no hesitation about singing with varied dynamic levels. Characterization? Schwarzkopf here (not with Bohm) is the only Fiordiligi on record to bring out all the conflicts in this character, whether these conflicts be real or make-believe. To cite one other excellent characterization on these records that surpasses any other on records, Lisa Otto's Despina is a real maid not a housekeeper or modern confidante. No other Despina on records has an inkling of how a maid should sound like. Devotees of Klemperer's approach to Mozart opera will no doubt disagree. The sound on these records is in any case very good indeed. – J.A.A.

ROSSINI – STABAT MATER Soloists, London Sym. Orch. & Chorus, Istvan Kertez (cond.) DECCA SXL–6534.

One hopes it is easier these days to accept Verdi's Requiem despite its undeniably operatic character. Rossini's Stabat Mater, however, seeming to lack Verdi's strong seriousness continues to find less acceptance what with its easy, opulent tunes and rhythms. Verdi's Italian is like almost all his operas up to the Requiem, dramatically tragic. Rossini's accent may naturally be expected to be that of earlier bel-canto opera, specifically of comic opera. We may easily forget Pergolesi's earlier masterpiece, the religious works of Mozart and Haydn are very much operatically inspired and often sound, to our ears at least, even too worldly and frivolous. Why is it easier in the case of these earlier works to say they are not for that reason any less religious? When one comes right down to it, one cannot seriously object to the operatic in religious music, for objectively speaking it is very hard to think of any religious work from the high baroque period (even Bach) down to Elgar that is not heavily in debt to the techniques and conventions of opera. It is quite true that this Stabat Mater may easily be mistaken for opera but I suppose it is as easy to revel in some of Bach's most religious moments only to forget the music is an adaption of an originally secular work. Like his later and finer Messe Solenelle, Rossini's Stabat Mater is content to use the language the composer is used to, and thus it is all the more unpretentious and moving. Like Verdi's great work, its weakest moments are those wherein Rossini tries to approximate more conventionally acceptable religious music: section 5 "Eja Mater and the Quartet "Quando corpus" (no.9). There are more marvellous moments, however, not the least being those melodies for which I feel with Stendahl that not even St. Peter could refuse Rossini admittance.

This recording makes the second Stabat Mater currently available. The earlier performance, available on an import CBS disc, and conducted by Thomas Schippers is an essentially more dramatic, if at times wayward, reading. Schippers' quartet sings well though it cannot match the voices here for more pleasing quality. I sometimes wish Kertesz would find more than surface strength in this music and not so much equate energetic speeds with intensity. His vocal quartet: Pilar Lorengar, Yvonne Minton, Luciano Pavarotti, Hans Sotin, is generally quite strong and as I said, more pleasing as to quality than that of Schippers. Pilar Lorengar is somewhat vocally unsteady, particularly in Inflammatus. Strange to say, Pavarotti here seems hard and forced but I think his Cujus Animam would not be as hard if Kertesz had been somewhat more considerate as to speed. Nevertheless the quartet's singing, and especially of Minton, is on a generally high level. 'Quis est homo' and 'Sancta Mater' are especially well done. Some of the male singing from the London Symphony Chorus is a bit rough at times but otherwise things are creditably done, even the final fugue. Recording is new and good, with fine range and balance but my initial copy had the familiar DECCA 'sshh' on the first side. – J.A.A.

MUSIC AT MAGDALEN (Record 1): The 17th Century – Choir of Magdalen College, Oxford; Elizabethan Consort of Viols, Bernard Rose (director) ARGO ZRG 693.

Three lesser known composers are brought to our attention here – Richard Nicolson, Nathaniel Giles and Benjamin Rogers – all associated with the music of Magdalen College during the 17th century. They are certainly brought to our attention with this fine recording directed by Bernard Rose. Nicolson steals the limelight with 9 items (including 2 very beautiful verse anthems and 3 delightful madrigals); Giles and Rogers are represented by 3 works each. What can one say about this music? Well, for a start, it is typically English in its comparative simplicity and conservatism (it should be remembered Monteverdi was at work in Italy at this time), and its uninvolvement with textual illustration. There are various sections one might easily mistake for Tomkins or Weelkes.

Some very fine singing here. Dr. Rose attains a high standard of performance though in a few spots he seems rather rigid. Certainly with English music of this period, one doesn't want too much involvement with the word painting but perhaps a little would not have gone amiss. Also obvious importance has been given to strict rhythem (important for this music) but once again I feel as though Dr. Rose has gone a little too far as there is just not enough time to round off phrases and give some sense of phrase structure. The madrigals are much easier to handle and here results have a good sense of continuity. I particularly like the two verse anthems "O God, consider my distress" (Nicolson) and "God who at this time"

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(Giles) which clearly show that England had a form unique from any on the continent. The Elizabethan Consort of Viols plays quite effectively as an accompaniment (intonation is generally good and pitch secure) but it seems to lack character -- nowhere does it give any sense of phrase structure. The workings here might do in the accompaniment of the vocal sections (even then I am sure we could have done with some sense of phrasing) but structure of the interludes needs to be more clearly defined. The soloists are all members of the choir and are very good indeed, though some of the lower notes of the male alto (not counter tenor as sleeve lists) are a little insecure. One is at first a little struck by the clarity of diction, especially from the trebles: every effort is made to "spit out" consonants, for example. Dr. Rose plays two organ voluntaries (by Benjamin Rogers) securely with very accurate and appropriate ornamentation. There are a few annoying clicks from the electric (yuk!) action.

