SEPTEMBER, 1973
50c*

electronics TODAY INTERNATIONAL

HI-FI

NUCLEAR FALLOUT - HOW DANGEROUS?

LINEAR MOTORS

$10,000 COMPUTER CONTEST!

Registered for posting as a periodical — Category C

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electronics TODAY INTERNATIONAL

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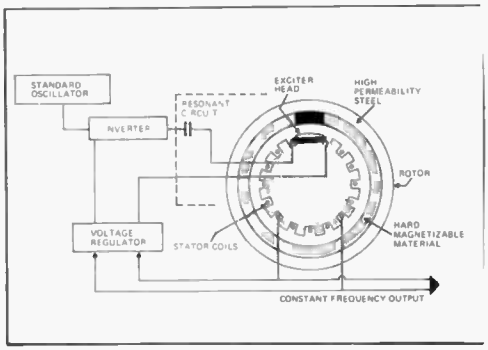
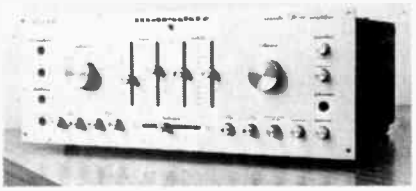
COVER: Official French government picture shows atomic explosion at Mururoa atoll. Observers report that explosion was of a 'small' triggering device for larger hydrogen weapon. (Special report on dangers of nuclear fallout – page 60, this issue).





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small speakers... GREAT SOUND

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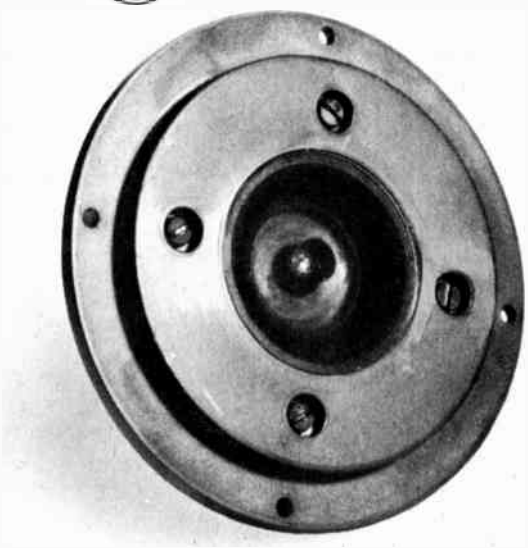

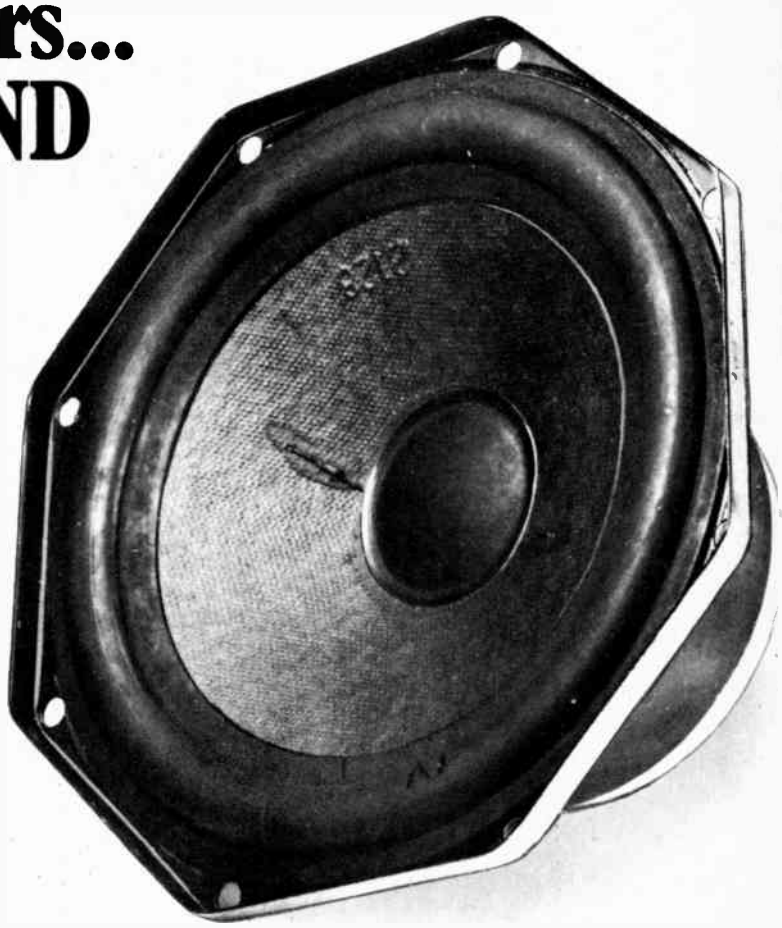

Here are the loudspeakers that make the Philips Quadreflect System the most exciting sound innovation of the seventies.

Illustrated are the tweeter (type AD0160/T8) and woofer (type AD7065/W8), just two examples of the imported Philips high-fidelity range.

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Have the tapes been altered?

TAPE recordings, made clandestinely by US President Nixon, may well contain absolute proof as to Nixon's prior knowledge of the Watergate cover-up.

Hence the speculation currently rife in US electronics circles that these tapes may have been edited to remove incriminatory evidence.

Despite the present level of expertise in tape editing, expert opinion is that, whilst it would be simple to edit the tapes so that they *sound* unchanged, such editing would not stand up to expert scrutiny. In fact were Senator Ervin and Special Prosecutor Cox to obtain access to the tapes, it is almost certain that expert analysis would reveal signs of tampering – had that happened.

Spectral analysis of background noise would reveal periodic phenomena, especially low level 60 Hz and 120 Hz hum. Narrow bandpass filtering could isolate this phenomena and it would then be a simple matter to look for discrepancies in the normally exact intervals between peaks.

Other authorities stress that as the White House oval office – where the recordings were made – has a long reverberation time, any edit would have to be made at least half a second after the cessation of any sound. This would be very difficult to do.

Another method of detection is the checking of bias frequency against that of the machine on which the recordings were made. Any change here would be immediate proof of tampering.

All in all the concensus of opinion is that if Nixon suggests a compromise – perhaps that the investigating committee listen to – but do not have actual access to – the tapes, then there is every reason to suspect tampering, but if the tapes were to be released for expert scrutiny, and were then cleared by experts, it is most unlikely that any editing had taken place.

For audiophiles who feel this is the 2-channel stereo receiver era—but want to be ready for 4-channel—we recommend our latest two-four receivers.
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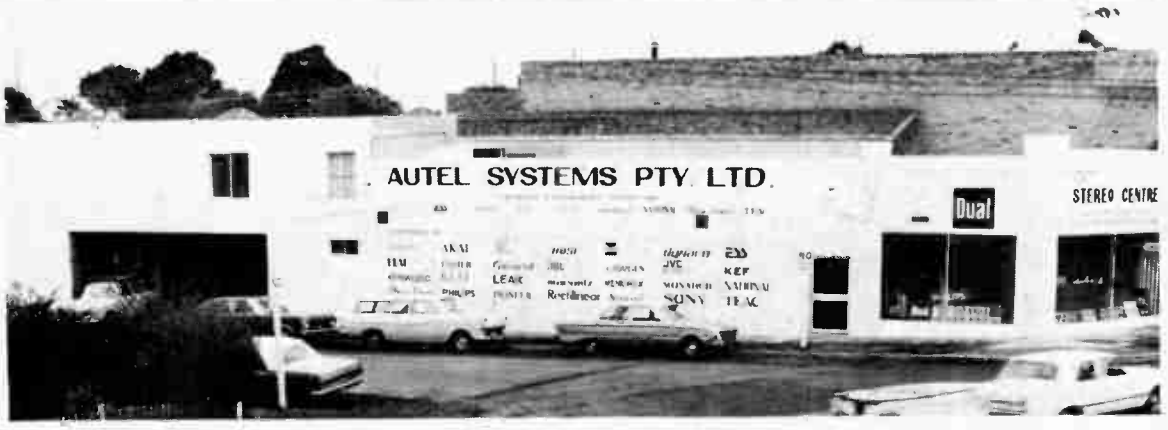

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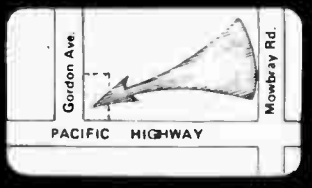

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Model 212 $1670 per pair *
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$720 per pair *

As a serious audiophile, you no doubt recognize that the weakest link in the sound reproduction system has long been the speaker. You would not tolerate an amplifier with 4-5% distortion or with response as poor as ± 4db or with a bandwidth of only 100-10,000 Hz. And yet, only a very few loudspeakers on the market today are even that GOOD! So no matter how fine the rest of the system, the sound has always been limited by the speakers.

Sensing this weakness, many music lovers have been begging for a line of Amcron speakers that would live up to the Amcron reputation for innovative excellence, earned by its professional tape recorders, power amplifiers and preamplifier. Amcron engineers have been working for many years to develop such a speaker design. But they felt that they would rather design none at all, than to ruin their reputation with a mediocre product that was "JUST ANOTHER SPEAKER".

At last, recent breakthroughs in electrostatic speaker design have made possible genuinely accurate sound reproduction. Now Amcron can offer you a line of three "Auralinear" Speaker Systems, which unite wideband electrostatic radiators with special long-throw woofers, each model worthy of the Amcron name in every respect. They are the first and only speakers to radiate "ABSOLUTELY FLAT AND HONEST SOUND".

Amcron is eager to make the "LIVE SOUND EXPERIENCE" yours. Who knows, you may already have live sound in your amplifier system just waiting to be expressed through Amcron Auralinear Speakers.

What makes Amcron speakers unique?

1. Radically new wideband electrostatic radiators have thinner membranes for greater efficiency and greater acoustic output. Special long-throw low distortion acoustic suspension woofers exhibit absolute flat response over the entire range. This means comfortable distortion-free listening at full realistic sound levels, even at low frequencies. Reliable electrostatic elements need no pampering.

2. Model ES212 has bi-directional radiators emanating sound through front, back and sides of upper enclosure.

3. Multi-element arrays of electrostatic radiators are set at precise angles to form a powerful "ACOUSTIC LENS".

4. All speakers are two-way with SEAMLESS electrostatic response.

5. The Electrostatic and woofer sections of each model, are protected from overload by solid state circuit boards (separate circuits for each section), coupled with a resettable circuit breaker.

Write for full literature and description of the Auralinear Speakers.

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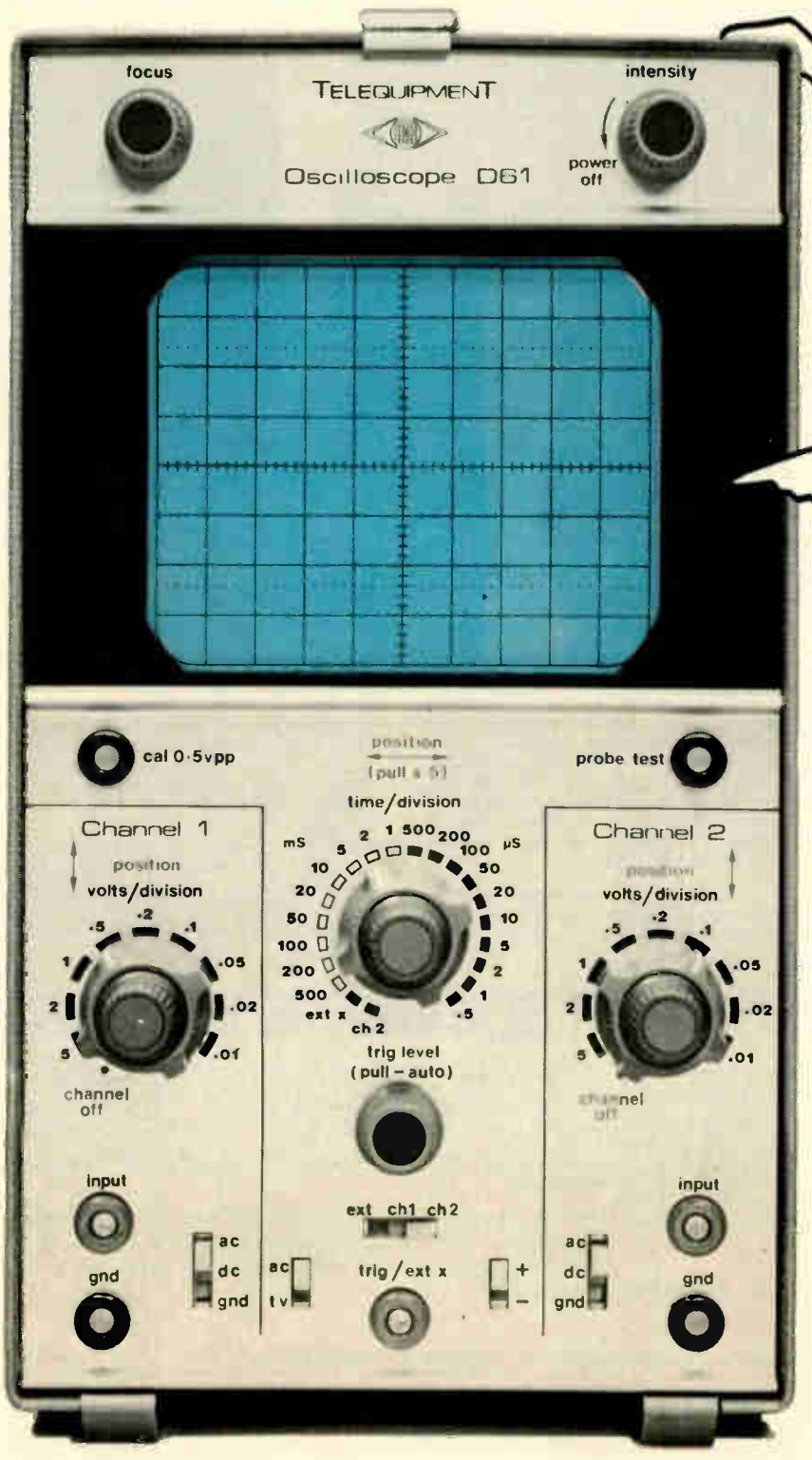
"...it's sort of like Rolls Royce coming out with an economy model!"



Tektronix have released this new D61 model in their Telequipment range. It's been specially designed for general purpose laboratory, educational and colour T.V. servicing applications. And its only

$299 DUTY PAID*

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The D61 is a MHz dual trace oscilloscope featuring rugged, all solid state construction. A minimum of controls make it extremely simple to use. Superb triggering qualities make the D61 ideal for discerning test engineers. Its compact size makes it easy to carry and it takes up little space on the busiest work bench. A lot of performance at a very reasonable price. **Compare and you'll find the value of this unit is unequalled.**

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

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

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

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

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

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

MEMOREX Recording Tape
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LER 038

news digest

AUTOBOX MAY POX VOX JOX

As radio broadcasters worldwide consider the possibility of automating studio operations, Britain's EMI group is launching a series of on-the-spot presentations both in Europe and Australasia of its EMI Schafer automated programming systems. These enable a high proportion of a radio station's daily broadcasts to be selected and presented fully automatically, utilising pre-recorded material. Designed to meet the full operational requirements of any radio station, these sophisticated systems can provide periods of non-stop broadcasting and pave the way for completely unattended station operation.

Following demonstrations to the New Zealand Broadcasting Corporation, and to the country's commercial station operators, Peter Granet, assistant manager, will switch to Australia to show another EMI Schafer system at several important trade exhibitions. Eventually, the radio automation equipment will be located at the Sydney offices of EMI (Australia) Ltd. for demonstrating to the country's radio networks.

EMI Schafer automation systems utilise pre-recorded material on both reel-to-reel tapes and tape cartridges stored in carousels. Any number of tape play-back decks and carousels can be used depending on the level of automated operation required by an individual radio station. The equipment can switch automatically between live broadcasts and recorded material providing station operators with full flexibility in programme format.

In Britain, the lead in studio automation has been taken by London's Capital Radio, the largest station in the country's commercial network, which was equipped with an EMI Schafer 903 system in August this year.

Incorporating a solid-state memory, this system selects on a time or sequential basis both live and pre-recorded 'events', including entertainment, commercials and station announcements, to provide long periods of broadcasting. Using a keyboard, an operator can insert a schedule of programmes in the memory, building up the programmes on a minute by minute basis if required.

NIXON LINK WITH ORGANISED CRIME?

The June issue of the US journal 'Computers and Automation' carries a sensational article linking President Nixon with the Mafia.

In part, the article says "The Watergate people, and rich Republican donors supporting Nixon in 1972, are involved with people and organisations in organised crime and in the assasination of President Kennedy . . .

The connections involve people and groups in Miami, Key Biscane, and the Florida Keys who are imbedded in many nefarious and illegal activities with the Mafia, the Syndicate and organised crime in general . . .

An all pervading area involves rich anti-Castro Cubans and organised crime. Much research has been done into Richard M. Nixon's Florida real estate and other connections with the Mafia".

CIRCUIT SELECTIVELY BOOSTS CAR RADIO SOUND

Music reproduced via a car radio tends to sound much louder than speech – for at any given volume setting, especially if the engine is noisy, or there is a lot of wind noise.

To compensate for this, STC (in the UK) have developed a circuit for automatically boosting speech and attenuating music.

The technique consists of connecting the variable resistance element of an indirectly heated thermistor in series with the volume control potentiometer.

The thermistor is a solid-state device that changes resistance as temperature varies – resistance falls as temperature rises. The thermistor chosen for this application has a cold resistance of approximately 20k falling to some 200 ohms when hot.

This thermistor has an inbuilt heater winding (hence its description as an indirectly heated device). Thus varying the current through the heater winding causes accompanying

variation in the thermistor bead resistance.

Automatic volume control is effected by sensing the average power level of the programme content and using this to establish a charge on a capacitor. Thus, the higher the average programme level, the greater the charge.

This capacitor charge level is then used to **inversely** control a current flowing through the thermistor heater winding.

Speech, because it is broken up into individual words with gaps between them, has a lower average level than music – hence when speech is received, the capacitor charge is low, the current into the thermistor heater winding is high, causing the bead resistance to be low.

As stated before, the thermistor bead is in series with the volume control, but when heated, its resistance of 200 ohms or so is negligible compared to the volume control resistance.

During music, which has a higher average power level than speech, the capacitor charge is high, current flow through the thermistor heater is low, bead resistance is this high – increasing to 20 k or more and the music signal is thus attenuated.

Indirectly heated thermistors have fairly long time constants – of the order of one to 10 seconds, hence no appreciable compression of the audio signal occurs.

CHANGES AT LOUIS A. CHALLIS & ASSOCIATES

A number of staff changes and changes in facilities have taken place at Louis A. Challis & Associates Pty. Ltd.

The most interesting of these is the addition of a new reverberation chamber with a volume of 340 cubic metres (12 600 cubic feet). This will allow Louis Challis & Associates, and thus Electronics Today International, to perform very advanced evaluations of loudspeakers and electro-acoustic systems. In addition, an anechoic termination has been constructed which will allow more accurate measurements of free field speaker responses on small loudspeakers as this facility has a cut off frequency of 50 Hz.

An addition to the staff is Mr. Cas Kondziolka. Mr. Kondziolka was previously with the Commonwealth Acoustics Laboratory and has extensive experience in electronics and electro-acoustics.

Mr. M. G. Wood and Mr. D. W. Cale have left the company's employment.

LARGE LIQUID CRYSTAL DISPLAYS

Japan's Sanyo Electrical Company has developed a large scale liquid crystal display.

It claimed that the display can be produced in very large sizes, suited for advertising, road signs, large clocks etc.

The technique involves transparent electrodes mounted on two glass base plates with liquid crystal sandwiched between layers. An additive is mixed into the liquid crystal to place the liquid crystal molecules in vertical orientation to the glass plates. As the crystal is sandwiched between plates which are polarized in opposition to each other at right angles, light passing through one polarized plate will be trapped by the second polarized plate if no voltage is applied. When voltage is applied, the arrangement of the liquid crystal molecules is disturbed and they are scattered. In this way light passing through the second plate to the front face of the panel becomes visible to the naked eye as a pattern. When the voltage is cut off, the liquid crystal molecules instantly return to their original arrangement and prevent light passing through. If a colour filter is placed behind the polarized plate, the light which penetrates under the influence of voltage assumes the colour of the filter.

OMEGA A CIVIL NAVIGATIONAL AID?

Headed 'RACAL helps Brazilian Submarines pinpoint position', this press release from RACAL in the UK is reproduced here as received, (apart from the omission of a photograph which was not suitable for reproduction) The release is dated 18th June 1973, and has the serial number PR. 73/085.

"Racal Instruments is supplying three precision OMEGA navigation systems for use in Oberon-class diesel electric submarines now being built in this country for Brazil by Vickers Ltd., Shipbuilding Group. The first of three, the Humaita, commissioned for service at her builders' works at Barrow-in-Furness on 18th June.

(Continued on page 18)

THE MODEL 5 QUARTET.
TWO PURRS, A TWEETER AND ONE BIG WOOFER.

Two things make a great quartet. Voices. And balance.

When you have both, you get near perfect sound. And that's exactly what you hear from this Quartet of Jensen speakers.

The Model 5 Speaker System. A great balancing act, if there ever was one, thanks to Jensen's Total Energy Response design.

You'll thrill to the lows from our big 12" woofer. Marvel at the highs from our Sonodome® ultra-tweeter. And be soothed by a duo of purring mid-range speakers, that thoroughly reproduce every sound in between.

But it's the things that go on behind the scene that make this three-way System what it is today. Jensen's foam Flexair® suspension system gives sound clarity and realism. The unique crossover networks provide smoothness and tonal blend.

There's a four layer woofer coil. A Tuned Isolation Chamber on each mid-range. And two rear panel balance controls.

This Quartet has a brilliant technical record, too. Power Rating: 60 watts. Frequency Range: 32-30,000 Hz. Crossover: 500/4,000 Hz. Dispersion: 170°.

It's all wrapped up in a luxurious, hand-rubbed walnut cabinet. And carries a 5 year parts and labor warranty.

Jensen's Model 5 Speaker System, you've never heard anything like it.

Model 5 Speaker System

jensen

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OANGER – ICEBERG ON TOW

The recent suggestions that icebergs, towed from Antarctica, could solve water shortage problems in Australia and South America, is gaining scientific support.

It has in fact been done before – back in the 1890's – when icebergs were towed from Laguna San Rafael in Chile, to Valparaiso and Callaco in Peru – some 3900 km away.

Now the US Army's Cold Regions Research and Engineering Laboratory (Hanover, N.H.) has issued a report, entitled "Icebergs As a Fresh Water Source: an Appraisal", in which the scheme is critically evaluated.

Their conclusion is that icebergs from the Ellesmere Ice Shelf, North Eastern Canada, are the only ones having a shape suitable for towing.

The authors of the paper, Drs Week and Campbell, say that the scheme is feasible although very large icebergs would have to be chosen. Any iceberg smaller than 3.5 million cubic metres would melt in transit. The power required to tow the icebergs would be roughly two/thirds of that of nuclear aircraft carriers such as the US Enterprise.

Estimated cost of the resultant fresh water is estimated to be US$0.007 per thousand gallons – about one percent of the cost of desalinizing sea water.

The report does not however mention what effects a large moored – albeit melting – iceberg has on the local ecology, nor does it discuss the obvious navigational hazards!

MOTOROLA TO MAKE ICs IN JAPAN

Motorola Inc. has announced plans to manufacture integrated circuits in Japan.

The company is establishing a joint venture with Alps Electronics who have their manufacturing plant in Yokohama.

President of the new joint company – to be called Alps-Motorola Semi-conductors – is Katsuro Kataoka. Sales are projected at US$9.74 million for 1973, US$16.23 million for 1974 and US$32.47 million for 1975.

Texas Instruments already have a wholly owned subsidiary in Japan, whilst Fairchild have joined forces with TDK.

LIQUID CRYSTAL COURSE AT MACQUARIE UNIVERSITY

Electrically operated liquid crystal alpha-numeric displays are now being used in ever-increasing quantities in digital instruments, wrist watches and even in race-course and stock market displays.

Because of their intriguing physical properties and great industrial application potential, liquid crystal research is pursued today at many universities and industrial research laboratories overseas, but notably in USA, England, France, Japan and Germany.

In keeping with the growing interest in Australia, on November 12-16, a short introductory course on liquid crystals is being conducted for the first time at Macquarie University. The course is to be given by Professor Glenn H. Brown, Director of the Liquid Crystal Institute, and Professor of Physics, Alfred Saupe, both of Kent State University, on the occasion of their visit to Macquarie University.

The course is open to staff and students in universities and colleges, but most importantly to application-oriented people in industrial research and non-destructive testing laboratories, and anyone wanting to update his or her knowledge on liquid crystals.

The course covers almost every aspect of the liquid crystal field by the following topics:–

1. Intermolecular Interactions and the Formation of Mesophases
2. Optical Properties and Textures of Liquid Crystals
3. Curvature Elasticity and Disinclination in Nematic and Cholesteric Liquid Crystals
4. Field Effects, Electrohydrodynamic Instabilities and Display Devices
5. Structure of Liquid Crystalline Systems by X-ray Techniques
6. Lyotropic Liquid Crystalline Systems
7. Liquid Crystals in Living Systems
8. Molecular Geometry and Liquid Crystallinity

(Continued on page 20)

news digest

9. Liquid Crystals in Analytical Chemistry

The lectures on each topic will be followed by an open discussion session. On Friday, November 16, a half-day Liquid Crystal Conference will be held, with a series of short papers presented by Australian authors.

The course ends with a forum on liquid crystals which enables the participants to inquire about any aspect of the present state of art in liquid crystals.

A detailed lecture program, time-table registration forms and further information can be obtained from E. Laisk, School of Mathematics and Physics, Macquarie University, North Ryde, NSW 2113, or dialling 88-9227. Pre-registration at an early date is desirable.

TEKTRONIX DEDICATED TO CALCULATORS

Will introduce in the near future one series of calculators for the science/mathematics market and another for commercial/statistical applications. The units now being put together are said to be entirely new designs and not merely upgraded versions of the Cintra line of programmable calculators, which Tektronix acquired about 2 years ago.

EARLY WARNING FOR EPILEPTICS

An electronic alert system to warn epileptics of impending seizures may soon be on the market. The device is small enough to fit into a pocket and contains telemetric equipment that distinguishes between normal and pre-seizure brain waves picked up by electrodes affixed to the side of the head. When pre-seizure waves occur, a buzzer goes off and lights flash in time to permit the patient to take medication or other protective action. At present, the device must be adjusted to each patient's brain waves; but with further refinements, its developers expect to be able to produce a standardized version. The University of California at Los Angeles, the Veterans Administration, and the McDonnell Douglas Astronautics Company are co-operating on the project.

PHILIPS GO TO MOTIONAL FEEDBACK

One of our European correspondents tells us of a new motional feedback loudspeaker shortly to be released by Philips.

Object of the technique is to obtain good bass response from a small enclosure, and prelimary reports are that Philips have been successful in achieving these aims.

Motional feedback is achieved by generating an electrical signal from (and proportional to) speaker cone movement and comparing this with the original amplifier input signal. If any deviation occurs, immediate correction is applied.

Although this technique has been tried many times before with varying success, the Philips system breaks new ground by tailoring the feedback loop to match the characteristics of the bass driver employed. The correction is in fact flat to down to 80 Hz but is rolled off at 6 dB/octave at frequencies below that. All frequencies below 35 Hz are blocked by a filter network, Philips' engineers do not seem concerned about the low frequency phase distortion that must surely be caused by the 53 Hz cut-off.

ANTI-SOUND

Messerschmidt, in Germany, have detailed – in Patent BP 1 304 329 – a noise reduction system that operates by generating an 'anti-sound' field in the area to be controlled.

The technique has been particularly developed for reducing the noise from aircraft propellers and hovercraft rotors. Noise sources of this type generate a noise field that can be represented by a spiral-shaped phase line. The noise has a period inversely proportional to the sources speed of rotation and number of blades.

Because of this characteristic, Messerschmidt say that the in-phase states of the noise fall as it were on a spherical Archimedian spiral. Noise reduction is effected by generating a sound next to the noise source but operating in reverse phase.

For optimum results a feedback control system is used to compensate the anti-phase noise generator for changes in speed or load of the rotors.

The mathematics accompanying the Patent are quite beyond the understanding of normal people, but subjectively at least the results are reported to be very impressive.

ALLIED CAPACITORS REFORMED

Allied Capacitors Pty. Limited, a name very familiar in the electronic component industry, is now active after four years of trading as Hawker Siddeley Components Division.

Allied Capacitors, was purchased by Hawker Siddeley Electronics in 1969 and then traded as a components division of Hawker Siddeley Electronics until June 30, 1973.

A syndicate, formed by Mr. Alleyne Bowler and Mr. Karl Trankle has purchased the business, now an all Australian investment, and will continue to expand its activities particularly in the local manufacture of a broader range of component products.

Allied Capacitors is well-known in the component Industry as a supplier of high quality locally manufactured and imported electronic component products and represents many major overseas electronic component companies.

The business will continue to operate in the Brookvale industrial area with Mr. Gordon Smith as Marketing Manager, Mr. Bernard Heybroek as Technical Engineer, and Mr. Richard Giles as Company Accountant.

FREQUENCY STANDARD 10^{13} STABILITY

The fifth generation of atomic standards for frequency and time-interval is nearing completion as NBS moves its new NBS-5 standard into testing at the bureau's Boulder, Colorado, laboratories.

The completely redesigned standard takes advantage of recent advances in cesium-beam technology and incorporates new features for better stability and accuracy. It shows promise, NBS says, of achieving an accuracy of at least one part in 10^{13}.

news digest

COMPUTER FILE SECURITY

Assessing a remote computer over Post Office telephone lines can raise some difficult security problems. Anyone in possession of the computer's telephone number and user's code word (password) can obtain all the confident ial data in any files stored in that computer.

Personnel authorised to use a terminal may leave the company to work for a competitor. Even if they are above reproach, the vital information may be inadvertently disclosed if it is written down to aid the memory.

Now, a new unit, designed and manufactured in Britain by Trium Co. Ltd., Kent, 12 Mount Ephraim, Tunbridge Wells, reduces the security problem by allowing authorised people to gain access to their company's computer without knowing its telephone number or the file password.

The security unit is connected between the user's terminal and the Post Office modem and stores both the computer telephone number and the user's unique file access password. Once the correct key is turned in a lock on the security unit, dialling is performed automatically by pressing a button. When connection with the computer is established, the file password is transmitted automatically by pressing a further button on the unit.

Only one person need know the computer telephone number and the file access password, thereby greatly decreasing the chance of this vital information falling into the wrong hands.

Each standard unit will store one telephone number of up to 13 digits, and four passwords, each of eight ASCII characters; each password has a separate high-security lock and each lock requires a different key. The locks are approved by the British Insurance Association and have no serial numbers, as is normal high-security practice. If desired, the Computer File Protector will store several telephone numbers and more than four passwords to special order.

Installation is simple. The multi-way connector, which normally plugs into the modem, is plugged into the security unit and a cable from the security unit is plugged into the modem. A mains 240 V, 50 Hz power supply is required.

There are three standard models. One version differs substantially from the others in that it outputs a digital code which is then converted to dialling pulses by a Post Office automatic dialler. This is model CFP-301.

The simplest model in the range, the CFP-101, stores the password but does not store any telephone numbers.

Type CFP-201 connects directly into the telephone line and can, if necessary, be programmed with intergroup dialling pauses which are needed for some trunk dialling systems.

For additional security, the passwords can consist of non-valid ASCII characters; that is, one of the many combinations of eight binary digits that are not used in the ASCII 64 character set. This means that additional security is assured because it is impossible for the teletype to print out the passwords as the character codes will not be recognised.

Programming the units with telephone numbers and passwords can either be carried out by the manufacturers or by the user. The task involves soldering short wire links into a matrix of holes. The matrix is 'scrambled' in a haphazard way so that it is not possible to read the numbers by inspecting the links unless one is in possession of a list of detailed instructions.

NEW STANDARDS FOR CAPACITORS

Two new Australian standards for capacitors for use by the telecommunications and electronics industries have been published by the Standards Association.

They are:

AS 1455 Fixed ceramic dielectric capacitors, type 2

AS 1456 Fixed capacitors for direct current, polyester film dielectric

Australian Standard 1455 relates to capacitors suitable for radio frequency currents up to 1 A or a reactive power of less than 10 var. This standard is technically compatible with Publication 187 of the International Electrotechnical Commission (IEC).

Australian Standard 1456 relates to capacitors for direct current with a rated voltage not exceeding 6300 V, using a polyethylene teraphthalate or similar material as a dielectric. It is compatible with Publication 202 of the International Electrotechnical Commission (IEC).

The purpose of the Standards is to establish uniform requirements for their electrical and mechanical properties and climatic resistance, to select test methods and to classify the capacitors into categories.

Copies of AS 1455 ($1.60) and AS 1456 ($2.40) may be obtained from the various offices of the Standards Association. (Postage extra).


When second
best is not quite
good enough....
think of Sweden...and Sonab
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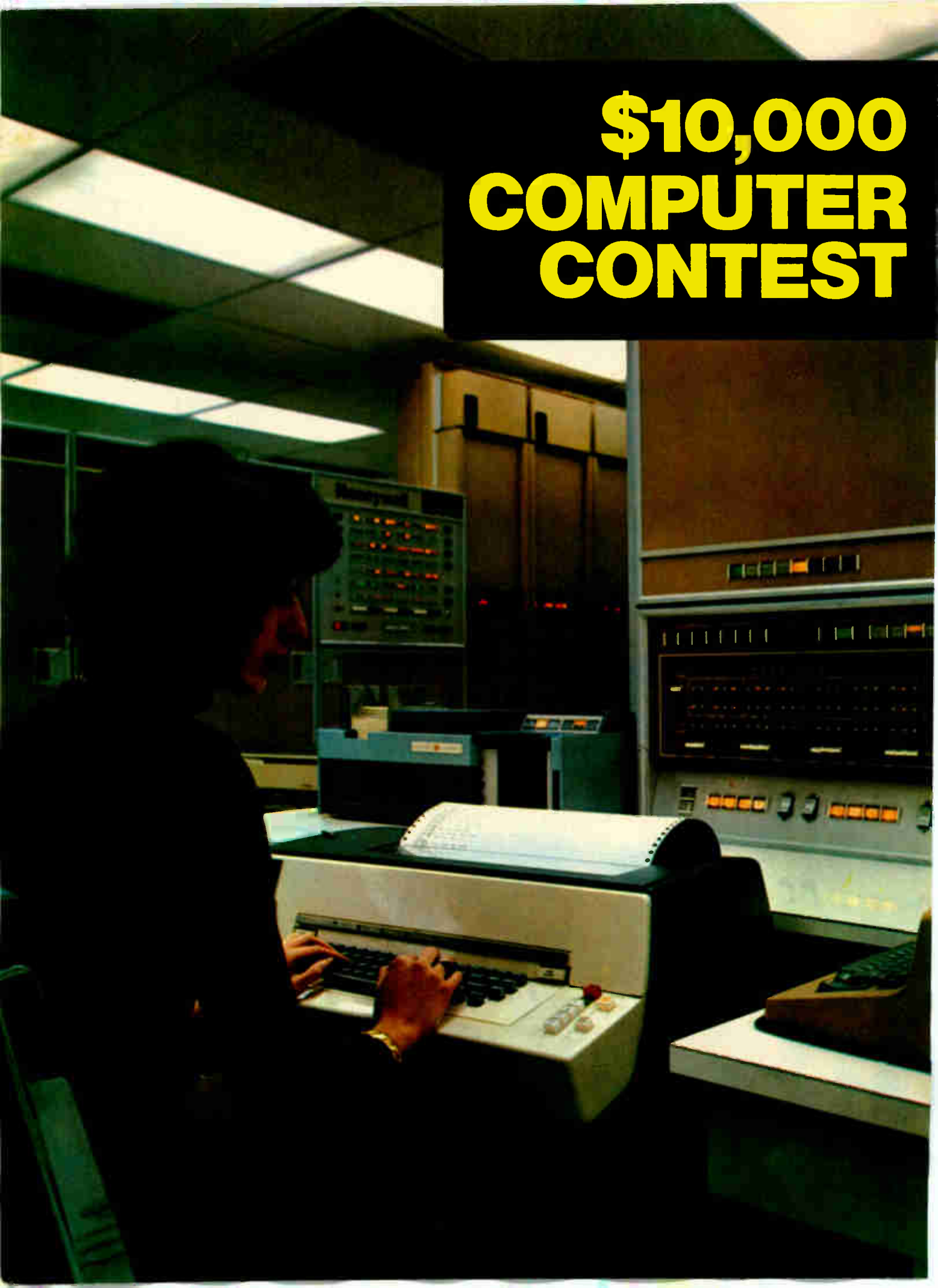

$10,000
COMPUTER
CONTEST

If you were given a computer terminal, plus free tuition, plus generous free computer time – for three months – what would you do with it?

CONSIDER the way in which a human being solves a problem.

He uses three basic steps – firstly, he obtains facts about the problem and stores them in his memory, then he uses a procedure for solving the problem on the basis of the facts that he has acquired, thirdly – and hopefully – he arrives at an answer.

A computer operates in a basically similar way. It has some means of accepting data – from a teletype or other input device – it then operates on this data, under the control of a set of instructions that may be stored within the computer's memory, or fed into the computer at the same time as the data. Finally there is some way of presenting the final results – again this may be via a teletype machine.

The set of instructions, (known in computer language as an 'algorithm') is stored in the computer's memory as a sequence of operations which the computer executes step by step.

This sequence of instructions is known as a 'program' and will have been devised by a human programmer. It is important to appreciate that a computer cannot solve a problem for which the programmer is unable to specify a means of solution.

But despite the similarities, there are some dramatic differences between the ways in which a human being and a computer approach a problem.

The human being has *creativity* – and he will (hopefully) use this creativity to enable him to consider any unusual facets of the problem, and to consciously or subconsciously sidestep any ambiguities.

The computer, on the other hand, is a strictly logical animal: it will follow its instructions to the letter, and if the demands of the problem exceed the capabilities of the program supplied to it, the computer will be unable to solve it. So, in essence, computers are limited to applying *predetermined* solutions to set problems.

A MILLION SUMS A SECOND

A further major difference is that while the computer can only do some of what a human could do – given

Some of the equipment which makes up the Honeywell time-sharing service.

CONTEST RULES

The concept, possibilities, and limitations of computer time-sharing are explained in this – and in the next two issues of Electronics Today International.

Following the study of this material, readers are invited to propose specific applications.

These applications will be judged on the basis of:–

* Practical feasibility
* Originality
* Ingenuity
* Overall value to the community

The competition is open to all Electronics Today readers resident in Australia except employees of Honeywell Pty Ltd and Modern Magazines Ltd.

To ensure that all readers have a fair go, entries will be judged in four classifications. These are:–

1/ Primary and Secondary Schools.

2/ Universities, Tertiary Educational Institutions, State and Commonwealth Departments and Instrumentalities.

3/ Industrial and Professional – this includes Private and Public Companies, Partnerships and employees of same – where the entry is either sponsored by, or in the name of a company or partnership, and/or where the nature of the entry is closely associated with the entrant's occupation and sphere of business or professional activity.

4/ Private – this classification covers private individuals not included in classifications 1-3 above, e.g. people at school or university submitting entries independently of their school or university, private experimenters, housewives, etc, etc.

The judges reserve the right to reclassify entries and to withdraw awards from any category if no entry in that category is judged to be of a sufficiently high standard to merit an award – in such case, the award will be re-allocated to another entrant classification if the number and/or standard of entries warrants.

The entry must consist of a summary of the idea or project, its benefits in terms of its social or commercial value – this should be outlined in not more than 500 words. An outline of the intended approach and methods to be used must also be included – but not necessarily within the 500 word description.

The entry must be accompanied by our official entry form – this will be published in our October and November issues. Do not send in entries until you have finished reading all three (Sept., Oct., Nov.) issues. Entrants may submit any number of entries – providing a separate entry form is included with each entry.

Final closing date for entries will be announced in our October and November issues.

$10,000 COMPUTER CONTEST

WHAT THE WINNERS WILL RECEIVE

Each winner will receive the following:-

- **One STC time-sharing computer terminal installed, in the place of his choice, free of charge.**
- **Up to $1500 of G26S Time-Sharing computer time.**
- **Free instruction in computer time-sharing.**
- **Free telephone service throughout Australia whilst the computer terminal is connected to the main computer.**

The following conditions are applicable to all winners.

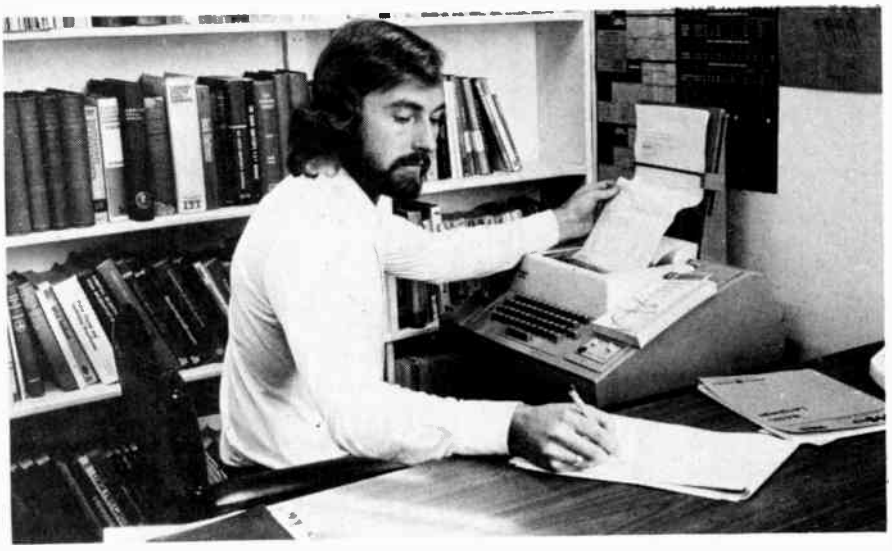
a) **Only the Honeywell G26S systems may be used.**

b) **There will normally be a time limit of three months duration — commencing from the date of terminal installation.**

c) **The organizers are prepared to extend the time limit and dollar value of any prize if, in their absolute discretion, they consider that further computer time would benefit the prize winning project, the project is of outstanding value, and that work so far completed on the project is sufficiently meritorious to warrant an extension.**

d) **Instruction in the use of computer time-sharing will be carried out at Honeywell's educational centres in Sydney and Melbourne. In the event that a prizewinner is prevented from attending such training courses, Honeywell will allot him (or her) 12 hours of terminal time for use with its Computer Assisted Instruction course of programs — which may be undertaken from the prizewinner's terminal.**

This multi-thousand dollar competition is sponsored by:- Electronics Today International • Honeywell Pty Ltd. Standard Telephones & Cables • Australian Post Office.



sufficient time and energy — it does it very much faster and with greater accuracy. This is one of the major strengths of a computer — it is very good at arithmetic — in fact some of the more powerful models can perform more than a million calculations a second.

A computer can also make logical decisions very rapidly, but naturally the relationships upon which such decisions are to be based must be specified by the programmer.