Balance is on the whole quite good – perhaps the treble line is a little strong (even though this was considered the "melody" line in most instances). But what a sheer delight it is to hear such freshness of tone quality, ie. some delightful cuckooing in Nicolson's "In a merry May Morn". The Chapel has some lovely acoustical properties and careful microphone placement has ensured fine clarity. One eagerly awaits further releases from the Magdalen choir. – C.M.W.

MOZART: Symphonies No. 29 K.201; No.30 K.202; No.34 K.338. English Chamber Orchestra/Barenboim. HMV ASD 2806 ($6.20).

The performance of these symphonies is all that one could wish for. From symphonies to choral music to piano concertos, Barenboim is showing himself to be as good a Mozart interpreter as he is of Beethoven; and no small amount of praise is due to the E.C.O. who have in all their recently-numerous recordings play with excitement and loving care. The violin section is probably the orchestra's greatest strength, but here the whole ensemble has ample opportunity to show its considerable talent in three symphonies which are all quite unalike one another.

No. 30 is the least interesting – it is unquestionably Mozart, but it has only the standard Mozart forms and orchestration patterns, none of the originality of the other two. Where No. 29 (rightly very popular) starts with and maintains that impeccable grace which is the domain of only Mozart, No. 34 is a much larger-scale work in all respects but length. Written shortly before Idomeneo, the first movement could easily be substituted for an operatic overture, and the last movement is joyous to the extent of being almost country-danceish. The performance of this last work is I think the best of the three, and it is a really magnificent one. The overall sound is excellent, perhaps even better than usual for the string tone is lush – quite unstarved even in upper reaches. Thoroughly recommended. – T.B.

POP IN RETROSPECT

MIKE DELANEY looks back at '72

1972 wasn't all bad a year for rock 'n roll – certainly more interesting in perspective than any one of the last four as far as real excitement is concerned. '70-'71 were both pretty dull, looking back, mostly because they saw the last of your huge sixties' acts peter out: Creedence Clearwater Revival, Beatles, Janis Joplin, Hendrix, The Doors, Simon and Garfunkel, Joe Cocker/Mad Dogs & Englishmen, Blood, Sweat & Tears etc.

'72 was the year for your first wave of truly new, truly seventies' stars. The most obvious and successful were David Bowie, Marc Bolan and T. Rex, Gilbert O'Sullivan and Alice Cooper. Of course, there was the usual amount of teenage tat as well: David Cassidy and the Partridge Family, The Osmonds, Slade, Rick Springfield and Cat Stevens. But, with the exception of Springfield, all the rest are already on the wane. Stevens hasn't done anything remarkable since "Tea For The Tillerman"; Cassidy is past tense; Slade will probably last another six, maybe nine months; The Osmonds and Partridge Family are just too clean to keep the kiddies wetting their pants for much longer. And besides, Donny Osmond's voice has broken.

The whole thing is really simple: kids want something dirty . . . something worth thinking evil over. Whether the current craze for bisexual rock 'n' rollers lasts is neither here nor there. But, as far as '72 is concerned, that was the year that was.

David Bowie had tried real hard since '67 to cut the star thing: he kind of made it in '68 with "Space Oddity" – the Ivor Novello Award Winner for best song of the year. But that turned out to be a flash – something that he failed to follow through singles-wise until the release of "Starman", "John, I'm Only Dancing" and "The Jean Genie": his '72 triad – the latter two of which have apparently been banned in Australia because they're both specifically gay in lyric content. Pity. It could have been quite amusing.

Anyway, Bowie kind of made it in '68 as your intensely poetic and emotionally paranoid folk-rock underground hero: no '68-'69 head party was complete without a copy of the "Space Oddity" album (deleted) – everybody sitting around feeling all ethereal and shimmery as the song went 'Planet earth is blue and there's nothing I can do.'

In '69 he tried the gay image reclining on the front sleeve of his "The Man Who Sold The World" album (deleted) in semi-drag. The music was better than "Space Oddity" but it didn't sell: people who loved his earlier stuff couldn't see Bowie as a butch rock 'n' roller baring his soul to the universe about his problems as an unliberated homosexual trying to be liberated. And vice versa. Songs like "The Width Of A Circle", "All The Madmen" and "After All" are somewhat classic in their genre. It's a real shame that people couldn't relate because, in many ways, those first two albums were just about as shit honest as Bowie will ever make.

'71 was "Hunky Dory" and '72 was "The Rise And Fall Of Ziggy Stardust And The Spiders From Mars" – Mars being one of his oft' quoted and favorite planets. Bowie was incorporating more and more theatre behind his image – well in keeping with the times.

"Hunky Dory" – re-affirmed his position as a great songwriter and an above average musician: "The Bewlay Brothers", "Life on Mars", "Andy Warhol", "Queen Bitch" – a superb album. Very schizoid but superb. It showed that there was a whole lot of different people inside Bowie, each of which wanted to get out as fast as he/she could.

"Ziggy Stardust" was the peak – a culmination of four years' development. He'd researched his medium: Marc Bolan was the king and Alice Cooper the anti-hero. Both of them got sussed out and turned around into the 'Ziggy' persona. It worked. Everybody had to have it: see them all swoon as he sang 'put your space face next to mine/Put your ray gun to my head'.