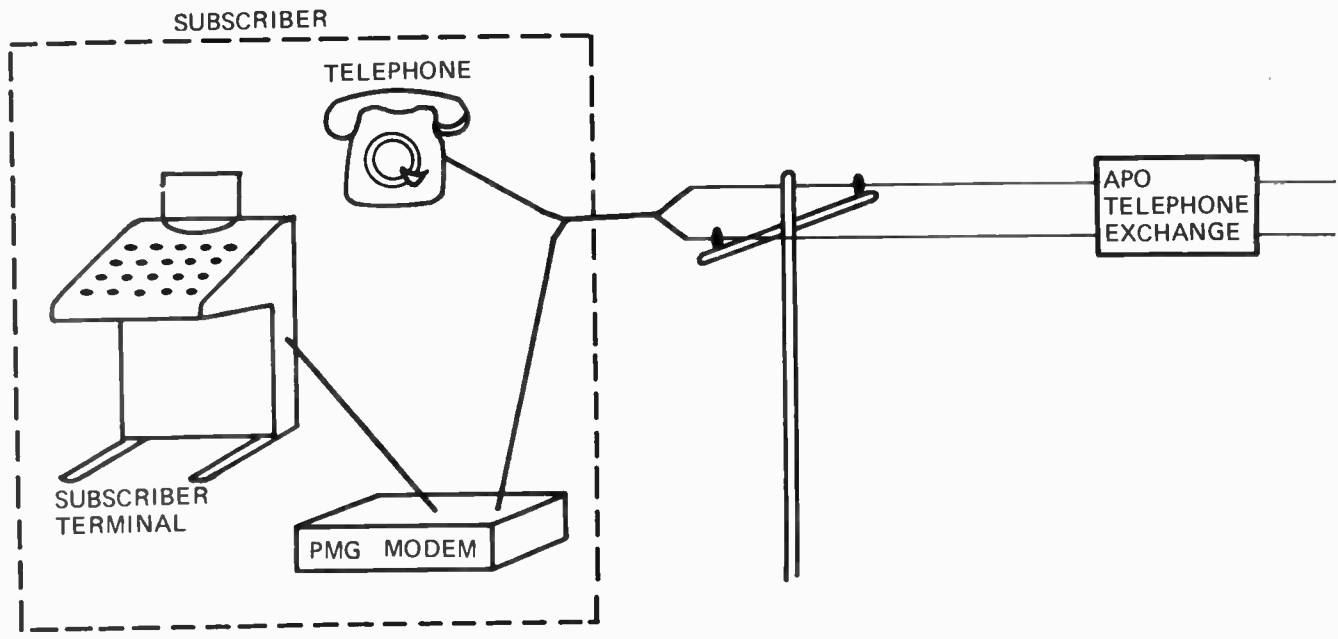
For instance, a computer used to work out a firm's payroll could be programmed to carry out a particular set of instructions — "if annual salary greater than $10,000".

Simple conditions such as these are usually specified (by the programmer) in terms of relationships such as "greater than", "less than", "equal to". By compounding such instructions, operators can achieve a very powerful logic capability.

The computer has the ability to tackle problems such as that outlined above because it can search, read, manipulate and transcribe massive amounts of information very quickly. However, whilst the computer's main memory is very quick-acting, it is not very large; a typical main memory stores somewhat less than one million characters.

If such a computer were to be given the personnel selection task described above, the volume of information to be searched would be far in excess of a million characters. So to handle problems such as this, auxiliary storage is used.

This auxiliary storage requirement is usually filled by magnetic tape, disc or drum units. The computer utilises these by storing in its main memory only the program, and then calling for



the next piece of information it needs to work on, from the appropriate tape, disc, or drum device. Each piece of information is called a 'record', and such records are usually grouped into logically related sets called 'files'. Sometimes, with very long programs, the program is handled in the same way: it is divided into segments and stored on one of these devices. These segments are then brought into the main memory as required.

Tapes or discs can usually be detached from the devices that read or record onto them (called drives), and stored elsewhere when not in use. The auxiliary storage can be expanded to practically limitless proportions by having a large number of reels of tape and disc packs. The main computer cannot read or record onto the auxiliary storage as quickly as it can its own inbuilt memory — nevertheless it is far from slothful — speeds of between 20 000 and 300 000 characters a second are quite common.

A limitation with auxiliary tape storage is that the computer can only call for the records in the order in which they are physically recorded on the tape. With discs or drums on the other hand, the computer can call for data in any sequence, providing of course that the program provides some method of defining the actual location of the desired record on the drum or disc. (The two systems — tape or disc/drum — may be compared in this respect to audio tape recorders and gramophone records. In the former case it is necessary to run the tape through the machine in order to find any particular recording — in the case of the gramophone record all that is required is to lower the cartridge onto the required groove — providing of course that one knows which groove it is.

How the time-sharing system operates. Although only one subscriber is shown in this illustration, up to 40 subscribers may be connected to the main computer.

PROBLEMS WITH EARLY COMPUTERS

The first generation of computers suffered from a number of basic disadvantages:

They were very costly for what they could do.

They were very difficult to use, principally because programs had to be written in a special 'language', or machine code. These machine codes differed from computer to computer, but were all complex — and totally alien to a human being's approach to the solution of a problem.

Computers tended to be used very inefficiently. Because they were operated by a human being, the computer was slowed to the speed of the operator while he decided what task should be done next. Another problem was that a given program would only utilise a small proportion of the computer's expensive facilities — for instance it might be driving the printer at top speed while doing hardly any computing. The printer is very slow relative to the other devices the computer has at its disposal, so this represented a gross inefficiency.

These operational problems aggravated the burden imposed by the high cost of the equipment to make the cost of doing a particular job very expensive by today's standards.

A computer could usually do only one job at a time. So an urgent task could not interrupt a less urgent task that was already running on the computer until it had finished.

INSTALLING THE COMPUTER TERMINAL

First, decide where your time-sharing terminal should be located. They can be installed quickly and easily, connecting to the system through telephone lines already in place.

From your terminal, you dial the Computer Centre as if you were making a telephone call. The system responds by typing out a brief series of questions:

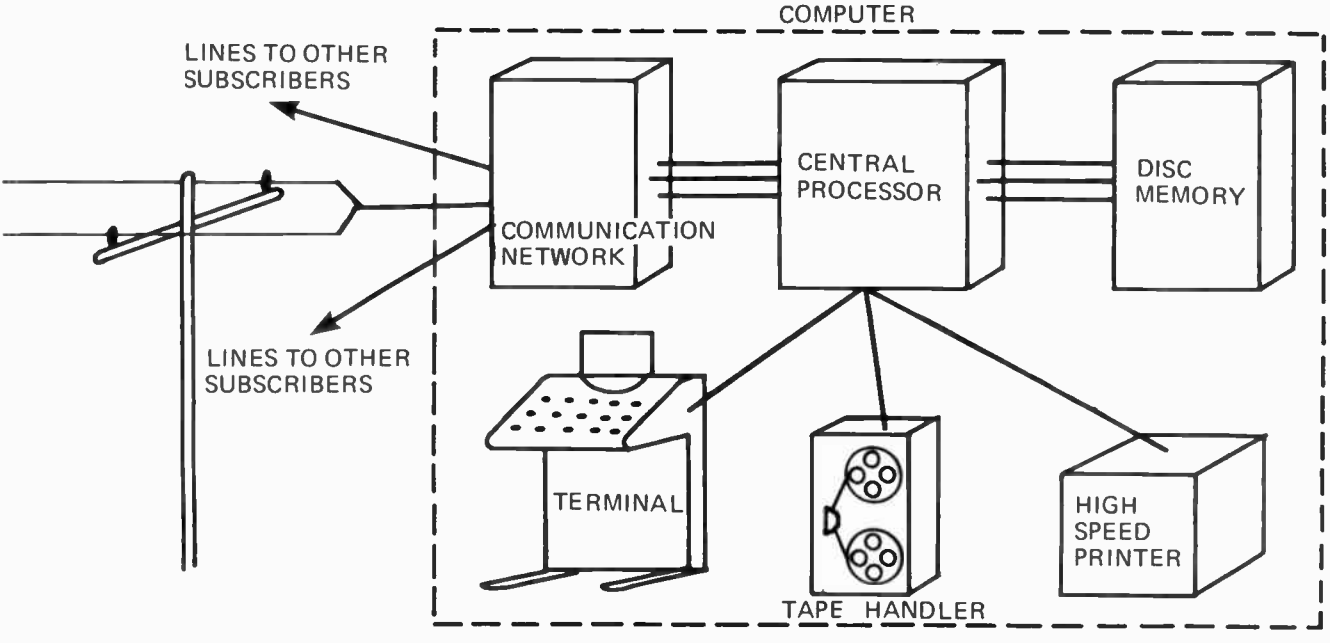
"What is your user number?"
"Is your program new or old?"
"What is the program's name?"

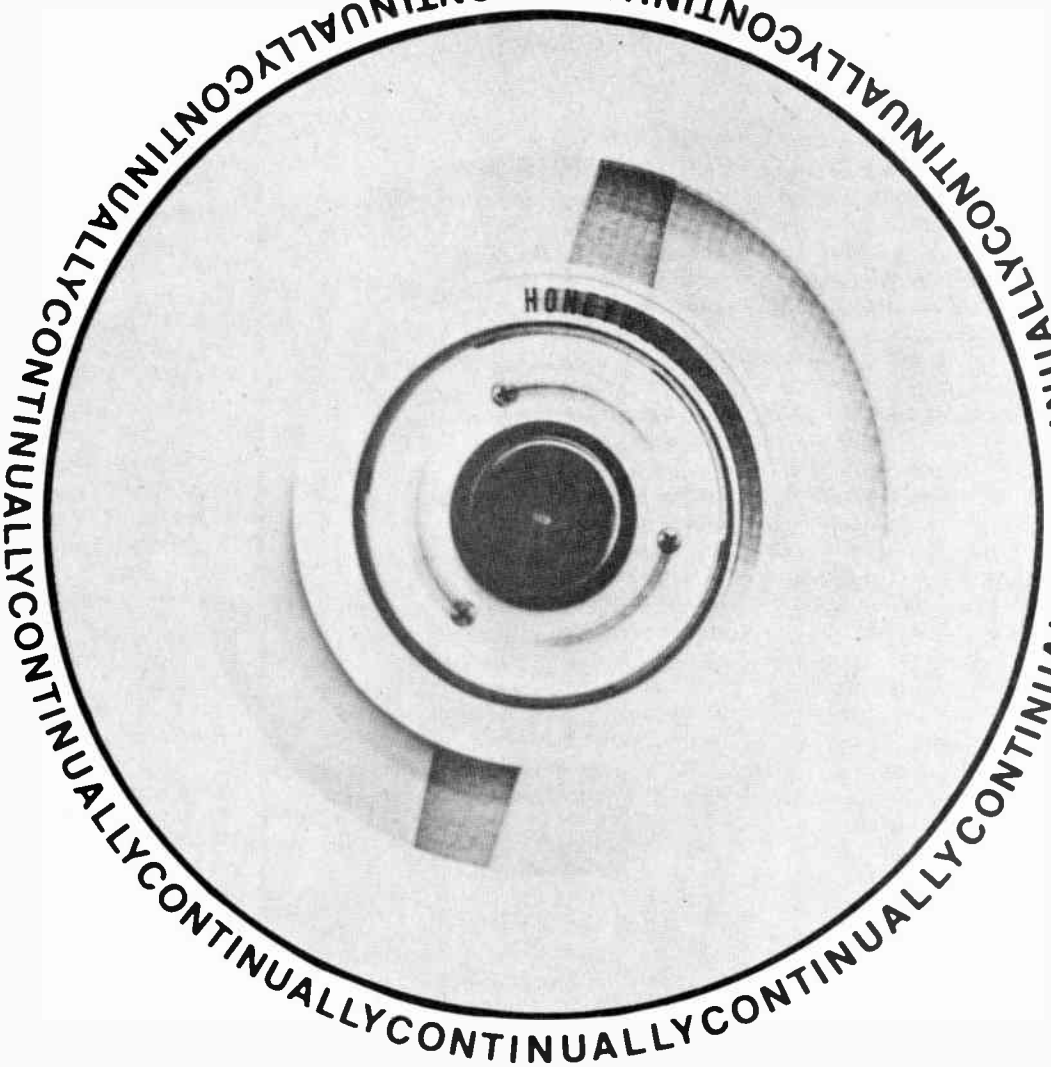
The system is now ready to go. You define the problem and, in seconds, back come your calculations.

Step-by-step you work with the system, evaluating each new information output before you go on. You provide the judgment and guidance. The system feeds back the computations. You work at your own speed, making all necessary changes and corrections as you go.

Easy? Even elementary school students can operate the system. (And many do). No programmers are needed. No special schedules must be followed. In short, time-sharing brings the power of a computer directly to you, when and where you want it.

The installation requirements are that the terminal and modem be located near a power point and the telephone line. Only about one square metre of floor space is required.





OFFERING TIME SHARING SERVICES IN SYDNEY AND MELBOURNE

- Only $100 a month for a $1 million computer.
- Available on one month's contract.
- Only 2 days' training required.
- Honeywell first in Australia, first in the world with Computer Time Sharing Service.
- Already hundreds of users in Australia.
- Communicate with the computer by P.M.G. telephone.
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$10,000 COMPUTER CONTEST

The computer was usually centralised and all work had to be brought to it.

These disadvantages led to a situation where only large organisations could afford computers, and only technocrats could use them.

A number of approaches have been taken to overcome these problems. A large amount of money has been spent on research into the design and manufacture of the computer equipment itself, (known as hardware). This, together with improvements in the electronic components used, such as microcircuitry, has led to a situation where the cost of computer power is actually declining, at the rate of about tenfold per decade. There has also been a dramatic increase in the power of the larger computers available commercially, with considerable economies of scale — the dollar buys much more power on a large computer than on a small scale model.

TALKING TO THE COMPUTER

Another concept that has led to a very substantial improvement in useability are universal computer languages that bridge the gap between the computer's own language, which varies from model to model, and the way a businessman or scientist thinks about a problem.

The two most outstanding examples of these are COBOL, primarily used for business and accounting problems, and FORTRAN, a formula oriented language, initially used mainly in scientific and mathematical problems, but now gaining ground in the business sphere as well.

TIME SHARING

So far we have been talking about centralised computers to which work is submitted, and results, usually in the form of printed output, returned. Such work is queued upon arrival, and little or no intervention is possible while it is running on the computer. Turnaround time varies markedly from installation to installation, from minutes to days — being dependent upon load on the system, its speed, and the volume of work submitted. To this has to be added the time for the work to be taken to and from the centre. So the fact that large computers tend to be centralised often introduces inconveniences. Frequently, it is not possible to have many smaller computers in place of the large central system — considerations of economics of scale, and power, often weigh against this.

These difficulties have been in part overcome by the use of remote terminals. A terminal, is connected to the central computer site by telephone line. It is used to input the batches of data, and to print out the results when the job has been run. To all intents and purposes, it 'looks' like the computer itself, the only difference being that it is usually much slower than the computer's own input and output equipment, because of restraints imposed by cost, and the bandwidth of the telephone line.

Both these forms of use are ideal for routine jobs involving large batches of input data. As mentioned above, no human interaction is usually possible while the job is running. Turnaround can be substantially improved by the use of remote terminals, but access to the computer is still far from instant. The terminals involved are fairly costly, and this means that the volume of work at a particular location must be high before the expenditure can be justified.

These limitations are largely overcome by a technique of computer use known as Time-Sharing. A large centralised computer is wired into the public telephone network. Users dial the computer when they desire access to it, and then communicate with its via low-cost electric typewriter-like terminals in their offices. The software and hardware is geared to handling many users simultaneously, so access is (almost) instant. The software is oriented towards conversational use: the user interacts with his job, (in a way which we will explain in more detail later) and if he does something which the computer cannot understand, or which is incorrect, the computer will tell him so. Turnaround is very rapid and results print back on the terminal itself.

The terminal gives the user access to the computer's file system, usually on magnetic disc storage, so that he can store and recall programs and files of data. The overall responsiveness is such that it is as though he had a computer in his own office-without, of course, the attendant capital outlays. To learn to use the system and to write programs in BASIC (a very easily learnt and powerful high level language) takes about three days, or about five for FORTRAN.

From the cost viewpoint, the new subscriber to the service is involved in no capital outlay. He rents the requisite telephone line and modem from the Australian Post Office, and the terminal device from a supplier of terminals such as Standard Telephones and Cables. The subscriber then pays for his computer time as he uses it.

It is in the applications area that the unique capabilities of time-sharing are pre-eminent. Firstly, the man with the problem is able to program the solution himself instead of utilising a specialist for this purpose. The communications problems that would otherwise occur are eliminated. Secondly, rapid access, (and almost instant response), combined with the conversational nature of the language, enable the power of the computer to be applied to a far wider range of problems, and it could well be that this competition will uncover many new applications.

As implied above, many time-sharing applications require very fast turnaround. For instance, a customer wanting an estimate likes to have it quickly. Other problems are not susceptible to a 'sausage machine' solution. Typical examples of this are the financial planner putting together

DIAL-A-COMPUTER CONTEST WINNERS

Honeywell, in conjunction with the British Post Office and Morgan Grampiar, recently conducted a Dial-A-Computer competition in the U.K. Competitors put forward ideas for original applications of Honeywell's Time-Sharing Service. The prizes were similar to those offered in this competition and the list of winners illustrates the wide range of applicability of time-sharing.

Mr Reynolds of Kent will use his prize to develop programs for the preparation of inflation adjusted accounts — a practice which could become mandatory for U.K. companies in 1974.

Mr Goddard of Southampton will use his prize to tackle the pressing social problem of arranging visits to elderly people who do not have relatives living nearby.

Mr Lane of London will use his prize to develop a library of routes which indicate the comparative incidence of taxation on income and capital flowing through the major capitals of the world.

Mr Burnett of Bridgewater will develop methods to aid with identification of missing persons in conjunction with charities working in this area.

Mr Freedman of London will attempt to quantify characteristics of garments in the fashion industry and thereby develop a method for forecasting future fashion trends, and finally Mr Davies of Coventry will develop methods to improve the efficiency of air charter operations.

$10,000 COMPUTER CONTEST

a five-year plan for his company, or the engineer designing a structure. In neither case can you simply put data in, and get the final solution out. The financial planner will use the computer's ability rapidly to assess the impact of a number of alternative business stratagems on his company's profitability. The engineer will use the computer to conduct the tedious and complex quantitative analysis involved in a particular design, while he concentrates on the qualitative aspects. In both cases this process of 'what if' conversational interaction between the user and the computer proceeds until a satisfactory result is obtained.

Time-sharing, as with any other technique of computer useage, has limitations. Some jobs require a high volume of input and printed output. A time-sharing terminal is relatively slow at reading input and printing output compared with other devices available for remote & local batch use. Typical relative speeds are –

Time-sharing terminal 10–30 characters per second

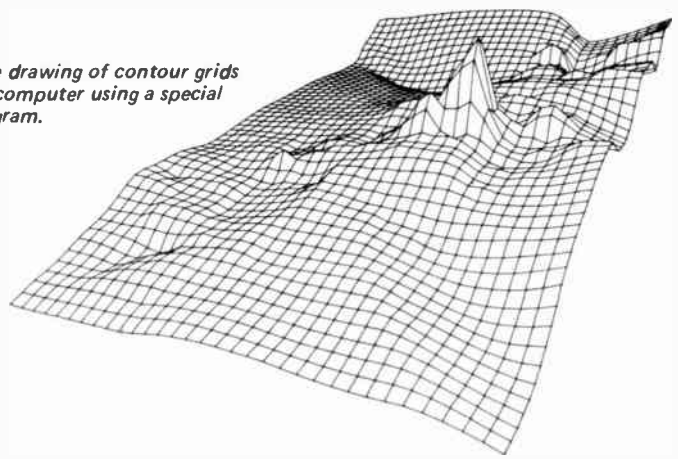
Remote batch terminals 120–480 characters per second

Local batch card reader (approx.) 1300 characters per second

Local batch printer (approx.) 2200 characters per second.

Some jobs too are so large that they require the entire resources of the computer. It is not feasible to process such a job in a time-sharing environment, since other users would be blocked out while it was being run.

Apart from the particular advantages and disadvantages of this technique of using a computer, time-sharing applications draw on the same basic computer strengths of high calculation speed, in conjunction with formidable logical decision-making and information manipulating abilities, as do other computer applications. The major advantage of time sharing is that it allows many subscribers to have access to a very powerful computer from a simple terminal conveniently located – and this at relatively low cost.



This perspective drawing of contour grids was made by a computer using a special contouring program.

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What our students say...

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Shortly after starting my Electronic Technology Diploma Course, my employers trained me on more advanced equipment through which I obtained pay increases and promotion. In the near future, after receiving my Diploma, I expect to obtain another promotion.
R. H. Catt, Blacktown, N.S.W.

New Business
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CREATIVE AUDIO

The Ultimate in Creative Capability? – the computerised Electronic Music Studio belonging to Peter Zinovieff (a director of E.M.S. (London) Ltd.) Note the recorders on the right of the picture – a 4-track Ampex, a stereo Revox (beneath the Ampex) and a stereo Philips Console Machine. In the background is a PDP8 computer which can interface directly with the music synthesiser to its right.

PART ONE

A practical guide to creating and producing your own sound.

by Terry Menzoza,BSc(Hons)

SOUND, is, potentially, one of the most creative of all media. It combines the plasticity of tape manipulation (i.e. management by editing or copying in different order from that in which the events actually occurred in time) with the immediacy afforded by the 'aural' mode of perception. Indeed to many "creators", sound is superior to the visual arts, painting, television and cinema, because these, by providing their own pictorial imagery, act as boundaries for the audience imagination. On the other hand, audio on its own (tape, disc, radio and even to a large extent, events such as orchestral concerts where the visual impressions are subjugate to the audible ones) allows the mind a framework to build *from*, with minimal restriction. Consider the example of a radio announcer; unless previously encountered visually, one person's concept of the 'face behind the voice' will radically differ from another's mental picture.

THE COMPOSITION – PLANNING

There are two approaches to audio creativity, first there is the "inspired" artist who has his project completely mapped out on paper, or in his head, and he uses the tape merely as the most effective means of transposing his ideas.

The other common approach is that which we will call mutual feedback. The creator commences with a possibly diffuse idea. He collects varied material around this one theme. The collecting of the material helps him to crystallise the idea into a more tangible form. Removing all that he considers non-essential or unsuitable gives a more condensed, cohesive structure to the emerging composition. Now when the recordist listens to the recording he will sense a rather more definite theme that will bear a relationship of sorts to his original one. Searching criticism by the recordist of his piece under creation may suggest rearrangements, removals and additions which he will undertake to reinforce the now definite theme. It is by this 'feedback' the final piece emerges – but the recordist must know where to stop, for otherwise he will go for ever trying to reach perfection.

CHOOSING EQUIPMENT

The quality of equipment should be the best that finances will allow. With the possible exception of the microphones, all units should be of roughly similar performance. It is better to have a basic set-up with reasonable and *consistent* fidelity, than a fully comprehensive set-up of widely varying performance, for the latter can at least give only a mediocre performance.

The only general exception is the microphone as it can be advantageous initially to purchase one of a higher standard than the rest of the equipment. By so doing, later improvements in the remaining equipment will not entail changing one's microphone technique.

THE ROLE OF TAPE

Tape provides a 'carrier" between the imagination of the creator and that of his audience. He has the opportunity, at his own particular whim, to introduce as many or as few mental clues as to the visual imagery that should accompany his creation i.e. he may leave his audience to fill in a mental picture from a few sparse sounds, say in a science fiction fantasy, or he may overlay the sounds with a narrative, leaving them there just to enhance the effect.

CASSETTE VERSUS OPEN-REEL

Although equipment is available to enable the editing of tape cassettes – principally for overcoming the bugbear of broken or tangled tape, reel-to-reel (open reel) machines are more suited to creative audio work. Even if cassette equipment is used 'on location' it is still preferable to copy the collected material onto an open reel machine and then to edit this copy rather than the original. The original cassette is then still available for re-use or 'archive' storage.

Another difficulty with cassette tape is that apart from the inherent fiddliness of trying to manipulate 1/8" tape, edit cueing is awkward.

The editing procedure entails locating,*with a high degree of precision,* the exact moment of the commencement of a sound (the 'attack'). A typical example of remedial editing would be the removal of a click with a duration of 1/30 second. This would be relatively straightforward with tape running at 7½ inches per second, for there the sound occupies ¼" of tape length. The same click would be virtually impossible to *locate,* let alone *remove,* with a cassette tape running at the

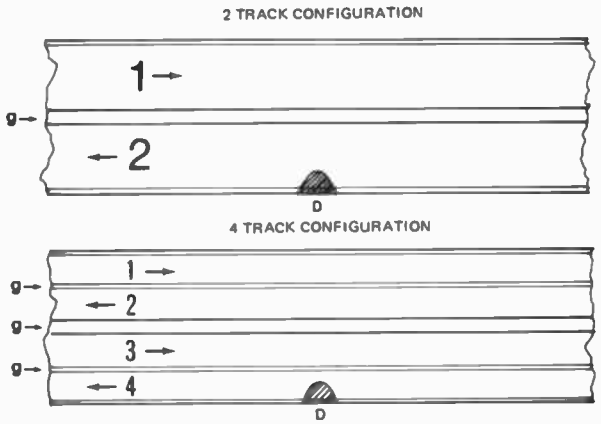


Fig. 1. Comparison of track configurations showing larger signal area affected by narrower (4) track width – tracks 1 and 4 are more prone to 'drop-out' affect.

Topics to be covered in this series include:—

CREATIVE TECHNIQUES: editing; dubbing; mixing (and mixers); multitrack recording, display.

MUSIC RECORDING: acoustics; microphone characteristics; microphone types; microphone placement; stereo recording; monitoring.

UNUSUAL EFFECTS: tape echo; pre-echo; extended loop feedback; phasing; speed change; reverberation.

LOCATION WORK: equipment; stereo problems; scripting and documentary programme compilation.

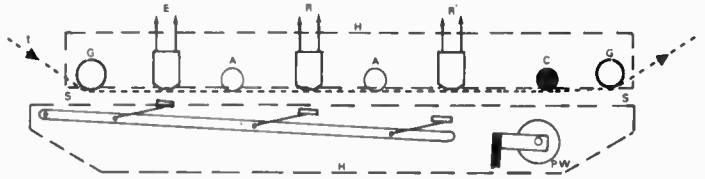


Fig. 2. E: erase head; r: record head; R': replay head; H: head cover; t: tape and direction of travel; C: Capstan; Pw: pinch wheel (rubber or neoprene); S: Sound channel; G: main guide; A: auxiliary guide.

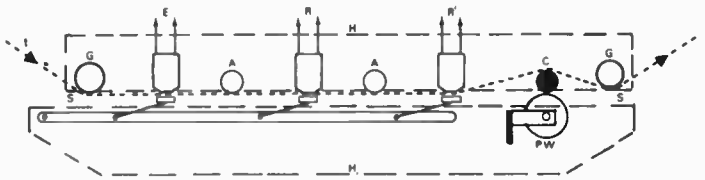


Fig. 3. Method of threading tape for "see-sawing" (bypassing capstan traction).

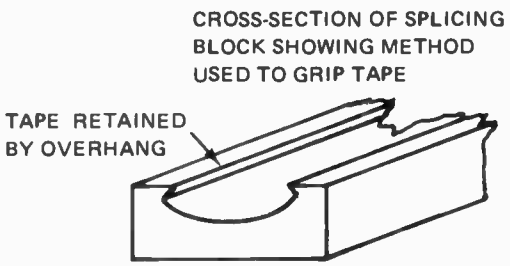


Fig. 4. Cross-section of splicing block showing method used to grip tape.

standard cassette speed of 1-7/8 inches per second.

One requirement for tape editing, is therefore a running speed of 7½ or 15 inches per second. (Editing *is* possible, although not very easy at 3¾ ips.) This 7½ ips speed requirement also goes part way to satisfying another recording characteristic necessary for creative work – a high grade of sound quality, very necessary for receptive audience response.

Sound quality may be fairly accurately equated with tape speed and track configuration on the basis of quality being proportional to the *area* of tape occupied by a standard length of sound (assuming the electronics of the recorder is not the limiting factor).

Thus a full-track 7½ ips recording will sound (slightly) better than a half-track 7½ ips version, which itself will be an improvement on the same recording made at half the speed, or on a quarter track configuration.

Relating versatility to price, the preference should be for a ½ track (three head) stereo recorder – the half track configuration giving enough width to avoid drop out. The edge tracks on a quarter-track recorder (usually tracks one and four) can be marred by oxide flake-off. This shows up as an annoying, momentary, loss of signal. (See Fig. 1).

This recommended track configuration, with the vast majority of machines, will allow the choice of stereo, ½ track mono and mono "pseudo full-track" operation.

The blank guard band will still be present between the tracks. If a *genuine* full track recording has been made and this is erased by replacing it with a "pseudo full-track" recording, the original recording will still be present on the guard band. Playback of this recording on a full-track recorder will reveal its presence. Similar effects can sometimes be encountered when playing back stereo tapes on different makes of machines due to different guard band widths. Half track stereo gives the added bonus of reverse play effects – having made the recording the feed and take-up spools are reversed so the recording is played from 'end-to-beginning'.

Possibly the next most important characteristic to take into account when choosing a machine is head accessibility. This contributes towards easy editing.

REASONS FOR EDITING

Editing is fundamental even to an elementary sound composition.

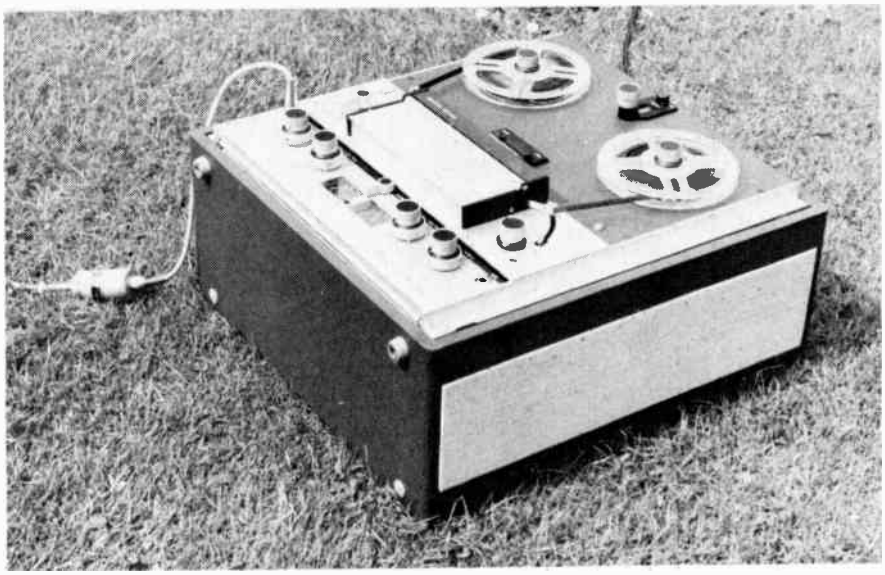
Initially it is a means of 'tidying up' recordings, removing unwanted passages, polishing speech by the removal of hesitations, fluffed lines coughs and stutters, and those most irritating of tape interruptions – the aperiodic transients due to electrical sources, the 'clicks and pops', can all be effectively eliminated. Once this process has been carried out, the results will sound acceptable, but the interest value may still be very low.

Editing as a creative process is the rearrangement of the material into a form and order pleasing to the aesthetic ideas of the editor.

A further possibility of the editing procedure may be the realization of effects which are not possible in actuality. The characteristic percepts of individual sounds can be completely altered by modifying, or removing their attack or decay (or both); This effect is well demonstrated by the difficulty encountered, even by musically-oriented individuals, when asked to identify recordings of various musical instruments from which the important first few milliseconds of attack have been removed.

THE EDITING SESSION

Standard or long-play tape is generally preferred as it is least affected by mechanical stress – It is important that the same brand and type of tape should be used throughout the compilation of the work to avoid any noticeable changes in background hiss levels.



The FERROGRAPH Series 7 stereo tape recorder — a sturdy semi-professional machine giving dependable quality and much creative scope including sound reversal, multitrack and speed change.

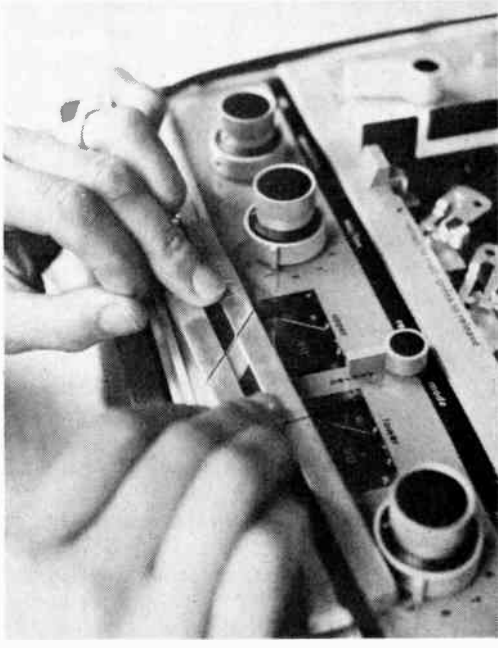


Fig. 5. Using the EMITAPE Splicing block — the two tape ends are just being abutted prior to applying the splicing tape (the tape is the black material).

The first stage in making an edit is to locate the edit-point. It is initially identified, roughly, by straightforward playback. The point where the cut should be made is directly adjacent to the replay head, i.e. the head nearest the take-up spool (see Fig. 2). To locate the edit-point with precision, the tape is carefully inched back and forth across the replay head with one hand on each spool. The tape replay drive has to be temporarily suspended prior to this operation.

Many recorders provide a pause control for retracting the rubber pinch wheel from its intimate contact with the capstan. The Revox is one particular example in which cut-out switches nullify the normal spooling tensions to facilitate normal tape movement. Even if neither mechanism is present, one can usually thread the tape on the 'wrong' side of the capstan to avoid the pinch-wheel traction. (See Fig. 3).

The Ferrograph, emulating its fully professional counterparts, incorporates variable speed spooling — a sort of gross "see-sawing" for cue location by monitoring the tape at different velocities. This type of monitoring is aptly termed "chatter monitoring".

The chosen point, adjacent to the replay head, is marked on the base (shiny) side of the tape with a Chinagraph (wax) pencil.

Should the construction of the sound channel be such that the tape cannot be marked 'in situ' a reference datum will have to be marked on the recorder deck. A distance, for example five centimetres, is accurately measured to the right of the replay head. Now a further mark is made the same distance to the right of the first mark as the first mark is from the head i.e. five centimetres. When the edit-point on the tape has been located, the tape is marked adjacent to the first deck mark. Spooling the tape on so that the tape mark is adjacent with the *second* deck mark brings the actual edit-point into coincidence with the first deck mark. The more useful alternative involves inscribing the 'head to first deck mark' distance on an editing block, to the right of the oblique-cut guide. Thus when the tape mark has been aligned with the mark on the block, the oblique-cut guide is in the correct position for cutting the tape.

At this point it is emphasized that *no metal objects* should be brought into

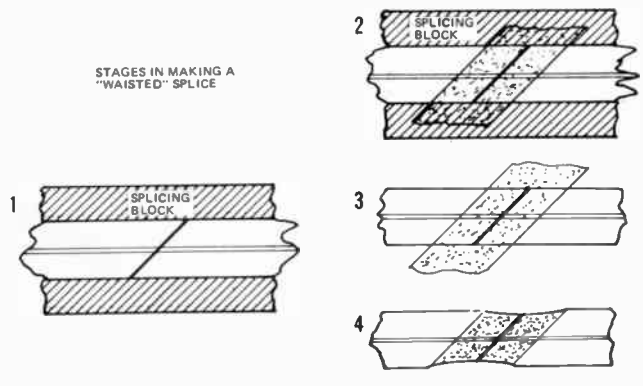


Fig. 6. Stages in making a 'waisted' splice.
1. The two tape ends are abutted in the splicing block.
2. A length of ½" wide tape is spread across the tapes and pressed into contact with them. 3. The partly-finished splice is removed from the block and the bubbles rubbed from beneath the tape.
4. Using a pair of demagnetised scissors or a razor blade the joint is now 'waisted' — here it has been exaggerated for clarity.

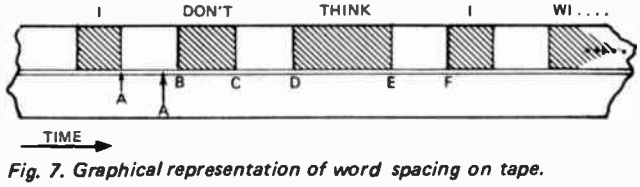


Fig. 7. Graphical representation of word spacing on tape.

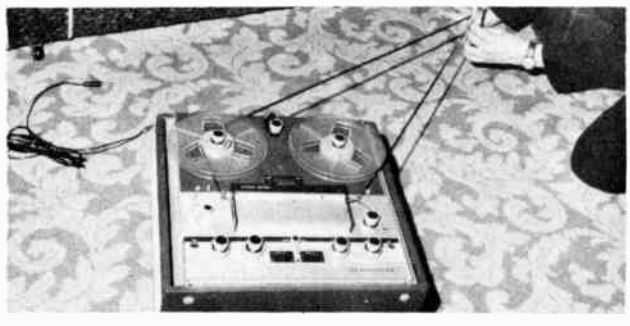


Fig. 8. Maintaining tension on a prepared tape loop, using a Chinagraph pencil.

contact with the heads, nor any item likely to damage their high finish.

The several semi-automatic splicers commercially available do not, in my opinion, match the reliability and performance of the humble slicing block. Consisting of an aluminium slab with a shaped channel to grip the tape (see Figs 4 and 5) the block has several deep cutting slots crossing the tape patch, one normally at 45° and the other at 90° angles.

Ideally a non-magnetic razor blade should be used for minimal edit noise – stainless steel blades are generally satisfactory.

The angle of the tape joint will also affect the level of edit noise, a 90° splice being the worst offender as the whole breadth of new tape edge passes the head at once. A 45° splice is preferable and gives the added advantage of greater physical strength. Actually the 45° splice may be considered as an ultra-rapid cross fade – one signal being rapidly curtailed as the other is brought up, as a respectively lesser and greater breadth of signal carrying tape traverses the vertical head gap.

Using a pair of scissors, elongated splices of up to around 6" may be carried out to give a more gradual cross-fade. Despite the above comments it is interesting to note that a number of professionals advocate the use of a 90° edit for stereo recordings to prevent apparent sound movement at the splice.

Ordinary adhesive tape should not be used for splicing or the heads and pressure pads will be fouled up – special pressure sensitive splicing tape has been formulated that will not stretch and avoids gum ooze.

One warning though, if it appears that the splicing tape has been in the shop for a long time, be careful, as it does tend very gradually to lose its adhesive properties.

Splicing tape is most commonly available in two widths, half inch and 7/32 inch.

Until fairly recently, magnetic tape stiffness decreed using the wider splicing tape, then 'waisting' the splice for easy passage through the sound channel. (See Fig. 6). Nowadays thinner splicing tape and improved magnetic tape pliability simplify the operation – once the two tape ends have been carefully abutted, a length of 7/32" splicing tape is laid across them, obviating the need for further trimming. For a secure, relatively permanent splice, between one and two inches of splicing tape should be used, taking care to rub the bubbles from under the join using a blunt non-magnetic instrument (the non-business end of the Chinagraph pencil is ideal).

Once a piece of tape has been removed it *must be kept* until the edited piece has been played back for once the 'sense' of a piece of speech or music has been upset, there is nothing more exasperating than searching through myriads of tape scrap on the floor trying to find the missing syllable or crotchet (the lost chord?!).

The 3" standard 8mm film spools are excellent for storing lengths of tape during the editing session – however don't be tempted to use them as feed spools when tape copying as some recorders do not have enough torque to cope with the small hub, and tape wow is the result.

It is always preferable to edit a tape *copy*, preserving the original intact. Then if any mishap should occur during the editing, it is an easy matter to re-copy the relevant passage again from the master.

We have so far covered the purely mechanical aspects of editing. Let us now consider editing in relation to basic material – speech and music.

EDITING SPEECH

Every speaker has his, or her, characteristic vocal inflection and rhythm of delivery, this is readily apparent when trying to edit interviews.

Let us carry out a simple exercise in editing speech using the sentence "I *don't* think I will go out tonight". We decide to reverse the meaning by removing the second word, 'don't. (See fig. 7). Figure 7 graphically illustrates the layout of the words on the tape. AB, CD and EF are the gaps between the words. The first stage will be to mark the beginning and end of the piece to be excised. The problem here is to decide which length (AB or CD) or what *modified* length should be interposed between A and D. In this particular example a suitable gap length would lay somewhere between that of AB and that of EF. 'See-sawing' the tape to the beginning of 'think', position D is marked. The tape is then manually rewound to B, the beginning of 'don't' and rocked back from this point to give an idea of the size of gap AB. With this knowledge a suitable gap length AA can be selected and edit points A' and D joined.

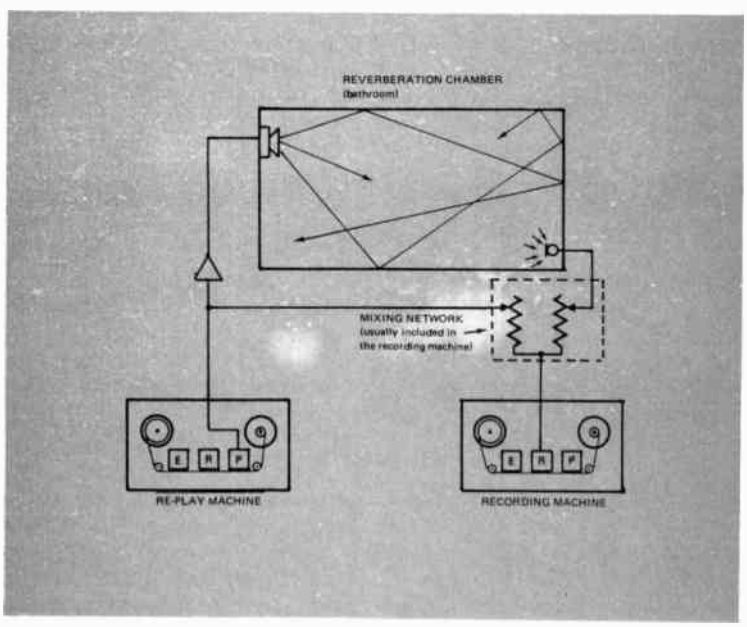
It may sound complicated but in practice this procedure takes a minute or less.

But no matter how carefully this cutting and splicing is done the results will sound neither natural nor convincing, for although the timing may be correct, the vocal emphasis will be wrong. A certain inflection is placed on 'don't' which is automatically followed by a complementary inflection on 'think'.

Although inflection and rhythm must always be considered in speech editing, in some ways our perception may be easily fooled. The remarkable conclusion from a research project utilising spliced speech is that inflection may carry as much, or more, meaning than the words themselves. As part of this project subjects listened to prepared sentences in which key words had been removed and replaced with neutral electronically-generated tones. It was found that the subject responded as if the key words had still been present!

The author has carried out a similar experiment, reversing syllables and even whole words, and has demonstrated a similar phenomenon.

Fig. 9. Diagrammatic representation of acoustic/electronic dubbing link (see text)



Whether or not to edit out, pauses, fluffs and hesitation, depends very much on the overall material. It could, if taken to extremes, convert what was an intimate interview into something very much resembling a commentary on the closing stages of a horse race.

Fluffed lines should in most instances be tidied, and the 'right' length for pauses will generally be determined by the type of production. Dramatic effect may be heightened by elongated pauses.

Probably the prime function of interview editing is to condense the material, to extract the very substance and character of what has been said. The character of a speech consists not only of rhythm and inflection but also of sniffs, coughs, stutters and 'verbal cabbage' like "you know" and "you see".

The padding that *should* be weeded out is that which impedes the clear flow of speech. However, to maintain consistent delivery it may be necessary to *add* breaths and pauses gleaned from the unused sections of the interview. A speaker's rhythm owes a great deal to short mid-sentence breaths and if parts of sentences are being removed it may be necessary to 'import' breaths to keep the flow.

If a length of silence is required during a speech tape use a piece of 'silence' taped at the occasion when the speech was recorded. Leader tape or virgin tape used as a spacer unfortunately draws attention to the presence of edits, audible as variations in the level of background noise.