The trouble with the "Ziggy Stardust" album won't become obvious for a couple more months yet. It no longer matters that David Bowie is a superb and remarkably gifted singer/songwriter; all that counts these days is 'Ziggy' himself – is David Bowie the real Ziggy Stardust or is Ziggy Stardust the real David Bowie. And that's not fair.

Perhaps Bowie wanted it this way all along: Ziggy is the ultimate shield against the personal. He couldn't and didn't cut it as a folk-rocker and ditto as a homosexual. Who needs the criticism – certainly not Bowie as he has stated many times over the last couple of months; ever since "Ziggy" made him a star. It's probably a good thing because nobody gives a damn who Bowie fucks anymore – boy or girl.

Bowie will most likely become to the seventies what a girl like Shirley Bassey was to the mid-sixties'. Listen to "Five Years" and "Rock 'n' Roll Suicide" – the same sense calculated melodrama, fraught with the same tension, caught up. In the same style charisma: "You're not alone . . . give me your hand . . . its wonderful . . . give me your hand . . . its wonderful . . . you're not alone". The same sentiments and overall grandiose. Lots and lots of the same theatre. High camp.

Marc Bolan is your other third of the seventies' superstar syndrome, sharing the throne with David and Alice. He's better, infinitely and worlds better because he's subtle – not sophisticated – just subtle. Bowie latched onto the Bolan persona when Marc started to make it circa '70-'71 with Tyrannosaurus Rex. Low key high fantasy with myth, sex appeal, style and imagination. Bolan was the original Ziggy Stardust simple because there's no such person as Marc Bolan. Mark Feld, the 5'4" Jewish kid from Tooting, created a media personality and dubbed it Marc Bolan through a duo called Tyrannosaurus Rex – later to become T. Rex: abbreviated and streamlined; acoustic to electric boogie woogie.

Bowie, the clever and sharp, watched the Bolan persona infest the charts, hearts and minds of an entirely new generation untouched by the Beatles. 'Tyrannosaurus Rex – the rider of stars/the eater of cars'. 'The Rise & Fall Of Ziggy Stardust & The Spiders From Mars'. Bowie didn't write his album about or around Bolan; he just used the same values, utilized the same or similar imagery, emotions, topics. Naturally it worked just as well. Perhaps a little too well.

Feld didn't go straight into it like David. He spent six years getting the Bolan thing together – defining, creating, discarding, working real hard. But never really changing. Bowie let it all out in one lump sum and dispersed it like a deluge; Feld let it build up and then he kind of siphoned it out. He must be a very clever businessman if nothing else.

'70 through '72 and onwards is really Mark Feld/Marc Bolan. From your dwarves and gnomes and dworns of yore circa '68-'71 with Tyrannosaurus – sitting cross legged on the stage, acoustic, gentle and delicate and altogether unattainable; Feld metamorphosed Bolan from "Prophets, Seers & Sages" through to Bolan the "Electric Warrior" and thence Bolan "The Slider" – the best record to come out of England in '72.

Feld is a genius – a master of disguise, of concept: a media man of the highest order. T. Rex is his vehicle – boogie band, funky as hell and metallic, real foreign sounding

Turn to page 117

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POP IN RETROSPECT

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just like a huge wind up clockwork mechanism. But simple – the same chords, the same progression, the same minors. And similarly, the same emotions, excitement, energy and reactions – sometimes slower like a ballad, sometimes faster like a boogie and sometimes real fast like an avalanche.

"The Slider" takes up eighteen months later from where "Electric Warrior" left off: more filth, longer and harder and more definite, better poetry, more incisive imagery and less samey in the regurgitation of the Bolan riff. And more, more and more and more egotistical: "Telegram Sam", "Main Man", "Ballrooms of Mars", "Metal Guru", "The Slider", "Baby Boomerang" – his genius for persona. "Me I funk but I don't care/I ain't no square with my corkscrew hair"; ". . . And gripped in the arms of the changeless mad-man/We'll dance our lives away in the Ballrooms of Mars . . ."; "Bolan likes to rock now . . . yes he does . . . yes he does . . . Bolan likes to rock now . . . yes he does . . . yes he does"; "I have never kissed a car before/It's like a door/I have always grown my own before/All schools are strange"; "Slider, Slider/You're just a sexual glider/Be my plane in the rain". Love songs from Bolan to himself.

Then there's that line; "I drive a Rolls Royce because it's good for my voice/But it still don't fool the Children of the Revolution . . .". Madness. Sheer unadulterated madness. And it sells and sells and sells and sells. The kids love it.

The reason why Feld is and will continue to be huge is simple. Alice and Bowie change with the times; Bolan makes the times change to suit what he wants to say about Bolan. Easy.

Bowie wrote a song about Alice Cooper on "Ziggy Stardust". He doesn't and probably won't ever say he did. But it's there; 'Ziggy really sang/Painted eyes and screwed down hair do . . . He was the Nazz with God-given charms/He took it all too far . . . Making love with his ego/Ziggy sucked up into his mind like a leather Messiah'.

Alice won't last because he's come on too strong too soon. '69-'71 were his formative years: from "Pretties For You" and "Easy Action", both little more than mediocre, up to the slightly more interesting "Love It To Death", the latter contained an American hit "I'm Eighteen" – perfect for pubescent high schoolers demanding their share of the passion. Then came the sales with "Killer" – a loud untogether, basic, dirty and brutal rock 'n' roll album: brilliant for what it was – kind of sado-masochist in its feel. Again, perfect for the times.