The background itself can pose awkward problems unless a brash actuality, or documentary, style is being attempted. A common fault encountered when editing a commentary with a background of, say, passing cars, is the ultra-sudden arrival or departure of the vehicles on the edited version. It is possible to disguise the effect if the background is not too prominent – by taping twenty seconds, or more, of the relevant background at the time the tape was made. (It is assumed that a stereo ½ track recorder with track to track re-cording facility is being used in conjunction with the location recorder.)

The location commentary is copied onto the lower track of the stereo recorder and this copy is edited down to the condensed essentials. The short length of location effect is copied onto the upper track of a separate piece of tape. Points are marked near the extremities of the sound effect where the characteristics accurately match i.e. in the example given, one point could be located just prior to a car fading up and the other just after a car has faded out. The two points are then spliced together to form a continuous loop that repeats once per revolution. The larger the tape loop, the less obvious will be the cyclic nature of the loop. The tape loop is replayed on the location recorder keeping it gently tensioned with a weighted jam-jar, or by running it around the ubiquitous Chinagraph pencil (See Fig. 8). Now the loop is copied onto the upper track of the stereo recorder whilst simultaneously copying the condensed commentary from the lower track to the upper one. The two sources are balanced to keep the loop sounds well to the background, although marginally louder than the erroneous background accompanying the edited commentary.

When preparing loops as described, avoid the inclusion of any discrete obvious sound i.e. a car horn or a shout. The repetition of any such sound will immediately identify the source as a loop.

Points to watch when editing speech are changing acoustics, acoustic balance or sound level. A change in sound level occurs when the subject moves relative to the microphone or the microphone position is shifted (all too easy with a hand-held microphone).

Change in acoustic balance is the result of trying to keep the tape equally modulated following a change of microphone subject position – if the microphone has been moved closer a more 'dead' acoustic results and vice versa.

A 'blanket' type correction can be used to 'equalize' recordings made indoors and outdoors by copying 'electronically' whilst using an additional acoustic link (See Fig. 9). An interesting variation is obtained by doing the copying with both recorders operating at twice the true speed – when the new copy is slowed down to the correct speed the reverberation time due to the acoustic link will have effectively been doubled. By siting the acoustic link in the bathroom, one can simulate a large hall or cavern.

A novel method of lending impact to a voice and/or sound effect is to find its counterpart (with a similar sound spectrum) and splice or cross-fade the two items together – several TV advertising agencies have linked the silibant name of the product with the sound effect of the product – in one instance the sizzling of bacon, and the hiss of gas escaping from a tonic-water bottle in the other.

MUSIC EDITING

A lot of the comments made in the last section apply equally to music editing, neverthless music editing also presents a further set of problems. For example, however strict the tempo supposedly is, it can never be an absolute quantity – splicing together different 'takes' of a piece of music may give rise to unfortunate and even comic changes of tempo. The best way to prevent this is to let the conductor hear the material already 'in the can' at frequent intervals as the session progresses.

The musician finds it naturally advantageous to work from the rests written in the score but herein lies a danger for the recordist – for the 'silence' of the rest will contain the decaying reverberation of the note played immediately prior to it. If one does split the score into short sections for the ease of the musicians, it is eminently preferable to commence each 'take' a bar, or more, *prior* to the edit point so that the correct spectrum of reverberation will be present at the edit point.

Much editing difficulty is found when trying to locate edit-points in music due to the complexity of the signal (music and reverberation). When combining 'takes' it helps to earmark a particular note. The initial tape is marked just at the attack of this note. The next piece of tape has the same note marked identically. The two are then mated together. This may seem obvious, but as any clear note can be chosen for the changeover it is far simpler accurately to maintain the beat.

When combining electronic music, or music concrete, greater latitude is present – note lengths may be altered at will using splicing techniques; additionally the attack and decay characteristics of the note may be modified by cutting the tape at different angles of obliquity. ●

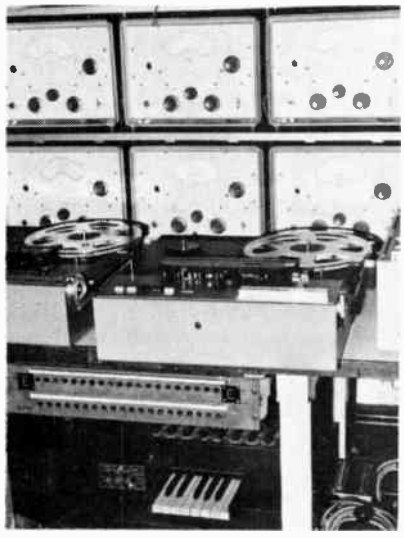
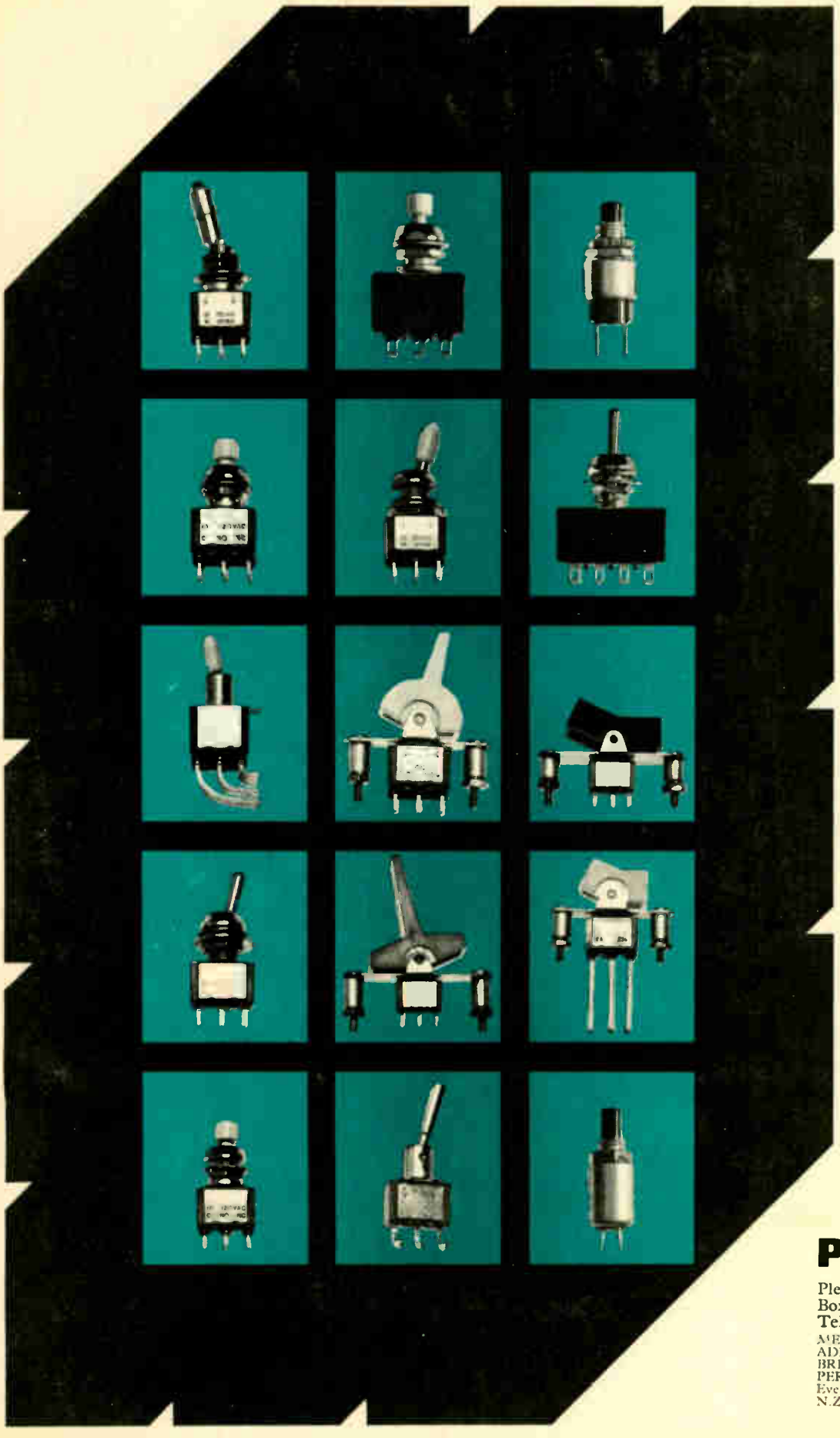


Fig. 10 – Corner of the BBC Radiophonic Workshop. Note, beneath the bank of oscillators the professional Telefunken editing machines with editing blocks bolted on the decks at front right. To the right of each recorder is a splicing tape dispenser.



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AC84

Build It Yourself Calculator

This calculator kit by Heathkit uses rechargeable batteries and has perfect overflow characteristics.

The completed Heathkit IC2009 has a pleasing appearance and is easy to use.

EVER since Heath brought out its first electronic kit (a $39.50 oscilloscope) in 1947 they have been leaders in the kitset field, so much so that their turnover has trebled in the last 10 years to an incredible US$66 million and kits are available for everything from trash compactors to scientific instrumentation.

The reason for this phenomenal success is the meticulous care that Heath puts into every kitset and the after sales service provided.

Each kit comes complete with an assembly-instruction manual that allows even those who have never held a soldering iron in his or her hand, to build a complex piece of electronic equipment with little fear of failure.

The most recent addition to the Heathkit line-up is the IC2009 calculator. This 8-digit unit comes complete with nickle-cadium rechargeable batteries and a battery charger. At a price of around $92 this is considerably cheaper than any calculator with comparable performance at present on the market.

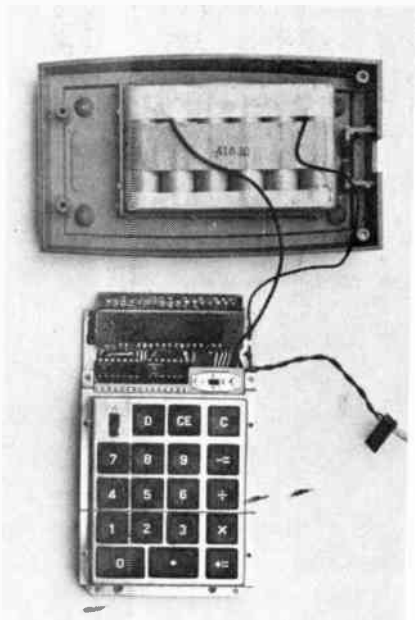
The calculator uses a five-chip logic set (one MOS calculator chip and four TTL/MSI display drivers) from Texas Instruments, an 8-digit LED display from Bowmar and thirteen transistors. The keyboard is also manufactured by Texas Instruments and is pleasing to use as the keys are relatively large and have a decisive microswitch-type action. Both keyboard and LED display plug directly into the main logic board; there are in fact only four wire connections, two to the battery and two to the charger plug.

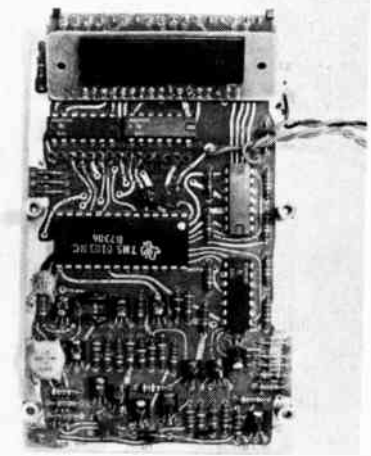
Operationally, the calculator features a perfect overflow system, that is, two numbers each of which overflows the input register may be multiplied to produce an answer of the eight most significant digits where the decimal point is displayed eight places to the left of its true position. Overflow in both entry and output is indicated by separate symbols.

Should the calculator be left on for more than 15 seconds without a new keyboard entry, the display blanks out to conserve battery power. The last number displayed remains in memory however, and is restored to the display when the D key is pressed. Constant operation and separate 'clear all' and 'clear last entry' keys are also provided.

The finished calculator has a pleasing appearance, is easy to use and has a bright easily read display.

Construction of the calculator is straightforward but unlike most other Heathkits we felt that it would be inadvisable for anyone without previous soldering experience to tackle this particular project as quite a few of the solder pads are very close together. The MOS calculator IC may also be damaged very easily by static electricity and must be handled with care. But for those with some experience this kit is excellent value, and may be constructed in a few hours with a minimum of tools. ●



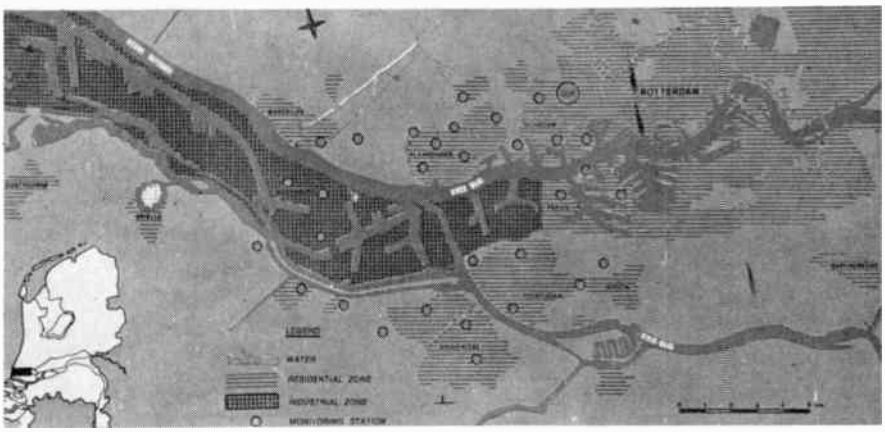


The main logic board with the display plugged in. Note the connector beneath the two top IC's into which the keyboard plugs.

The completed calculator before final assembly into the case.

TOWARD A BETTER ENVIRONMENT

Proposed automatic pollution monitoring system may result in cleaner cities. This report by Peter Sydenham M.E., Ph. D., M. Inst. M.C.



1. Location of SO_2 monitors in the Rijnmond supervisory network.

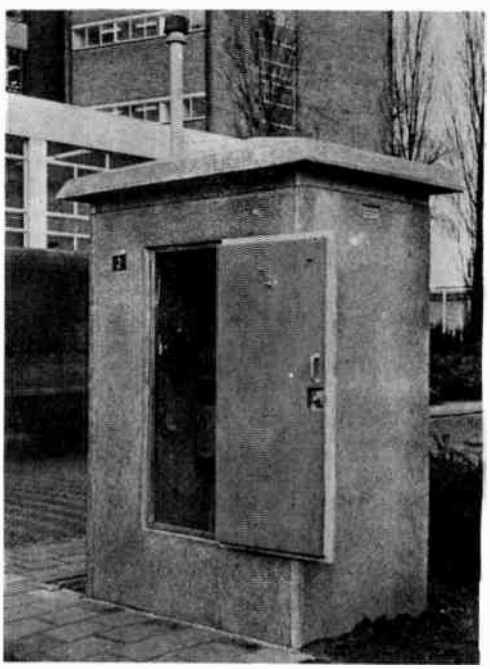
2. Inside the Rijnmond central control room.

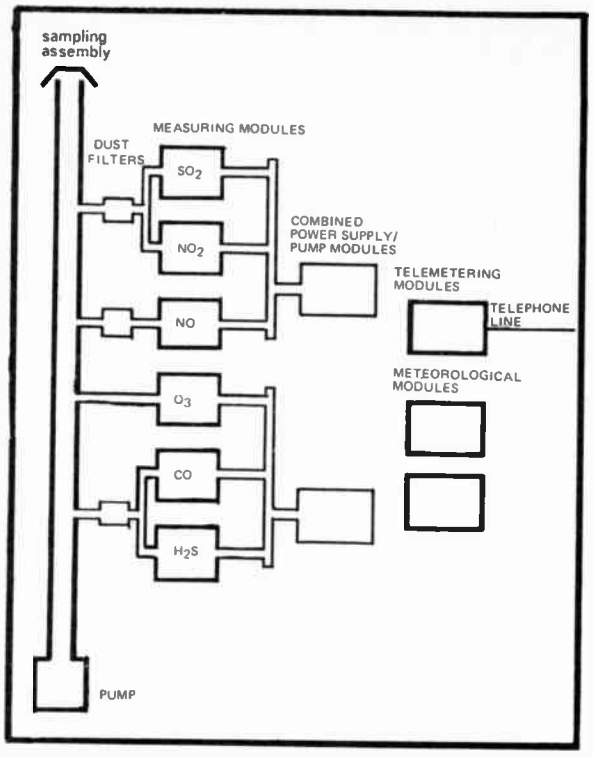
3. Monitoring cubicle for up to nine modular units.

AUTOMATIC POLLUTION MONITORING SYSTEMS FOR CITIES

ALTHOUGH pollution control of the air and water has been in vogue since mediaeval times it has long suffered from the want of a way to *measure* the excess and pinpoint the source of the trouble. It is one matter to legislate against it, another to enforce the law.

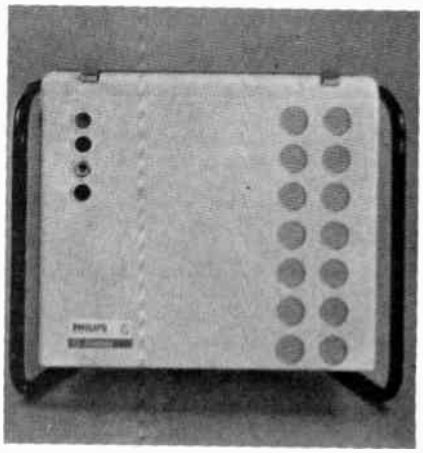
Protection really starts with measurement, for subjective opinion can be misleading in this emotional area of our existence. Nature has inbuilt purifying mechanisms but our excessive generation of poisonous gases and wastes emitted into the air and water have overloaded natural methods in many places. Few large cities in the world can claim to have

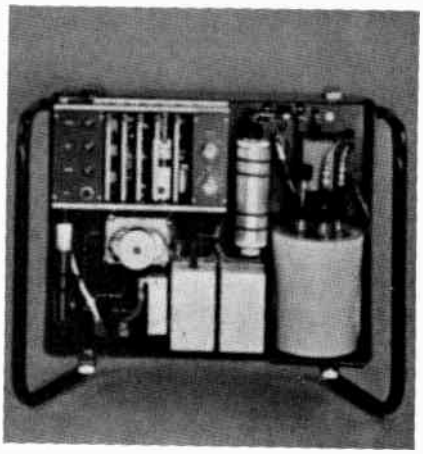




4a. Schematic of the multi-measurement station.

b. Views of the module (coulometric unit).





the situation in control, for adequate awareness of the problem is a recent realisation occurring too late in many cases.

Motor vehicles pour out carbon monoxide, carbon dioxide and solid hydrocarbons. Factories and power-house furnaces pour out tons of dust each day along with sulphur dioxide, nitrous oxide and hydrogen sulphide. Sulphuric acid may rain down near the smoke stacks of unprotected furnaces!

Already the pollution levels in many cities exceed considered safe levels. Existence of contamination may be evident – dead fish in rivers, discolouring paint and buildings, obnoxious smells, floating debris, sickness due to lack of enough oxygen to breathe – the picture has been portrayed so many times in the news media one cannot fail to know of it. In such cases obvious action is needed.

Where pollution is not so clearly evident, it is even *more* important to monitor it with instruments, for our natural senses are inadequate to judge the level of contamination building up to critical proportions. Pollution penalties are now large – $10,000 a day for oil pollution at sea, $10,000 for continuing to pollute water. But to *enforce* these penalties needs evidence that can be provided only by continuous monitoring with rapid response instruments.

Did you know that many factories flush their waste out at night so as to go undetected?

Not all recognised pollution is man-made. Even so, a warning of approaching unhealthy weather conditions given to the populace in time would enable people to reduce the severity by restricting the use of polluting sources normally operating at acceptable levels.

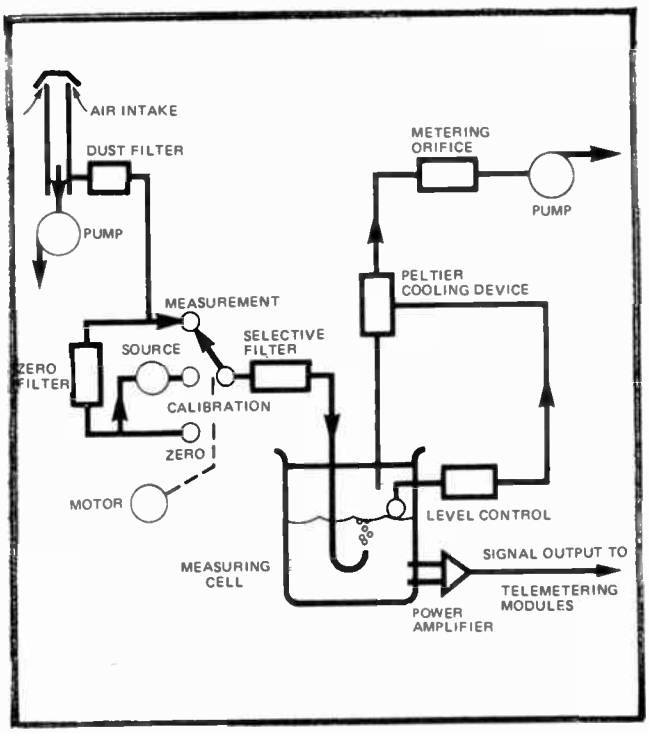
MONITORING SYSTEMS

The measurement (and hence control) of air and water pollution over a large area is usually a complex problem. It involves many sources, each being a contributory factor in different ways. The problem of control is compounded by political difficulties. Cities and suburbs are invariably administered by a number of largely independent councils each of whom may decide on different levels of safety, and different financial emphasis on the problem. Pollution, however, has no boundaries, so regional differences must be overcome in setting up satisfactory control schemes. It is essential that many sensors at many sites be used – not just one placed where high levels are known to exist.

One company who can claim to have answers to pollution measurement of cities in Philips. In 1969 they installed the first completely automatic pollution monitoring network in the world at Rinjmond, near Rotterdam in Holland. The air pollution product manager, Mr. Werhoef, recently visited Australia to study how, if given the chance, they would instrument places like Sydney and Melbourne. By 1974 Philips will have a national, computerized network operating all over Holland – 250 stations will be in use, in conjunction with 10 mini-computers. They have 1000 pollution monitoring units working across the globe.

In essence, the system at Rijnmond consists of monitoring stations, detecting SO_2 placed at strategic locations over the city area (as shown in Fig. 1). Thirty-odd stations provide data on pollutant levels that are relayed back to a central control room (see Fig. 2). There, a small group of controllers visually watch the changing levels, accept public complaints by telephone, correlate the various information received and warn

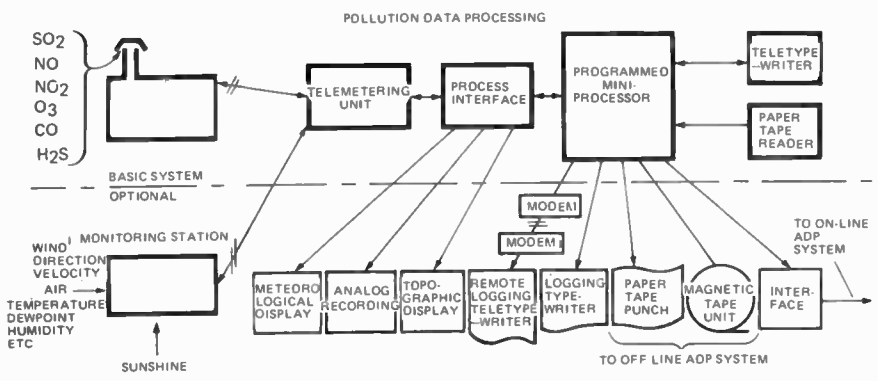
TOWARD A BETTER ENVIRONMENT



5. Flow diagram inside a coulometric unit.

6. Performance specifications for the various gas pollutant sensors.

MODULES	SO_2		NO_2		NO		O_3		CO		H_2S	
	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³
NOMINAL MEASURING RANGES	0,3 1 3	0,8 3 8	0,3 1 3	0,6 2 6	0,3 1 3	0,4 1,3 4	0,2 0,5	0,4 1	2 7,5 75 (200)	2,5 9 90 (250)	0,1 0,3 1	0,1 0,4 1
MINIMUM DETECTABLE CONCENTRATION	0,01	0,03	0,01	0,02	0,01	0,01	0,005	0,01	0,1	0,1	0,005	0,007
MAXIMUM ZERO DRIFT (24 H) NON CUMULATIVE	0,01	0,03	0,02	0,04	0,02	0,03	<0,005	<0,01	0,1	0,1	0,005	0,007
TIME CONSTANT (SEC) 63%	90		180		180		—		120		90	



7. Monitoring network having stored programme data processing for use in many-sensor systems.

factories in areas where levels exceed safe limits.

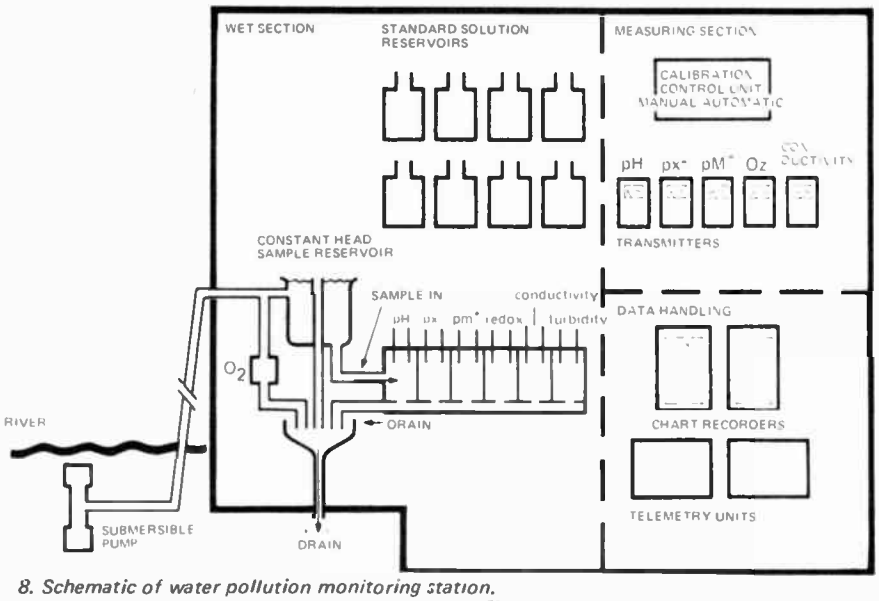
The network is represented by a mimic map in the central control room which has lamps placed at the corresponding locations of stations. Levels exceeding a preset value are indicated by the lamps, and the observers warned. Many lamps appearing as a group indicate that a relatively massive source has appeared. The preset levels can then be slowly increased to find the highest level,thus pinpointing the area. A quick phone call to an inspector – and remedial action is in progress within minutes. Already one Philips system has been instrumental in the closure of a refinery in Holland.

MONITORING THE AIR

Accurate measurements are the basis of successful air management. Because the major air polluting gases occur virtually independently of each other it is necessary to monitor them individually. (The level of SO_2 is regarded as a useful general purpose indicator but not a totally reliable one). Speed in measurement is important. Most cities already have monitoring services using manual data collection, but this method can take up to 12 hours or more to provide concentrated information. This is just not fast enough in many instances. For example, high speed factors such as weather conditions can change in hours from a safe cleansing situation to an unsafe situation where levels rise due to stagnation. So study of the problem of monitoring in cities adds up to the need for automatic, continuously operating, monitors having response times of minutes, reliabilities measured in weeks and capable of being centrally controlled. Let us now see how the Philips system fulfils these needs.

At the selected monitoring point there would be an instrument cubicle similar to that shown in Fig. 3. Outwardly, all that is to be seen is an air intake through which air is drawn by a small pump. Inside are a number of modules around 0.5 by 0.3 by 0.2m in size. Each is similar in respect to size and mountings, but has a different function to perform. It might contain a system for measuring a pollutant concentration, or power supplies, telemetry circuits or meteorological instruments. The actual number and type of the modules used depends on the requirements. Figure 4b is a block diagram of one of the modular measuring stations incorporating many different units. The drawing also shows a typical module.

Five of the possible six gas-measuring modules use the same coulometric principle to determine concentration



8. Schematic of water pollution monitoring station.

levels of SO_2, NO_2, NO, CO and H_2S. The sixth unit, for measuring O_3, uses chemiluminescence. Coulometry was chosen in preference to alternative analytical techniques, for it can be used to monitor a wide range of different gases with the same basic setup. It is also claimed to be more reliable over a long term — an important factor of the Philips system that can operate unattended for up to three months.

In the coulometric technique the gas of interest is bubbled through an electrolyte. A pollutant in the gas changes one of the components of the electrolyte and this is compensated by an electro-chemical reaction with a current proportional to pollutant concentration. A block diagram of the coulometric modules is shown in Fig. 5. Each module needs different pretreatment of the incoming gas — NO, for instance, is measured as NO_2 after oxidation. Specially designed selective filters ensure that such unit is sensitive only to the chosen gas. The Peltier cooling device is included to condense water back into the cell to maintain the level.

A special, three-way, flow switch enables the module to be periodically set; firstly to establish the zero of the cell output amplifier as zero mA.

(This is done by drawing air through a filter that removes all pollutants — thus providing pure air). Secondly, the tap is switched to draw this purified air through a standard source (a glass bulb containing pollutant gas of known concentration) where the 100% range of the cell output amplifier is set to be 20 mA. The output drifts less than 2% over a 24hr period following the calibration. Finally, the cell is piped to the incoming air and provides a signal proportional to pollutant concentration. This sequence, which is remotely initiated, ensures that the module is always calibrated, ensuring accuracy for legal validity.

The ozone module relies on the phenomenon in which light is emitted by Rhodamine B when it is exposed to O_3. The luminous intensity is proportional to the O_3 level but is, however, a low level effect requiring a photo-multiplier to sense it. This test is specific for ozone only. Research was needed in the development of this sensor to reduce the effects of the relative humidity of the incoming gas.

Measuring modules can detect concentrations as low as 0.005 parts per million (0.01 mg/m^3). Ranges have been designed in each case to cover expected levels of pollutants. They are summarized in the table of Fig. 6. The modules can be used independently, provided power and the intake pump are supplied. Staff of the University of Newcastle, New South Wales, for instance, operate a SO_2 monitor in a van for mobile monitoring around the City of Newcastle.

HANOLING THE OATA OBTAINEO FROM MONITORS

If there are only a few monitors involved, the data rate can easily be handled on locally-placed chart recorders. As the numbers rise, however, decisions must be made regarding the use of data, for it is not practicable to use numerous recorders. A system as large as that at Rijnmond, or the one proposed for Sydney, is best operated by continuously sending the signals of all cell modules back to the central control room in an on-line mode of operation. Telephone lines or microwave links can be used to relay the information via the signal processing units provided in each station. Within the CCR there is obviously a need for extensive and versatile data processing power to handle the incoming information effectively: a mini-computer is the natural trends. It is also vital to eliminate the topographical, meteorological and time factors that might otherwise bias the results. Warnings must also be given of excessive levels, these showing, perhaps, on the mimic diagram.

PARAMETER	MEASURING TECHNIQUE	MEASURING RANGES	*(zero) drift per day less than	*(zero) drift per 10 C variation in sample temp less than
DISSOLVED OXYGEN	Membrane amperometry	0-10; 30; 100% sat. O_2 0-3; 10; 30 ppm	1% f s d.	1% f s.d.
CHEMICAL OXYGEN DEMAND	Coulometry with zirconium cell	0-100; 300, 1000; 3000; 10 000 mg O_2/l	automatically corrected	—
pH	Glass electrode	2; 5 or 10 pH units span	0,1 pH	0.01 pH
CONDUCTIVITY	4 electrode cell	0-1; 0-3; 0-10 mg/l soluble salts 0.1, 0.3 mmho (and up)	—	0 5%
CHLORIDE	Ion selective electrodes	$10^{-1} \cdot 5 \quad 10^{-5}$, mol/l	2 mV	—
FLUORIDE		$1 \quad 10^{-6 \cdot 5}$, mol/l	2 mV	—
AMMONIUM		$10^{-1} \cdot 10^{-5}$ mol/l	1.5 mV	—
HARDNESS (pCa)		$1 \cdot 10^{-5}$ mol/l	2 mV	—
REDOX	Metal electrodes	— 500 to 500 mV — 100 to 100 mV etc.	1%	1% f s.d
TURBIDITY	Light dispersion	0-10 to 0-2000 ppm SiO_2	1%	—
TEMPERATURE	Resistance thermometer	— 10 to 30 C	negligible	negligible

* Figures given for drift are non-cumulative

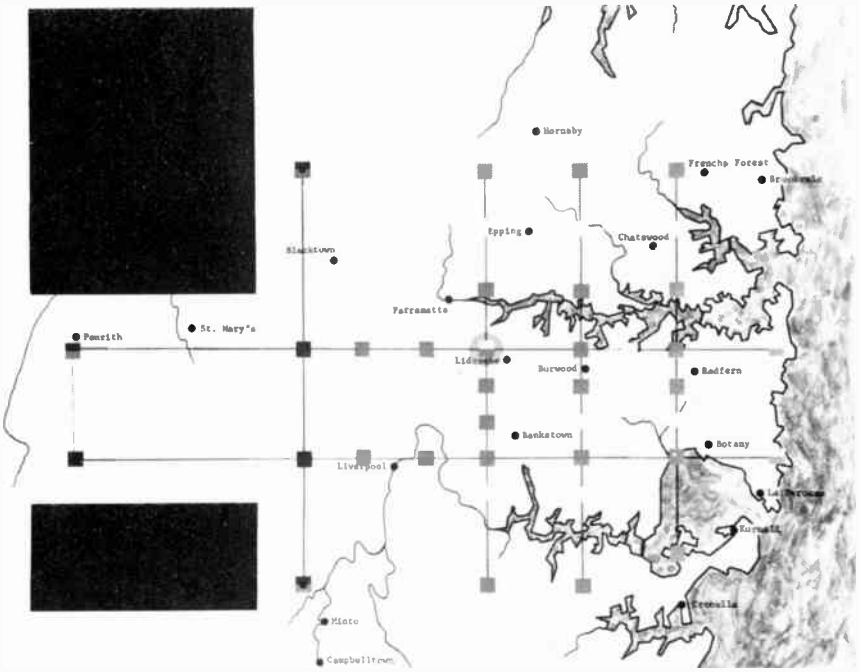
9. Performance specifications of the water monitoring sensors.

TOWARD A BETTER ENVIRONMENT

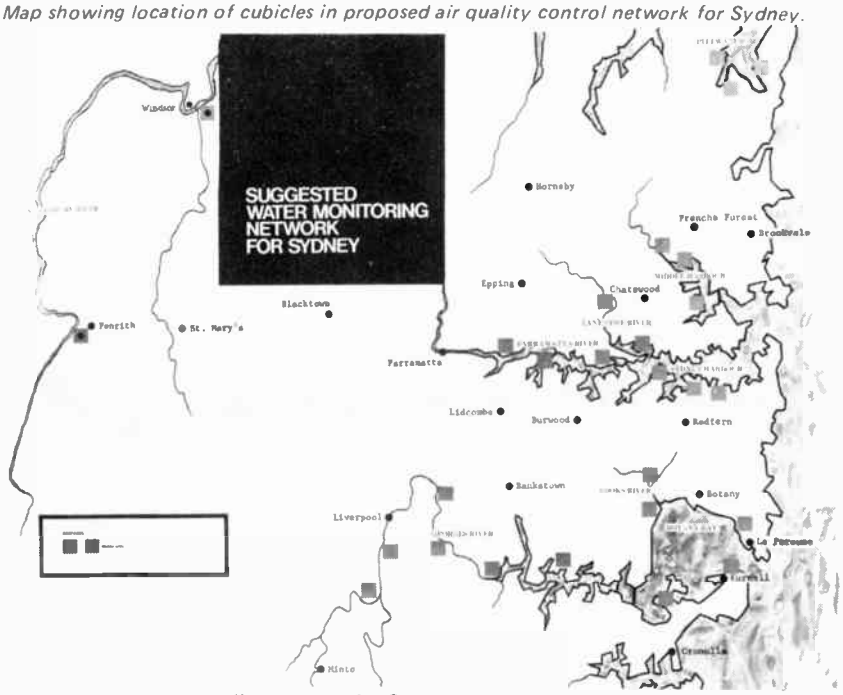
Considerable data storage is also needed to maintain runs of record for establishing long-term trends and for legal purposes. Options at the data-processing stage are many, ranging from simple direct recording, through fixed program arrangements to stored programs controlling large systems. Schemes available for a large network (with five to 250 monitors) are depicted in Fig. 7. The final choice has few restrictions: it depends upon the needs of the customer.

MONITORING WATER QUALITY

One estimate suggests that the demand for clean fresh water rises at about five percent per year. Discharge of used water is also rising and, as with air, water can become contaminated without obvious evidence. Again, the only satisfactory approach is to monitor various parameters. Philips have also developed water monitoring stations that can be linked to a central control room if need be. Parameters of interest might be the dissolved oxygen (DO) level, chemical oxygen demand (COD), pH, conductivity, level of concentration of the various specific ions, redox potentials, turbidity and temperature.



10. Map showing location of cubicles in proposed air quality control network for Sydney.



11. The suggested water quality network for Sydney.

A typical water pollution station is shown in Fig. 8. The pump continuously feeds sample water to the row of measurement cells and to the oxygen monitor (that uses a different principle). As with the air sensors, the designers have incorporated remotely controllable switches that fill the sensors with standard solutions to define the 0 and 20 mA signal levels. A list of parameters monitored and the attainable precision and stability of measurement is given in Fig. 9. It is not practicable (as yet) to monitor all of the variables with a single principle to the same extent as the coulometric method. This increases the difficulty of obtaining long-term reliability: these monitors need fortnightly attendance.

Telemetry uses the same techniques as found in the air monitors.

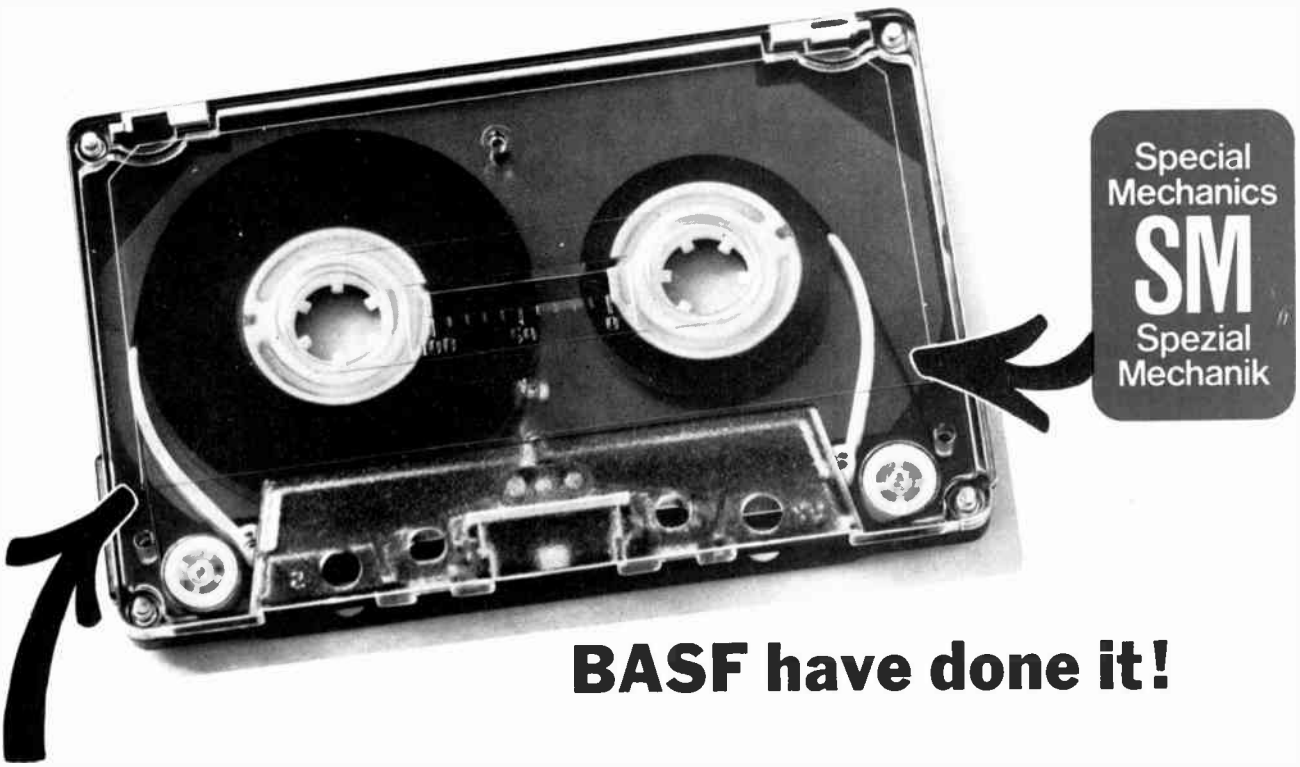
A PLAN FOR SYDNEY

Following their success at Rijnmond, Philips, in conjunction with officers of the N.S.W. Department of the Environment, have drawn up proposals for a supervisory network to cover Sydney and its environs. Thirty-eight stations would be involved: their approximate position being as shown in Fig. 10. The central control unit would be situated at Lidcombe – from there the overall state of pollution would be monitored and controlled. Two mobile units would operate out of the Blacktown and Minto areas, the remainder being permanent installations. The choice of monitors installed in each cubicle is governed by local requirements and experience already gained. Some would measure hydrocarbons, ozone, nitrogen and aldehydes, others carbon monoxide and sulphur dioxide; hydrocarbons and sulphur dioxide. Several stations would also monitor the meteorological instruments sensing temperature, humidity, wind direction and speed.

The company is also interested in the possibility of supplying a water monitoring network for the area -- See Fig. 11. Two of the 27 stations thought necessary are mobile for use along the Hawkesbury River. Here also, a detailed knowledge was needed to propose the plan – not all situations are as obvious as the need for a monitor at, say, Kurnell where oil is refined.

The proposal has been put to those responsible for action in this matter. Naturally, the price will be high (running into several million dollars) for the scheme is widespread and advanced. If either of the two proposals are adopted it would help to make Sydney one of the cleanest cities in today's increasingly polluted world. ●

the jamproof cassette



BASF have done it!

We've eliminated the biggest source of cassette customer complaints you have to unravel (sometimes literally). BASF made the world's very first recording tape. Now we've patented a brilliantly simple, foolproof improvement for the innards of cassettes.

It's called Special Mechanics and it consists of two plastic "tusks" that guide the tape accurately on and off the hubs. So it *stays* neatly wound instead of looking like a ball of string, and jamming in the cassette.

As well as the worst kind of jam ups, Special Mechanics virtually eliminates the wow and flutter that happens with anything less than perfectly smooth running.

Special Mechanics is *guaranteed* to give your customer smoother, trouble-free recording and playback. Or we'll give them a . . . FREE REPLACEMENT CASSETTE.

And once you've solved your customer's jamming problems, he'll be able to enjoy 2 other BASF firsts. LH tape—Low noise and High output, both together in the one tape. Or Chromium Dioxide tape for dramatically improved dynamic range and frequency response at 1⅞ i.p.s.

BASF's BIGGEST EVER NATIONAL ADVERTISING CAMPAIGN will be telling your customers all about SM, LH and CrO_2. So they'll be looking for the BASF bullseye in your store. Make it easy to find, and make yourself some jam!