The trendies kicked off '72 with "Killer": the kiddies followed a couple of months with "School's Out" – less effective than "Killer" but with greater rudeness and pretention. Crass. It was huge. Everybody went 'round humming . . . HHHmmm . . . "School's out for summer/School's out for E–V–E–R". Big, big, big in Bankstown.

How do you follow two albums that peak their genre? By staging a Broadway adaption taking out the best of both – electric chairs, the hanging scene, the boa, a full scale riot scene with real props, simulated murders, blood capsules everywhere that showed, no chickens nor dresses but lots of mascara and sweat. Right. But what do you do next to be even dirtier than things like "Publi Animal"?

In many ways, the Who did a similar job to Alice with songs like "My G – G – G – G – G – G – Generation", "Substitute", "I'm A Boy" and "Pictures of Lily". The only real difference is that Alice came along in the seventies; Townshend, Daltrey, Enthwiste and Moon made it back in the early sixties. Seven or so years later, with great things like "Tommy" and the "Who's Next" album behind them, they're obliged to run through "My Generation" because it's what the kiddies want most. Forget your rock operas, cantatas or whatever. The kids want revolution, filth, vulgarity and dirt and lots of it.

Anyhow, that was the other third of the '72 triumvirate. Perfect for the times – last year I should talk about Gilbert O'Sullivan but it'd only be an anti-climax. So I won't. Social Significance? It's up to you. I got better things to do.

Apart from all that, there was a whole lot of other great artist/album things out through last year – none of which should go by without a mention.

"Surf's Up", released in the very early months, was and is the best, most imaginative, complete and beautiful record ever put down by the Beach Boys in their slightly altered but basically original line-up. As far as the band goes, their music can be sorted out into two sections: the Beach Boys plus or minus Brian Wilson.

"Surf's Up" is the culmination of over 13 years' playing. It was the last disc to boast the merits of Wilson as both composer and producer/musician. Simply this: it's one of the greatest American rock albums ever – up there alongside Van Morrison's oft lauded but seldom bought "Astral Weeks" and "Sweetheart Of the Rodeo"/"The Notorious Byrd Brothers" by the Byrds. It's the definitive Beach Boys album. You owe it to yourself to buy it because, as a band, they'll just never get any better song-wise: "Looking At Tomorrow", "Disney Girls (1957)", "Don't Go Near The Water", "Feel Flows", "Take A Load Off Your Feet" and the amazing "Surf's Up" sez it all.

Neil Young cried his heart out unmercifully all over another album, this time, called "Harvest" – more poignant, depressing, haunted and sorrowful than ever. It still managed to be a good record anyhow. Not even Young could spoil songs like "The Needle & The Damage Done" – Lord knows he tried . . .

"Some Time In New York City" – the John & Yoko Lennon double set, held back for months and then unleashed on an unsuspected Xmas market, is the best thing they've done since Lennon made it public property that the dream was indeed over. "Luck Of The Irish", "New York City", "Angela", "John Sinclair", "Sunday Bloody Sunday" and a live "Cold Turkey" recorded with Zappa in London are some of the most effective songs he/she/they have written. It shits on anything McCartney has done since

POP IN RETROSPECT

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the split – the first Wings album was simply drab.

Another good thing is that it shows Yoko to be what some of us knew all along anyway: that she can and does sing/write/perform with more funk than anybody outside of the late Janis Joplin. They'll be playing this album in 2072 just to see what it was really like back then. What's more, it'll give pretty accurate representation of all those publicised burns, bummers and busts that made it big over the last two years. Buy it: for only $7.98, it's roughly $1 more than you'll pay for Bowie and that's only a single record. At $6.95 R.C.A. have got to be having us on.

America may not be the greatest band around, but for sheer loveliness, their first album (and, for that matter, their second entitled "Homecoming") was one of last year's best. Simply called "America", it revived the same feel that made the first Crosby, Stills & Nash album one of the best back in '69. Songs like "Riverside", "Sandman", "Children", "I Need You", and the hit "A Horse With No Name" are just beautiful – like a breath of fresh air in a climate over intellectualized by people such as Jethro Tull, Curved Air and Roxy Music.

For those who prefer their rock more articulate and outspoken and funky, Jethro Tull brought out two excellent discs, "Thick As A Brick" and the double set "Living In The Past" – both of which contained some of the most original English sounds this side of Yes. Ian Anderson's persona, though not as accessible as someone like David Bowie, is nevertheless just as forceful: "Your love's in the gutter/Your sperm's in the sink' and other pleasant thoughts have built somewhat of a cult following among the trendies not just for the music but for his poetry as well. Not bad.

"Living In The Past" will probably appeal more than "Thick As A Brick" because it's a composite thing tracing the group's career from their first single "Love Story" through five subsequent albums – each of which got gold awards in the States. It's a fairly startling collection particularly for those who missed out on the original discs. Now's the time to fix it up.

Jefferson Airplane did "Bark" on their own Grunt record label – the most interesting set they've done since the classic "Crown Of Creation". All Airplane Discs have songs that run the gamut from great to shit awful: this is by no means an exception. But, at least, the bad ones aren't as embarrassing as usual. "Pretty As You Feel", "Feel So Good", "Crazy Miranda" – Grace Slick's best song since "Lather" – "War Movie" and the boring "When The Earth Moves Again" give a pretty good idea of what they've been doing over the last eighteen months since Marty Balin and Spencer Dryden split.

"Exile On Main Streets" is the greatest album yet released by the Rolling Stones. It came around August/September '72 and should be part of your collection already. Pure dirt.

Ego-rock was still as big last year as it was the two years before. This time Paul Simon, Elton John (again), Todd Rundgren and Australia's Rick Springfield did the best with what they had. Springfield's "Beginnings", his first solo album since he split up the greatest rock 'n' roll band this country will ever see – namely the Zoot, was huge America. And rightfully so. Simply this: he's a star. He has talent, looks, musicianship, taste, an ear for catchy tunes and lyrics, a sense of style unlike anyone else, and a great manager capable of leaping international bestselling lists in a single bound.

The rest of the best I'll have to list off – not in any semblence of order:

"Fog On The Tyne" – Lindisfarne. Phonogram. Stereo. 6369.914.

"Meddle" – Pink Floyd. EMI. Stereo. SHVL.795.

"Recall The Beginning" – Steve Miller Band. EMI. Stereo. SMAS. 11022.

"Himself" – Gilbert O'Sullivan. EMI. Stereo. MAM-SS.501.

"Led Zepplin 4" – Led Zepplin. WEA. Stereo. SD.7208.

"Last Of The Red Hot Burritos" – Flying Burrito Brothers. Festival. Stereo. SAML.934559.

"There's A Kiot Goi' On" – Sly & The Family Stone. C.B.S. Stereo. K.E.30986.

"Fifth" Lee Michaels. Festival. Stereo. SAML 934257.

"Bolan Boogie" – T. Rex. Phonogram. Stereo 2326.012

"Farther Along" – The Byrds. C.B.S. Stereo. SBP. 234060.

"Music From The Body" – Roger Waters & Ron Geesin. EMI. Stereo. SHVL. 4008.

"St. Dominic's Preview" – Van Morrison. WEA. Stereo. BS.2633.

"The Eagles" – Eagles. EMI. Stereo. SYTC.101.

"Graham Nash/David Crosby " – Graham Nash & David Crosby. WEA. Stereo S.D.7220.

"Close To, The Edge" – Yes. WEA. Stereo. S.D.7244.

"Anticipation" – Carly Simon. WEA. Stereo. EKS.7655.

"Greetings From L.A." – Tim Buckly. WEA. Stereo. B.S.2631.

"20 Granite Creek" – Moby Grape. WEA. Stereo. RS.6460.

"Tupelo Honey" – Van Morrison. WEA. Stereo. WS.1950.

"Milesago" – Spectrum. EMI/Harvest.

"Warts Up Your Nose" – Murtceps. EMI/HMV.

"Stephen Stills/Manassas" – Stephen Stills & Manassas. WEA. STereo. S.D.2-903.

"Jonathan Edwards" – Jonathan Edwards. WEA. Stereo. S.D.862.

"Grave New World" – Strawbs. Festival. Stereo. SAML. 934522.

"The Morning After" – J. Geils band. WEA. Stereo. SD.8297.

"Sex, Dope, Rock 'n' Roll" – Daddy Cool. Sparmac. Stereo. S.P.L.002.

"Sittin' In" – Kenny Loggins with Jim Messina. Columbia. Stereo. S.B.P. 234118.

"Gene Clark" – Gene Clark. Festival. Stereo. SAML. 934353.

"Fanny Hill" – Fanny. WEA. Stereo. MS.2058.

"Triology" – Emerson, Lake & Palmer. WEA. Stereo.

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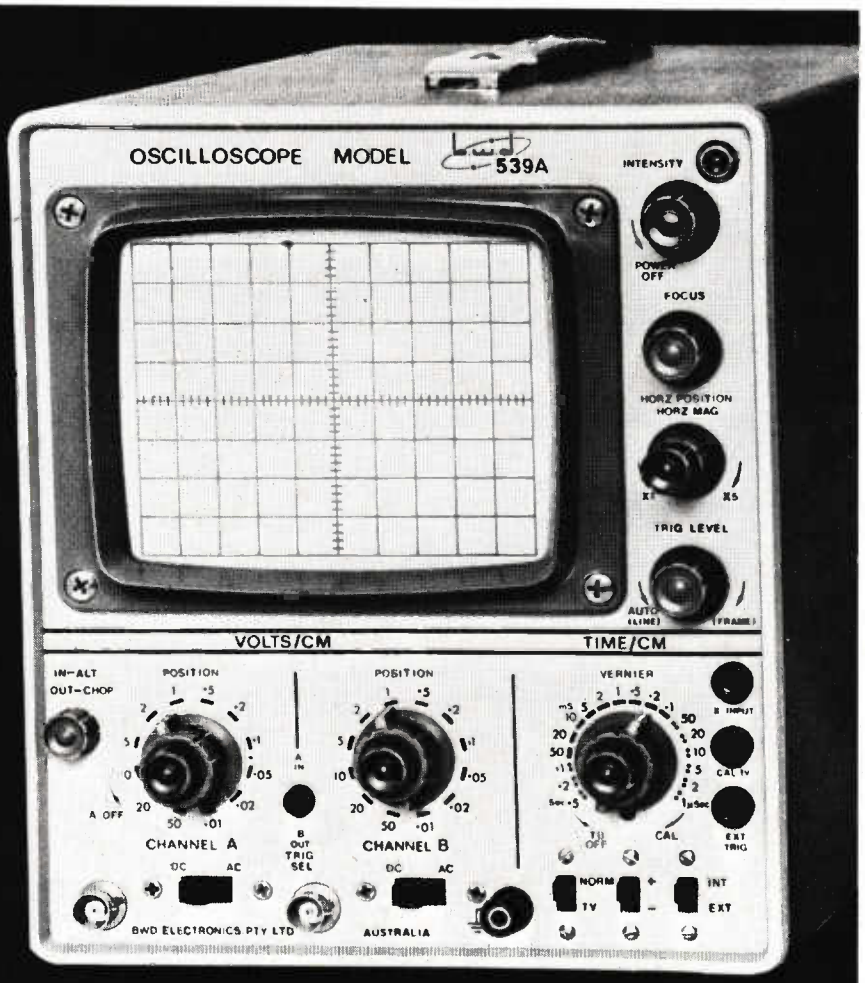