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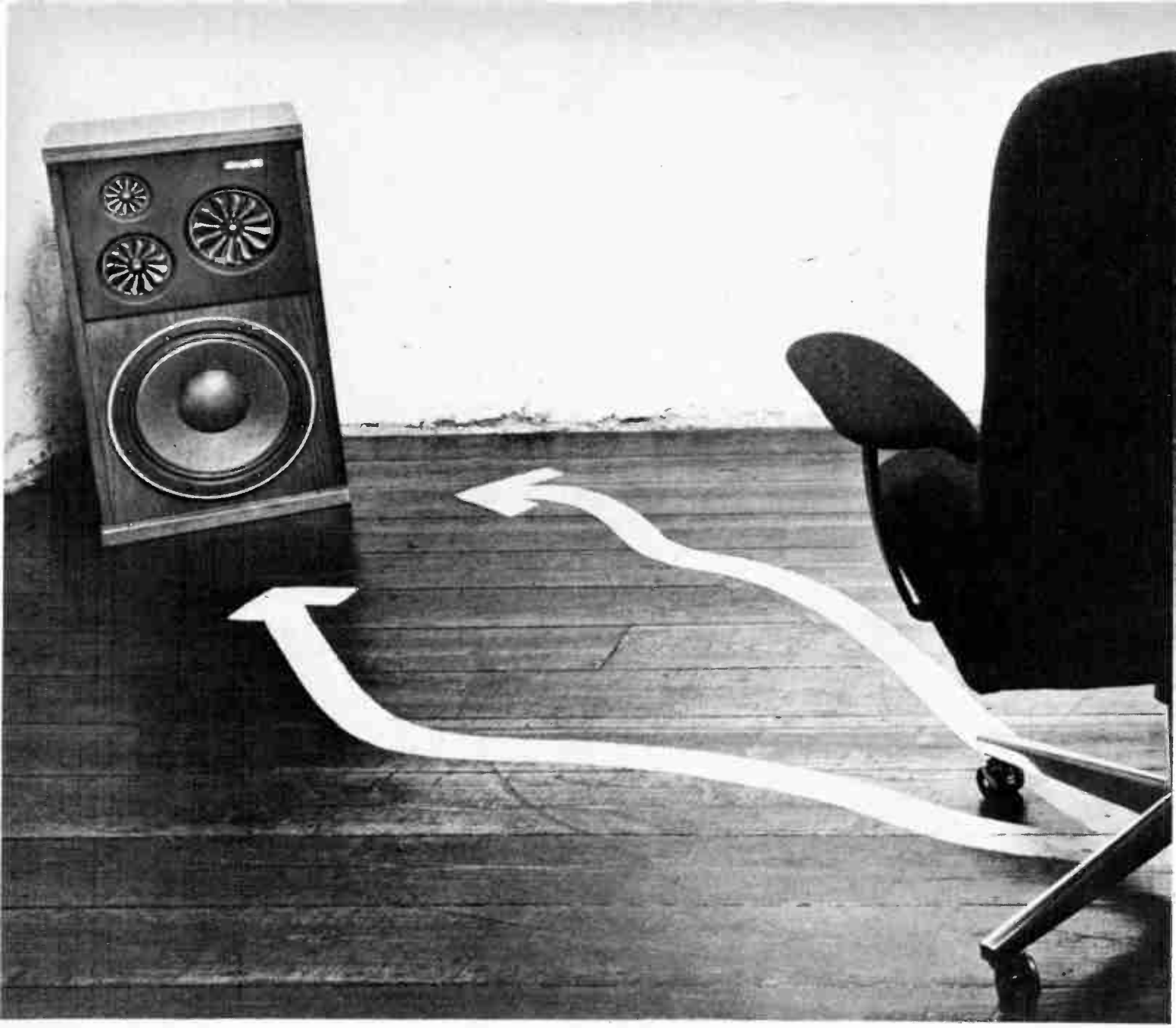
BA2753



HOW TO TEST-DRIVE THE NEW

You will need your favourite stereo recordings and a chair you can easily move around the room.

Start playing your music through the Stage 7's, and take up a position normal for stereophonic listening, i.e. the same distance from both your speakers, the familiar 'triangle' arrangement.

Now move your chair back, and to the side. Sit for a moment, then move across to the other side. Work backwards to the corners of the room.

Notice how the stereophonic effect never varies. There are no points where the high frequencies blur or fade.

Blurring and fading is something you may have noticed on your speaker system if you move too far from the triangle. But that's because your speaker system doesn't have wide-focus acoustic lenses. Coral does.

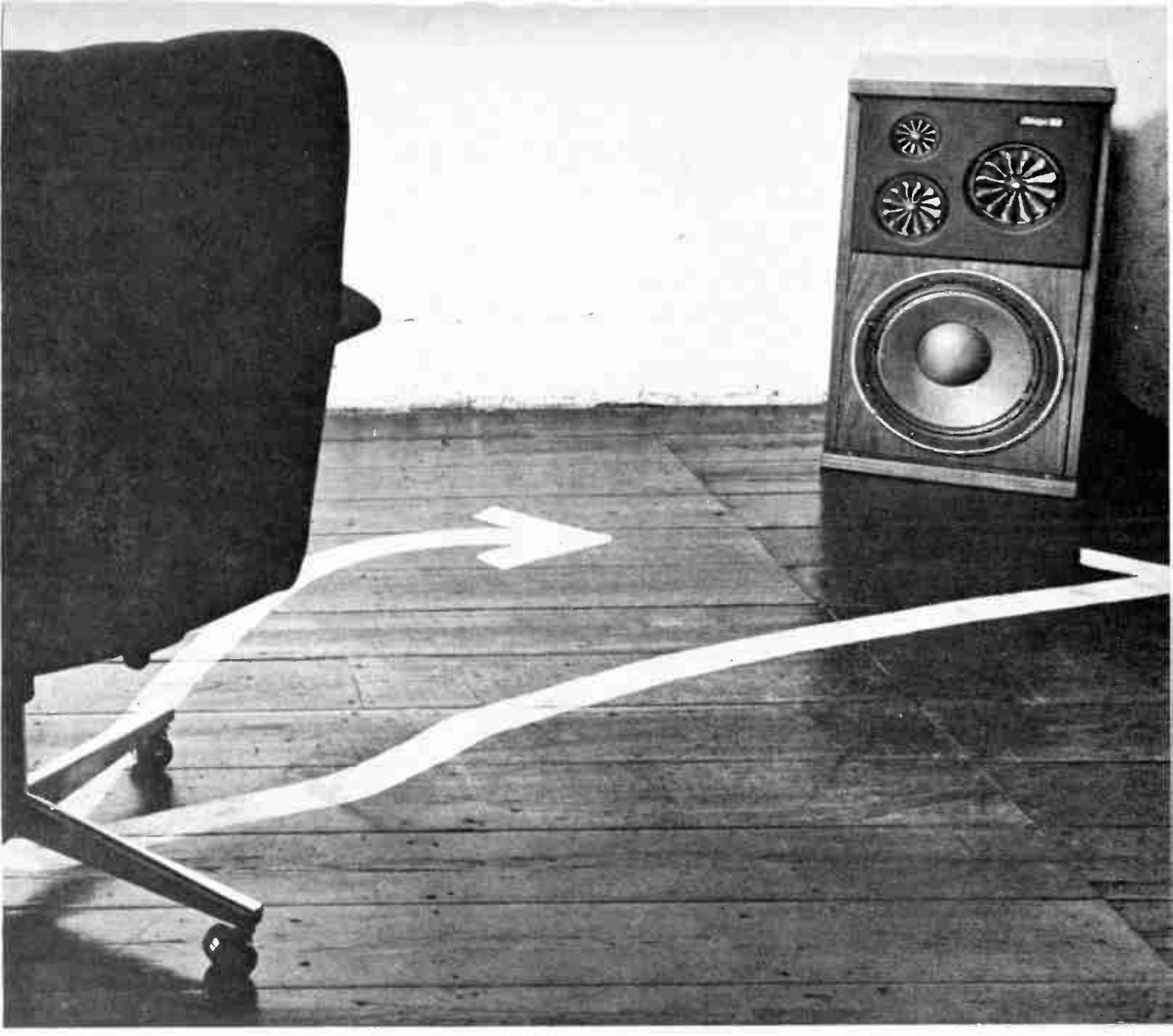
Snick the grille off the speaker enclosure. Those metal whirligigs are the acoustic lenses. They make a narrow cone of high frequency soundwaves, fan out, to reach all points in the room. Consequently, you can sit anywhere in the room and hear every detail of stereophony, and even quadrophony, as it was meant to sound.

To help you hear every detail, the Stage 7 has a range from 25–20,000 Hz.

The 12″ woofer has a hollow-formed cone made of specially sensitive chemical fibre pulp, mounted on a walnut baffle, flat on both sides, to give you clear, undistorted bass, free of acoustic bounce.

There's a 5″ mid-range speaker, a 3½″ tweeter and a 2″ super-tweeter, each fitted with an acoustic lens.

You'll notice we've polished up



CORAL STAGE 7 SPEAKERS.

the baffle and set the high frequency speakers in a toning fabric panel.

Ever wondered what was behind the grille of your present speaker system?

It could be unfinished wood, ugly screws and even bits of insulation sticking out round the speakers.

It doesn't show. And so it doesn't matter.

But it matters to Coral. It's a point of honour to finish the whole speaker system like a piece of fine furniture: not stop short.

And this applies to all the speaker systems in the Coral range, right down to bookcase systems, whether you can physically remove the grille or not.

One word of warning, during your test drive. Please don't try to spin the acoustic lenses. They're fixed. It's just the music that goes round and around.

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CORAL

Its every word is crystal clear.

You won't miss a word with this fully solid state Acitron SSB025 transceiver. The crystal stability combined with the special 'noise blanker' ensures maximum clarity at all times.

It operates in the frequency range of 2-12 MHz and is ideal for long range communications. Operation is simplicity itself.

The transceiver is particularly compact and light but it's tough too. Takes any amount of handling whether in mobile, portable or fixed station use.

The Acitron SSB025 is designed and made by ACI Electronics in Australia to RB209 and fully backed by service. Like to know more? Then mail this coupon for a technical brochure.

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Please send me technical details of your Acitron SSB025 transceiver.

Name:.....

Company position:.....

Company name:.....

Address:.....

.....Postcode.....

ACI A.C.I. Electronics

ACE2780FP/R.

The Payneco Field Plotter

The simple unit solves field problems that are difficult or even impossible by conventional mathematical methods.

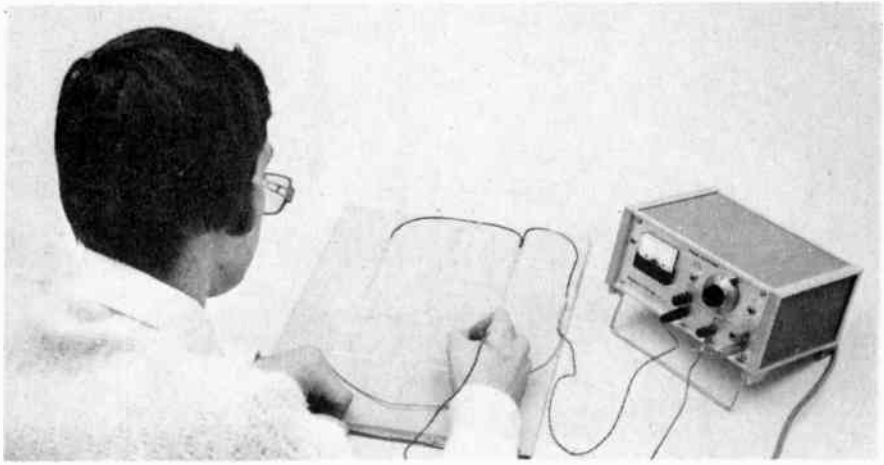
A SIMPLE, inexpensive instrument available from Ronald J. T. Payne Pty Ltd uses the resistance analog technique to solve field problems in electrostatics, magnetics, mechanics, thermodynamics, hydraulics and earth sciences.

The solutions for many important field problems in these disciplines are normally obtained by the application of equations due to Laplace and Poisson. However when boundary conditions become complex such mathematical solutions may well become impossible.

A well known alternative to mathematical methods is the use of an electrolytic tank as a three dimensional analog to plot the fields. Often, however, a three dimensional analog is not really necessary and a two dimensional analog will suffice. Such a two dimensional analog may be constructed using the Payenco field plotter.

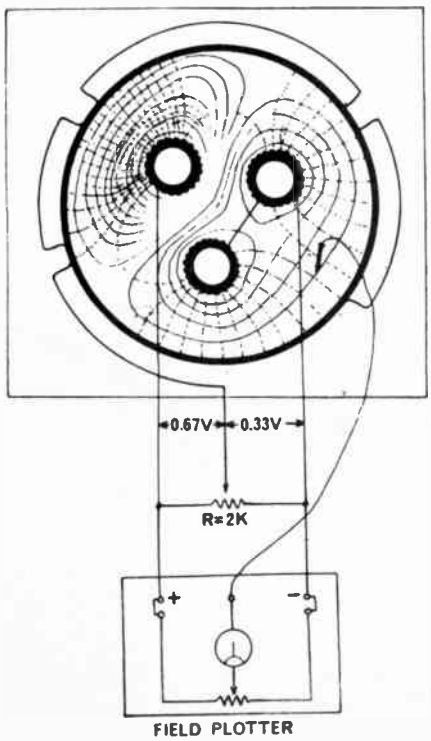
The method is to paint conducting electrodes onto resistive Teledeltos paper with special silver paint to represent the boundaries of the real system. These electrodes are then energized via leads from the instrument and the lines of equipotential plotted by means of a special probe. From this plot the required parameter may be calculated by means of a simple formula.

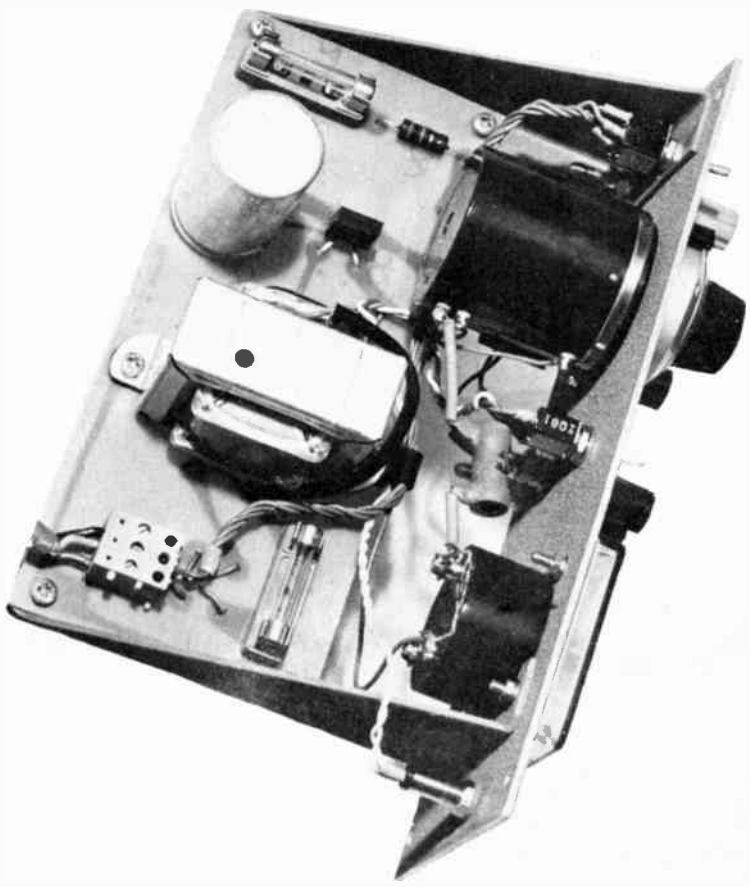
The instrument is well made and offers an inexpensive means of solving field problems. It would be of especial value in schools and universities as well as design laboratories.



The Payneco field plotter in use.

Typical setup to plot the fields in a three core shielded cable.





The interior of the plotter, which is essentially a bridge and excitation power supply.

MARANTZ AMPLIFIER MODEL 1120

Top line US amplifier has three year guarantee.

THE first Marantz amplifier was manufactured in the USA in 1953. Subsequently, the company has built-up an enviable reputation for top quality equipment with a special emphasis on finish and durability.

In mid-1971 the company entered a new market with a line of low to moderate priced amplifiers and tuners all of which were manufactured in Japan. Careful attention to quality and quality control ensured that Marantz image as manufacturers of the finest and costliest equipment did not suffer unduly – if at all.

Nowadays, Marantz manufacture only their top-line products in the USA. The model 1120 amplifier reviewed here is the smallest of this range so produced.

The unit arrived adequately packed in expanded polystyrene. Once unpacked the first unique feature to catch our eye was a rigid plastic overlay protecting the front panel. In fact, the overlay is so designed that it can be left permanently in place without affecting the operation of the amplifier controls.

The front panel is of anodized aluminium with a very pale gold colouring overprinted with black lettering. Layout of this panel is completely symmetrical arrangement about the vertical centre line. The front panel controls are arranged in two rows with an exception at each end. The left hand end of the panel has four sockets mounted vertically in line: the top two are tip and sleeve sockets for microphone inputs; the second two are tip and sleeve sockets for a tape recorder, (in and out respectively). A large selector knob adjacent to the microphone sockets has six positions for microphone, phono, tape 1, tape 2, tuner and 'auxiliary'. Directly below the selector knob are four push buttons for tape 1 monitor, tape 2 monitor, mono in left channel and mono in right channel.

The centre of the front panel has five slide controls, four mounted vertically side by side, and one horizontally under the four vertical ones. Each potentiometer has a small indexing notch at the centre. The two left hand vertical potentiometers are for left and right channel bass boost and cut. Similarly, the two right hand ones are for treble boost and cut. The horizontal slide at the bottom is the balance control.

Next in line to the slide controls is the volume control, with four push buttons below it; these are for low

filter, high filter, audio muting (—20dB) and loudness control. Down on the right hand side there are two push buttons for speaker system 1 and speaker system 2 select, a ring tip and sleeve socket for headphones, and a power on/off push button. A small blue recessed bezel lamp is centrally located above the slide potentiometers to indicate when the power is on.

All input and output sockets are closely grouped together on the back panel, so close in fact that a number of our patch cords would not fit above one another in adjacent sockets. The intending user would need to be careful that he selected small RCA plugs and not the moulded type generally seen on commercially available patch cords.

Inputs and outputs are phono, tape 1 in and out, tape 2 in and out, tuner, auxiliary, preamplifier out, main amplifier in and scope out. In addition, two combination record playback DIN plugs are provided for tape 1 and tape 2. Speaker outputs are via two sets of four spring loaded terminals mounted directly below the heatsink fins.

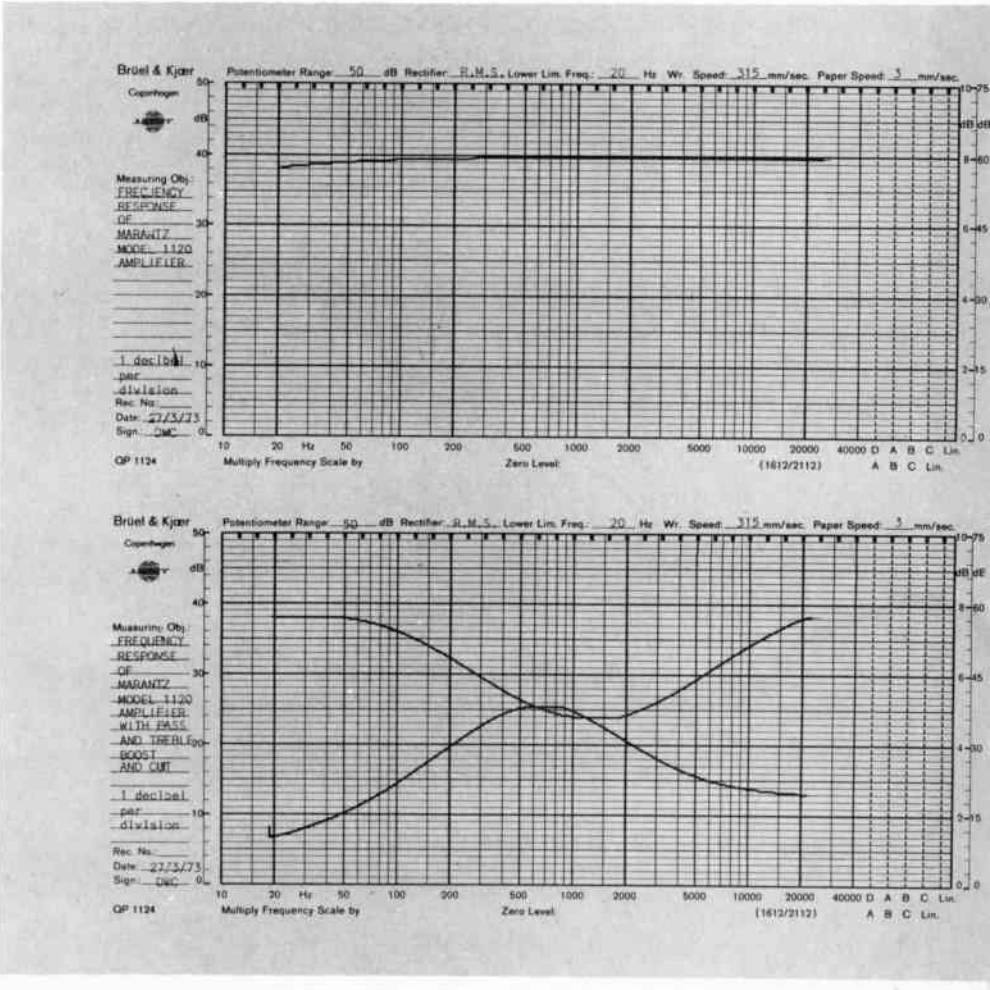
The left hand side of the back panel has three two-pin power outlets, one unswitched. A three amp power fuse is located directly below the outlets. The unit tested was designed for flush mounting in a panel, but the amplifier can be supplied with an oiled walnut veneered timber enclosure if required.

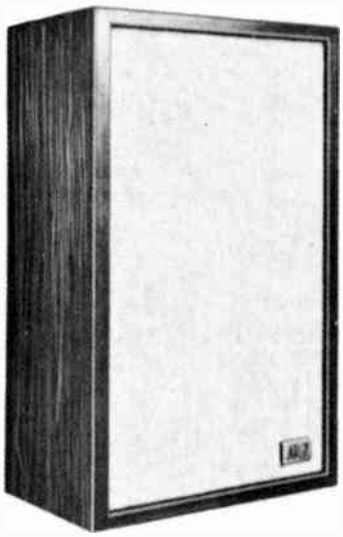
The internal layout is very interesting: firstly because the components only take up about 20 percent of the total volume of the enclosure, and secondly (the most interesting feature) because printed circuit boards are used virtually exclusively to replace wiring harnesses.

All sockets, switches and potentiometers are soldered directly on to the printed circuit boards. The main power amplifier board is awkwardly positioned behind two large capacitors. It was impossible to do tests on it with the board in-situ. However by undoing six screws, the heatsink complete with the power board may be easily lifted out and re-connected to the amplifier for testing. All other boards had adequate access for test probes. The power

MEASURED PERFORMANCE OF MARANTZ MODEL 1120 SERIAL NO. 1728

Power Output	60watts		
Frequency Response: (Tone controls flat position)	20Hz to 20kHz $^{+\frac{1}{2}}_{-2}$ dB		
Channel Separation	100Hz	1kHz	10kHz
	60dB	43dB	26dB
Hum and Noise (With respect to rated power):	dB Lin.	db 'A'	
Auxiliary Input:	77dB	90dB	
Phono Input:	64dB	74dB	
Total Harmonic Distortion (At rated output:)	100Hz	1kHz	6.3kHz
	0.15%	0.15%	0.3%
Tone Controls:			
Bass:	14dB boost at 50Hz 15dB cut at 50Hz		
Treble:	10dB boost at 10kHz 11dB cut at 10kHz		
Loudness Control:	7dB boost at 50Hz 6dB boost at 10kHz		
Highpass Filter:	5dB cut at 50Hz		
Lowpass Filter:	4dB cut at 10kHz		
Dimensions:	39cm. wide by 14cm. high by 33.6cm deep.		
Weight:	12.2 kg.		
Recommended selling price	$569.00		





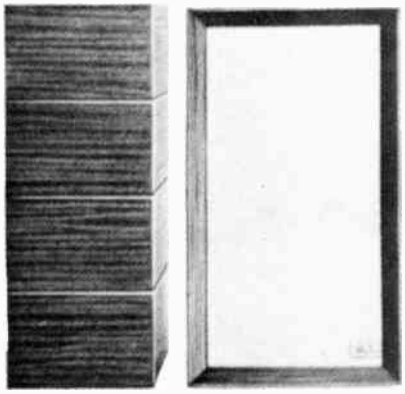
AR-7

a new standard of excellence in a speaker of small size

The AR-7 is the smallest speaker system Acoustic Research has ever designed. It is purposely small.

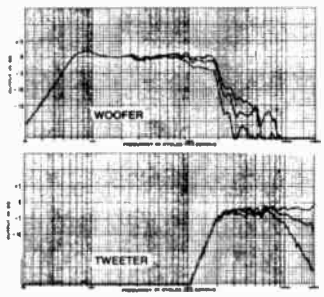
Recognizing the space demands imposed by four channel stereo music systems, AR decided to develop a small speaker to permit installation in areas where our larger speakers are not appropriate. At the same time, this speaker must offer the extended range usually associated with speakers of much larger dimensions.

That the AR-7 has achieved both design objectives is clearly evident.



The size ($9\frac{3}{4}$ x $15\frac{3}{4}$ x $6\frac{1}{4}$) is such that 4 AR-7's occupy less cubic volume than a single AR-3a.

The accuracy of the sound is such that we show these power response curves and guarantee each AR-7 speaker to match the curves within ± 2dB. Such accurate, full frequency range performance from an enclosure of this size did not come easily. It required years of development and state-of-the-art technology.



AUSTRALIAN DISTRIBUTORS

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AR systems may be purchased from:

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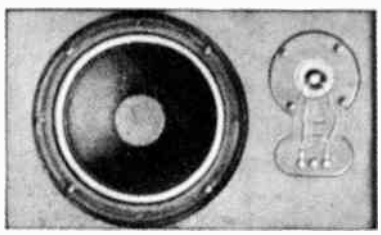
Perth	Arena Distributors
Brisbane	Brisbane Agencies
Adelaide	Sound Spectrum
Canberra	Duratone Hi-Fi
Hobart	Quantum Electronics



The woofer of the AR-7 uses such advanced design and manufacturing techniques that its low frequency response extends substantially below that of competitive speakers of far greater size.

The tweeter of the AR-7 is similar to the tweeter used in the highly acclaimed AR-6. It produces smooth, wide dispersion sound. Both the woofer and the tweeter use high temperature voice coils, permitting higher power handling capability.

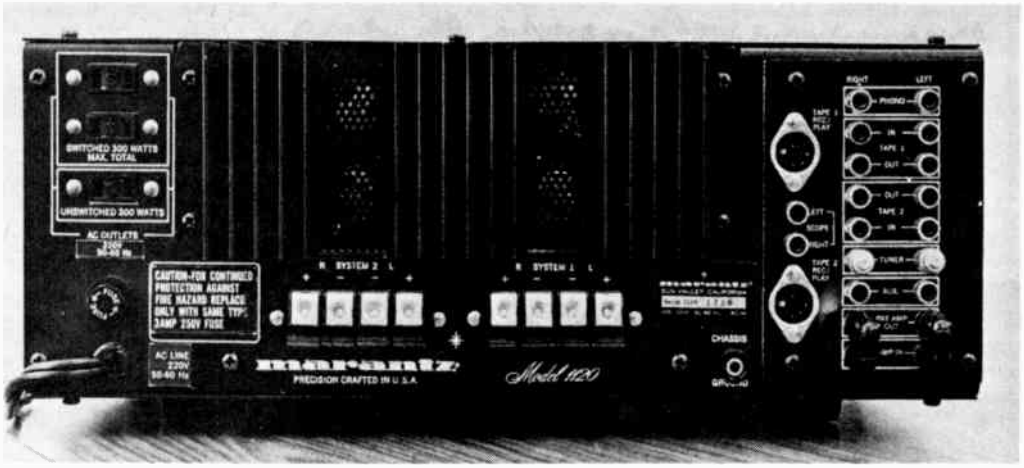
Though the AR-7 was designed primarily with four channel stereo installations in mind, its accurate wide frequency response makes it a wise choice for high quality two channel stereo systems.

AR-7, priced at $189 a pair*. Compare the superb sound of the modestly priced AR-7, AR 4xa and the AR-6. Even to the most critical ear, the difference is subtle.

*Recommended retail price

W1396

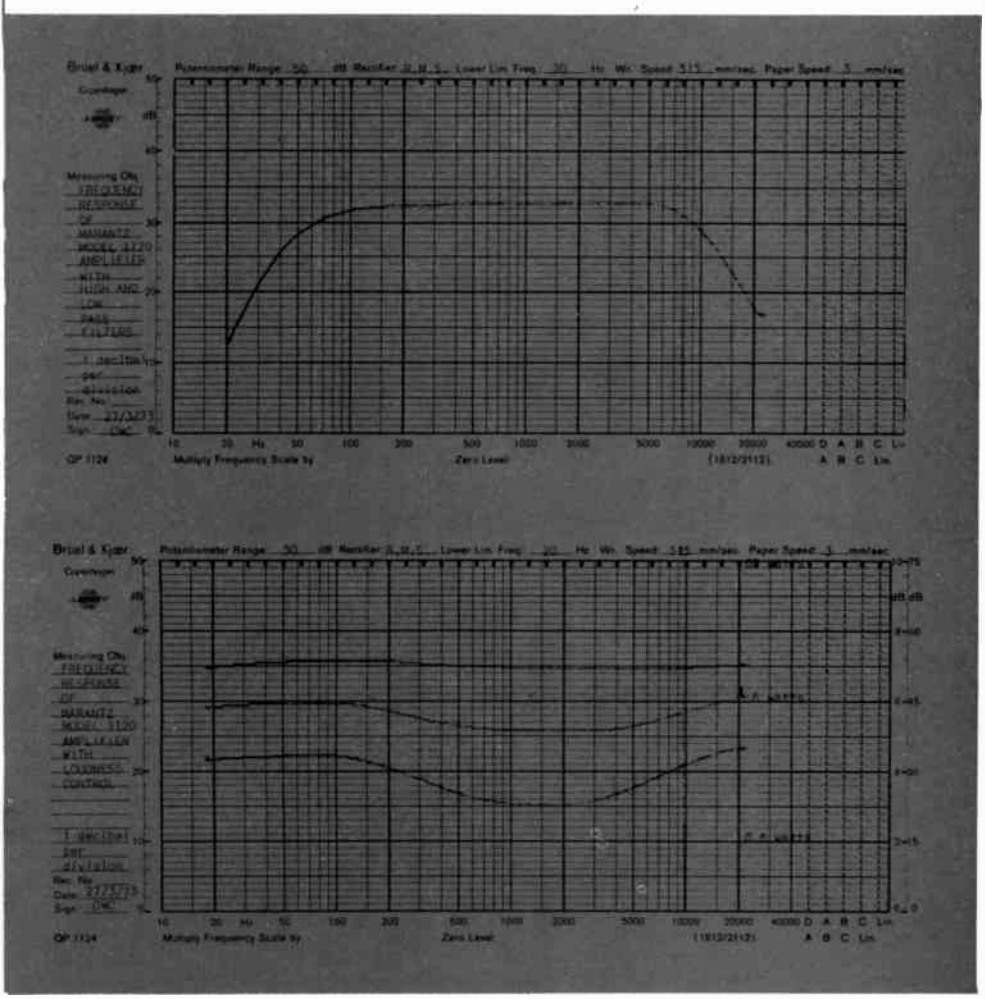
MARANTZ AMPLIFIER MODEL 1120



supply board was inadequately supported at the rear end and with pressure applied, could be shorted out against the casing of the mains transformer. The only protection was the wiring harness from the transformer to the board which was pushed down between the board and the transformer.

It was intriguing to note the numerous brands of components used in this amplifier. Most of the capacitors were of European origin – the electrolytic capacitors, for instance, were mostly Austrian.

No doubt Marantz has selected the best, rather than the most economical components for each function. Such a policy would in any case be almost essential because of the three year warranty given on each Marantz amplifier.



LABORATORY TESTING

During the laboratory tests the amplifier protection circuits came into operation when the unit was driven continuously at 60 watts with a sine-wave input; demonstrating the unit's excellent protection against overheating.

Total harmonic distortion was quite good being 0.15% at 60 watts (at 1kHz), rising to 0.2% at 75 watts (at 1kHz). Harmonic distortion increased slightly with an increase in frequency, being 0.3% at 6.3kHz.

Frequency response, with the tone controls at the indexed flat position, showed a 2dB roll off at the bass end (see spectrogram). This could be corrected by moving the tone controls off the zero position – enabling a frequency response within ± 1dB to be obtained.

The equivalent noise, claimed by Marantz to be 140dB, has us puzzled. The best we could obtain was a still adequate measurement of 90dB ('A' weighted). All other parameters were close on specification.

The instruction handbook included unpacking and wiring details, operation, technical specification, block wiring diagram with two pages of circuit description, response curves and warranty information. The warranty basically covers the amplifier against normal operating defects for a period of three years. A panel mounting template and a wiring diagram with all of the part numbers shown was also included. The wiring diagram showed the preamplifier circuitry on one side and the power amplifier and power supply circuitry on the other side.

The Marantz 1120 amplifier has the excellent performance and attention to detail typical of previous models made by this company.

It is this attention to detail and quality that enables Marantz to provide the all but unique three-year warranty. ●

KLIPSCHORNS

From the review by **ELECTRONICS TODAY** *Magazine.*

Klipschorns are for serious audiophiles.

THE SOUND PRODUCED IS MOST CERTAINLY ONE OF THE CLEANEST WE HAVE HEARD TO DATE.

and there is a distinct advantage in the smaller cone excursions of the bass unit in reducing distortion.

From the review by **'HIGH FIDELITY'** *Magazine.*

Our tests were run on the Klipschorn and Cornwall individually, and then on a pair of Klipschorns with a Cornwall serving as a "centre", or AB, channel. The big corner job, (Klipschorn), to begin with, is a most impressive-sounding speaker.

THE BASS EXTENDED SMOOTHLY TO WELL BELOW 30 CYCLES.

At lower amplifier power levels (perfectly feasible with this speaker because of its very high efficiency), the bass response actually went below 20 cps.

THE MIDRANGE AND HIGHS WERE EXCEPTIONALLY CLEAN AND SMOOTH, AND EXTENDED TO BEYOND AUDIBILITY.

Virtually no directive effects, even at frequencies as high as 10 kc, could be discerned, and the full output of the speaker could be heard anywhere in a very large room.

RESPONSE TO TRANSIENTS, SUCH AS BRIEF INTENSE SOUNDS, WAS EXCELLENT.

The sound of this system, reproducing music as well as voice, was natural, unstrained, and well balanced. They are, of course, robust enough to withstand high amplifier power as well, and show no signs of strain at output levels that rattle windows and shake doors.

INDEED ONE GETS THE FEELING THAT EITHER OF THESE SYSTEMS IS UTTERLY DEPENDABLE, AND WILL TAKE IN STRIDE WHATEVER SIGNAL IT RECEIVES FROM AN AMPLIFIER WHETHER THE AMPLIFIER IS SPOON-FEEDING IT WITH PIANISSIMOS OR HURLING THE SOUND OF THUNDERBOLTS.

You are invited to a Personal Demonstration in our new Listening Room. Phone 939 1833 for details. Brochure & Dealer List, write:

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Dual 1214 or belt drive turntable fitted with magnetic cartridge.

J.V.C. Nivico VN300 amplifier 15 watts R.M.S. per channel.

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

Complete System: $335

Dual 1214 or belt drive turntable fitted with Shure M44Mb magnetic cartridge.

J.V.C. Nivico VN300 amplifier 15 watts R.M.S. per channel.

Sonics three-way four speaker system with 12", 6½", 3½".

Complete system: $435

Dual 1216 or J.V.C. Nivico belt drive turntable fitted with Shure M91 ED magnetic cartridge.
J.V.C. Nivico VN700 amplifier 35 watts R.M.S. per channel featuring built-in sea control system, dual facilities for tape monitoring and dubbing.
Sonics 70 watt three-way four speaker system featuring 10", 6½", 3", dome tweeter with eight-way attenuator control.
Complete system: $695.

Four-channel belt drive turntable.

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

Three-way four speaker system 10", 6½", 2 x 3¼".

Three-way three speaker system fitted with 8", 5½", 3¼".

Four channel complete system $625.

Phone: 522-6747 anytime

NUCLEAR FALLOUT — the effects

This report was specially written for ETI by nuclear geochemist Dr. John Kleeman B.Sc., Ph.D.

Official French government photograph teken at Mururoa atoll.
Explosion is that of a 'small' atomic device — similar to that used to devastate Hiroshima.
An explosion of this magnitude is required to detonate the large hydrogen weapons that France is attempting to develop.

FALLOUT is the air-borne debris produced by nuclear explosions. The amount depends on the type of bomb, the power or "yield" of the explosion and its distance from the ground. Explosions are caused by fission or fusion reactions.

Fission bombs (also called A-bombs) use the rapid chain reaction of fission of super critical masses uranium-235 or plutonium-239. Each fissioning atom splits into two parts of unequal mass (called fission products), and produces an average of two neutrons which in turn induce fission of two more atoms of uranium 235 or plutonium 239.

There is also an enormous amount of energy. About fifty percent of this energy yield is in blast effects, thirty five percent is heat and light, and fifteen percent as prompt radiation, including neutrons. These neutrons can activate ordinary material, dust, soil, air into radioactive nuclides. The amount of soil activated depends on the proximity of the explosion to the ground. After a few seconds, the explosion is a fireball of hot vapours containing fission products. If the prompt radiation has produced radionuclides these will also be included, and if the fireball touches the ground, vaporized soil will be caught up.

Fusion devices (also called H-bombs, or thermonuclear explosions) use the fusion of two small nucleii (tritium or deuterium) to produce a bigger nucleus plus one or two neutrons, prompt radiation, and extremely large amounts of energy. These are much more powerful bombs. The fusion reaction requires temperatures around several million degrees; this is supplied by a fission bomb triggering device. The yield of the bomb can be increased by surrounding it with uranium-238, as the neutrons produced by the fusion reaction are energetic enough to cause fission of this uranium isotope. This is a "high yield device". The fireball of a fusion explosion will contain the fission products of the triggering bomb, and also any activated dust from the atmosphere. Since the triggering device is usually a small fission bomb, thermonuclear explosions can be relatively "clean", with quite small quantities of radioactive debris. However, if it is a high yield device, with uranium 238 casing, the fireball will contain a very large quantity of fission products, and contain vaporized soil and dust if it touches the ground. Part of this extra burden may be newly formed radionuclides if the explosion was low enough for the prompt neutrons to bombard soil. A large thermonuclear detonation can vaporize up to 20 000 tons of soil or sand.

The radioactive debris in the fireball will eventually come back to the ground. This is fallout. The fireball may have a large, or relatively small burden of radioactive material, depending on the type and size of bomb, and how close the explosion is to the ground.

All of these factors, and the weather, will determine how the fallout is distributed.

DISTRIBUTION OF FALLOUT

Nuclear explosions, with yield less than 100 kilotons, form fireballs which reach altitudes of 11 kilometres or less, and thus do not leave the troposphere. The products of megaton and multimegaton detonations will reach 20 to 30 kilometres altitude, penetrating well into the stratosphere. Fallout will occur in three zones (i) local, (ii) intermediate, (iii) world wide.

Local fallout is fallout in the vicinity of the explosion, say a few hundred kilometres. The larger particles will be responsible for this type of fallout, and the amount will depend on how much soil is caught up in the fireball. Fission products and other radionuclides will condense on any larger particles present. For surface explosions, up to 80% of all radioactive debris will fall as local fallout. Depending on the size of the bomb, the remainder will go into the

troposphere or stratosphere.

Detonations made at an altitude such that the fireball does not touch the ground will deposit 20% or less of their debris as local fallout. If this falls within a few days it will be extremely dangerous as a short term radiation hazard. It will include a large proportion of short ived isotopes. The gamma radiation dose can be high enough to induce radiation sicknesses or death. Beta emissions from dust particles on the skin will cause radiation burns. Food and water supplies will become unusable for a time. In a nuclear attack, fallout within 200 kilometres of the detonation, and falling within a day or so, will cause up to four times as many casualties as the blast.

Fine particles of radioactive debris remaining in the troposphere will be deposited within two months under average meteorological conditions. Within this time it will have travelled thousands of kilometres, and may have circled the earth. This fallout will usually be confined to a zone 40° latitude wide. Being fine material, this debris will take several days to commence falling out. By this time many of the short-lived isotopes will have decayed away, so that an immediate threat to life will be unlikely. Isotopes of importance will be strontium 89 and 90, cesium 137, iodine 131 from fission products, plutonium 239 from activated uranium 238, and carbon 14 from activated nitrogen. If prompt neutrons have bombarded soil, calcium 45 and iron 55 and 59 will also be present. Any effects from exposure to these isotopes will be in the long term.

Radioactive material stabilizing initially in the stratosphere will take six to twelve months to precipitate, by which time it will have been distributed world wide, though not evenly. Only plutonium 239, cesium 137, strontium 90 and carbon 14 will remain. The actual dose from these isotopes is small.

HOW FALLOUT IRRADIATES HUMANS

Radioactive debris will affect humans by internal and external exposure. External exposure comes from active particles in the air, on foliage and in soil. (That is external to the body). Gamma ray emissions are the most important here because beta- and alpha-particles are of very limited range. The gramma radiation background is measured using Geiger-Muller tubes, proportional counters, scintillometers or ionization chambers. As there is a natural radiation background, steps must be taken to distinguish normal background from additions by fallout. Outside local fallout zones, external radiation is not likely to be very significant; internal radiation is much more important.

Some fallout is taken up by the body, where it irradiates from within. This is potentially more important for long term effects. One route of entry is by breathing dust containing radioactive particles. This can be monitored by filtering large volumes of air and measuring its activity.

A more important route is via food and water. Iodine 131 has an eight-day half life. By the time most foods have been processed and marketed, there is not much left, but fresh milk is an effective agent. Cows eat grass over large areas and pick up surface contamination from precipitated debris. They also concentrate strontium 89 and 90 and cesium 137, so that monitoring fresh milk is one of the most effective ways of collecting data on the intake of these isotopes. Strontium 89 and 90 will also be present in many other foodstuffs. Much of the isotope 89 will decay away before consumption, but strontium 90 has a very long half life, and persists. Once in the body, strontium is fixed in bones, and iodine in the thyroid, but cesium is not particularly specific and does not remain long in the body. Plutonium is quite insoluble and does not appear to be taken into humans in noticeable quantities. Carbon 14 will take its place with normal carbon in our bodies, but will also become part of actual genetic material, a reason for special concern.

FALLOUT AND THE NATURAL RADIATION ENVIRONMENT

Apart from accidents, or miscalculations, massive local fallout is not a consideration in respect of bomb tests. Fallout from atmospheric testing from 1945 to 1962 has been recorded, with various degrees of accuracy. We know fairly well how *much* radiation populations have received, but very little is known about the ***effects*** of this exposure. One difficulty is that there is a natural radiation environment. World wide fallout adds to this background, and in some ways cannot be distinguished from it.

In one year the average person receives 125 units (millirems) of radiation. This is made up of 50 units of cosmic radiation, with the remainder from terrestrial sources. External radiation comes from naturally occurring uranium 238, thorium 232, radium 226, potassium 40, and some of their products including the gas radon 222. These isotopes occur in rocks, granites having more than double the amount found in common sediments, such as sandstone, and hence there are wide variations in natural radiation from place to place. Cosmic radiation intensity increases noticeably with altitude. A total contribution of 25 units of radiation is normally added by isotopes within the body. Potassium 40 is the major source, with minor contributions from radium 226 and 228, radon 222 and carbon 14. Medical X-rays may add up to 100 units.

Intermediate and world wide fallout will add to this background by enhancing external and internal radiation. Is the addition significant? In 1958, after a very extensive series of multi-megaton bombs by three nations, the external background from terrestrial sources was observed to rise by 20%. That is, by 10 units, much less than the difference in natural background between various population centres in Australia.