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UPDATING MEDIA

I am writing to you in common with other printed media outlets to suggest that in this TV age the traditional "Magazine" format is not necessarily the only or the best form in which to sell printed up to date information to the public.

When the home computer-linked teleprintout becomes reality as we hope it may, the editorial function of selection will have passed completely to the consumer. As of now the reader can only buy the finished product – all nicely rounded off balanced and laid out. But what if he wants something else? Publishers spend great efforts and much time in seeking consumer feedback and especially recently are catering for a desire on the part of their readers to preserve printed information rather than wastefully throwing out after one reading. Technical magazines are usually preserved in entirety until quite old when they then go the way of all flesh.

What do people *do* with "Magazines?" I believe that quite apart from the instalment encyclopaedias and other forms of Consumer Library Building Facilities, provided by the printed media, that there is a necessity for a basic extension and modification of "Magazine" format. It involves being the same and yet different. Printed up to date information outlets should rethink their function and specifically design themselves for the purpose of enabling the reader to store easily selected articles of his *own* choice – without the need to keep the whole magazine which may contain extraneous and spacewasting material.

In order to facilitate this the "Mag." or P.U.T.D.IN. outlet, as I prefer to call them – in preference to terms which carry preconceptions with them must simply

1. Provide a 25mm margin at the spine side of editorial pages (Yes – mess up your lovely lay-out that's right, never mind. Yes – all that wasted space, I know, don't worry about it.)
2. Ensure that articles retain individual extraction integrity, i.e.: ensure that copy belonging to different articles never appears on flip sides of the same leaf. (Yes more messing up your lay-out, Ahh shame.)

At this point there are various possibilities:

(A) I am either a bloke who has produced a useful though not necessarily original idea, or I am an impractical simple minded twit.

(B) You have either skipped briefly through this letter and not really understood all the implications of it, or you have read it and understood it.

(C) You will either discard this letter or schedule the matter for wider discussion.

(D) It is either a good idea in which case practical objections have relevance to us only in so far as we are looking for ways to overcome them, or it is not.

As a consumer of traditional outlets of printed up to date information, who desires to store selectively articles which interest me and to discard the rest, I have found them wanting. If traditional "Magazines" gradually change now to a *"Filable"* format so that we can file articles in standard sized files from ordinary stores P.U.T.D.I.N. outlets are "go" for the electronic age baby. Otherwise nix.

A.D.D. Plymouth, U.K.

* *We welcome comments from interested readers.*

CARS – FUTURE SHOCK

Your article 'Cars – Future Shock' in last month's issue was extremely interesting. It is unusual to find a technical publication that can on occasion cover two separate engineering disciplines with equal competence.

Does the recently announced Sarich engine in any way change your views on pollution and the need for alternative power sources?

J.L. St. Ives. NSW

**As far as emissions are concerned the Sarich engine is excellent. We cannot in a primarily electronics magazine give too much space to this question, but briefly a conventional petrol engine must run at high temperature to reduce the emissions of unburnt hydro-carbons. Unfortunately the resultant high peak cylinder temperatures create nitrous oxides which react photo-chemically with sunlight to create 'smog'.*

But the Sarich engine, due to an orbital piston motion has such excellent combustion chamber turbulence that the mixture is burnt almost in its entirety thus reducing (by definition) unburnt hydro-carbons. And it achieves this without the need for high combustion chamber temperatures. – Hence no nitrous oxides are created.

The Sarich engine is thermodynamically more efficient than conventional petrol engines – it burns less fuel for work performed. Nevertheless there are only limited supplies of petroleum bearing deposits in our world – and even though the Sarich engine may be more economical, its possible adoption would only put off the ultimate problem a bit longer.

(A full technical appraisal of this engine is included in the March 1973 issue of our sister publication "Modern Motor" on sale now). ●

An instrument for TV servicing that is ...keyed to COLOUR

KYORITSU MODEL K-200
FET · METER

This meter gives you all the advantages of a VTVM in voltage, current and resistance measurement with **instant warm-up** . . . a feature of the field effect transistor which is even superior to a vacuum tube in loading characteristics minor scale and knife-edge pointer. 10 megohm input resistance on DC and AC means you can measure voltages accurately with minimum load. Eight AC current ranges . . . minimum circuit loading. Peak to peak scales with freq-response to 3 MHz. Fully solid state and battery operated so you can use anywhere, anytime—**with built-in battery check.**

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For full details on this "keyed to colour" instrument contact:

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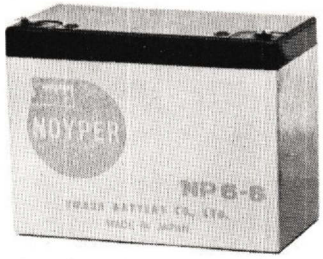

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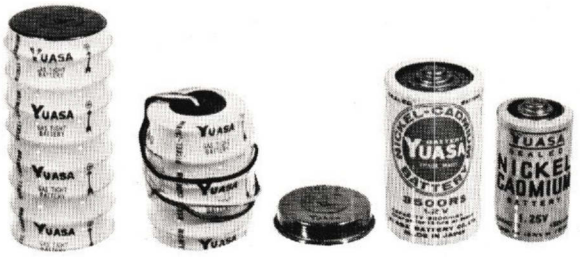
The NOYPER battery is light in weight, compact in size and is maintenance free (except for recharging). Has a long service life, is leak proof, explosion proof and can be operated in any position, but must be recharged in the vertical position with a specially designed Clyde Noyper Battery Charger. The batteries are suitable for a wide variety of electronic equipment such as two-way radios — transmitters and receivers, emergency lighting, security and fire alarm systems, portable TV video recorders and measuring equipment. They are available in 6 or 12 volt with capacities ranging from 1 ampere hour to 8 ampere hour at the 10 hour rate.



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The ULTNICA range of batteries are all hermetically sealed, which guards against leakage. They can be used in temperatures as low as *20°C. and are completely shockproof. Suitable for usage in electronic equipment and communication equipment and electrical tools.

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For further information on Advertisers listed below complete the coupon/s stating information required including company and position held (if relevant). Cut out the coupon and post to:—

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FOR MANUFACTURE OF COAXIAL CONNECTORS AND THEIR TERMINATION ONTO CABLE

DID YOU KNOW THAT AMPHENOL IS THE WORLD'S LARGEST CONNECTOR MANUFACTURER

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REALISTIC DX 150A

. . . a professional-looking set that appeals to amateurs and short wave listeners alike. The DX150A gives long-range, world-wide realistic reception on 4 bands, including Broadcast. Fully transistorised—all solid state—no warm-up delays; the DX150A will run on dry cells if current fails or is not available; will operate from a car's cigarette lighter or any 12V DC service. A 240V AC power supply is also built in. Over 30 semi-conductors—product detector for SSB/CW, plus fast and slow AVC—variable pitch BFO—illuminated electrical bandspread, fully calibrated for amateur bands—cascade RF stage—ANL for RF and AF—zener stabilised—OTL audio—illuminated "S" meter—built-in monitor speaker plus front panel jack for external (optional) matching speaker.

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Resistors European CR 37 5% ½ Watt 3.5 cents each, $2.75 per hundred; 1 Watt 6c each, $5 per hundred; 2N3638 55c, 2N3055 $1.50 ea. $12 per 10. BC107, 8, 9 35c ea. $3 per 10. EM401 25c ea. $2 per 10. EM404 30c ea. $2.50 per 10. EM408 40c ea.; 2 inches square 0 — 1mA meter $4.75; alligator clips 4 colours, small 10c ea. $1 per twelve, large 12c ea. $1.20 per ten. Magnetic earpieces 35c ea. $1 per 3; SPST Toggle Switches 45c ea. $4 per 10; 4mm banana plug & socket 4 colours 20c pair, battery leads suit 216 10c ea. 79c per 10; twin speaker cable 2c foot; hook up wire 7 — 010 many colours 4c yard; single shielded microphone cable 12c yd; twin shielded microphone cable 25c yd. Samples on request; spring terminals 5 colours 18c; Hi Fi quality stereo headphones $5.95 plus 50c postage. CDI kit ideal for all cars $21.50 plus 50c post advise polarity. 5 Watt audio amplifier kit, mono $7.85 stereo $15.50. Power supply kit lamp 6V to 15V $6.35 plus 50c postage; twin cone 8 inch hi fi speaker 8 ohms $8 plus 65c postage.

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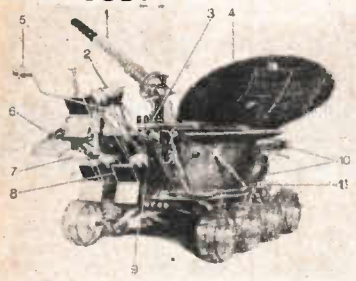
news digest

(continued from page 14)

RUSSIA'S LATEST MOON BUGGY



1. High-gain aerial. 2. Steerable television camera. 3. Photo receiver. 4. Solar battery. 5. Magnetometer. 6. Corner reflector. 7. Space photometer. 8. Television camera. 9. Soil analysis experiment. 10. Lunar surface photometer. 11. Orientation device.

Russia's second remotely controlled moon buggy landed on the lunar surface aboard the Luna 21 space vehicle on January 16.

The TAS newsagency report that one of the main tasks of the vehicle will be to investigate the moon's surface about 180 km north of the recent Apollo 17 landing point.

Apart from other instruments the unmanned machine is equipped with a space photometer which will be used to measure the zodiacal light near the Sun. It will also observe the Milky Way and the pole of the galaxy.

Andrei Severny of the Crimean Astrophysical Laboratory says that it is hoped to establish whether there are traces of cosmic dust in the lunar atmosphere.

IRH APPOINTS ADDITIONAL DIRECTORS

Two additional directors have been appointed to the board of the Australian electronics and cable group, IRH Industries Limited.