Additions to internal radiation background are almost entirely from strontium 89 and 90, iodine 131, cesium 137 and carbon 14. While other isotopes are included in fallout, they do not readily become part of our food chain, and hence do not enter the body. The doses of radiation from these sources have been calculated for 1955-1958, a period of very heavy bomb tests. Strontium 89 and 90 are fixed by the body in bones, as strontium can take the place of some calcium. Growing children are at a greater risk because they are forming new bone. A one year old child in 1955-1958 would have received 30 units (millirem) of radiation to his bones in the next year, reducing to eight units a year, and stabilizing to two to five units thereafter. Iodine 131 concentrates in the thyroid. During periods of heavy atmospheric testing additional doses to the thyroid were calculated at 40 or more units per year. Iodine 131 decays relatively quickly, and this exposure will cease soon after testing stops. New carbon 14 has added about one unit per year to natural background. These are all maximum values, reflecting over a decade (1945-1962) of hundreds of atmospheric explosions, many of them multimegaton high yield devices. Ten years have passed since that time.

It is true to say that nuclear weapons testing has permanently added five to 10 percent to our natural radiation background. Every new test adds more, but more important, adds a burst of thyroid seeking iodine 131 and bone seeking strontium 89 and 90. Children are most vulnerable.

BIOLOGICAL EFFECTS OF FALLOUT

Is there a real danger to humans?

Large doses of radiation can cause death within days or hours. In a large scale nuclear disaster, local fallout may kill three or four times more people than detonation effects. Fatal doses could be received in an hour or so of

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The 75+ is a multichannel receiver. Which means that it plays stereo, "enhanced stereo" (stereo records through four channels), matrixed quad and discrete quad. (It plays discrete quad tapes and cartridges now, and will be easily adapted to play discrete records if and when they arrive later on.)

Of course, a lot of other quad receivers will play stereo too. But how well?

When you switch them to stereo, you literally disconnect the two back channels and the amplifiers that power them. So if a receiver was 60 watts in four-channel, it becomes a thread-bare 30 in two. Or something considerably less than full-powered stereo.

The 75+, on the other hand, has a unique bridging circuit that combines the power from four channels into two. From 18 watts RMS per channel in quad, it more than doubles to 45 watts RMS per channel in stereo. So it's not only full-powered, but sounds as good as the best stereo receiver available.

(In fact, it's practically indistinguishable from the stereo receiver many regard as the best available — the H/K 930. Circuitry is almost identical.

So if you are interested in the best, most technologically advanced quad receiver around, you can buy a Harman/Kardon 75+.

If you'd rather stick to stereo, you can buy the same thing.

In all, we have four new multichannel receivers. For complete details on them, write Jervis Australia Pty. Limited, P.O. Box 6, Brookvale, 2100.

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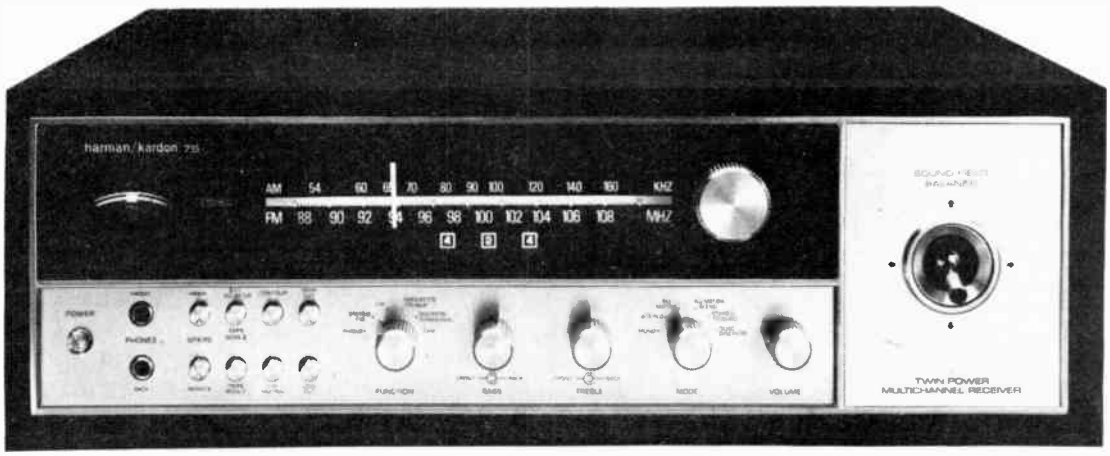

NUCLEAR FALLOUT

exposure to radioactive debris less than a day or so old.

Such exposures are most unlikely to result from bomb tests, as steps are taken to minimise local fallout, and populations are excluded from the danger zone. In general we need only consider the doses from intermediate and world-wide fallout. It has been shown above that the doses of radiation are relatively small, although during heavy testing children may receive almost as much again as the natural background for periods up to one year. In the long term everyone gets 5-10 percent more background radiation. It is a matter for debate whether such levels will cause harmful effects.

These levels of extra radiation are clearly insufficient to cause death in the short term.

Possible additional risks are mainly bone cancer, leukemia and other blood disorders from radioactive strontium in bones; cancer of the thyroid from iodine irradiation; general cancers from increased overall background; increased genetic defects from increased xposure to the reproductive system.

There are two schools of thought regarding the potential dangers: some believe that a distinct amount of threshold of radiation must be exceeded to produce these effects. Others maintain that there is *no* threshold, that any increased radiation exposure is potentially harmful.

The problem is a difficult one. Current evidence seems to suggest that there is no threshold. This then suggests that some proportion of cancers, leukemias, genetic defects are precipitated by the natural radiation environment, and the number of cases will be increased by any additional exposure to radiation. However, given the fallout doses mentioned above, this increase will be a small percentage, and it will be well nigh impossible to distinguish the cause in individual cases. Only careful statistical studies will be able to confirm that there has been an increase in the number of these disorders in whole population.

Society must decide whether weapons testing is worth the price of even a small number of premature deaths. I find the price too high. ●

Select Sansui stereo amplifiers for...

Superior design
Superb engineering
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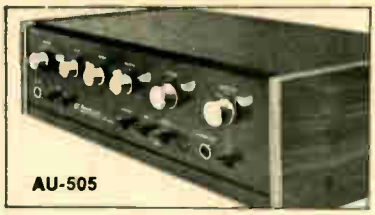
AU-505

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:


AU-555A

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!

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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 .....

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Sansui

Sansui Distributors: Australia, excluding W.A.:

Bleakley Gray Corporation Pty. Limited.

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

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In 1969 the Technocentre was the first to introduce the TEAC A20 Cassette deck — and say, "here is reel-to-reel sound from a cassette at $200" — years ahead of all other Hi-Fi suppliers. We are saying it again now with the TEAC CHALLENGER using TDK-ED cassettes. Professional quality sound from Cassettes!
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HOW IT WORKS

The input signals are attenuated as required by RV1-RV4 before being summed by amplifier 1C1. The gain of IC1 is determined by the value of the resistor in series with each input. The value of this resistor must be at least five times the value of the input potentiometer otherwise input impedance will change with variations in the potentiometer setting.

For dynamic or electret microphones (250 or 600 ohm) a 1 k potentiometer and a 22 k series resistor will provide full output with an input of 2 millivolts. For guitar inputs a 47 k potentiometer and a 220 k series resistor will provide full output with 20 millivolts input and an input impedance of 47 k.

Amplifier 1C1 is followed by conventional tone controls and a further amplifier 1C2 in which RV7 alters the gain and hence is used as the master volume control. This stage is configured as a positive, or in phase, amplifier in which a gain of less than one cannot be obtained. However the gain variation of 37 db will be found adequate for most purposes.

Two different power supplies are described. The first is a separate mains supply (where the unit is to be built into a separate box) which is simply a 12.6 volt CT transformer rectified to provide ±9 volts for the ICs. The second is used where the unit is built into the 100 watt amplifier and derives its supply by resistively dividing down the power amplifier supplies.

PARTS LIST

R1	resistor)	
R2	")	See text
R3	")	and Table I
R4	")	
R5	"	470 k ½ Watt 5%
R6	"	2.7 k " " "
R7	"	12 k " " "
R8	"	1.8 k " " "
R9	"	3.3 k " " "
R10	"	470 " " "
R11 *	"	2.7 k " " "
R12 *	"	1 k " " "
R13 *	"	1 k " " "
R14 *	"	2.7 k " " "

* dc powered version only

RV1	potentiometer)	
RV2	")	See text
RV3	")	and Table I
RV4	)	
RV5	"	250k log.

C1	capacitor)	
C2	")	See text
C3	")	and Table I
C5	33 pF ceramic	
C6	0.0022µF polyester	
C7	0.022µF "	
C8	0.022µF "	
C9	0.22µF "	
C10	33 pF ceramic	
C11	1µF 25V tag tantalum	
C12	47µF 16V electrolytic	PC mount
C13	47µF 16V "	" "
IC1	integrated circuit	LM301A mini-dip or T03
IC2	" "	LM301A mini-dip or T03

PC board ETI 419
* Transformer A & R 6474 or similar
* D1-D4 diode EM401 or similar
* 240 volt ac version only
Plugs, sockets, knobs to suit individual requirements.

MIXER PREAMPLIFIER

Simple yet effective unit is specifically intended for use with our 100 W guitar amplifier.

OUR 100 watt guitar amplifier, ETI 413, has proven to be extraordinarily successful. A very large number have been built, and are in use in conjunction with the 8 channel master mixer for which it was specifically designed.

There has also proven to be a large demand, as evidenced by letters to kitset suppliers and to ourselves, for a simple pre-amplifier to be used with the guitar amplifier. This project describes such a preamplifier, which may be built as a separate unit, or within the 100 watt amplifier as desired.

The basic preamplifier may have up to four inputs, each with separate volume control, and the sensitivity and input impedance of each can be tailored to suit individual requirements. The inputs are mixed in a summing operational amplifier and the combined signal is then operated on by a common set of bass and treble controls.

A master volume control is provided so that the level of the combined signal may be varied. Although specifically designed for the 100 watt amplifier, this unit is very flexible and may be used as a separate general purpose mixer/preamplifier.

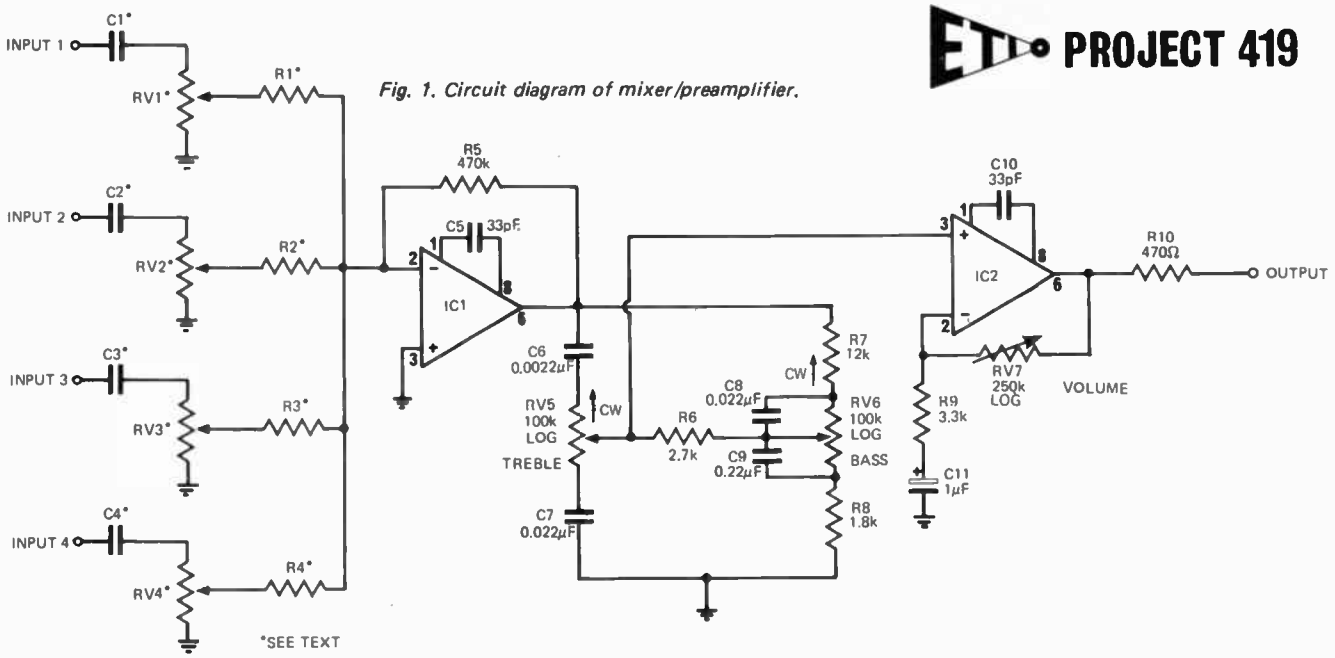


Fig. 1. Circuit diagram of mixer/preamplifier.

CONSTRUCTION

We mounted our prototype unit within the existing 100 watt amplifier: This is a simple and neat method of housing the unit, but has a limitation in that there is only room for two sets of input channel controls – so if this arrangement is used, R3 and R4 should be omitted from the printed circuit board.

Apart from limitation of space, due to the proximity of the power transformer, mounting the unit within the main amplifier increases the possibility of hum pickup. This may be minimized by using twisted leads or shielded cables for wiring to the controls and using a single earth only for the preamplifier, namely the shield of the input cable to the main amplifier. In addition the input sockets should be of the insulated type to prevent earth loops. If the insulated types are unavailable, then standard types may be mounted on a piece of bakelite or fibreglass board. These precautions will enable a hum level of –65 dB to be obtained.

If the unit is constructed in a separate box with its own power supply a much lower hum level should be realised. In this case the resistors shown in Fig. 3 are omitted from the board and the power supply of Fig. 2 should be used. In the latter case diodes D1 – D4 are mounted on the board.

Mount the components to the PC board in accordance with the overlay applicable to the ac or dc version as required. Ensure that ICs and capacitors are correctly orientated.

Select values for the input components from Table I depending on your individual requirements. We used a 1 k microphone input and a 47 k guitar input on our prototype.

(Continued on page 70)

SPECIFICATION
(when used with ETI 413 amp)

Number of inputs	4
Input level	
Input impedance 1 k	2 mV
" " 47 k	20 mV
Distortion at 80 watts	< 0.5%
Tone control range	
bass	± 10 dB at 100 Hz
treble	± 10 dB at 10 kHz
Master volume control range	37 dB
Hum level referred to 100 watt output	–65 dB
Noise level (excluding hum) referred to 100 watt output	–75 dB

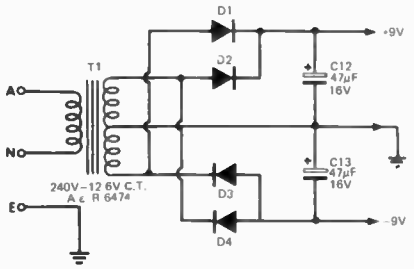


Fig. 2. Power supply for preamplifier as a separate unit.

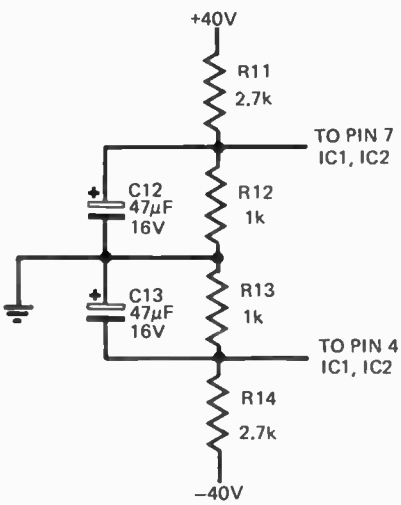


Fig. 3. Divider network; resistors as shown are fitted to PC board if 100 watt amplifier power supply is used.

HEAVY DUTY HORN DRIVER UNIT

PLESSEY ROLA Pty. Ltd. has produced a high power, heavy duty speaker for incorporation into a number of sound systems, primarily public address where high acoustic output is required.

The driver unit was originally developed as part of a field public address system for the army and was designed to military specifications requiring great durability. Built with immense strength, the unit is also blast-proof.

Subsequent uses found for the system, as well as normal P.A. operations, are as a sound source and receiver in scientific investigations of the lower atmosphere and as a monitoring device for air pollution control. One, used by the University of Melbourne's Department of Physics for atmospheric investigation, was still fully operational after a free fall from 80 000 feet when a balloon burst!

Although the various components of the system can be altered, the basic speaker driver units are each able to handle up to 120 watts rms in their frequency range, with the army system being coupled to a sophisticated 200 watt amplifier.

The heart of the system is the Plessey H 120 M Driver Unit which has the following specifications:

Power rating	120 watts rms
Frequency response	250 Hz to 6000 Hz
Impedence	32 Ohms
Radiation angle	90° – Horn speakers may be combined to give 360° radiation
Horn Speaker Dimensions	34.3 cm high x 66.0 cm wide x 41 cm deep
Horn material	Polyester fibre glass reinforced
Acoustic Output	128 dB at 4ft. on axis with 50 watts input at 1 kHz.

The H 120 M Horn Driver is a permanent magnet, twin driver, heavy duty, high power, compression unit.

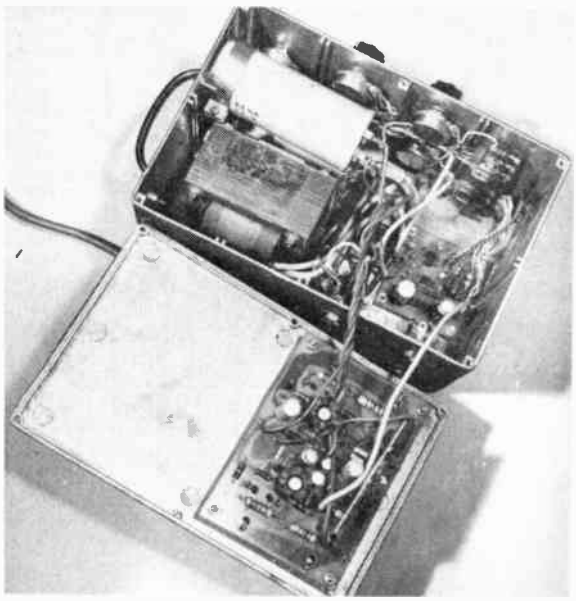
The speaker driver units are adaptable to a very wide variety of amplifiers.

Enquiries should be directed to Plessey Rola Pty. Ltd., The Boulevard, Richmond, Vic.

MIXER/PREAMPLIFIER

TABLE I

APPLICATION	RV1	R1	C1	SENSITIVITY
Microphones (600 or 250 ohms)	1 k log	22 k	4.7μF	2 mV
Microphones or guitars (47 k)	47 k log	220 k	0.1μF	20 mV
Crystal microphones, line inputs, ceramic pickup etc	1 M log	2.2 M	0.1μF	200 mV



The preamplifier is mounted in the bottom of the existing power amplifier and the controls and input sockets on the right-hand side.

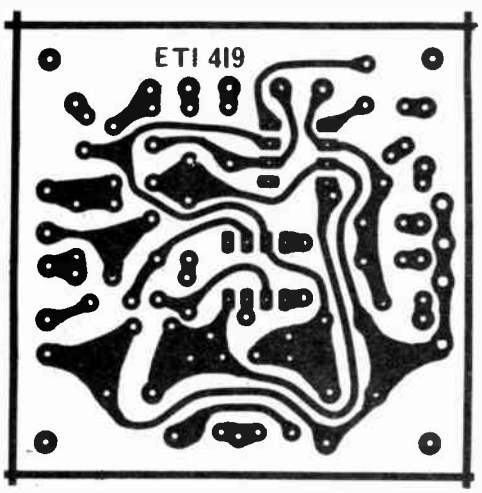
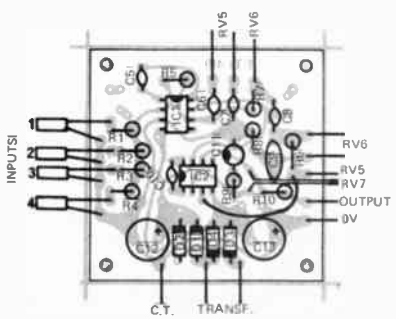
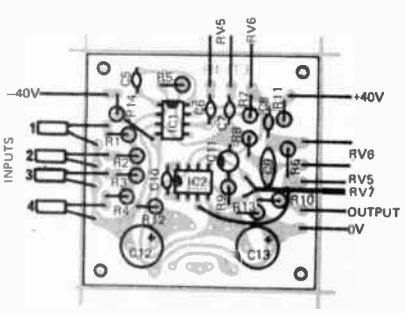


Fig. 4. PC board layout (both versions).

Fig. 5, Bottom left: Component overlay for ac powered preamplifier.

Fig. 6, Bottom right: Component overlay for preamplifier powered from 100 watt amplifier supply.





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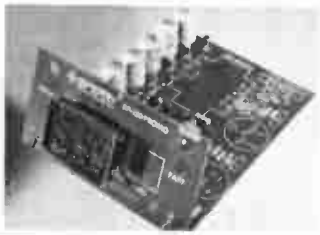
NATIONAL SEMICONDUCTORS

New swell Designers Kit now out!

An excellent opportunity to evaluate the LM308 Operational Amplifier and LM321 precision Pre-Amplifier at 1/3 off normal price. The LM308: (A precision Op-Amp featuring input currents nearly a thousand times lower than industry standards like the LM709C. The LM321: a new product featuring low drift and designed specifically for use with Op-Amps for greatly increased DC accuracy. The Kit SK1003N includes one of each plus data sheets and application notes, all for a mere **$6.50** including post.

NATIONAL-SPERRY DIGITAL CLOCK KIT — Uses new MM5314 MOS I.C. CHIP.

Now available, the new NATIONAL-SPERRY SP-151 Digital Clock Kit (as reviewed in September issue of Electronics Australia) is the cheapest and best yet. The readout has been specially designed by Sperry in the U.S.A. for digital clock use and it has many advantages over other types of readouts. It can be easily read from up to 40 ft away, it has a flat plane (may be read from any angle) and has a lifetime of at least 200,000 hours (about 23 years).



The National MM5314 I.C. Clock Chip contains all the requirements of a 4 or 6 digit clock IN ONE SINGLE 24 Pin package. It is so easy to build even a child could do it. Also in the Kit are 13 transistors, 2 P.C. Boards, connectors and full instructions. All external components (resistors, capacitors) are readily available or may be purchased in a complete PRE-PAK Kit. The addition of a seconds display (6 digit) is optional.

Model SP-151 National-Sperry Kit $28.75
Complete Digital Clock Kit (as in EA) incl. SP-151 Kit and all additional components required ..... $49.50.

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We have made a fantastic purchase of these super-heavy duty 100W Speakers. Intended primarily for use with guitar amplifiers, they are also suitable for organs and high-power audio applications. If you are interested, DON'T MISS OUT. Order yours today.

Australian made: available in 8 or 15 ohms. Weight of magnet: 13 lbs. Total weight: 19½ lbs. Flux density 11,500 gauss; 260,000 maxwells. Bass resonance: 25 Hz. Power rating — 100W r.m.s. continuous. Voice coil diameter 3" on aluminium former bonded with high temperature epoxy. Very heavy duty cast aluminium frame. Price: $125 , plus Freight. 50W, 15 inch bass speaker, Model 15BH. Similar in style and purpose to above. Specifications Australian made; available in 8 or 15 ohms. Weight of magnet: 7½ lbs. Total weight: 10½ lbs. Flux density 15,000 gauss; 180,000 maxwells. Bass resonance: 50 Hz. Power rating — 50W r.m.s. continuous. Voice coil diameter 2" on aluminium former bonded with high temperature epoxy. Heavy duty steel frame. Price: $55 , plus freight.

NEW

OMNI-DIRECTIONAL SPEAKER ENCLOSURE KIT- SYSTEM 601.

A true omni-directional speaker system . . . at a price you CAN afford.

Unlike conventional speakers, the sound is radiated from the top of the enclosure and a well defined stereo image is created wherever you may be in the room.

This easy-to-build design was offered as a project in the June '73 issue of Electronics Australia, (Page 58) and has proved a popular choice of HI-FI enthusiasts for its ease of construction and quality sound.

Available exclusively from PRE-PAK ELECTRONICS, the price of each Kit, together with Plessey C-80 Woofer, X-30 Dome Tweeter and professional 2-way Crossover, is just $49.00 (Post $3.00)

Specifications: Size : 13" x 12" x 30" High. Finish: Teak or Walnut veneer, matt black metal grille top. Frequency Range: 30 Hz to 20 kHz. Power Rating: 20W. We will be pleased to forward further information on request.

DON'T BUY A CATALOGUE WHEN OURS IS FOR FREE!

This easy-to-read quick reference catalogue of components, Kits and equipment is a necessity to every electronics constructor.

It consists of 12 pages (more to come) as advertised in June-July issue. Available free on request.

STEREO CASSETTE DECK

'VORTEX' Stereo Cassette Deck mechanism with tape eject facility and resetable counter. Easily operated by 5 push-button (piano key) controls and includes high quality heads. Price $28.00. Post Free.

RECORDING AND PLAYBACK PRE-AMP KIT

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

Price $28.50
Post: 50c

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stockists of the world's leading sound brands

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Now! Get more sound quality for less than you expected to pay!

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JØRGEN

Hi Fi Excellence

COMPLETE SYSTEMS FROM . . .

$199 to $499

(2 channel) (4 channel)

JORGEN 'CENTAURUS' — WOW! WHAT A BUY FOR ONLY $399

Way ahead of any stereo system in the price range. Big, powerful amplifier delivers 20 watts to each speaker enclosure. Has tape monitoring facility and input for two changers when editing. Amplifier is equipped with low filter, high filter and mute switch.

DON'T TRY TO COMPARE THE JORGEN 'CENTAURUS' WITH ANY OTHER $399 HI-FI SYSTEM . . . YOU CAN'T. CHECK THESE FEATURES

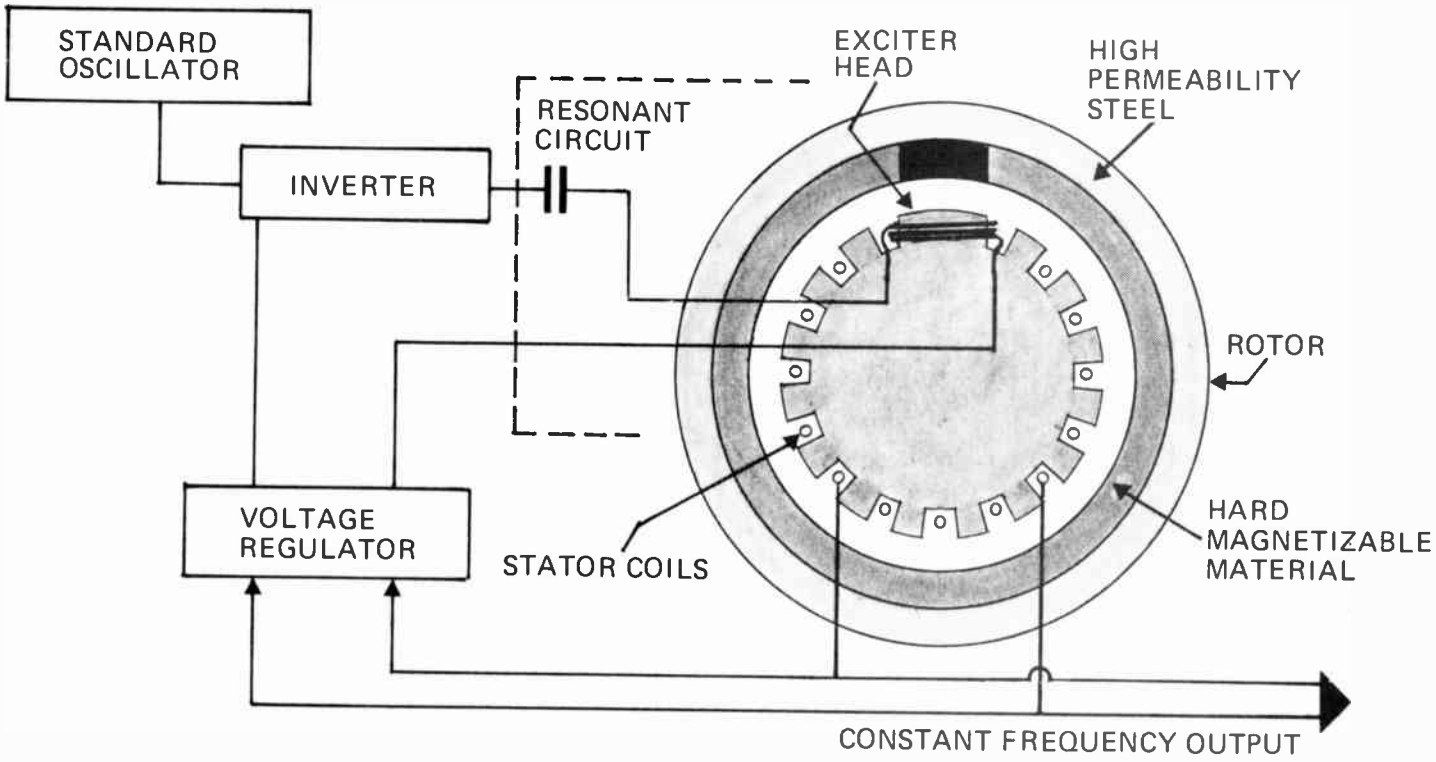
● Amplifier — .555 Jorgen 40 watts RMS ● Changer — Dual 1214 Manual/Auto ● Cartridge — Magnetic Goldring ● Styli — Diamond ● Speakers — 10" 3 way, tuned vent encls.

MIRANDA HI-FI

The sound is best when there's no crowd around . . . Thursday to Saturday is busy and noisy, so call Monday, Tuesday or Wednesday — relax! listen! save!

Constant frequency alternator

New alternator principle ensures frequency stability regardless of running speed.



ELECTRICITY authorities maintain the frequency of the power mains very accurately indeed, often to within fractions of a Hertz.

There may be very slow fluctuations, but over any reasonable period of time the number of cycles that has been generated will be very close indeed to the nominal frequency.

This is just as well, for many electronic devices depend upon the mains frequency to be accurate for their correct operation. Synchronous motors driving electric clocks, record players, tape decks and many digital instruments (they use the 50 Hz mains as a frequency reference), all rely absolutely upon closely controlled mains frequency.

PORTABLE POWER

Just so long as a 50 Hz *mains* supply is available, the average user has few frequency control problems. But, for the person who must generate his own 50 Hz supply, frequency stability becomes a very big problem indeed.

One approach is to use some form of inverter, converting dc power derived from batteries – or a suitable electric generator – to the required voltage and frequency. This works fairly well if low power output is required – or if the shape of the waveform is not important – but becomes extremely complex and expensive if a sinusoidial output has to be produced at high power levels (i.e. 100 watts upwards).

A second method is to use an alternator driven by a suitable source of motive power. This may be a petrol or diesel engine – or an electric motor energized by batteries. Alternators generate precisely the sinewave required and there is no real limitation on the amount of power that can be produced – in fact the larger the unit the cheaper the generating cost becomes.

But there is one very big drawback and that is that the frequency of a conventional alternator's output is directly related to rotational velocity:-

$$\text{freq (Hz)} = \frac{\text{number of poles}}{120} \times \text{rpm}$$

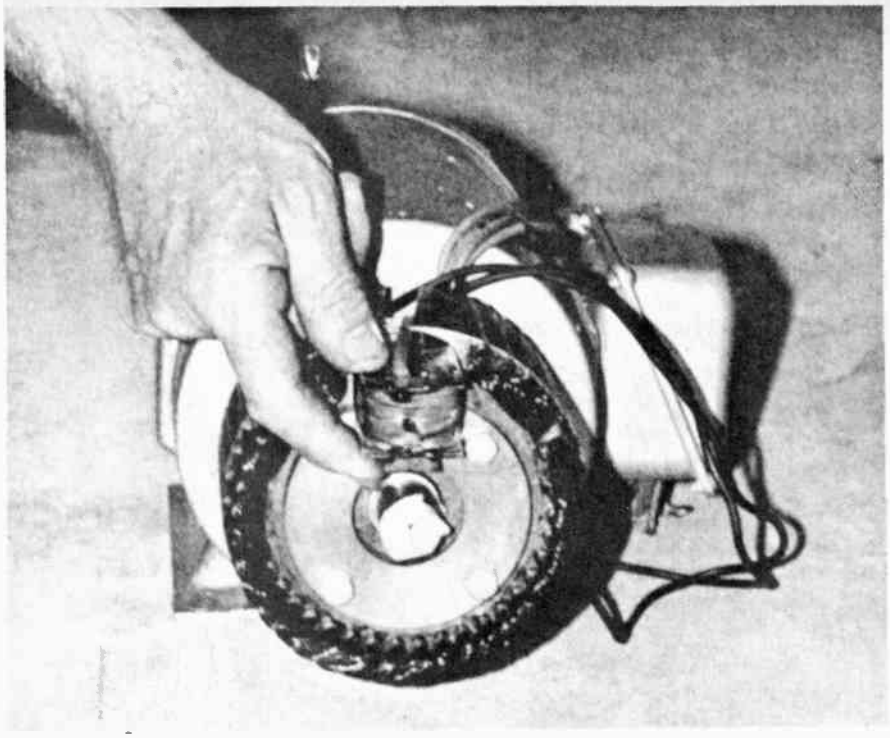
hence the frequency stability of the alternator depends entirely upon how rigidly one can control the speed of the device that drives it – and this is extremely difficult to do accurately.

This characteristic is true of every alternator that was ever built – except one.

The exception is a brilliantly conceived machine recently developed by the Precise Power Corporation of Bradenton, Florida, USA.

Unlike conventional alternators, which have a fixed number of poles, this new machine has an outer housing lined with a continuous layer of magnetizable material. The stator of the machine, apart from its normal function, carries an excitation head that continuously imprints the required pole disposition onto the magnetic material.

The signal for the 'magnetic pole imprinting' is derived from an external precision oscillator and power amplifier thus, as the stator speed varies, the imprinted pole spacing varies accordingly. In other words the stator coils see the same number of poles per second regardless of actual speed of rotation. As a result, the frequency stability of the alternator is governed by the stability of the precision oscillator, and can be



Coil imprints 'pole pattern' on magnetizable rotor.

tailored to suit the individual application.

One example, demonstrated by the designers, held frequency within 0.01 percent whilst being driven by a very old lawn mower engine!

Another, powered by a straightforward induction motor energized from the mains, generated a 400 Hz sinewave with a frequency stability of better than 0.001%. Even a momentary break in mains supply voltage did not cause the output frequency to shift.

The power required for the pole imprinting process is approximately five percent of the alternator's output. Overall efficiency of the system is claimed to be not less than 65 percent for small units – and somewhat better than that for larger ones.

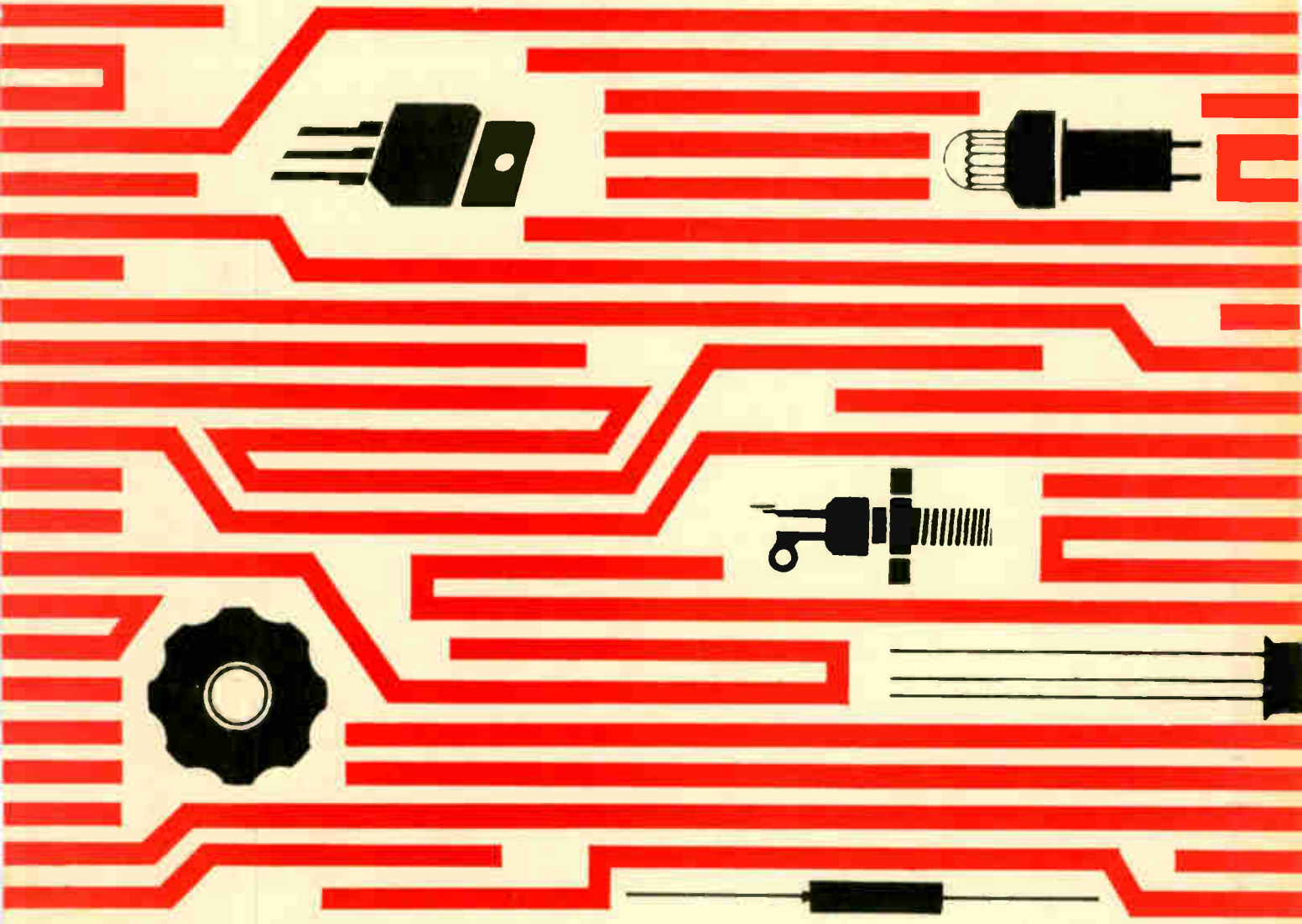
Voltage regulation is achieved by sampling the output voltage and then using this signal via a feedback loop to control the output voltage of the oscillator used to imprint the pole signals. This technique enables the output voltage to be maintained within three percent.

Apart from its obvious advantages as a source of portable regulated ac power, the new alternator will find many applications in no-break power supplies. There are many electronic devices, such as medical instrumentation, digital computers, etc, that cannot tolerate even momentary breaks in supply, and for such applications the new alternator is ideal.

Other uses include power generation from variable speed sources such as windmills, water wheels, solar powered motors. Here, the alternator will enable constant voltage, constant frequency power to be generated despite variations in speed of as much as 75 percent. ●

MS COMPONENTS
EVERYTHING IN ELECTRONICS

CATALOGUE



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To all our Customers and Friends

PAST . . . PRESENT . . . & TO COME

Greetings from M.S. Components, and our thanks for your tremendous support.
It proves that our trading policies are correct . . .

"THE BEST POSSIBLE VALUE"
for
"THE BEST POSSIBLE PRICE"
with
"THE BEST POSSIBLE SERVICE"

With two large stores now operating at high pressure . . . with loads of electronic gear, hi-fi components, and a myriad of other sophisticated componentry for you to browse over and discuss with our attentive staff, with our mail-order department running at full speed, we now take pleasure in presenting our catalogue. To cover every item in our vast range would be an impossible task, but the following pages will show you a good cross section of our stocks. As our buyers are at all times looking for the latest and the best in electronics we will publish additional information at regular intervals to update these pages.

Although comparatively a new company we have made our mark in the industry for our 'square-dealing', our low prices and our very rapid attention to mail order. It is our intention to maintain this high standard and to improve wherever possible.

Very Sincerely Yours,

See page 10 for Free Gift Offer

MICHAEL SHERIDAN
Director.

CONDITIONS OF SALE

QUOTATIONS: 1. Orders are accepted at the prices shown on current quotations and price lists but we reserve the right to amend these prices to those ruling at the date of desptach and to amend any accidental errors or omissions. Prices are net and no settlement discount will be allowed except where otherwise stated. **PAYMENT:** 2. Terms are cash with order, C.O.D. or against Pro Forma invoices except in the case of Government Dept., Hospitals, Public Companies, Colleges, Schools, etc., or approved industrial and Commercial accounts. New accounts may be opened against two satisfactory Trade and a Bank reference. Accounts are due 30 days following month of invoice. **CARRAIGE:** 3. Carriage will be charged extra, and if no specific instructions are included in customers order, consignments will be despatched by our normal route and mode of transport to destinations indicated in customers orders. All goods are packed carefully to ensure safe carriage, and M.S.C. cannot accept responsibility for loss or damage in transit. No goods should be signed for unless they have been examined. If it is impracticable to examine goods on receipt they should be signed for as "unexamined." **DAMAGE OR LOSS IN TRANSIT:** 4. Complaints of danger or shortage must be notified to the carriers and to us in writing within three days of the date of delivery; a claim must be similarly be made in writing within seven days of date of delivery. **DELIVERY:** 5. Every effort is made to meet quoted delivery dates, but it is impossible to guarantee them, as they are contingent on strikes, accidents and other causes beyond our control. We shall not be liable in any way for failure to deliver on time. Quotations ex-stock are subject to the goods being unsold at the time of receipt of order. **NON-ACCEPTANCE OF GOODS:** 6. We reserve the right to require customers to take delivery of goods at the agreed times, or, where goods cannot be accepted at these times, to render invoices for goods, payment to be affected at the end of the month in which the invoice is rendered. **INSURANCE:** 7. Where goods are insured by us voluntarily or at a customer's request a charge will be made on the invoice; but we are under no liability to take proceedings for the recovery of the loss or damage, and are to be liable only for the amount received by us under such insurance, less expenses. **GUARANTEE:** 8. All the equipment supplied by M.S.C. is guaranteed in accordance with the conditions laid down by the individual manufacturers concerned. **SPECIFICATION CHANGES:** 9. We reserve the right to discontinue or modify instruments in our catalogue range without incurring any liability to modify existing instruments to later designs.

HOURS OF TRADING — Monday to Wednesday & Friday: 9 a.m. to 5.30 p.m. Thursday: Redfern Store — 9 a.m. to 7.30 p.m. Gore Hill Store: 9 a.m. to 6 p.m. Saturdays — Redfern & Gore Hill: 8.30 a.m. to 1 p.m.
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The greatest component value ever offered. Astounding savings brought to you through our Bulk purchasing.