They are Mr. Nicholas Shehadie, O.B.E. and Mr. John Marks, Managing Director of Supervised Securities Limited.

Announcement of the new board memberships was made by the Chairman of IRH Industries, Mr. L. W. Port, B.E.

LASER MEASURES SATELLITE ORBITS

Artificial satellites are used more and more for 'down-to-earth' purposes. The institute of Applied Geodesy (IFAG) recently started operating a satellite observation post in Bavaria, West Germany, the purpose of which is to to precisely measure the trajectory of survey satellites to withing a centimetre with the aid of a large laser telemeter, in connection with an international research program. The laser equipment for the observation post was supplied by Siemens, and it is hoped that the data obtained will eventually provide more accurate information about the Earth's field of gravity, polar migration and supposed continental drift.

The principal equipment is a giant pulse laser with a peak intensity of more than 100 MW (which is available during the 20-50 ns pulses). The laser beam is reflected back to the ground station by a corner reflector mounted on the satellite. The distance between the ground station and the satellite at the instant of measurement can be determined with the aid of a universal time clock by measuring the time taken by a laser pulse to reach the satellite and return.

To obtain a precise definition of the satellite's position in space it is also necessary to photograph it so as to record its position in relation to the constellations, taking sidereal time into account. The exact position of the satellite at the instant of measurement can only be ascertained from the combined information obtained from the return time of the pulse, sidereal time and universal time.

Under the most favourable conditions it is possible to use the laser telemeter to take 70-80 'shots' during each transit. A cloudless night is one of the prerequisites. During the day the data that have been obtained are edited, supplemented with additional data from the satellite's flight plan, details of which are made known every week, and forwarded to a computing centre.

It is hoped that in the course of time the wealth of data obtained will help answer questions about the Earth's gravitational field, since any deviations in the satellite's prescribed flight path are caused by changes in the Earth's field of gravitation. Besides this, scientists think that they will be able to find out more about the phenomena known as continental drift (the disruption and drifting apart of the land masses) and polar migration. This is because the satellite station not only makes it possible to determine the precise position of a satellite but that of the ground station as well. Besides the IFAG system, there are observation posts in France, Australia and the United States making up the international chain of research stations.

The laser equipment is mounted on a carriage that can be both rotated and tilted to allow the laser beams to be aimed at the satellites as they orbit the Earth at a height of between 600 and 2,000 km. Besides the devices for transmission and reception of the laser beams (the optical section consists of Cassegrainian telescopes) there is a

bearing sight for visual location of the satellite. When the satellite station is expanded it is planned to use a television camera to transmit the picture from the bearing sight to a screen. This will mean that the position of the laser gun can be adjusted by hand. It will also be possible to have a process computer automatically align the system with the moving satellite. ●

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FEATURE ARTICLES

BOOK REVIEWS

PRODUCT TESTS

CONSTRUCTIONAL PROJECTS

Bi-directional record and playback tape deck
Model A-4070
● 4 Ferrite heads (6 head function) ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .06% at 7½ ips ● F/R 25 to 24,000 Hz at 7½ ips ● S/N ratio 58dB

Make music- not noise

You may not realise it, but until now, even the best tape decks allowed a degree of noise during recording and playback. This may have been all right for conventional tapes, since they were far from perfect.

But with the recent introduction of the low noise/high output tapes, it's no longer permissible.

Which brings us to a new generation of decks by TEAC. And TEAC calls them Superior Sound/Low Noise decks: decks designed to get the most out of the low noise tapes as well as the conventional types.

Five of these new generation decks are described here. If you'd like to know more, write to us and we'll send you further information (catalogue, dealer list and price list) on the unit(s) that interests you.

Stereo Tape Deck
Model A-3300
● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .06% at 7½ ips ● F/R 25 to 24,000 Hz ● S/N Ratio 55dB

Stereo Tape Deck
Model A-1230
● 3 heads-4-head function ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB

Automatic Reverse Stereo Tape Deck
Model A-1250
● 3 heads-4-head function ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB

Combination Head Stereo Tape Deck
Model A-1030
● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● One motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB ● Auto. Shut-off

TEAC
A Sound Idea

Australian Distributors: Australian Musical Industries P/L, 155 Gladstone St., Sth Melbourne Vic., 3205. Ph 69-5888 — 619 Pacific H'way, St. Leonards, NSW, 2065. Ph 439-5752 — Arena Distributors, 273 Hay St., East Perth. Ph 25993.

INSTROL for SYSTEMS

INSTROL SYSTEM 299

AMPLIFIER:	Rotel 310 amplifier (15 watts RMS per channel)
SPEAKERS:	Magnavox 8-30 speaker system (choice teak or walnut)
TURNTABLE:	Garrard Sp25 Mk3 Player
CARTRIDGE:	A.D.C. 220X magnetic
FURNITURE:	Choice teak or walnut player stand with hinged moulded dust cover (tinted)
PRICE:	Fully inclusive $299.00

SONAB SYSTEM 419

ROTEL 310 Amplifier (15 watts RMS per channel)

Pair of SONAB V1 speakers (choice teak or walnut colour)

J.H. belt-drive turntable

SANSUI tone arm

A.D.C. magnetic cartridge

TEAK or walnut base, hinged perspex cover

PRICE $419.00

PLUS full manufacturer's warranty, as well as Instrol's own warranty, free capital city delivery, complete showroom demonstration facilities.

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