'TRIMPAC' Plessey miniature trimming potentiometers, Types V10K5 & PMD. 21 different values from 100 ohms to 2 megohms. All P.C. mounting. ONLY **$2.50** plus 15c post.
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'SWITCHPAC' 20 ARROW toggle switches S.P.D.T. Packed in their original cartons of 20. Beautifully made & sturdily constructed. ONLY $3.00 plus 30c post N.S.W. Other States 65c post.
'TRANSPAC' All the necessary components you require to construct a 9 transistor Radio. This PAC does not include circuit or Speaker, but has the data on all the components. Tremendous value at ONLY **$7.50** plus 25c post.
'BEYPAC' Consisting of 50 assorted BEYSCHLAG resistors. One of the best resistors in the world. A special offer of 1/8, ¼ and 1/3 watt resistors in 1% and 2% tolerence. You cannot buy these under 15c each. ONLY **$2.50** post free N.S.W. Other states 12c.
'SEMI-PAC' 50 assorted NPN & PNP silicon & germanium transistors & diodes, Zener diodes & rectifiers. All sound, some unmarked but guaranteed. Only **$8.50** plus 30c post.
'VARIPAC' 7 High-grade Wire-wound potentiometers — specially made for Radio & Television. These are quality grade. In the following values:— 5, 10, 20, 50, 200, 250 & 500 ohms. ONLY **$3.00** plus 25c post. LIMITED QTY.
'KNOBPAC' 20 assorted GOLD & SILVER finished knobs, mainly suitable for Radio & Television replacements. All new and unused. ONLY **$2.00** plus 20c post.
'ZENAPAC' 15 different values of Mullard 400Mw series zeners, in the following voltage range — 3.6 — 3.9 — 4.3 — 4.7 — 5.1 — 5.6 — 6.2 — 6.8 — 7.5 — 8.2 — 9.1 — 10 — 12 — 20 & 30V. Complete Pac ONLY **$7.00** plus 12c post.
'JACPAC 1' 20 3.5mm open type Jack sockets. **$1.00** plus 12c post.
'JACPAC 2' 10 3.5mm Housed type Jack sockets. ONLY **$1.00** plus 12c post.
'JACPAC 3' 10 2.5mm Housed Type Jack sockets. ONLY **$1.50** plus 12c post.
'1078PAC' 10 mixed BC107 & BC108 transistors. These are manufacturers unmarked ones but perfect & guaranteed. We have now sold 1000's of these without any returns. Only limited quantity now available. ONLY **$1.50** plus 12c post.
'800-PAC' 10 NPN transistors in T05 case. These are unmarked and slightly below spec. but useable. (Believed to be TT800 series) Guaranteed quality. ONLY **$1.50** plus 12c post.
'PLANAPAC' 10 Fairchild PNP Planar Epitaxial transistors in moulded T018 case. Guaranteed quality. ONLY **$1.50** plus 12c post.
'FUSEPAC' 4 Car standard nylon fuse-holders (In-line type) in White, Green, Red & Black mouldings, complete with springs & eyelet contacts. ONLY 75c plus 12c post.
'DIOPAC' 25 assorted Germanium & Silicon diodes including a number of Shockley diodes. General purpose and signal types. All new and guaranteed. ONLY **$2.00** plus 12c post.

All the above components are guaranteed new & unused ... money gladly refunded if not fully satisfied.

TEST EQUIPMENT

GRID DIP METER
Model TE-15
(Fully transistorised)

A most versatile instrument which operates as a grid dip oscillator, absorption wavemeter and an oscillating detector. 6 plug-in coils are supplied and is housed in a handsome robust case. Comes to you complete with earpiece, battery, meter and full operating instructions. A boon to all electronic enthusiasts. Price ONLY $34.00 plus Post $1.00.

SPECIFICATION
Freq. Range: 440 kHz-280 MHz in 6 Coils
A Coil 0.44 — 1.3 mHz
B Coil 1.3 — 4.3 MHz
C Coil 4-14 MHz
D Coil 14-40 MHz
E Coil 40-120 MHz
F Coil 120-280 MHz
Transistor: 3 TRs & 1 Diode
Meter: 500uA Fs.
Battery: 9V (BL-006P)
Dimensions: 180x80x40mm
Weight: 730g

MINI-SWR METER
Model SE-406

A very small and compact instrument that can be carried in the pocket. Sturdily constructed and very handsome in appearance, this will match in performance similar instruments costing much more. Another must for the connoisseur. Price ONLY $9.00 plus 50c post.

SPECIFICATIONS:
Type: CM detection
Measuring ratio: 1 : ! to 1 : 3 ~oc
Measuring freq. range : 1.9Mc 180Mc
Meter sensitivity : 100μA
Impedance: 75Ω or 52Ω
Connector: M-type
Dimensions: 80 x 30 x 30m/m
Weight: Approx. 100g

UNIVERSAL-SIGNAL INJECTOR

Model SE-260
(New powerful type)
Employs a blocking oscillation circuit. Its oscillation waves contain higher harmonics and its output voltage is as high as 50V (p-p—, so a signal is injectable into the circuit to be measured without prod circuit contact. Ideal for trouble-shooting of Antenna and RF circuit of Radios, transceivers and car radios. Price ONLY $7.50 plus 30c post.s,

SPECIFICATIONS
Oscillator: Blocking oscillation
Frequency range: Approx. 3kHz and its harmonics (continuous up to 30 KHz)
Oscillating voltage: 50V (p-p) when non-loaded
Output impedance: 20K (capacitive)
Power source: Dry cells UM-5 x 2pcs.
Dimensions: Approx. 12.7 mm dia. x 169mm long (0.5" dia. 6.65"0
Net weight: 40g including dry cells (2.1 oz)
Specifications subject to change without notice.

SANSEI SIGNAL TRACER
Model SE-500
Pocket type and in the past has proved a most useful piece of equipment at its price. Complete with earpiece and leads. ONLY $5.00 plus 30c post.

AUDIO GENERATOR
Model TE-22D

A De-Luxe instrument of very high standard and accuracy with a performance that will amaze you at its price. M.S.C. Price ONLY $40.00 plus $2.00 post.

SPECIFICATION
Freq. Range: Sin: 20 Hz-200 kHz
Square: 20 Hz-25kHz
Output Voltage: Sine: 7volt. Square 7volt
Output Impedance: 1000ohm
Freq. Accuracy: ±3% + 2 Hz
Distortion: Less than 2%
Tube Complement: 6BM8, 12AT7, 6X4
Power Source: 105-125, 220-240V AC, 50/60cps. 19W
With Attenuation Range,
4 Ranges — 1/1, 1/10, 1/100, 1/1K
Compact-Space Saving.
Printed Circuit for a uniform Characteristics.
Low Distortion.
Dimensions: 140 X 215 X 170mm
Weight: 2.8kg.

RF SIGNAL GENERATOR
Model TE-20D

This unit will match with the Model TE-22D Audio Generator, and is built with the same high standard in accuracy and stability. A really super grade instrument at a very competitive price. M.S.C. Price ONLY $48.00 plus $2.00 post.

SPECIFICATIONS:
Dial has 7 separate band TE-20D covers 120 kHz — 500 MHz
(6 Fundamental Bands & 1 Harmonic Band)
Freq. Accuracy: ±2%
Audio Output: to 8 volt
Internal Modulate: on 400 Hz approx.
Tube: 12BH7A, 6AR5
Power Source: 105-125V, 220-240V AC, 50/60 Hz. 12 watts
TE-20D employs a Xtal socket and can be used as below.
a. — Self-Calibration
b. — Marker Generator
Small size-Space Saving.
Printed Circuit for a uniform Characteristics.
Dimenions: 140X215X170mm
Weight: 2.8Kg.

I.T.T. 20 & 25 WATT HYBRID AUDIO POWER AMPLIFIERS.

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

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

INTEGRATED 3 WATT AUDIO POWER AMPLIFIERS

Type M5102AY complete with necessary diode. 10 pin I.C. in modified JEDEC T03 Case. Vcc + 13.8 volts Max 18 volts. Full Data sheet and layout wiring supplied. ONLY LIMITED QUANTITIES AVAILABLE ... ONLY **$3.25** each Plus 12c post or 2 for $6.00 plus 15c post.

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No idle boast - but we are the cheapest!!

ELECTROLYTIC CAPACITORS

ELECTROLYTICS .... Top Grade .... No hidden Tariffs or Surcharges.
LOWEST IN THE COUNTRY .... You can count on M.S.C. for money saving.

PT (PIGTAIL)

Cap (Mfd)	VW	Price each
1	25	13c
1	50	15c
1	359	23x
2.2	25	14c
2.2	50	15c
2.2	315	22c
2.2	350	30c
3.3	25	13c
3.3	50	16c
4	350	35c
4.7	35	18c
4.7	50	16c
4.7	500	42c
8	350	34c
8	500	40c
10	25	17c
10	50	20c
10	160	45c
10	350	55c
16	300	30c
16	350	40c
16	450	45c
16	500	50c
22	10	12c
22	25	15c
22	50	20c
24	250	40c
24	350	50c
24	500	72c
25	150	30c
33	10	14c
33	25	19c
33	16	16c
33	350	50c
33	500	75c
40	16	16c
40	150	35c
47	10	12c
47	16	16c
47	25	19c
47	50	23c
50	6.4	15c
50	25	19c
80	16	13c
100	6	12c
100	10	12c
100	15	18c
100	16	19c
100	25	23c
100	35	24c
100	350	75c
200	6	20c
200	35	33c
220	16	24c
220	25	27c
220	35	35c
220	50	37c
250	6	25c
250	25	30c
250	35	35c
330	16	24c
400	15	26c
400	16	28c
470	10	27c
470	16	30c
470	50	62c
500	6	30c
500	15	33c
500	25	38c
500	70/80	75c
640	25	45c
1000	6	29c
1000	25	58c
2200	16	68c
2200	35	$1.30
2500	6	55c
2500	15	60c
5000	6	60c
10000	6	75c

Post 7c each.

PC (PRINTED CIRCUIT)

Cap (Mfd)	VW	Price each
1	50	15c
2.2	25	14c
2.2	50	15c
3.3	50	16c
4.7	16	14c
4.7	25	15c
4.7	50	16c
10	16	15c
10	25	17c
10	50	20c
22	6.3	11c
22	25	15c
22	50	20c
30	6	16c
30	6.3	17c
30	10	18c
33	6.3	12c
33	10	14c
33	16	16c
47	10	12c
47	16	16c
47	25	19c
47	50	23c
100	10	12c
100	16	19c
100	25	23c
100	50	28c
200	6	20c
220	16	24c
220	25	27c
220	50	37c
330	25	27c
330	50	57c
470	10	27c
470	16	30c
470	25	38c
470	50	62c
500	15	35c
1000	25	58c

Post 7c each

ELECTROLYTIC CAN TYPES

Cap (Mfd)	VW	Price each
16	500	50c
16+16	500	60c
25+50	3000	75c
100	200	60c
150	150	50c
200+60	275	$2.65
2500	63	$2.30
1000	50	$1.45
1000	63	$1.30

Post 12c

Computer Grade Electrolytics (Ex I.B.M.) Guaranteed All Canned Type

Only limited quantities available of these 'hard to obtain' Electrolytics

Cap (Mfd)	VW	Price each
200	200	$1.25
250	110	$1.50
2500	70	$1.25
3500	75	$2.25
4000	50	$2.25
4000	60	$2.45
4000	75	$2.75
5500	45	$1.25
6600	45	$2.25
7000	13	$1.25
8000	13	$1.50
8000	75/80	$3.00
10000	25	$3.00
10000	33	$3.50
11000	10	$2.75
14000	13	$2.75
15000	10v & 55v	$2.75
16000	12	$3.00
25000	6	$2.50
74000	10	$4.00

Post 50c

SPRAGUE 'TAG' TANTALUM

Type 196D Printed Circuit Type. Not colour coded — Identification By Marked Capacitance & Voltage.

One of the best & reputable capacitor manufacturers in the world.

Cap (Mfd)	VW	Price each
0.10	35	25c
0.22	35	25c
0.47	35	25c
2.20	25	25c
1.00	50	32c
1.50	35	40c
3.30	15	40c
4.70	10	40c
6.80	25	40c
10.00	20	40c
15.00	15	40c
22.00	10	40c
33.00	6	45c
47.00	6	45c
68.00	6	45c
100	4v	45c

Post 10 for 12c — 5c ea.

We hold the largest stocks of components in Australia

CAPACITORS

STYRO-SEAL Capacitors

ALL PREMIER MAKES . . .

Cap:	Volts	%	Price:
39pf	125	5	8c
68pf	125	5	8c
100pf	630	10	12c
150pf	630	20	12c
220pf	125	20	7c
330pf	63	10	6c
360pf	125	20	12c
680pf	1Kv	5	18c
820pf	125		15c
.0015	400	1	20c
.0015	125	10	12c
.0022	500	20	15c
.0033	400	20	15c
.0039	400	10	18c
.0047	63		15c
.01 x 2	630	5	55c
.01	100	1	22c
.01	63	1	18c
.1	400	20	20c
.022	630	20	22c
.033	630	20	25c
.039	630	20	25c
.33	63	10	40c
.47	63	1	60c
.47	400	2	60c
.5x2	630	5	$1.25
1	400	10	40c

DISC CERAMICS Capacitors

Cap:	Volts	Price
.0033pf	600	8c
4.7pf	100	5c
18pf	100	5c
.01μF	1000	20c

T.C.S. – Foil-wrapped capacitors

Cap:	Volts	%	Price:
.001uf	63	5	18c
.39uf	63	2.5	18c
.1uf	63	2	18c

Poly-Carbonate capacitors

Cap:	Volts	%	Price:
270uf	125	10	25c
.0047uf	125	10	27
.0027uf	125	5	30c
.0027uf	125	1	35c

F & F POLYESTOR capacitors

Cap:	Volts	TYPE	Price:
1uf	400	PT	40c
1 uf	250	PT	35c
.47uf	400	PT	30c

PLASTIC FILM in "GREEN CAP" or "RED CAP" 50V rating 10% tolerence

Values in Microfarads.

.0068, .0082, .018 ALL 8c each
.047, .082, .22 ALL 12c each
.47 20c each

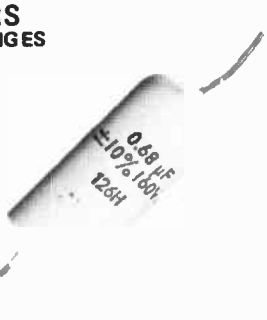
"GREEN CAP" PLASTIC FILM

100V rating single ended 10% tolerance. Values in Microfarads. .001, .0015, .0022, .0033, .0039, .0047, .0056, .005, .0068, .0082, .01, .015, .022, .02. All 12 c each.
.003, .039, .047, .056, .068, .082. All 15c each.
.1, .15, .22. All 16c each.
.27, .33, .39, .48. All 22c each 200V rating.
1uf 200V 36c, 2.00uf 54c, 3.3uf $1.40.

PHILIPS TUBULAR POLYESTER CAPACITORS

A FINE SERIES OF CAPACITORS IN THREE VOLTAGE RANGES

Values	160V	400V	630V
.001, .0012, .0015, .0018, .0022, .0227, .0033, .0039, .0047, .0056, .0068, .0082		12c	14c
.01, .012, .015, .018, .022, .027, .033, .039	13c	15c	17c
.047, .056, .068	15c	17c	20c
.082, .1, .12, .15, .18	22c	24c	26c
.22	24c	27c	33c
.27	32x	36c	42c
.33	34c	38c	44c
.39	35c	43c	50c
.47	36c	45c	53c
.56	38c		
.68	42c		
.82	46c		
1uf	50c		



INTEGRATED CIRCUITS

CASE 'A'

CASE 'B'

CASE 'C'

Made by N.S. ELECTRONICS – MOTOROLA – FAIRCHILD – MITSUBISHI

Type	Case	Function	Price
SN7400	C	Quad 2 input Nand Gate	0.85
SN7402	C	Quad 2 input Nor Gate	0.85
SN7403	C	Quad 2 input Nand Gate open Collector	0.85
SN7404	C	Hex Inverter	0.85
SN7406	C	Hex Inverter Buffer	1.85
SN7408	C	Quad 2 input positive Nand Gate	0.85
SN7410	C	Triple 3 input Nand Gate	0.85
SN7413	C	Dual Schmidt Trigger	1.00
SN7420	C	Dual 4 input Nand Gate	0.85
SN7430	C	8 input Nand Gate	0.85
SN7440	C	Dual 4 input Nand Gate	0.85
SN7441	C	BCD to Decimal Decoder/Driver	2.50
SN7442	C	BCD to Decimal Decoder	2.35
SN7446	C	BCD to 7 segment Decoder/Driver	4.10
SN7473	C	Dual JK Flip-Flop	1.40
SN7474	C	Dual D-Type Edged triggered Flip-Flop	1.40
SN7475	C	Quad Bi-stable Latch	1.75
SN7476	C	Dual JK Master-Slave Flip-Flop with Preset & Clear	1.35
SN7490	C	Decade Counter	1.65
SN7492	C	Divide — by 12 Counter	2.25
SN7493	C	4 Bit Binary Counter	1.65
SN74121	C	Monostable Multi-vibrator	1.30
SN74192	C	Up-Down Decade Counter	9.25
M 5933	C	Dual 4 input Expander	0.85
M 5935	C	Hex-Inverter without input diode	0.85
M5945	C	Single R-S/JK Clocked Flip-Flop	0.85
M 5946	C	Quad 2 input Nand Gate	0.85
M 5962	C	Triple 3 input Nand Gate	0.85
LM301A	B	High input Op. Amp	1.45
LM307	A	General Purpose Op.Amp	2.20
LM308H	B	Low input current HI-Performance Op.Amp.	10.50
LM309K	T03	Voltage regulator — 5V 1.5Amp	4.25
LM370	C	A.G.C. Squelch Amplifier	4.35
LM565	C	Phase-Lock Loop	7.55
LM709	C	General Purpose Op.Amp.	0.95
LM710	B	Single Comparitor	1.95
LM711	B	Dual Comparitor	1.95
LM741	B	General Purpose Op.Amp.	1.45
LM741	C	General Purpose Op.Amp.	1.45
TAA521 (LM709C)	B	General Purpose Amplifier	1.20
MM5311		MOS DIGITAL CLOCK	28.00
LM380	C	2 Watt Audio Amplifier — 14V	2.85
DM946	C	DTL quad 2 input Nand Gate	1.50
MC1810P	C	MDTL quad 2 input NOR gate	1.50
Connectors for I.C.'s.			
2150—01—01		8 Lead I.C. Socket for T05 Case	0.65
041-001-111		14 pin D.I.L. Socket	0.75
H-1938		50 Lug. 1" I.C. Socket Strip	0.95

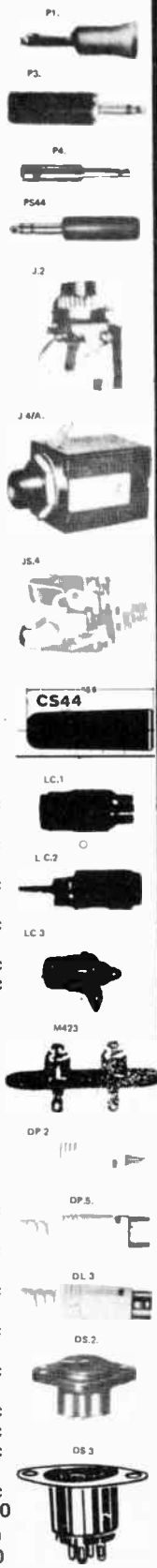
Please include 7c P & P for single items — pro-rataquantity orders

THE GREAT NAME FOR ELECTRONIC MSC COMPONENTS IN AUSTRALIA

M.S.C. The 'Square Deal' firm...

CONNECTORS

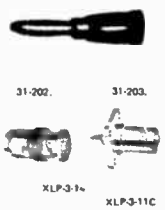
P1.	2.5mm sub-miniature plug — white	.15c
P2.	3.5mm miniature plug — white	.18c
P3.	3.5mm plug, large bodied, blk, red grey	.20c
P4.	6.5mm plug (PMG type) Mono, all metal	.45c
PS4.	6.5mm plug, stereo 3 circuit (PMG type) all metal	.64c
PRA4.	6.5mm right angle plug, mono. All metal	.45c
PR4.	6.5mm plug (PMG type) mono. Bakelite handle — blk/grey	.35c
PS44.	6.5mm plug, stereo 3 circuit (PMG type) bakelite handle, black or grey	.56c
P.1/A.	2.5mm sub-miniature plug, medium body Red or black	.18c
J.1.	2.5mm panel jack (for P.1 & P.1/A)	.12c
J.2.	3.5mm panel jack (for P.2 & P.3/A)	.15c
J.3.	3.5mm panel jack, heavy duty (for P.3)	.28c
J.1/A.	2.5mm panel jack, plastic housed (for P.1 & P.1/A)	.15c
J.2/A	3.5mm panel jack, plastic housed (for P.2 & P.3/A)	.20c
J.4/A.	6.5mm panel jack, plastic housed (for P.4 & P.44)	.50c
J.4.	6.5mm panel jack (for P.4 & P.44) mono	.35c
JS.4.	6.5mm panel jack (for PS.4 & PS.44) stereo	.46c
C3.	3.5mm in-line socket, all metal (for P3)	.45c
C4.	6.5mm in-line socket, all metal (for P4)	.55c
CS4.	6.5mm in-line socket, all metal stereo 3 circuit	$1.00
CS.44.	6.5mm in-line socket, bakelite, stereo 3 circuit, blk or grey	.54c
LC.1.	R.C.A. in-line socket, red or black (for LC.2)	.20c
L.C.2.	R.C.A. plug, bakelite handle, red or black	.20c
LC.3.	R.C.A. socket, panel mounting (for LC.2)	.25c
M423.	R.C.A. twin panel terminal mounted with plugs	.30c
M698.	R.C.A. single panel terminal mounted with plug	.20c
DP.2.	'DIN' plug, 2 pole	.25c
DP.3.	'DIN' plug, 3 pole	.30c
DP.5.	'DIN' plug, 5 pole	.40c
DL.2.	'DIN' in-line socket, 2 pole	.28c
DL.3.	'DIN' in-line socket, 3 pole	.34c
DL.5.	'DIN' in-line socket, 5 pole	.45c
DS.2.	'DIN' 2 pin panel socket-plastic (for DP.2.)	.20c
DS.3.	'DIN' 3 pin panel socket-plastic (for DP.3)	.24c
DS.5.	'DIN' 5 pin panel socket-plastic (for DP.5)	.28c
DC.1.	D.C. inlet-plug — 2.1mm hole, grey	.19c
DC.2.	D.C. inlet plug — 2.5mm hole, grey	.19c
DJ.1.	D.C. panel jack — 2.1mm (for DC.1)	.40c
DJ.2.	D.C. panel jack — 2.5mm (for DC.2)	.40c
BP.1/A.	Panel socket for banana plug — red or black	.17c
BP.1.	Banana plug - red or black	.18c
83-ISP.	U.H.F. straight plug — PL-259	.92c
83-IR.	U.H.F. panel receptacle — S0239 (clear plastic insulation)	.90c
	As above but in TEFLON insulation	$1.10
31-202.	BNC straight plug — UG-88A/U	$1.10
31-203.	BNC panel receptacle —UG-209A/U	$1.50



DE-9P.	Miniature 'DEE' range connector. 9 pin plug	
DE-9S.	Miniature 'DEE' range connector. 9 pin socket	$4.85 pr.
RP8.	McMurdo 'RED RANGE' 8 pole plug	
RS8.	McMurdo 'RED RANGE' 8 pole socket	$5.00 pr.
PP10.	McMurdo 'STRIP CONNECTOR' — 10 pole plug	
PS10.	McMurdo 'STRIP CONNECTOR' — 10 pole socket	$2.20 pr.
'DIN'	2 pole loudspeaker skt. 2 pos. switched	.25c
'DIN'	2 pole loudspeaker skt. switched only	.22c

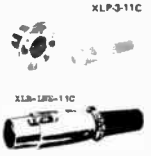
CANNON AUDIO CONNECTORS

XLP-3-11C	Straight cord plug-socket contacts-3 pole	$2.00
XLP-3-14	3 pole wall mounting receptacle-pin contacts	$1.35
XLP-3-12C	3 pole straight cord plug-pin contacts	$2.00
XLP-3-13	3 pole wall mounting receptacle-socket contacts	$1.85



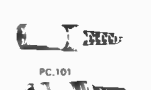
CANNON XLR-LNE MAINS CONNECTORS (Rating 230-250V 5 amps)

XLR-LNE-32	3 pole wall mounting receptacle-2 live & 1 earth	1.85
XLR-LNE-11C	3 pole cord plug to suit above	$2.25



TUCHEL

8 pole polarised plug & socket, complete with top entry cover & cable clamps $1.25



McMURDO

"Q" range polarised miniature connectors

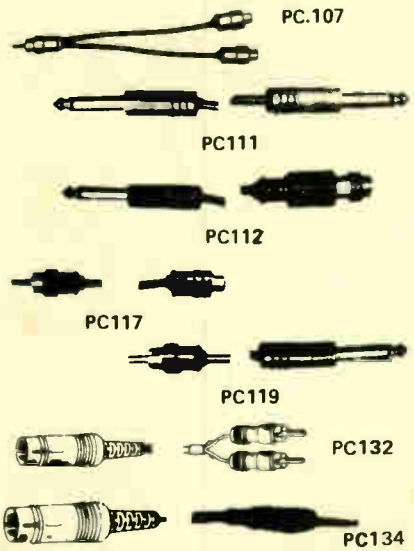
4 pole chassis mounting socket 4 pole cable plug complete push-on moulded cover — complete set	35c pr.
5 pole chassis mounting socket 5 pole cable plug complete with push-on moulded cover — complete set	40c pr.

CONNECTING CABLES

PC.100	5 pin din plug to 5 pin din plug 72"	$2.20
PC.101	5 pin din plug to 5 pin din in-line socket 72"	$2.45
PC.102	5 pin din plug to 4 moulded RCA plugs 72"	$3.95
PC.103	4 RCA plugs to 4 moulded RCA plugs 72"	$3.00
PC.104	5 pin din plug to 4 6.5mm mono mouldeo plugs 72"	$3.50
PC.130	5 pin din plug to 4.35mm moulded plugs 72"	$2.75
PC.105	6.5mm stereo plug to 6.5mm in-line socket with 15' curled cable	$3.00
PC.124	6.5mm mono plug to 6.5mm mono plug with 15' curled cable	$2.85
PC.125	6.5mm mono plug to 6.5mm mono in-line socket with 15' curled cable	$2.85
PC.122	3 pin din plug to 3 pin din plug 72"	$2.15
PC.123	3 pin din plug to 3 pin din in-line socket 72"	$2.15
PC.127	6.5mm stereo plug to 6.5mm stereo plug 72"	$1.55

M.S.C. for 'JET' Mail order Service

PC.128	6.5mm stereo plug to 6.5mm stereo in-line socket 72"	$1.65
PC.4	3.5mm plug to 2 alligator clips, vinyl covered 72"	$1.25
PC.107	RCA plug to 2 RCA in-line sockets-'Y' connector	$0.85
PC.108	3.5mm plug to 3.5mm plug 72"	$0.95
PC.109	3.5mm plug to 3.5 mm in-line socket 72"	$1.10
PC.110	3.5mm in-line socket to 3.5mm in-line socket 72"	$1.20
PC.111	6.5mm mono plug to 6.5mm mono plug 72"	$1.20
PC.112	6.5mm mono plug to 6.5mm mono in-line socket 72"	$1.50
PC.113	6.5mm in-line socket to 6.5mm in-line socket 72"	$1.50
PC.114	3.5mm plug to 6.5mm plug 72"	$1.10
PC.115	3.5mm in-line socket to 6.5mm mono plug 72"	$1.20
PC.116	RCA plug to RCA plug 72"	$0.95
PC.117	RCA plug to RCA in-line socket, red or black 72"	$0.95
PC.118	RCA plug to 3.5mm plug 72"	$0.95
PC.119	RCA plug to 6.5mm mono plug 72"	$1.10
PC.120	RCA plug to 3.5mm in-line socket 72"	$1.10
PC.121	RCA plug to 6.5mm in-line socket 72"	$1.25



CONNECTING CABLES (Special Application)

Stereo to mono-record playback

PC.131	5 pin din plug to 2 x 3.5mm plug 72"	$1.70
PC.132	5 pin din plug to 2 x RCA plug 72"	$1.70

Stereo to mono record

PC.133	5 pin din plug to 1 x 3.5mm plug 72"	$1.55

Stereo to mono playback

PC.134	5 pin din plug to 1 x 3.5mm plug 72"	$1.55

.Special application — single circuit ..... moulded — colour coded

PC.135	3.5mm plug to 2 x 3.5mm plug 72"	$1.40

TRIO OSCILLOSCOPE CO-1303A.

DC — 1.5MHz. 75mm Solid State Oscilloscope

This is an all solid state 75mm scope, with outstanding performance features — vertical sensitivity of 20mV/cm, frequency response from DC to 1.5MHz — despite its small size and ease of operation. Lightweight and portable, it will prove to be a very handy and reliable instrument in electronic equipment assembly centres, school class-rooms and amateur radio stations for a wide range of scope applications. Sweep frequency 10Hz — 100KHz in 4 range. 100v (or 117/230v) AC 50/60Hz 15 watts. Complete with operating instructions and Data. **Price: $155.00 Post $1.50.**

TRIO SIGNAL GENERATOR Model SG-402.

Solid state, wideband RF signal generator, which produces low impedance, low-distortion RF signals. Special features include: generates wide range signals from 100kHz to 30MHz in six frequency ranges. All solid-state construction for instant waveforms, compact & lightweight portability. Includes 400Hz signal source for modulation of output signal, which can also be modulated by external sources. Specifications: vertical sensitivity 20 mV/cm. Frequency response: DC: DC to 1MHz (−3dB) AC: 2Hz to 1MHz (−3dB). Max. input voltage: 300V (DC AC peak) or 600 Vpp. Horizontal sensitivity: 500 mV/cm. Input impedance: 1 megohm shunted by 30pF. Time base: sweep frequency 10Hz to 100kHz in 4 ranges. Power requirements: 100V (or 117/230V) AC 50/60Hz. Dimensions: (Approx) width 7½", height 5¼", depth 14". Complete with instructions. $98.00 plus $2.00 post (registered).

TRIO FET VOLT-OHM METER Model VT-108

This is a new FET-type, electronic Volt-Ohm meter equipped with a memory circuit. Special features include: high sensitivity for wide-range voltage measurements. All transistorised (FET) type circuitry for compact, lightweight utility. Neat and efficient panel layout. "Memory" circuit stores measured value for instant recall reference after completion of measurement.
Specifications:
DC VOLTMETER: range 0.5 to 1,500V in 8 ranges. Input impedance: 11 megohms on all ranges. Accuracy: Within + or − 3% at full scale. Max. input voltage: 1,500V DC or 1,500 Vpp. (DC+AC) Polarity: plus or minus.
AC VOLTMETER: Range (AC sine wave voltage): 1.5 to 1,500V r.m.s full scale in 7 ranges. Input impedance: 1 megohm less than 80pF at 500 to 1,500V range. Less than 145 pF at 1.5 to 150V range using (PC-14) probe. Frequency response: 15Hz to 5MHz + or − 10%. 30Hz to 2MHz + or − 3%. (1kHz standard).
OHM METER: Range: 0.1 ohm to 1,000 megohms in 7 ranges. Dimensions: approx. width 7½", height 5¼", depth 4 1/8". Complete with full instructions.
$76.00 plus $2.00 (registered).

PANEL METERS

Square face in clear plastic panel type.

TYPE	PART NO:	SCALE READING:	SIZE:	PRICE EA:
MR	45P	0-50 Microamp	2" sq.	$6.35
MR	45P	0-1 Milliamp	2" sq.	$5.25
MR	45P	VU Meter (1.22v=OV.U)	2" sq.	$6.70
MR	65PA	0-50 Microamp	3" sq.	$8.95
MR	65PA	0-1 Milliamp	3" sq.	$6.65
MR	85PA	0-50 Microamp	4" sq.	$9.25
MR	85PA	0-1 Milliamp	4" sq.	$8.25

"SERVICE with COURTESY... & A SMILE..."

AERIALS

CA20 CA30 CA40

CA.20. Top Cowl Car antenna. 3 section type that can be easily fixed to any surface. One hole fixing. Individually cartoned. $2.45 + 30c post.
CA.30. Lock-down Car antenna. Completely vandal proof. 3' 4" extended. Nil feet when locked-down. 2 keys supplied, and included 4' lead and connector. $3.40 + 30c post.
CA.40. Top Cowl Car antenna, but with spring base. Heavily chromed. Complete with lead and connector. $4.25 + 30c post.
VW402S. Top Cowl car antenna particularly suitable for Volkswagon cars, due to high slope fitting of the mounting. Also suitable for many other cars. Made of stainless steel. $4.35 + 30c post.

HCA.300. Car power Antenna. 5 section extending to 1m. D.C. voltage 12v 5a. Extending & shortening time is 2½ seconds. Cable length 1m. Supplied complete with high grade switch and fitting instructions. Sturdily packed in individual cartons. $17.75 + $1.00 post.

HCA 300

TA10

TA.10. Car Tape antenna. For installation around windscreen. Individually display packed. $2.65 + 25c post

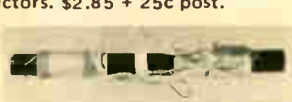
MS100

EXTENDING AERIALS

Transistor or Television type. Sturdily made & finished in heavy chrome. Extends from 6" to 36". Totally direction due to the integral swivel base. Only from M.S.C. can these be bought at the fantastic price of $1.25 each or 2 for $2.25.

MS. 101. Miniature extending aerials, suitable for Transistor sets or Radio control. Pulls out to 12". Nickel plated. 35c each + 12c post.

RT.4000. Antenna extension leads for Cars. Extends from Front of Car to rear should you wish to erect antenna at rear position. Complete with the appropriate connectors. $2.85 + 25c post.



FERRITE ROD AERIAL Dimensions 4½" x 3/8". Fully wound with Broadcast, Shortwave & Aerial coils. Complete with polythene end clamps. Only 95c each + 20c post.

REED RELAYS

M.S.C. DOES IT AGAIN

Exclusive purchase of High Quality REED RELAYS

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

L.E.D. LOGIC PROBE

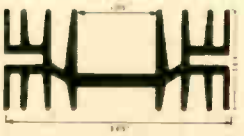
The Model 300 'LOGIC PROBE' is a lite-emitting-diode applied instrument capable of detecting logic levels and responding up to 12MHz. It operates from circuits under test and gives instantaneous logic level indication. Other features include compactness and high input impedence. Ideally suited for check-up of the logic state and the pulse circuit operations of Multi-vibrator, flip-flop, etc. in laboratory, production line and field service applications. Price $11.50 plus 25c post.

MiniFin

HEAT EXCHANGERS

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

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



All plus 25c post.

FINNED HEAT SINKS

Finned type. Size 2" x 6". Ready drilled to accept either 1 Power Transistor in T03 Case (2N3055 or similar) or 2 Power Transistors in 5—66 Case (2N3054 or similar). Originally made for Car radio's 50c each or 2 for 90c. Post 25.

LORIMIER BUZZER

LORIMIER BUZZERS 12 volt 70 ohm coil. Base mounting & adjustable armature. $1.50 plus 20c post.

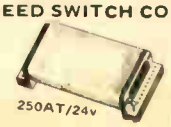
REED SWITCHES

Type	Function	Overall length	Length of Tube	Volts	Current	Prices
XS2/4	n/o	2¾"	1-7/8"	250	.2A	60c
XS4/3	..	1¾"	1-1/16"	250	.1A	55c
R060991/3	..	1"	¾"	150	100mA	45c
XS4/2	n/c	1¾"	1"	250	.1A	55c
XS10	..	3-1/8"	1-3/8"	250	.2A	60c

All the above plus 12c post. Mftd. by Plessey-Hivac.

REED SWITCHES Made by HAMLIN.
Type MLC-DT. Miniature Single pole Double Throw. Low Cost-Economy Family. 28v. 110 amp. 3 watt. Form 'C'. Price $1.25 or 10 for $11.25.
Type DRG-2. Standard general Duty application. Standard Form 'A'. 250v 1 amp. 15 watt. Single pole Single Throw. Price 80c or 10 for $7.00.

REED SWITCH COILS Made by OSMOR.



Miniature Type MS. Part No: 95AT/12v. Coil res. 1040 ohms. 95 nominal Amp. turns 12 mA nominal current. For use with Reed switch MLC-DT. Price $1.00 or 10 for $8.50.
Type SQ Quadriple. Will accept 4 DRG-2 Reed switches. Part No: 250AT/24v. Coil res. 516 ohms. 250 nominal Amp. turns. 47mA nominal current. Price $1.75 or 10 for $16.00.
P & P Switches 12c Coils 20c Pairs 20c.

SONALERT

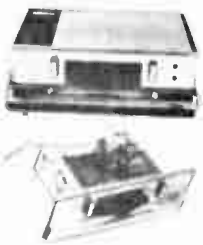
Electronic Audible signal. 'Sonalert' is a startling innovation in the audible signal warning field. It produces a penetrating sound by purely electronics means. Circuitry is all "solid-state" for maximum efficiency, lowest current requirements, and highest reliability. Operating voltage: 6-28 VDC, 6-28 VAC/VDC, 110 VAC. Operating current: 3 mA at 6v, 6mA at 12v, 12mA at 24v, 14mA at 28v. Sound output: 68-80 decibels depending on voltage. Sound frequency: 2800Hz — 300Hz — 4500Hz ± 500Hz. Model No: SC628. $10.25 + 15c post.

Mini-SONALERT
Mini version of the bove. 4 types available for either 1.5v — 6v — 12v — 18v — 24v. at 4, 12, 14 & 16mA respectively. Sound frequency of all types 3500Hz ± 500Hz. $7.35 + 15c post.

THE GREAT NAME FOR ELECTRONIC MSC COMPONENTS IN AUSTRALIA

You will always find it at M.S.C.....

DISCATRON



GET ON THE BAND-WAGON WITH ANOTHER FANTASTIC PURCHASE FROM M.S.C.

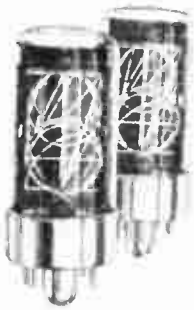
Exclusive to us . . . cannot be purchased elsewhere. PORTABLE RECORD PLAYING DECK MECHANISM. Will take 7" Records at 45 rpm. Deck includes superior 12 V.D.C. Motor, High-grade sapphire Stylus delivering 180 millivolts. Complete with driving wheels, disc retainer, quick release Push-button mechanisms for take-up and Stop. All that is required to build this up to a high class player for the Home or Car is a simple amplifier and Speaker. Complete in handsome black and chrome metal case and carrying handle and fittings. COMPLETE as above and supplied with full building and Amplifier circuit data. ONLY $6.50 plus $1.00 post and packing. MUST BE SEEN TO BE BELIEVED * * * * *

'RODAN' DIGITAL INDICATOR TUBE

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

Specifications:

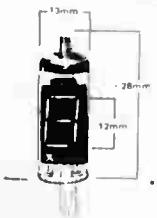
Anode Supply Voltage (Vdc) Min.	200v
Ionization Voltage (Vdc) Max.	170v
Cathode Current (mA DC).	5 m/a
Power consumption per Electrode	1W
Diameter of Glass Tube	30 mm
Height of Tube (Excluding pins)	63 mm ±3
Height of Digits	35 mm
Colour of Display digits	Neon Red



MSC Price ONLY $4.35 plus 20c post Under ½ of normal price.
LIMITED QUANTITIES ONLY OR 5 FOR $20.000
DATA SHEET SUPPLIED

PLESSEY 3 + 3 AMPLIFIER.

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



Apollo NUMERICAL INDICATOR TUBES

INCANDESCENT 7 SEGMENT
5V or 12V Types

DESCRIPTION

Apollo readout tube consists of 7 special luminescent material segments in a single plane arrangement on a black ceramic base sealed in glass. A direct high source for the display is provided by each of the segments. This single-plane indicating system provides an ultra wide viewing angle and superb readability. Extra long life is assured by rugged unit construction. Brightness is fully adjustable from zero output to a level easily viewed even in direct sunlight by simply varying the voltage. In addition to photography and copying being possible, any desired filter color may be selected. The utilization of Fresnel lens permits display magnification.

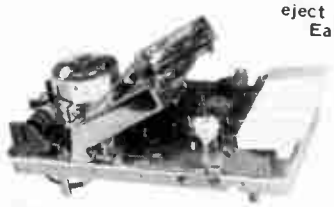
The Apollo incandescent readout tube is especially designed for employment in small indicating devices, i.e. measuring instruments, aircraft instruments, precision devices and electronic clocks, and operate on low voltage and current. The Apollo DA-1300 Series is therefore, ideally suited for IC decoder/driver employment.

DA1300 5V type without decimal point, $4.10 each.
DA1310 5V type with decimal point, $4.35 each.
DA1600 12V type without decimal point, $4.10 each.
DA1610 12V type with decimal point, $4.35 each.

All 25c P & P including data sheet

'VORTEX' Reverse.

SCOOP PURCHASE!!



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

$28.50 post free

Full data and specifications now supplied FREE with each purchase.

STEREO TAPE ADAPTOR (REPLAY) KIT

Kit consists of all necessary components and instructions to construct this Unit which is designed to operate with the 'VORTEX' Stereo Cassette Deck. Technical Data: 2 channel amplifier internally equalised to accept signals from tape heads and converts it to feed any amplifier system. Max. output 200m/V. Freq. response 25Hz. Power requirements are 18 volts at 6 m/a., which can be supplied by 2 x 9v batts. Complete kit of parts $6.50 plus 25c post.

SINCLAIR.

The World famous kits for the home Constructor.

SUPER IC12
SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak). 6—8Ω. Frequency Response: 5Hz to 100kHz ± 1dB. Total Harmonic Distortion: Less than 1%. (Typical 0.1% at all output powers and frequencies in the audio band (28V). Load Impedance: 3 to 15 ohms. Input Impedance: 250 K ohms nominal. Power Gain: 90dB (1,000,000,000 times) after feedback. Supply Voltage: 6 to 28V. Quiescent current: 8mA to 28V. Size: 22 x 45 x 28mm including pins and heat sink.

With FREE printed circuit board and 40 page manual. $8.00. P & P 50c.

Z.30 & Z.50 POWER AMPLIFIERS

The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to provide unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and are intended for use principally with other units in the Project 60 range. Their performance and design are such, however, that Z.50s and Z.30 may be used in a far wider range of applications.

SPECIFICATIONS (Z.50 units are interchangeable with Z.30s in all applications). Power Inputs: Z.30 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M.S. into 3 ohms using 30 volts. Z.50 40 watts R.M.S. into 3 ohms using 40 volts : 30 watts R.M.S. into 8 ohms using 50 volts. Frequency response: 30 to 300,000 Hz ±1dB. Distortion: 0.02% into 8 ohms. Signal-to-noise ratio: better than 70dB unweighted. Input sensitivity: 250mV into 100 K ohms (for 15w into 8Ω). For speakers from 3 to 15 ohms impedance. Size: 14 x 80 x 57 mm. Built, tested and guaranteed with circuits and instructions manual. Z.30 $13.00. Z.50 $16.00 P & P 50c.

STEREO 60 PRE-AMP/CONTROL UNIT

Designed specifically for use on Project 60 systems, the Stereo 60 is equall suitable for use with any high quality power amplifier. Since silicon epitaxial planar transistors are used throughout a really high signal-to-noise ratio and excellent tracking between channels is achieved. The Stereo 60 is particularly easy to mount.
Specifications — Input sensitivities: Radio — up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A. curve ±1dB ; 20 to 25,000 Hz. Ceramic p.u. — up to 3mV ; Aux — up to 3mV. Output: 250mV. Signal-to-noise ratio: better than 70dB. Channel matching: within 1dB. Tone controls: TREBLE + 12 to —12dB at 10 kHz ; BASS + 12 to —12dB at 100Hz. Front panel: brushed aluminium with black knobs and controls. Size: 66 x 40 x 207 mm. Built, tested and guaranteed $31.00. P & P $1.00.

WE STOCK THE FULL RANGE OF SINCLAIR PRODUCTS. — Please send your enquiries.

THE GREAT NAME FOR ELECTRONIC MSC COMPONENTS IN AUSTRALIA

M.S.C prices are the LOWEST.....

CARGARD

CAR BURGLAR ALARM

CARGARD 100HR

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

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

CARGARD is fully guaranteed by the manufacturers for 12 months from date of purchase. $29.50 complete.

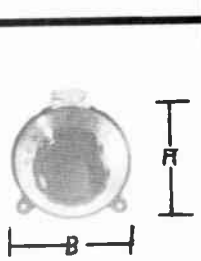
FREE GIFT

FOR 1 MONTH ONLY

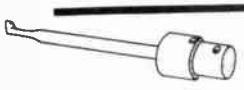
M.S.C. Trimming Tool kit in handy plastic wallet
Given with every purchase of $10 and over

VERNIER DIALS

All the listed types are constructed with heavy black bakelite base and nickel-silver dial plates, with deeply etched clearly legible scales. Moulded knob with fluted grip. Internal parts of phosphor bronze and brass for long life dependability. No back lash, positive logging can be read to 1/10th of a degree. Planetary drives in either ratio in 180 degrees counter clockwise.



Type No:	Scale:	Size A	Size B	Size MM	Rotation Ratio	Price each
BN-900	0—10	43	32.5	36	8 : 1	$3.60
BN—910	Frequency	43	32.5	36	8 : 1	$3.60
BN—920	0—100	57	42	50	10 : 1	$4.20
BN—930	Frequency	57	42	50	10 : 1	$4.20



I.C. TEST CLIP
A most useful piece of equipment for the test bench. In Red or Black. 55c each plus 10c post & packing.

RECORDING TAPE & ACCESSORIES

High quality Cassette Tapes by two famous manufacturers, TDK. Super Dynamic Low Noise, 30 Hz-20 kHz. C60 SD $3.45. C90 SD $4.15, C120SD $6.85. All P & P 30c.

TDK Low Noise De-Luxe C30 $0.95, C60 TP $1.75, C90 TP $2.25, C120 TP $3.25. All P & P 30c.

HC-1 TDK Head Cleaner $1.60, Compact Head Cleaner $1.35. All P & P 30c.

SONY Low Noise Cassette Tapes. C60 $1.65, C90 $2.20. All P & P 30c.

TRANSFORMERS

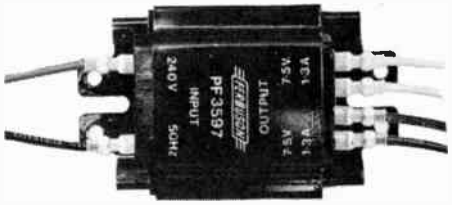
FERGUSON

VERSATILE RANGE OF LOW HEIGHT POWER TRANSFORMERS

These transformers comply with the requirements of Australian Standard C126, where applicable, with respect to insulation and winding construction.

All the transformers in this range are suitable for connecting to 240 Volts 50 Hz, single phase supply and are nominally rated at 20VA. Dimensionally they are identical, with height limited to 1½" width 2-3/8", length 4-5/16" and mounting centres 23/32" by 3-27/32 inches.

Each transformer is provided with two identical secondary windings which permit series or parallel operation, are fitted with round pin terminations and are supplied with a set of six leads with shrouded recepticals.



TYPE No.	Nominal RATING	VOLTS OUTPUT ●: 5VA	10VA	15VA	20VA	25VA
PF3596	6V ● 10VA	13.0	12.6	12.0	11.5	11.0
	6V ● 10VA	(0.39)	(0.80)	(1.25)	(1.74)	(2.28)
PF3599	12V ● 10VA	26.4	25.6	24.6	23.5	22.4
	12V ● 10VA	(0.19)	(0.39)	(0.61)	(0.85)	(1.12)
PF3600	15V ● 10VA	33.0	32.0	30.0	28.9	28.0
	15V ● 10VA	(0.15)	(0.31)	(0.50)	(0.69)	(0.89)
PF3602	25V ● 10VA	54.0	52.2	50.4	48.4	46.2
	25V ● 10VA	(0.09)	(0.19)	(0.30)	(0.41)	(0.54)

Approximate current in Amps shown in brackets.

Price $5.25 + 25c P & P.

'HUSKY' BATTERY CHARGER Type TSB143
Specifications: 240/250 volts 50 Hz. Input. — 12 V.D.C. 4amps Output Dimensions: 3¼" H, 3¾" W, 5¼" L. Wt: 3.8lbs. Case injection moulded in unbreakable polycarbonate plastic case. 5amp. glass cartridge "IN LINE" fuse, Guaranteed for 90 days. Price $18.00 each plus 50c P & P.

A & R MAINS TRANSFORMERS — 240 Volt Primary.

Type:	Current:	Secondary Volts:	Price:	P & P
2155	1 amp	6.3 —7.5 —8.5 —9.5 —12.6 & 15 volts	4.75	50c
6672	1 amp	30— 27.5 —24 —20— 17.5 & 15 volts	5.95	50c
5508	2 amp	6.3 volts X 2	6.50	75c
7243	2.4 amp	50—40—33—25—19 or 50V C.T.	9.75	$1.00
6978	2 amp	6.3—7.5—9—10.5—12.6 & Minus 15volts (or 15V C.T.	5.95	75c
5509	5 or 2.5 amp	12.6 or 25 volts	7.25	50c
5755	1.25 amps	40V C.T.	6.40	50c

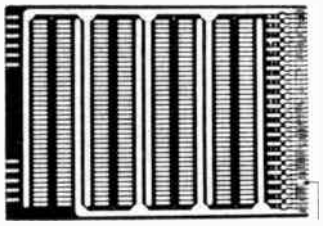
SOLDERING IRON TRANSFORMERS

5577	Primary Volts 240 Sec. Volts 3.3 Sec. Watts Max. 100 Inst. For quick heating irons. Outlet has screw type terminals. $8.50 plus 50c P & P.
SCOPE	Primary Volts 250 Sec. Volts 3.3 Sec. Watts Max. 100 A superb transformer for all your soldering needs. $8.75 plus 75c P & P
W3A	JABEL type Approved Soldering Iron Transformer. Variable voltage 5, 6 & 7 volts. Iron retaining stirrup mounted on transformer. Has carrying handle and indicator light. 40 watts rating: $10.95 plus 75c P & P.
W3C	Economy version of the above but only 6 & 7 volts. $7.45 plus 75c P & P.

THE GREAT NAME FOR ELECTRONIC MSC COMPONENTS IN AUSTRALIA

Full Warranty... Buy More...Save More at M.S.C.

D.I.P. PLUG BOARDS



VERO D.I.P. Boards may be used for mounting and interconnecting dual-in-line packages for development applications, as well as production runs where variations of the basic design may be required. Power rails are positioned adjacent to all D.I.P. locations and are connected to the outer contact fingers. Duplicate power rails are reproduced on the reverse side and have been specially provided in order to reduce power rail impedance. the lay-out pattern permits the mounting of packages having any number of terminations provided they are on 0.1" centres. When fitted in horizontally mounted Card Frames the D.I.P's are positioned in parallel vertical rows to permit maximum possible cooling by convection. D.I.P. Boards are punched overall with a matrix of holes on 0.1" centres ready to accept dual-in-line packages or I.C. sockets. Plain holes off the copper tracks can be used for terminal pin interconnection of circuit networks.

Types available:

Part No.	Length	Width	Tongue Width	Useable Pads	Ways on connector	Price
11821	6.5"	4.5"	4.025"	40	40	$5.35
12759	3.8"	2.75"	4.025"	21	24 + Pol	$3.25

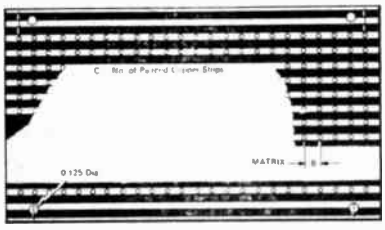
EDGE CONNECTORS FOR D.I.P. PLUG BOARDS

For 11821 $3.50 complete with 2 mounting feet. For 12759 $2.50 complete with 2 mounting feet. Eno Guides $0.45.

AMPHENOL

143 Series Edge Connectors. Mates with .054" .071 PC Boards. Part No: 143-015-01. 15-way. Gold plated contacts and solder lug terminations. Our price only $1.75 P & P 25c.

FULLY PIERCED VERO BOARD



Pt. No.	Length	Width	C	F	Pitch	Price
122	17.9"	3.744"	34	179	0.1" x 0.1"	$2.95
123	17.9"	4.7"	36	179	0.1" x 0.1"	$3.90
2/7003	17.9"	3.394"	16	89	0.2" x 0.2"	$2.45
6/7006	17.9"	4.994"	24	89	0.2" x 0.2"	$3.25
41/1501	17.0"	2.544"	16	113	0.15" x 0.15"	$1.85
44/1505	17.0"	3.744"	24	113	0.15" x 0.15"	$2.60

Legend: 'C' No. of pierced Copper Strips. 'F' Rows of Holes.
All the above 25c post.

Enquiries for any other type of VERO board are welcome as we do carry the full range. The above are the most popular and consequently carry a larger stock.

VERO accessories are also a stock item — Please let us know your requirements.

VERO MATRIX BOARD 0.1" Pitch

Type	Length	Width	Rows of Holes Across	Rows of Holes Down	Price
PB/522	17.9"	3.744"	179	34	$1.65
PB/111800	6.95"	2.6"	61	22	1.00
PB/112002	6.95"	6.1"	61	57	1.85
PB/112003	9.95"	7.9"	91	57	2.65
PB/112006	15.00"	1.75"	149	16	1.25

Post and Packing on above 25c each

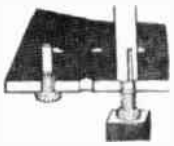
VERO ACCESSORIES

PIN INSERTION TOOL

These tools with a new style handle are designed to aid the insertion of Terminal Pins. A Terminal Pin is pushed into and lightly held by the end of the tool, and when inserted into a hole in the Veroboard, the tool is removed leaving the pin correctly positioned. Although very simple in design and application it will be found that an insertion rate in excess of 1,000 per hour can be achieved.

Pt. No:	For Use with:	Price
IT/2150	.052" Pins	$2.10
IT/2151	.040" Pins	$2.10
IT/11772/4	.052" Min. Terms	$2.10
IT/11772/5	.040" Min. Terms	$2.10

Plus 15c P & P each



SPOT FACE CUTTER

This cutter when used by hand or with the handle removed and fitted in a bench drill, will remove the copper strips locally to make a copper break. Best results are obtained when light pressure is used. The handle of this cutter is of the same design as the Pin Insertion Tool. Part No. 2002. Price $1.25 P & P 15c.

CARD HANDLES

Part No:	Price
CH/10035	30c
CH/10036	50c
CH/10037	50c

Plus 10c P & P.

Part No. CH/10036 Part No. CH/10037 Part No. CH/10035

Attractively styled to suit modern industrial applications, this unique range of P.C. Card Handles has been specially designed with user requirements in mind.

Two of the Handles, Part Nos. 10035 and 10037 have a specially designed clip-on feature, which enables them to be assembled onto a PC Board which has been pre-drilled with one or two holes respectively. Handle Part No. 10036 is attached by means of two 6 BA nuts or Chorbet rivets.

All three handles have provision for Card Identification Part Nos. 10036 and 10037 have three recesses to take self-adhesive identification labels, and Part No. 10035 has three small circular recesses for colour code identification.

Part Nos. 10036 and 10037 are suitable for use with P.C. Boards mounted at a minimum of .04" pitch and when using Part No. 10035 boards can be to a minimum of 0.25" spacing.

All Card Handles are designed for use on $\frac{1}{16}$" P.C. Board, although Part No. 10036 can accommodate other thicknesses. Noryl is adversely affected by some solvents.

Handles moulded in alternative materials can be supplied.

SOLDERING IRONS & EQUIPMENT

SCOPE . . . Known & respected throughout the World. The perfect soldering instrument for the Hobbyist-Technician & Laboratory use. Heating time only 5 to 6 seconds. All models has switching feature built into the handle for ease and safety of operation. Will perform all functions of conventional slow-heating irons rated from 40-150 watts. Operates from Scope or A & R Iron Mains transformers (See Transformers on Page 10). All SCOPE irons are packed in a durable and re-usable plastic touch pack which will keep the iron free from dirt when not in use, but will also make a handsome gift.

Scope Standard Iron, $6.45; Mini-scope Iron, $5.95; Scope De-luxe, $7.20; P & P 50c.

SPARES FOR SCOPE IRONS

Copper Tips (Standard) $0.15; Copper Tips (Instrument), $0.15 Barrel (Standard), $1.25; Barrel (Stainless Steel), $2.20; Element (Carbon), $0.15; Push Rod Assembly, $1.35; Flex Lead,$1.60; Handle complete, $2.75; Switch ring, $0.40.

SPARES FOR MINI-SCOPE

Copper Tips, $0.15; Barrel (Stainless Steel), $1.60; Switch Lever, $0.80; Flex Lead, $1.10; Handle Brass sleeve, $0.85; Handle, brass sleeve, $0.80.

MICRO SOLDERING IRONS

Miniature Type. The 'MICO' Soldering Iron is a lightweight, precision made tool developed by electronic engineers to fulfil the specialized needs in both the electronic and auotmotive industries. Very rugged design which will give it many years of good service. Fully guaranteed for 3 months, with a repair and spares service that is second to none.

Type	Wattage	Voltage	Color of Handle	Price
4/10	10 watts	6v	RED	$4.75
6/10	10 watts	6v	BLACK	$4.75
12/10	10 watts	12v	GOLD	$4.75
4/20	20 watts	4v	RED	$5.65
6/20	20 watts	6v	BLACK	$5.65
12/20	20 watts	12v	GOLD	$5.65
12/70	70 watts	12v	BLACK	$7.85

All Irons P & P 50c.

All spares available for MICO Irons . . . enquiries welcomed.

ETCHING KITS

Packed specially for us. Kit is packed in Plastic case (Suitable as a board dip) and contains 2 pieces of single-sided P.C. Board for initial experimentation, Ferric Chloride, Resin, Etching Pen & Full instructions. Only obtainable from us. ONLY $1.75 plus 25c P & P.

SOLDER

1lb Cartons of 5 core solder $2.50 P & P 50c.

M.S.C... for the Best in component Value

SPEAKERS & HEADPHONES

PHILIPS . . . the great sound in Speakers. For the most exciting sound innovation of the Seventies . . . with the PHILIPS QUADREFLECT SYSTEM.

Model No:	Size:	Impedance	Power Handling	Res. Freq.	Freq. Range.	Price:
AD5060/W8	5"	8 ohms	10W rms	50 Hz	50-4200Hz	$11.50
AD7065/W8	7"	8 ohms	20W rms	28 Hz	50-2000Hz	$12.50
AD8065/W8	8"	8 ohms	20W rms	28 Hz	35-1800Hz	$14.50

ADO160/T8 TWEETER

AD---/W8 WOOFER

TWEETERS — High Fidelity Dome Type

Model

AD0160/T8 1" 8 ohms 20W rms 1kHz 1kHz-20kHz $10.90

Stereo kit comprises 2 Tweeters as above plus Crossover Capacitors & full instructions. In presentation pack. Only $20.50

KAD 2WX
A complete Cross-over Network for Stereo systems. Kit consists of 0.5 mH Air-cored Coil, 2.1 mH Choke, 8mfd. capacitors and P.C. Board with full instructions. $5.50 plus 50c P & P.

KAD 3WX. As above but 3 way system (ready mounted & wired) $11.50 + 50c P & P

STARVOX
High Quality Woofers at Australia's Lowest prices.

Model						
SS2000B	8"	8 ohms	23W rms	40-60 Hz	40-10kHz	$14.00
SS1600B	6½"	8 ohms	18W rms	60-80 Hz	60-11kHz	$12.00
M.S.P.	5" x 3"	8 ohms	3W rms	$3.25		All 50c p. & p.

MODEL SS2000B

WINSTAR Miniature Transistor Type Speakers, TYPE 'A' 3" 8 ohms $2.00 plus 20c post. TYPE 'B' 2¾" 8 ohms $1.85 plus 20c post. ALL NEW AND INDIVIDUALLY PACKED.

Model RE500. 4 Speaker, 3-way System Bass Reflex. 25W rms. 30-20kHz Frequency Response. Housed in Teak cabinet 25" High x 15" Wide x 12" Depth. Has 2 3" Tweeters, 1 6½" Mid-range & 12" Woofer all of 8 ohms impedance. A really high class speaker system and very moderately priced. Wt: 46lbs. $110 Plus $3 P & P.

CAR SPEAKERS.

KS.709

KG705 — 5¾" Speaker 8 ohms, complete with Circular Chrome Grille & Hook-up wire. Flush mounting. $7.25 or $13.95 pair. P & P 75c.

KG705V — Same as KG705 but with black Vinyl Grille & Frame. $7.50 or $14.00 pair P & P 75c.

CR-405 — 4½" Speaker 8 ohms, complete with Flush mounting rectangular speaker Grille in moulded bakelite. $6.00 or $11 pair. P & P 75c.

KS709 — 5" 8 ohms speaker mounted in a handsome Plastic cabinet with sloping front, black with chrome embellishment. Complete with hook-up wire & fixing screws. $7.50 or $14 pair P & P 75c.

KG.705

S.P.1

SP.2

SP.3

EXTENSION SPEAKERS

SP. 1 — 4" x 6" 8 ohm 4 watt Speaker in woodgrain cabinet complete with volume control. Size: 200x135x90mm. $9.55 plus $1.00 P & P.

SP.3 — 5" 8 ohm 5 watt Speaker in woodgrain cabinet complete with volume control. Size: 222x172x90mm. $11.55 plus $1.00 P & P.

SP.2 — 5" 5 watt 8 ohm speaker in woodgrain cabinet complete with volume control. Size: 240x165x95mm. $10.55 plus 75c P & P.

REFLEX SPEAKER
RUH-5 — 5" Horn Type. Finished in Grey hard baked enamel, making it suitable for outside use. $8.50. plus 50c p & p.

STEREO HEADPHONES
Below is a popular and moderately priced range of Stereo Headphones. Manufactured to stringent specifications by the makers of the 'ALPHA' brand electronics company of Japan, M.S.C. can fully recommend these for long and efficient service. Fully guaranteed and all handsomely gift packed.


HP 6

Type HP.6 — Very popular and economical. Padded ear-muffs, complete with leads & Stereo plug. $5.35 plus 50c P & P.

Type SDH.7D — De-luxe headphone. Fully padded Earphones and headband. ½ watt, 25-17kHz 4-16 ohms. Complete with 10 ft spiral cord and Stereo plug. $9.25 plus 50c P & P.


SDH 7D

Type SDH.7DV — Deluxe Headphone, with fully padded Earphones and Headband. ½ watt, with Volume control for each channel and includes a Stereo/Mono switch. 25-17kHz — 4-6 ohms. Complete with 10 ft spiral cord and Stereo plug. $11.00 plus 50c P & P.


SDH.7DV

HP.55 — Deluxe Headphone with fully padded earphones & headband. ½ watt with a slide volume control for each channel. 20-18kHz — 4-16 ohms. Complete with 10 ft of Spiral cord & stereo plug. $12.25 plus 50c P & P.


HP.55

SDH.205V — High quality Headphone. Fully padded earphones & headband. Chrome fittings. ¾ watt — 18-20kHz. Volume control for each channel $16.00 plus 50c P & P.


SDH 205V

HP501W — A Superb Headphone, with fully padded earphones & headband. Full Wide Range with 2 speakers in each earpiece. Magnetic circuit using Alnico 5-system magnet. ½ watt — 16-22kHz — 4-16 ohms. Separate volume control and Tone control for each channel. $25.50 plus 50c P & P.


HP 501W

HP.504CH — Another superb Headphone. With fully padded earphones & headband. This is a 4 channel headphone and uses 2 stereo plugs with inbuilt Wide Range speakers. 0.2 watt — 16-22kHz — 4-16 ohms. Another must for the connoisseur. $23.75 plus 50c P & P.


HP.504CH

CB.501 — Control Box Adaptor for 2 Stereo Headphones. Has 2 slide volume controls for Left & Right channels for both headphones. In handsome moulded case this is complete with cord and plug. $8.75 plus 30c P & P.


CB.501

We Buy in Bulk....Means lower prices to you....

TRIMPOTS

Plessey Miniature Trimming Potentiometers.
Power rating 50 mW. Voltage rating 100 volts D.C. Current rating 12mA. Total angular rotation 280 deg + or — 15 deg. Linear Law.

TYPE V10K5
Range available. 330ohms — 470ohms — 500ohms — 1.5Kohms — 2.2Kohms — 10Kohms — 25Kohms — 47Kohms — 150Kohms — 250Kohms — 470Kohms — 500Kohms —1Mohms.

TYPE PMD
100ohms — 220ohms — 1Kohm — 3.3Kohms — 5Kohms — 100Kohms — 220Kohms — 330Kohms. All types above 15c each plus post.

Elna Miniature Trimming Potentiometers. Power rating .1W. Voltage rating 100 volts D.C. Current rating 12 mA. Rotational Angle 220 deg. Linear Law.

TYPE KOA VTU
Resistance Range Standard stock values:— 500ohms — 1K — 2K — 5K — 10K — 25K — 50K — 100K — 250K — 500K — 1M — 2M. 25c each plus post.

HORIZONTAL MOUNTING TRIMPOTS

2.2Mohms & 5Mohms only. 25c each.

MINIATURE POTENTIOMETERS

Plessey Preset Type MPWT/PC (Dealer)
This range of miniature preset potentiometers use the Plessey moulded track construction. They are intended for mounting on insulated or printed circuit boards and connection to the wiper arm is made through the centre mounting stud or pin. The knobs are made with acetal resin enabling the maximum ambient operating temperature to be increased to 70 deg. C. A moulded in arrow on the knob enables you to indicate the position of the wiper on the track.

MPWT/PC

In 1Kohms & 10Kohms 'A' Curve (Linear). Rating: ¼ watt. Effective rotation: 230deg. min. 90c each plus 10c.

'P' TYPE

IRH. 'P' Type Presets. Linear Taper ¼watt. Voltage rating 500V. 150 ohms & 1500 ohms . 25c each plus 7c post.

VC4

MINIATURE VOLUME CONTROL WITH SWITCH
Suitable as Transistor replacement. With 5/8" Knurled & Split Shaft, standard ¼ Dia spindle. Type VC4. Resistance 5Kohms. 55c each plus 7c post.

VC1

TYPE VC1.
Standard replacement volume control and switch for most Transistor Radios. 5Kohms. 35c each plus 7c P & P.

TYPE VC.2
As above but 'National' type. 40c plus 7c P & P.

TYPE VC.3
As above but Sub-miniature type. 38c plus 7c P & P.

VC2

POTENTIOMETERS

Noble Brand. Standard carbon type. 2" shaft x ¼ Robustly constructed & Individually poly packed. Silver plated terminals with triple contact wiper of phosphor bronze.
Legend: VCS - Std. DPST Switch. VCU = Std. Bush mounted Single. VGU = Std. Bush mounted 2-Gang. VCU Range: 1K, 2.5K, 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M, 2M, & 5M (Linear only). Available in Log. or Lin.. 45c each. VCS Range: As above but no 5M. Log or Lin. 90c each. VGU Range: 10K, 25K, 50K, 100K, 250K, 500K, 1M & 2M. Log or Lin. $1.40 each.

SLIDE POTENTIOMETERS
Standard single. For silky smooth action, precise control of variation with ultra modern appearance. Available either in Log or Linear. VSU Range: Linear ('A' Curve) 1K, 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M & 2M. 90c each. As above but in Log ('C' Curve) 5K, 10K, 50K, 100K, 500K, 1M. 90c each. VSG Range: (Gang + or — 3dB). Linear ('A' Curve) 25K — 50K — 100K — 250K — 500K — 1M & 2M. Log ('C' Curve) 10K — 25K — 50K — 100K — 250K — 500K — 1M & 2M. $1.85 each. Post & Pkg. on all sliders 12c.

WIRE WOUND POTENTIOMETERS
Manufactured by a very reputable Japanese electronic company. Made specifically for T.V. these are extremely well constructed and can be vertically mounted direct to P.C. board. The control knob of polythene is an integral part of the construction.
Resistance: 5 — 10 — 20 & 250 Ohms 1 watt. 80c each. 20 — 50 — 200 — 500 ohms — 25Kohms 2 watt. 95c each. 12c P & P. Enclosed type Wire Wound potentiometers: 3/8" x ¼" Spindle. In the following values. 5 — 10 — 15 — 50 & 100 ohms. $1.15 each. 12c P & P.

TAB MOUNTING POTENTIOMETERS

Part No.	Value
6772111	1Kohms
6772221	1.5Kohms
6770172	25Kohms
6771641	2Megohms.

All linear. Screwdriver slot front & rear. 35c each P & P 12c.

RESISTORS

BEYSCHLAG ... The finest resistor in the world. The resistor rods are of a high grade aluminium oxide ceramic produced by BEYSCHLAG. They meet the requirements for all types of resistive layers due to their excellent physical and chemical properties. We offer you the following range in either 1% or 2% tolerance.

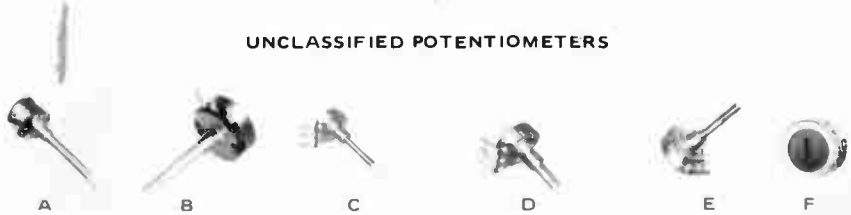
2% 3 watt in the following values:— 110ohms — 4.3Kohms — 6.2K — 13K — 20K — 43K — 75K. All 3w 14c each 2% 2 watt: 12 — 27 — 33 — 39 — 82 — 130 — 160 — 200 — 240Ω — 360 — 750ohm. 1.6K — 5.1K — 16K — 20K — 33K — 82K — 150K — 180K — 270K — 330K — 390K — 560K — 820K — 1M — 1.2M — 1.5M — 1.8M — 2.7M — 3.3M — 3.9M — All 2w 13c each.
2% 1 watt: 8.2 — 68 — 82 — 100 — 110 — 120 — 160 — 220 — 240 — 430 — 750 ohms — 1.1K — 4.3K — 9.1K — 13K — 16K — 160K — 300K — 360K — 620K — 750K — 910K — 1.1M — 1.3M — 1.5M — 2M. All 12c each. 1% ¾ watt:— 820ohms — 330K — 390K — 470K — 620K. All 15c each. 2% ¾ watt:— 51 — 100 — 180 — 200 — 240 — 300 — 560 — 600ohms — 1.3K — 3.9K — 4.2K — 5.3K — 8.2K — 9.1K — 10K — 10.4K — 16.2K — 20K — 21.5K — 31.6K — 56K — 64.9K — 215K. All 9c each 2% 1/3 watt:— 10 — 12 — 18 — 27 — 33 — 47 — 68 — 140 — 330 — 680ohms — 1.2K — 1.5K — 1.8K — 1.96K — 3.9K — 6.8K — 56K — 150K — 180K — 270K — 390K. All 10c each.
1% ½ watt:— 22 — 56 — 68 — 91 — 300 — 330 — 430 — 560 — 910 ohms — 1K — 1.1K 1.2K — 1.6K — 1.8K — 3.6K — 3.9K — 4.7K — 6.1K. All 10c each.
2% ½ watt:— 13 — 15 — 91 — 130 — 300 — 400 — 910 ohms — 24K — 62K — 75K — 240K — 430K — 470K. All 8c each.
PLEASE NOTE:— Our 'STARPAC' Offer of 50 assorted 1 & 2% BEYSCHLAG resistors at $2.50 per Pac.
PHILIPS 5% Resistors — ¼ & ½ watt all values at 4c each. 1 watt all values at 7c each.

I.R.C. WIRE-WOUND RESISTORS
6.8Kohms 6 watt Vitreous Wire wound resistors 15c each — 3.9Kohms 3 watt Vitreous Wire wound resistors 10c each — 270ohms 3 watt Vitreous Wire wound resistors 10c each — 22ohms 5 watt Vitreous Wire wound resistors 12c each — 30ohms 20 watt Tubular Power Wire wound adjustable resistor. 40c each — 40ohms 20 watt Tubular Power Wire wound resistor 30c each — 90ohm 20 watt Tubular Power Wire wound resistor 30c each — 2.2Kohm 5 watt Tubular Power Wire wound resistor 12c each — 75ohms 10 watt Tubular Power Wire wound resistor 15c each — 300ohms 50 watt Tubular Power Wire wound resistor 45c each.

PLEASE REMIT WITH POSTAGE

We hold many thousands of different grades and values in resistors. If you are in need of that 'odd bod' let us know and we'll try to assist.

UNCLASSIFIED POTENTIOMETERS



A B C D E F

Make	Curve	Value	Spindle	Type	Pix	Price
Ducon	'A'	100Kohms	2 1/8" x ¼"	Push-on Switch	A	65c
I.R.C.	'A'	250Kohms	1 5/8" x 1/8"	Split shaft	B	50c
Aerostat	'A'	500Kohms	1 5/8" x 1/8"	Split shaft	C	40c
Aerostat	'A'	1Kohms	5/8" x ¼"	Standard	D	35c
Aerostat	'C'	1Mohm	1" x 1/8"	Split shaft	E	35c
Darston	'A'	500ohm	Trim	Miniature	F	75c
Darston	'A'	1Kohm	Trim	Miniature	F	75c
Darston	'A'	25Kohm	Trim	Miniature	F	75c

All the above Pots. 12c P & P.

Thousands of other types in stock at the lowest prices in the Country. It will pay you to enquire first before purchasing elsewhere.

THE GREAT NAME FOR ELECTRONIC MSC COMPONENTS IN AUSTRALIA

We Avoid Price Uplifts.....

MICROPHONES

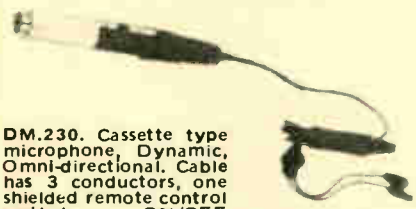
DM.402. Dynamic microphone supplied complete with handsome adjustable table stand. Impedance 50,000 ohms. $5.50 + 50c post.

TW.210. Cassette type microphone with built in switch & plastic stand. Impedance 200 ohms — non directional. $2.65 + 30c post.

UDM.105. Cardiold Dynamic microphone (Omni-directional Dual impedance, hand-held high-globe type). Die cast of semi-polished chrome. Built in wire mesh screen. on-off/high-low switches. Equipped with Mike-holder & shielded cable. Impedance: High 50,000 ohms, Low 600 ohms. Sensitivity: -57dB/1000cps. Freq. response: 100-10,000 Hz. $20.00 + 65c post.

DM.17. Cassette type microphone. Omni-directional, complete with Mike-holder & 3' shielded cable with remote control plug. Packed in individual plastic case. Impedence 200 ohms. $3.75 + 25c post.

CM.22. Crystal microphone housed in rectangular moulded case & nickel stand. $3.85 + 25c post.



DM.230. Cassette type microphone, Dynamic, Omni-directional. Cable has 3 conductors, one shielded remote control switch or ON/OFF switch. Impedance 200 ohms. Frequency response 100 Hz — 8000Hz. Finished in Chrome & Black. $3.55 + 25c post.

DM.109. Dynamic microphone (Omini-directional) Hand-held ball type microphone. Die-cast on beautiful satin chrome finish. With on/off switch, Mike-holder & shielded cable. $15.50 + 65c post.

INTERCOMS

KE.117. An ultra efficient 2 Station solid state intercom unit, sturdily constructed in handsome moulded cases. Will operate up to 500'. Suitable for mounting on wall or desk use. Master unit has volume control, and comes complete with battery and 50' cord. $10.75 + 65c.

KE.630. As above but with 1 Master & 2 Slaves. $18.50 + 75c post.

KE.720. As above but with 1 Master & 3 Slaves. $23.50 + 75c post.

CARTRIDGES — MAGNETIC — CRYSTAL — CERAMIC

"JELCO" Magnetic-Styli — HEADSHELLS

Supreme quality at Low prices — Fully Guaranteed. — Individually packed in clear moulded case with full data.

MODEL	MC1.5	MC.12D	MC.12E
Frequency Response	15 ~ 20,000Hz	10 ~ 27,000Hz	10 ~ 27,000Hz
Sensitivity	5mV at 1,000Hz/50mm/sec	5mV at 1,000Hz/50mm/sec	5mV at 1,000Hz/50mm/sec
Channel Balance	±0.1dB at 1,000Hz	±0.5dB at 1,000Hz	±0.5dB at 1,000Hz
Channel Separation	25dB or over at 1,000Hz	27dB or over at 1,000Hz	27dB or over at 1,000Hz
Impedance	2.2KΩ at 1,000Hz	4.5KΩ at 1,000Hz	4.5KΩ at 1,000Hz
D.C. Resistance	600Ω	600Ω	600Ω
Load Resistance	50KΩ ~ 100KΩ	50KΩ ~ 100KΩ	50KΩ ~ 100KΩ
Compliance	8 x 10^{-6} cm/dyne	13 x 10^{-6} cm/dyne	13 x 10^{-6} cm/dyne
Stylus	0.6mil Diamond	0.5mil Square Diamond	0.3 x 0.8mil Elliptical Diamond
Needle Pressure	3gr ~ 5gr	1.2gr ~ 2.2gr	1.2gr ~ 2.2gr
Empty Weight	6.5gr	5.6gr	5.6gr
Prices	$10.00	$12.00	$17.00

ALL PLUS 25c POST

UNIVERSAL ½" MOUNTED HEADSHELLS

JS.10 $3.75 + 15c post.
BLACK COATED FINISH

JS.20W $4.00 + 15c post.
BRUSHED ALUMINIUM FINISH

M.100 Crystal Mono $1.75

M.241 — Crystal, Mono $2.50.
S.243 — Crystal, Stereo $3.45
MC.241 — Ceramic, Mono $2.60
SC.243 — Ceramic, Stereo $3.50

S.144 Crystal, Stereo $3.45.

SC.303 Ceramic, Stereo $4.00

M.110 — Crystal, Mono $1.75
S.110 — Crystal, Stereo $3.10
MC.110 — Ceramic, Mono $1.75

SPECIFICATIONS FOR CARTRIDGES

CARTRIDGES: Packing: Sealed Plastic Bag Inside Printed Carton
Stylus: Sapphire — All Items

MODEL	MC – 110	MC – 241	M – 241	M – 100	M – 100
OUTPUT	0.6V at 1000$\frac{1}{2}$, 5 cm/sec	0.55V at 1000$\frac{1}{2}$, 5 cm/sec	2.2V at 1000$\frac{1}{2}$, 5 cm/sec	2.2V at 1000$\frac{1}{2}$, 5 cm/sec	3.0V at 1000$\frac{1}{2}$, 5 cm/sec
COMPLIANCE	3 X 10^{-6} cm /dyne	1.5 X 10^{-6} cm /dyne	1.5 X 10^{-6} cm /dyne	1.2 X 10^{-6} cm /dyne	1.0 X 10^{-6} cm /dyne
NEEDLE PRESSURE	4 – 6 grs	6 – 8 grs.	8 – 8 grs	6 – 8 grs	5 – 7 grs.
RESPONSE	0 – 15,000$\frac{1}{2}$	30 – 15,000$\frac{1}{2}$	30 – 15,000$\frac{1}{2}$	30 – 15,000$\frac{1}{2}$	30 – 15,000$\frac{1}{2}$
WEIGHT	2.5grs	6grs	6grs.	3grs	3grs.

MODEL	S – 243	S – 144	S – 110	SC – 243	SC – 303
OUTPUT	1.2V at 1000$\frac{1}{2}$, 5 cm/sec	1.0V at 1000$\frac{1}{2}$, 5 cm/sec	1.2V at 1000$\frac{1}{2}$, 5 cm/sec	0.5V at 1000$\frac{1}{2}$, 5 cm/sec	0.42V at 1000$\frac{1}{2}$, 5 cm/sec
COMPLIANCE	1.0 X 10^{-6} cm /dyne	1.0 X 10^{-6} cm /dyne	1.2 X 10^{-6} cm /dyne	1.2 X 10^{-6} cm /dyne	2.7 X 10^{-6} cm /dyne
CHANNEL SEPARATION	15db	10db	15db	25db	18db
NEEDLE PRESSURE	6grs	6grs	6grs.	4grs	4grs.
RESPONSE	30 – 15,000$\frac{1}{2}$	30 – 15,000$\frac{1}{2}$	30 – 15,000$\frac{1}{2}$	30 – 15,000$\frac{1}{2}$	30 – 15,000$\frac{1}{2}$
WEIGHT	6.5grs	3.5grs	3grs	8.5grs.	6.2grs

DISC CLEANER

KS.20. Fits all types of Turntables. Fully adjustable and is supplied with 2 spare Anti-static Rollers. Absolutely indispensible. $3.95 plus 25c post.

LORIMIER 12volt DC Relay. 3-pole change-over 6 amp contacts. Complete with clear plastic cover.
Only $3.50 P&P 25c.

M.S.C... the money savers

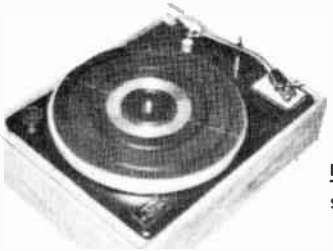
TURNTABLES AND BASES

apan MUSIC MAKER

BELT DRIVE TURNTABLES

QUALITY PRODUCTS AT A MODEST PRICE***

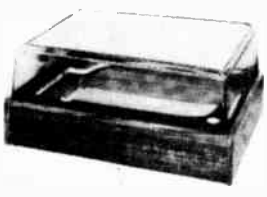
General specifications for all models: For operation on 240 volt/50 Hz; Stereo magnetic cartridge with diamond stylus — wired ready for Audio and A.C. input. Belts — Neoprene rubber. Speeds — 33-1/3 and 45 R.P.M. Turntables are all of 12" diecast aluminium. Shielding is incorporated in all models. Wow & Flutter — Less than 0.2% WRMS measured with RMS sealed meter through ear curve. Starting voltage — Less than 80% voltage without load. Speed variation (at nominal voltage) 45 RPM — 45.11 to 46.15 RPM. 33-1/3 RPM — 33.33 to 34.09 RPM. BMU-121 Motor 4 pole induction. BRU-121 & BFU-121 4 Pole Syncro.



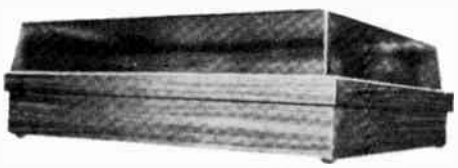
BMU-121 Fully Manual Turntable **$68.50** plus $3.00 P & P.

BFU-121 Fully Automatic Turntable **$88.00** plus $3.00 P & P.

BRU-121 Semi-Automatic Turntable **$78.00** plus $3.00 P & P.



BRU-121/BC Base & Cover Teak or Walnut **$22.50** plus $1.00 P & P.



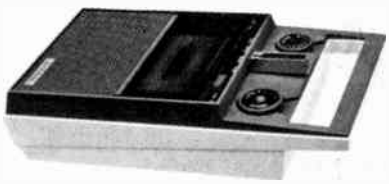
BFU-121/Bc Base & Cover Teak or Walnut **$25.00** plus $1.00 P & P.

12 months warranty on all APAN Models.

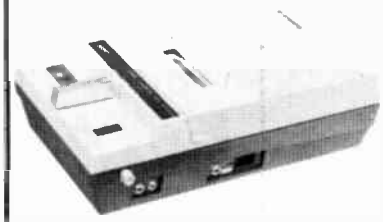
CASSETTE RECORDERS

EXPO The Sound of Excitement

The choice of three portable EXPO Cassette Recorders for Go-anywhere enjoyment. Each unit is fully transistorised for absolute reliability and for AC/DC operation.



Model VC-100/AC. Recorder & Radio. In handsome 2 colour Case. Frequency response — 100-7500 Hz. Output — 500mW. Wow & Flutter — 0.3%. Complete with Microphones, batteries, Cord & Blank cassette. **$68.50** plus $2.50 P & P.



Model KC-500AC/Dc. In handsome 2 colour Case. Frequency response — 100-7500 Hz. Output 500mW. Wow & Flutter. 0.35%. Complete with Microphone, batteries, Cord & Blank cassette. **$38.50** plus $2.50 P & P.

Model KC-803S/AC. In handsome 2 colour Case. Frequency response — 100-8000 Hz. Output 600mW. Wow & Flutter 0.35%. Complete with Microphone, batteries, Cord & 2 Blank cassettes. **$48.50** plus $2.50 P & P.

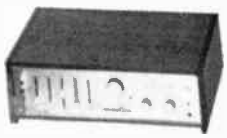
AMPLIFIERS

. . . the Name of Quality coupled with Modest prices. Best standards with best performance . . . GO NOW WITH EXPO******

EXPO

Model TA-3100
The EXPO TA-3100 is a top grade stereo Hi-fi Amplifier which incorporates the best features of higher priced similar units, and will give years of perfect reproduction with high stability. Made by one of the most reputable Japanese electronics companies, we can fully recommend this as a must for the rest of your hi-fi equipment. Case in Teak or Walnut, and front panels finished in brushed Aluminium with full control facility. Frequency response: 20-40000 Hz. Power output: 24 Watts RMS (2 x 12) 50 Watts peak. Features include operation of magnetic, crystal or ceramic cartridges, scratch filter and stereo headphone jack, and also includes provision to use with Radio turner and tape recorder.
Price **$85.000** plus $2.00 P & P.

Model KA-3300



Another EXPO winner. An Amplifier with all the best features for first-class sound reproduction with high fidelity and performance. Has all the features of the TA-3100 plus many more. Case in Teak or Walnut and brushed Aluminium front panel with slide controls etc. Frequency response: 20-60 kHz. Power output: 40 Watts RMS (2 x 20) 113 Watts peak. Has full facility for operation of magnetic, crystal or ceramic cartridges, scratch filter and stereo headphone jack, and also includes Loudness & Sound effects controls. Can be used to include Radio tuner and tape recorder.
Price **$149.00** plus $3.00 P & P.

THE GREAT NAME FOR ELECTRONIC MSC COMPONENTS IN AUSTRALIA

Not satisfied?.. then we refund your money in full!

SEMICONDUCTORS

NOW . . . The cheapest of 'em ALL. Compare our prices and then decide****

We only stock from the prime manufacturers, viz: MOTOROLA – N.S. ELECTRONICS – PHILIPS – R.C.A. – G.E. – FAIRCHILD – S.T.C./ITT-TEXAS INSTRUMENTS.

TRANSISTORS

	PRICE
AC107	.80c
AC125	.95c
AC126	.95c
AC127	.95c
AC127/128	$1.85
AC128	.80c
AC132	.95c
AC172	.95c
AC187	.95c
AC187/188	$1.85
AC188	.92c
AD149 (OC26)	$1.95
AD161/162	$2.90
AF115N	$1.25
AF116N	$1.25
AF117N	$1.25
ASZ15 (OC28)	$2.40
ASZ16 (OC29)	$2.50
ASZ17 (OC35)	$2.40
ASZ18 (OC36)	$2.50
BC107	35c or 6 for $1.95
BC108	35c or 6 for $1.95
BC109	35c or 6 for $1.95
BC147 (BC107)	35c or 6 for $1.95
BC148	35c or 6 for $1.95
BC149 (BC109)	35c or 6 for $1.95
BC157 (BC177)	.50c
BC158 (BC178)	.50c
BC159 (BC179)	.50c
BC177	.50c
BC178	.50c
BC179	.50c
BC186	.65c
BC208A (BC108A)	.55c
BC208b (BC108b)	.50c
BC208C (B108C)	.55c
BC209 (BC109B)	.55c
BC209C (BC109C)	.55c
BD139	$2.30
BD139/140	$4.80
BDY20 (2N3055)	$1.50
	or 2 for $2.75
BF115	.66c
BF167	.65c
BF173	.70c
BF180	$1.10
BF184	.60c
BF185	.60c
BF194	.45c
BF195	.45c
BF197	.65c
BSX20	$1.95
D13T1 (2N6027)	$1.25
MJE2955	$3.00
MJE3055	$2.90
MJ802	$7.70
MJ4502	$8.50
MPF102	.78c
MPF105 (2N5459) 2 for	$1.75
MPF106 (2N5485) 2 for	$2.15
OC26 (AD149)	$1.95
OC28 (ASZ15)	$2.40
OC29 (ASZ16)	$2.50
OC35 (ASZ17)	$2.40
OC36 (ASZ18)	$2.50
OC44N	.45c
OC45N	.48c
OC71	
OC72	
OC74N	.75c
OC75N	.75c
OC81	.65c
TT797	$1.10
TT798	$1.10
TT800	$1.10
TT801	$1.10
2N301	$2.10
2N697 (BFY50)	$1.10
2N706	.70c
2N706A	.75c
2N2102 (40408)	$2.50
2N2646	$1.20.
2N2647	$1.20
2N2926	.75c
2N3053 (BFY50)	$1.10
2N3054 (40250)	$1.55
2N3055	$1.50
2N3564	.90c
2N3565 (BC108)	.35c
2N3566	.96c
2N3638	.50c
2N3638A	.50c
2N3640	.90c
2N3641	.57c
2N3642	.64c
2N3643	.70c
2N3644	.77c
2N3645	.95c
2N3819	$1.40
2N3866	$2.50
2N4250	.70c
2N4360	$1.20 or 2 for $1.75
2N5459	.95c
2N5485	
40250 (2N3054)	
40408 (2N2102)	
40409	
40410	

S.C.Rs.

	MAX CURRENT R.M.S.	P.I.V.	PRICE
BRY39			$1.80
BT100A/300R	2A	300	$2.10
BT100A/500R	2A	500	$2.30
BT101/500R	6A	400	$3.70
BTY79/500R	6A	500	$4.20
C106Y1	2A	30	$2.20
C20D (BTY79/500R)	6A	500	$4.20
TS1219	10A	400	2.50
TS1220	10A	500	2.75

PHOTO ELECTRIC DEVICES

RPX25 Silicon NPN	$3.20	ORP12/B8/731/0	.65c
FPT100 Silicon NPN	$2.70	ORP 60 CDS CELI	$1.50
OCP71 Germanium PNP	$2.70		

ZENER DIODES . . . PHILIPS

400mW Series: Coded by BZY88 type numbers which replaces the old BZY94 series.

	PRICE		PRICE
BZY88/C3V3	.50c	BZY88/C10	.50c
BZY88/C3V6	.50c	BZY88/C11	.50c
BZY88/C3V9	.50c	BZY88/C12	.50c
BZY88/C4V3	.50c	BZY88/C13	.65c
BZY88/C4V7	.50c	BZY88/C15	.65c
BZY88/C5V1	.50c	BZY88/C16	.65c
BZY88/C5V6	.50c	BZY88/C18	.65c
BZY88/C6V2	.50c	BZY88/C20	.65c
BZY88/C6V8	.50c	BZY88/C22	.65c
BZY88/C7V5	.50c	BZY88/C24	.65c
BZY88/C8V2	.50c	BZY88/C27	.65c
BZY88/C9V1	.50c	BZY88/C30	.65c

1.7W Series: Coded by BZX70 type number which replaces the old BZY95 series. As with the BZY88 series, the BZX70 types are 5% tolerance and the last two numerals denote the voltage, e.g. C9V1 is a 9.1V type and C18 is 18V.

	PRICE		PRICE
BZX70/C7V5	$1.20	BZX70/C27	$1.20
BZX70/C8V2	$1.20	BZX70/C30	$1.20
BZX70/C9V1	$1.20	BZX70/C33	$1.20
BZX70/C10	$1.20	BZX70/C36	$1.20
BZX70/C11	$1.20	BZX70/C39	$1.20
BZX70/C12	$1.20	BZX70/C43	$1.20
BZX70/C13	$1.20	BZX70/C47	$1.20
BZX70/C15	$1.20	BZX70/C51	$1.20
BZX70/C16	$1.20	BZX70/C56	$1.20
BZX70/C18	$1.20	BZX70/C62	$1.20
BZX70/C20	$1.20	BZX70/C68	$1.20
BZX70/C22	$1.20	BZX70/C75	$1.20
BZX70/C24	$1.20		

SIGNAL DIODES

AA119	.28c	OA90	.20c
2-AA119	.56c	OA91	.20c
AAY21	.50c	OA95	.25c
BA100	.35c	OA200	.30c
BA102	.92c	OA202	.35c
BA114	.30c	IN914A (IN4148)	.25c
OA5	.50c		

POWER DIODES

	Max. Current R.M.S.	P.I.V.	PRICE
D59	0.5A	75	.95c
A15A	3A	100	5 for $1.95
BY100 – replaced by EM408			10 for $1.95
BY126/100 (EM401)	1A	100	8 for $1.95
BY126/400 (EM404)	1A	400	5 for $1.95
BY127/800 (EM408)	1A	800	$5.00
BYX21L/200	25A	200	$5.00
BYX21L/200R	25A	200	$4.50
BYX39/600	6A	600	10 for $1.95
EM401	1A	100	8 for $1.95
EM404	1A	400	5 for $1.95
EM408	1A	800	4 for $1,95
EM410	1A	1000	
OA679	1.5A	100	.45c
A14A	2.5A	100	.40
IN5059	2.5A	200	.45
IN5060	2.5A	400	.50
IN5061	2.5A	600	.60
IN5062	2.5A	800	.70
A14P	2.5A	1000	.95
RS812	80A	120	$3.75
RS801	80A	100	$2.75

TRIACS

	Max Current R.M.S.	P.I.V.	
SC146D	10A	400	$3.20
MAC77/6	4A	400	$2.50
TC1102 (with Diac)	6A	400	$2.75

BRIDGE RECTIFIER ASSEMBLIES

SILICON	Max Current R.M.S.	P.I.V.	
MB1	2A	100	$1.40
MB2	2A	200	$1.45
MB3	2A	300	$1.85
MB4	2A	400	$1.80
MB6	2A	600	$2.55
MB8	2A	800	$3.20
MB10	2A	1000	$4.00
PB40		400	$6.70
PA40		400	$5.10
PA60		6.00	$5.90

SELENIUM	Max Current R.M.S.	P.I.V.	
25F	1A	25	.95c
LT91	2A	25	$1.40

Our name comes first - Profit second!

SEMICONDUCTOR 'Bits & Pieces' . . .

Below is a list of "Odd" or discontinuted semiconductors which the beginner or experimenter will find useful for his prototype or his experimental project. The devices are all new, unused and marked and are fully guaranteed by us.

Type	Function	Description	Make	Price
IS94	Diode	P.I.V. 500 .36A	Toshiba	20c
IS33	Diode	P.I.V. 100 4.0 mA	Toshiba	20c
IS34	Diode	P.I.V. 60 4.0 mA	Toshiba	20c
GD12	Diode	P.I.V. 20 2.0 mA	S.T.C.	15c
TS3	Transistor	PNP Vce 20 Ic mA 25	S.T.C.	20c
TS13	Transistor	PNP Vce 150 Ic mA 20	S.T.C.	20c
2SB54	Transistor	PNP Ge. Low power 20/30v	Toshiba	25c
2SB56	Transistor	PNP Ge. Low power 25/30v	Toshiba	25c
2SA49	Transistor	PNP Ge. Low power 6-18v	Toshiba	25c
2SA53	Transistor	PNP Ge. Low power 6-18v	Toshiba	25c
2SA52	Transistor	PNP Ge. Low power 6-18v	Toshiba	25c
2N218	Transistor	PNP RF Alloy IF Amp	Anodeon	20c
2N526	Transistor	PNP Vce 30v 500 mA	Thompson	25c
AN6101	Diode		Fairchild	15c
AB2014	Diode		Fairchild	15c
IN540	Rectifier	Silicon-400v .75A	S.G.S.	35c
IS539	Rectifier	Silicon-300v .75A	S.G.S.	30c
SD54	Diode	Shockley-PIV 75 5 mA	S.T.C.	15c
SJ203F	Rectifier	200V 2.5A	A.E.I.	48c
BA123	Cap. Diode	200pf-Diffused Sil.	I.T.T.	30c
FAX1355	Transistor	NPN Moulded T018	Fairchild	18c
AX1320	Transistor	NPN Moulded T05	Fairchild	24c
AX1356	Transistor	PNP Moulded T05	Fairchild	24c
AX1318	Transistor	PNP Moulded T05	Fairchild	24c
AX1319	Transistor	NPN Moulded T05	Fairchild	24c
KM904B	Transistor	NPN Moulded T05 Output	Toshiba	30c
KM953G	Transistor	PNP Moulded T018 Audio Driver	Toshiba	25c
KM905P	Transistor	PNP Moulded T05 Output	Toshiba	30c
KM902D	Transistor	NPN Moulded T018 RF & IF	Toshiba	25c
AS306	Transistor	NPN	A.W.A.	12c
AS302	Transistor	PNP	A.W.A.	12c
KM905B	Transistor	PNP Moulded T05 Output	Toshiba	30c
GET103	Transistor	PNP Vce 20 250 mA	G.E.C.	15c
AX1242	Transistor	NPN (Sim to SE4001)	Fairchild	25c
AY1113	Transistor	NPN High gain	Fairchild	20c

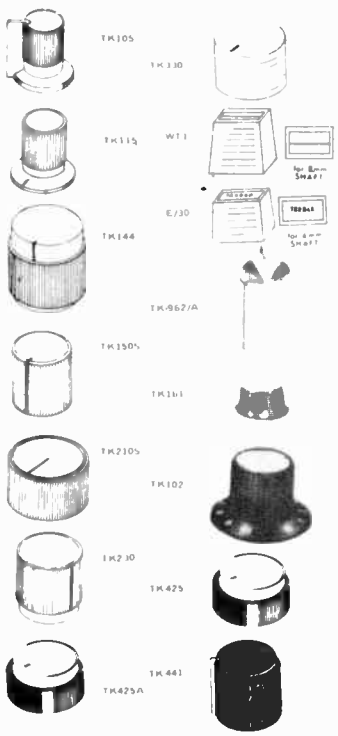
OR — One of each type as listed above (A total of 35) for $5.50 +25c Post. Normal total value of this would be $8.11.

KNOBS

Extremely high-quality knobs . . . precision turned. All solid aluminium for ¼" shaft, with grub screw.

(2G) denotes 2 grub screws. Diameter and height are indicated in millimetres. All have indicator marks.

Type No:	Description	Dia	Ht	Price each
TK105	Silver knurled and skirted with bar	18	19	.60c
TK115	Silver knurled and skirted with bar	18	16	.42c
TK144	Silver knurled with bar	24	20	.42c
TK150S	Silver knurled with bar	19	20	.45c
TK210S	Silver (2G) knurled	24	13	.60c
TK230	Silver knurled	20	17	.50c
TK425A	As above but knurled	24	12	.32c
TK330	Silver smooth	23	13	.45c
WT1	Slider Pot. Handle. For Sonar pot's	8mm		
E/30	Slider Pot. Handle. For 1RH Pot's.	4mm		
TK-962/A	Silver knurled with Black pointer	Small shaft		.50c
TK161	Moulded black with white line.			.25c
TK102	Moulded black with gold top plate and numbered.			.50c
TK425	Push-on .1574 flat, Black with Silver Cap.	24	12	.32
TK441	Anodised Black, Silver ring & Bar.	21	17	.60



MULTIMETERS

Superior Type made by SANWA

Type A-303TRD — $28.35 plus 50c post and Packing.

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

Measurement Ranges: DCV 0.3 1.2 3 12 30 120 300 1.2K 6K (20KΩ/V). AC V6 30 120 300 1.2K (8KΩ/V). DCA 60μA 3mA 30mA 300mA 12 amp (300 mV). OHMS R x 1R x 100 R x 1K R x 10K (MAX 50 M ohm). L.1. 60mA 600μA 60μA LV 1.5V 1.5V 1.5V DB -10~+ 17~ +63 dB.

A303TRD

U50DX

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

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

Measurement Ranges: DCV 0.10.5550 250 1000V (20KΩ/V). ACV 2.5 10 50 250 1000V (8KΩ/V). DCA 50μA 0.5mA 5mA 50mA 250mA. OHMS R x 1, R x 10, R x 100, R x 1K (MAX. 5M ohm dB -20~ + 62 dB. Capacity 0.0001 ~0.2μF. MEGOHM 1~500 M ohm. USE EXTERNAL POWER.

Type 460 ED — $52.00 plus 50c post and Packing.

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

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

P2B

450ED

Type P-2B — $12.50 plus 50c post and Packing.

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

Measurement Ranges: DCV 10 50 250 500 1000V ACV 10 50 250 500 1000V. DCA 0.5mA 10mA 250mA OHMS 1m~ 500K ohm. dB -20 ~+ 22 dB and + 20 ~+ 36dB

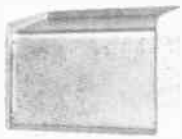
MEGOHMS 0.1 ~50 MΩ
CAPACITY 0.0002 - 0.3μF
0.1 ~0.6μF

M.S.C.... the Gem of the Electronic Industry

MISCELL ANEOUS COMPONENTS

INSTRUMENT CASES

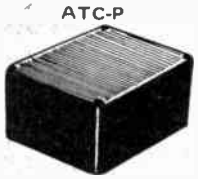
Moulded in either Grey or Natural Plastic the following selection of instrument cases and boxes will find a ready place in the experimenters project planning. All are in top grade bakelite and will readily withstand a lot of hard work.



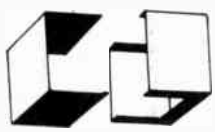
ATC-P

LPC

ATC-754



042 A00



AMB4

ATC-724 FEATURES — * ALL-METAL CONSTRUCTION * ATTRACTIVE BLACK VINYL COATED STEEL * ANODISED LONG-LIFE ALUMINIUM FACE PANEL * NEAT, RECESSED FRONT AND REAR SURFACES * SCREWS SUPPLIED.

Type	Length	Width	Depth	Price	Post
ATC-P	7"	5"	4½"	$3.95	50c
SPC	4-5/8"	2½"	1-3/8"	$1.10	30c
LPC	6-1/8"	3-3/16"	2-9/16"	$1.35	30c

METAL INSTRUMENT CASES & BOXES — Types:— S Steel D Die-cast A Aluminium

Part No:	Length	Width	Depth	Type	Price	Post
ATC-754	7"	5"	4"	S	$5.15	50c
042 A00	4½"	2¼"	1½"	D	$2.75	50c
043 A00	4½"	3½"	1"	D	$2.45	50c
043 B00	4½"	3½"	2"	D	$2.80	50c
064 A00	6½"	4½"	2"	D	$3.55	50c
085 A00	8½"	5½"	2"	D	$545	50c
AMB3	3¼"	2¼"	1½"	A	0.95c	25c
AMB4	3¼"	1-5/8"	2¼"	A	0.95c	25c
AMB6	4"	2-1/8"	1-5/8"	A	1.35	25c
AMB7	4"	2¼"	2¼"	A	1.40	25c
AMB10	5"	3"	4"	A	1.45	25c
AMB12	5¼"	3½"	4½"	A	1.95	25c

CHASSIS & CASE

Made of high-grade Steel, ready drilled & supplied with brackets — 2 types available: MUSICOLOR 2 $5.75, ET401 MIXER $4.50 Plus 75c p & p.

JB4A

JB4C

JIFFY CABINETS

Manufactured by CAPASTAN, These are an all purpose storage facility for small components and hardware. Finished in rust proof zinc-steel and coated in durable grey enamel for lasting use. Each cabinet has 4 clear plastic drawers each supplied with 2 dividers, giving you a total of 12 storing sections. Additional cabinets can be lip-fastened to each to secure. Supplied with self-stick labels this is a sure must for the workshop or den.

Type	Width	Dimensions	Depth	Price
JB-4A	11½"	2"	6"	$1.60
JB-4C	11½"	3"	6"	$2.40

Post & Packing 50c or 2 for 65c.

MANUALS & HANDBOOKS

G.E. Electronic Experimenters Manual Over 250 pages $3.45. G.E. Transistor Manual Over 600 pages $3.45. G.E. S.C.R. Manual Over 500 pages $4.30. G.E. Semiconductor Data Handbook Over 1300 pages $7.00. Philips 1973 Pocketbook Over 500 pages $2.00. Philips Audio Amplifier Systems $3.45.
Given free with each book 1 Philips Resistor & Capacitor Colour Code Chart. Post & Packing on above all plus 50c.

TOOLS

BAHCO . . . Made by the world famous Swedish Company who specialise in tools for the Electronic Industry. Each pair of pliers has been developed and tested in collaboration with leading Swedish and International manufacturers of Electronic equipment. Cutting edges are precision machined and specially hardened, ground and honed to give a clean cut along the whole length of the blade. Side cutters and end cutters cut copper wire up to 17 gauge (1.5mm) and annealed steel wire up to 19 gauge (1mm). All fitted with jaw-opening springs.

Type No:	Function & Design	Price:
2111-4	With outer edge bevel. Side cutters.	$5.30
2112-4	Cutting edges bevelled on inside only. Side cutters.	$5.30
2118-6	Side cutters. Long configuration provides good accessibility in confined spaces.	$7.00
2211-4	End cutters. Angled blades set at 70deg. Flush-cutting edges bevelled on inside only.	$6.85
2212-4	End cutters. With sharply angled blades. Flush cutting edges bevelled on inside only.	$6.45
2215-4	Long jaws with sharply angled cutting edges. Can cut extremely close to workpiece.	$5.65
2411-4	Long-nose Pliers. With straight jaws. Slim narrow jaws of half round section.	
2412-4	Long-nose Pliers. With curved jaws. Jaw tip is curved at an angle of 30 deg.	$5.25
2418-6	Long nose Pliers. Long configuration provides good accessibility in confined spaces. Smooth gripping surfaces with slightly rounded edges ensure a firm but gentle grip on workpiece.	$5.30

211-4

2118-6

2412-4

2418-6

2415-4

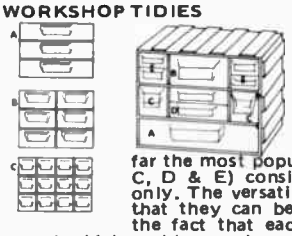
2416-4

2415-4	Flat-nose Pliers. These Pliers have jaws of rectangular section.	$4.50
2416-4	Flat-nose Pliers. Extremely thin and slender jaws.	$4.75
2511-4	Round-nose Pliers. Tapered jaws are fully smooth-ground to ensure non-damaging handling of materials.	$3.60
2418-6	Long-nose Pliers. Long configuration provides good accessibility in confined spaces.	$5.30
2415-4	Flat-nose Pliers. These pliers have jaws of rectangular section. Smooth gripping surfaces and slightly bevelled edges ensure a firm but gentle grip on workpiece.	$4.50
2416-4	Flat-nose Pliers. Extremely thin and slender jaws.	$4.75
2511-4	Round-nose Pliers. Tapered jaws are fully smooth-ground to ensure non-damaging to handling of materials.	$3.60
3020	Mains Testers with Screw driver-Pocket type	$1.00 + 20c
'VOLTART'	Fountain pen type Mains Tester ***NEW	$1.20 + 20c

All 2 — Series tools plus 30c P & P

JABEL Aligning & Trimming tool kit. In handsome Plastic wallet with 4 Standard aligning tools manufactured in high-grade polythene. $1.50 + 25c P & P.

WORKSHOP TIDIES



The workshop tidy is available in 6 different Models, offering you five basic Drawer types, and in five different colours. The 'COMBI' combines all five Drawer types and is by far the most popular. The five remaining models (A, B, C, D & E) consist of one particular type of Drawer only. The versatility of the basic Drawer units is such that they can be combined to make larger units plus the fact that each basic Drawer unit is dovetailed all round which enables you to put drawers of any type together in any order you may want — the precision dovetailing coupled with the strong plastic material makes the assembled units absolutely rigid. $6.75 plus $1.00 P & P.

PERSPEX SHEET

New tinted sheets. Size 10" x 11½". Dozens of uses. Only 75c each plus 25c post or Packet of 10 for $5.50 plus 50c post.

THE GREAT NAME FOR ELECTRONIC COMPONENTS IN AUSTRALIA

M.S.C's hot SPECIALS

DIGIVAC TUNGSOL Readout Tube.

Type DT 1707. Displays + or — 1 with Decimal point. 9 pin miniature Socket. Only limited quanitities available. Data sheet supplied. Clearing price only $1.00 each plus 25c post.

S.T.C. COUNTING RELAY

Type ZM-53. The counting relay is an electromagnetic relay with 10 seperate armatures and their associated contacts, 1 seperate and 1 release winding. It has been designed to suit a wide range of applications, such as:— Counting operations in industrial manufacture, releasing of signals when a predetermined number is reached, storing of Test data for subsequent evaluation, recording os specific operations, parcelling of exact quantities for packing and forwarding, replacement, adjusting or supervision of tools used in maghines at regular or irregular intervals. Comparison of input and output quantities in a manufacturing process. Normally worth $32. To clear only $5.00 each plus 30c p & p.

HONEYWELL COMPUTER BOARDS

Approximately 90-100 High grade components consisting of Diodes, Resistors, Transistors, Capacitors. All mounted on a moulded re-useable module. Last few to clear. Only $1.25 plus 50c P & P.

FERRITE RING CORES

Assorted Torroidal Cores. These are of a high permeability. For use in pulse & Wideband transformers. Suitable for hand or machine winding. Cores are in grade SA503 & SA601 materials which are high-stability Manganese-zinc ferrites with low losses. 6 assorted types for ONLY $1.50 plus 25c p & p.

ELECTRO MAGNETIC COUNTERS

High speed type. As used on P.O. equipment. Has 4 digits from 0 — 9999. Non-resettable. 500 ohm coil which will operate from 18v to 36v. Useful for batch counting, lap timing and dozens of other uses. ONLY 50c each to clear plus 12c p & p. Limited qty's only.

HAND GENERATORS

Ex-P.O. Produces approximately 190V A.C. Mounted on wood base, complete with operating handle. ONLY 95c each plus 30c p & p.

P.C. BOARD

Copper clad in Fibre-glass. Mainly 1/16'' thick. Approximately 2lb. of useful off-cuts. Single and double sided. None smaller than 3" square. Only slightly discoloured but can easily be washed off. ONLY $3.00 for 2lb. Post & packing 40c every 2lb. LAST AVAILABLE QUANTITIES AT THIS PRICE.

TWIN TRANSFORMER UNIT

Matched pairs of 600 ohm balanced Line 1 to 1 isolating transformers. Both mounted in sturdy metal case. ONLY 95c each to clear, plus 30c p & p.

I.B.M. SILVER WIRE RELAYS

Precision type relays made for I.B.M. Computers. Can be used for Electronic organs etc. Nominal working voltage 24-48 volts. 4 change-overs. Complete with base. ONLY 40c each to clear plus 12c p & p.

RELAYS

Post office type 3000 — from .25 ohms to 10,000 ohms. Many contact variations. ONLY 50c each plus 20c p & p.

I.C.L. High speed relays. 4 pole change-over 24 V.D.C. To clear 50c each plus 20c p & p. (ILLUSTRATED)

Siemans High-speed relays. 2 pole change-over 1000 ohm coil 24 V.D.C. Last few to clear. 50c each plus 12c p & p.

BUZZERS

Ex-P.O. Equipment. In moulded bakelite case — for wall or bench mounting. Will operate on 20V. With adjustable armature. TO CLEAR ONLY 50c plus 20c p & p.

TURRET UNITS

Consists of 2 12AU7 or 2D21 Valves — 2 18 pin Connectors, resistors, capacitors etc. Very useful for the beginner or experimenter. 2 units ONLY FOR 75c plus 25c post and packing.

CARBON MICROPHONES

Ex-Army type. Can be hand held. In original cartons packed single. 2 for 50c plus 20c post and packing.

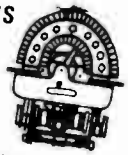
CAPACITORS

Paper block type in rectangular Aluminium can. Capacity 2 mfd. 200v. Ideal for Cross-over Networks and Time delays. New & Unused. ONLY 10 for $1.50 plus 50c post or 20c each plus 12c post.

I.B.M. COMPUTER BOARDS

Definitely the last few available in the Country. Size of boards are approx. 2¼" x 4". Packed with top grade resistors, Capacitors, Diodes, Transistors in T05 or T018 cases in PNP or NPN in silicon and germanium. 10 Boards with a quantity of 40 transistors, plus the diodes, resistors and capacitors ONLY $3.00 plus 25c post and packing.

UNISELECTORS



Made to stringent P.O. specifications. Suitable for Digit counting and Storage, Numicator selections, Batch counting and controlling, switching and Phasing and many other uses. Type A (illustrated), 4 Level 25 wiper with Forward and Reverse Coils each of 120 ohms. Can operate on 18 volts. $4.00 plus 50c post. Can operate on 18 but single coil and only forward switching. 75 ohms Coil, 24 volt operation. $2.75 plus 50c post. Type C. 8 Level 25. Full Doubit wiper 75 ohms Coil. 48 volt operation. $4.00 plus 75c post.

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Mounted on large finned Heatsink. Removed from I.B.M. Power supplies this is equivalent to ADZ11 Germanium P.N.P. Power transistor. IC = 15 amp. Nominal 10 amp. Vceo-37v Vcbo-40v Vebo 20v. Frequency 20kHz. Last few to clear ONLY $2.00 each plus 30c post & packing.

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S.T.C. Solid State Rectifier Assemblies Type SY207 incorporating SILICON AVALANCHE POWER DIODES. Provides an up-to-date replacement for the older Mercury Vapour, Xenon filled or High Voltage Vacuum rectifier valves. Incorporating the very latest ITT avalanche silicon diodes which are virtually self-protecting against over-voltage transients. Technical spec: Max. P.I.V. KV.10 — Peak Ia 45A — average Ia ... 1.0A Base-American UX4 Pin. Some equivalent to SY207 are:— 2G and 2v/402A — 2v400A — 2H28 — 2H66 — 2XM/600A — 3069 — 3828 — 866A — AG/866A — CV32 — CV1835 — DX2 — RR3/250 — TH5021B — VT46A — Z225 and many others. Normal Price $35.00. Our Price $7.50 plus $1.00 Post & Pkg.

VALVES

Z505S. Mullard Cold cathode Decade tube with 0-9 brought out separately for use as a Counter or Selector. Max. stepping speed 50kHz. Supply voltage 475v Output current 800uA. Base B138B. $2.00 to clear plus 15c post & kg. 92AV Mullard Photoemisive tube. Vacuum surface-Caesium antimony. Sensitivity — 45uA/1m. at 85v. Anode supply voltage 100v. Max. dark current .05uA. Base B7G. To clear $1.75 plus 15c post & packing.

12 AT7 35c each plus 12c post. 6AK6 $1.25 each plus 12c post. 6BY7 $0.85 each plus 12c post. 0A4G 50c each plus 12c post. 7058 50c each plus 12c post.

Limited quantities only-buy now... prices slashed

THE GREAT NAME FOR ELECTRONIC MSC COMPONENTS IN AUSTRALIA

Only the BEGINNING... ...not the END

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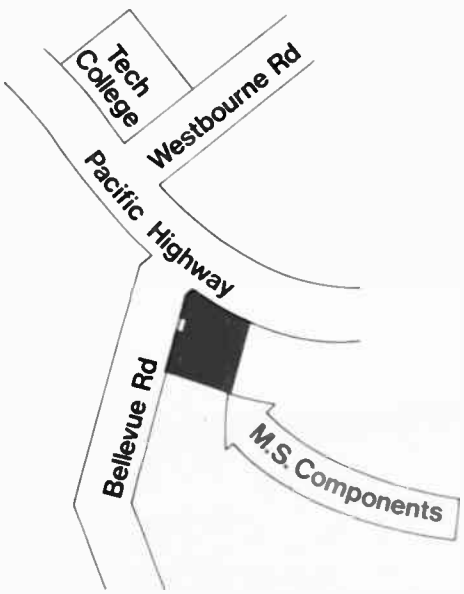
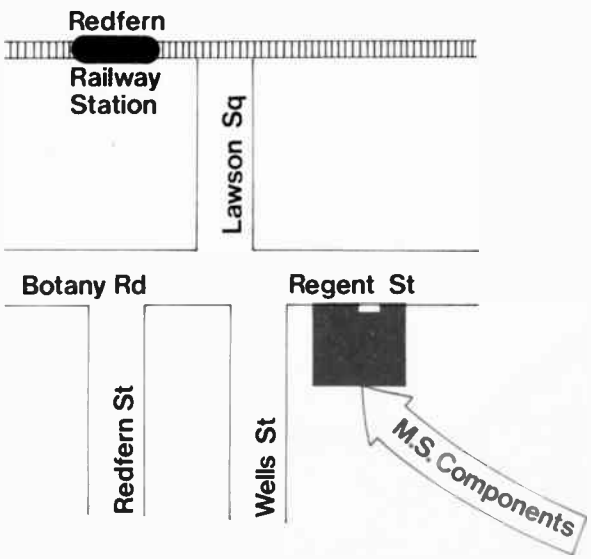
STORE LOCATION MAPS

GORE HILL



REDFERN



THE GREAT NAME FOR ELECTRONIC MSC COMPONENTS IN AUSTRALIA

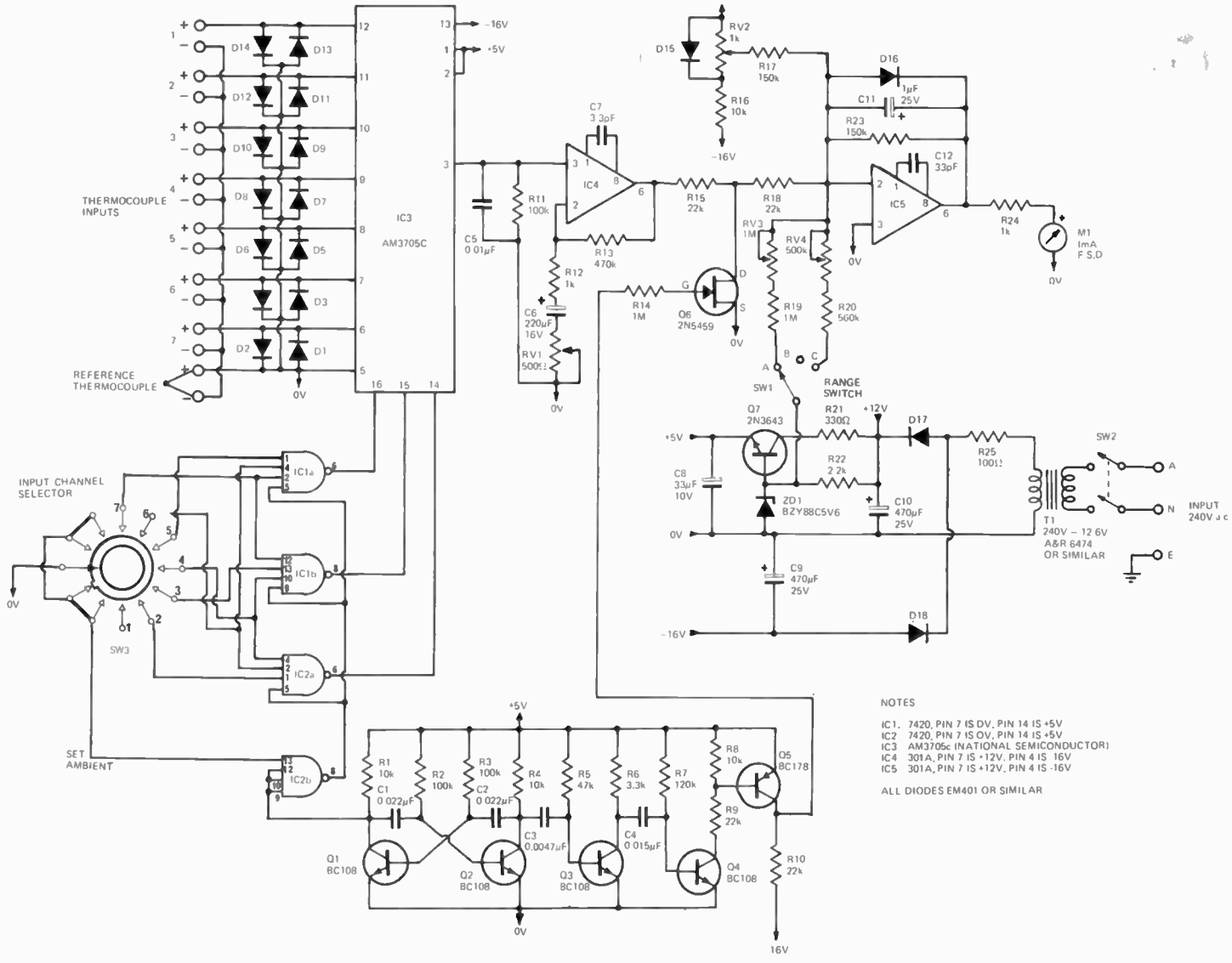


Fig. 1. Circuit diagram of the thermocouple meter.

INTERNATIONAL THERMOCOUPLE METER

The International 113 thermocouple meter enables 0 to 200°C temperature measurements to be made from up to seven separate points.

ETI PROJECT 113

THE need to make temperature measurements, often from a number of different points virtually simultaneously, is a common requirement of experimenters – both amateur and professional.

But measuring the temperature of small objects is much more difficult than it at first appears.

A temperature measurement determines the degree of heat possessed by a body at a particular instant – if that body is small it is essential that the transducer used to make the measurement does not remove a significant amount of heat energy in the process of taking the measurement. Whilst thermistors and diodes may be used as heat sensing transducers, thermocouples are generally more satisfactory where accurate repeatable measurements need to be made of small devices.

The ETI thermocouple meter has

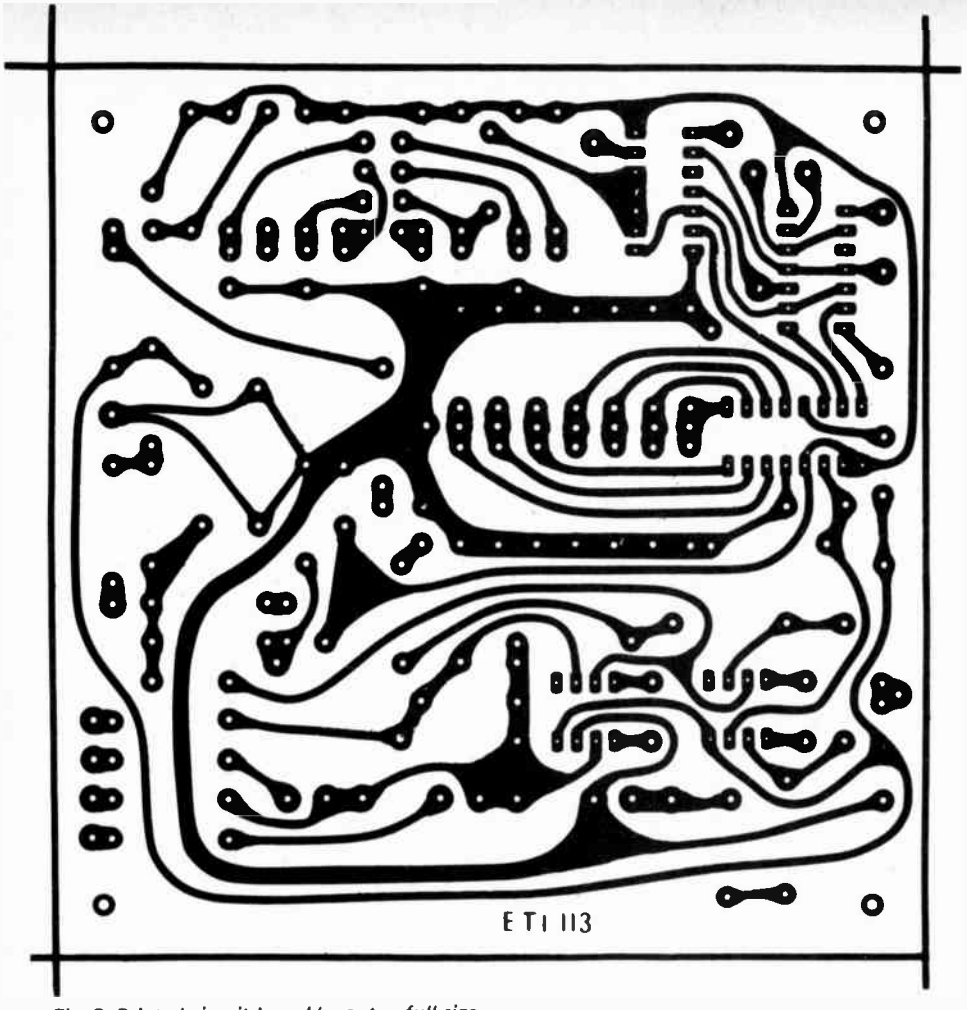
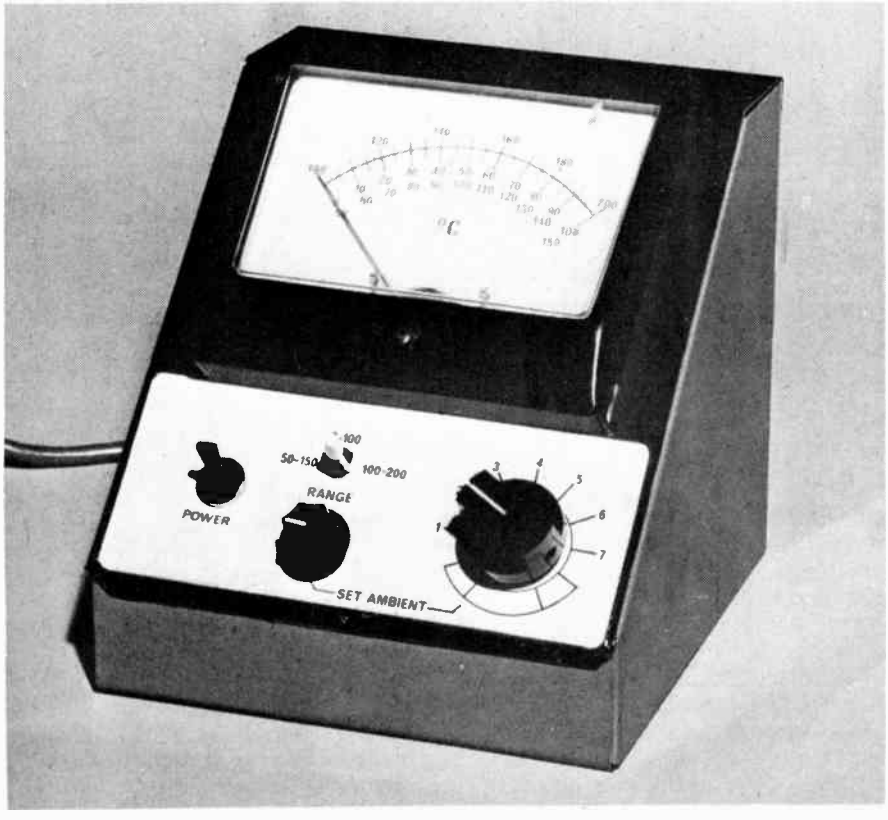


Fig. 2. Printed circuit board layout — full size.

INTERNATIONAL THERMOCOUPLE METER



been designed to suit the requirements of the average experimenter, nevertheless its specification is sufficiently good to enable it to be used satisfactorily for the majority of industrial and scientific applications.

Facilities are included for seven thermocouple inputs, thus enabling temperatures to be monitored at up to seven different points without the need to reposition thermocouple sensors.

Three, overlapping, temperature ranges are provided, so that any varying temperature in the range of 0° to 200° Celsius may be monitored without end-of-scale problems. The 200 degree range of the meter is more than adequate for the range of temperatures normally encountered in most applications.

CONSTRUCTION

Our unit was constructed using a 152 x 152 x 152 mm box with a sloping front panel. Any suitable box may be used as the layout is not critical.

Drawings of front panel and terminal strip art work are provided for those who wish to use the same box.

The meter is a standard 1 mA movement rescaled as shown in Fig. 5.

Do bear in mind that meters are delicate instruments, and great care must be taken whilst dismantling and re-assembly. If you are doubtful of your ability to tackle this operation it is better, either to find someone who can, or to purchase a 0 to 100 scaled meter and to add, mentally, 50 or 100 to the reading, depending on the range in use. If this latter course is adopted the range switch should be marked accordingly.

SPECIFICATION

Number of inputs	7
Ranges	0-100°C 50-150°C 100-200°C
Sensing element	iron/constantan thermocouple wire
Linearity	(see Figure 7)
Accuracy at full scale reading	±3°C ±linearity
Calibration points	ambient temperature 100°C
Ambient compensation	Manual

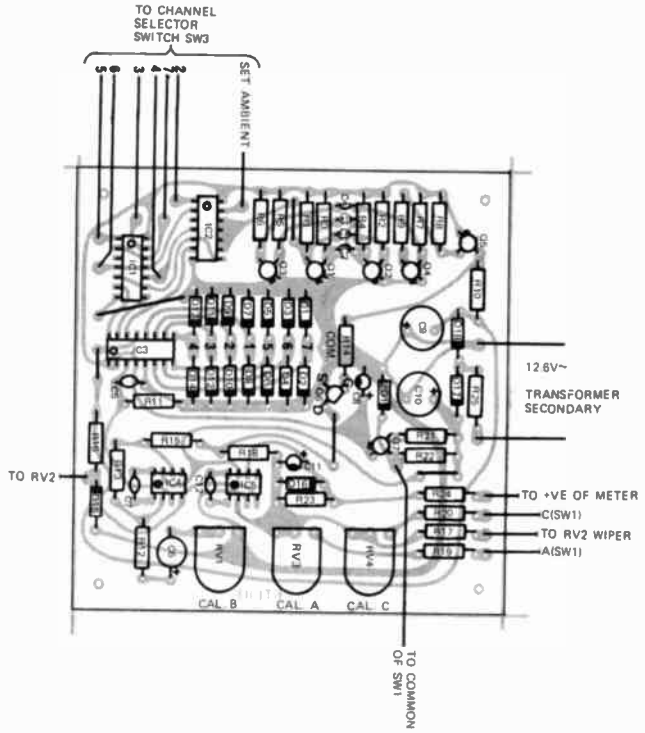


Fig. 3. Component overlay.

Preparation of a thermocouple.
(a) Unprepared wire
(b) Braid bared back
(c) Individual wires stripped
(d) Wires twisted
(e) Wires soldered and cut back.

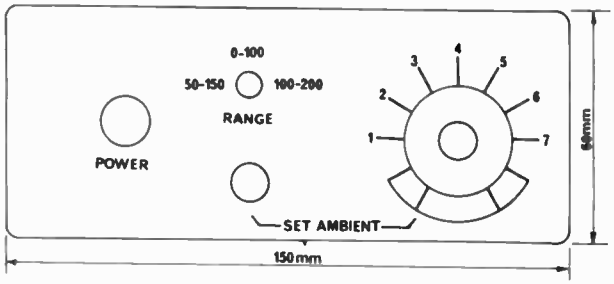


Fig. 4. Front panel artwork (half scale).

Figure 2 shows, full size, the foil pattern for a suitable printed circuit board. Whilst this unit can be built using veroboard or other forms of construction, we strongly advise that our printed circuit board be used.

Assemble all components to the board except IC3 (AM3705C). Make sure that the components, particularly ICs, diodes and capacitors are correctly orientated *before* soldering.

The AM3705C is a MOS device and is easily damaged by static electricity discharges or leakage currents from certain types of soldering irons. Because of this, do not insert this IC until all other components have been soldered in place.

Then, before soldering it in, check that the soldering iron is correctly earthed. Check this with a meter if possible. Finally, once you pick up the IC, do not let go of it until it has been correctly inserted in place. Then solder it in quickly and cleanly.

Instal the assembled printed circuit board, meter, switches and connector block into the case and complete interconnections in accordance with the component overlay and circuit diagram.

Note that all the negative thermocouple terminals are linked together on the terminal block, and that the reference thermocouple is mounted external to the unit (interior of box may be 5° hotter than ambient). All unused thermocouple inputs should be shorted.

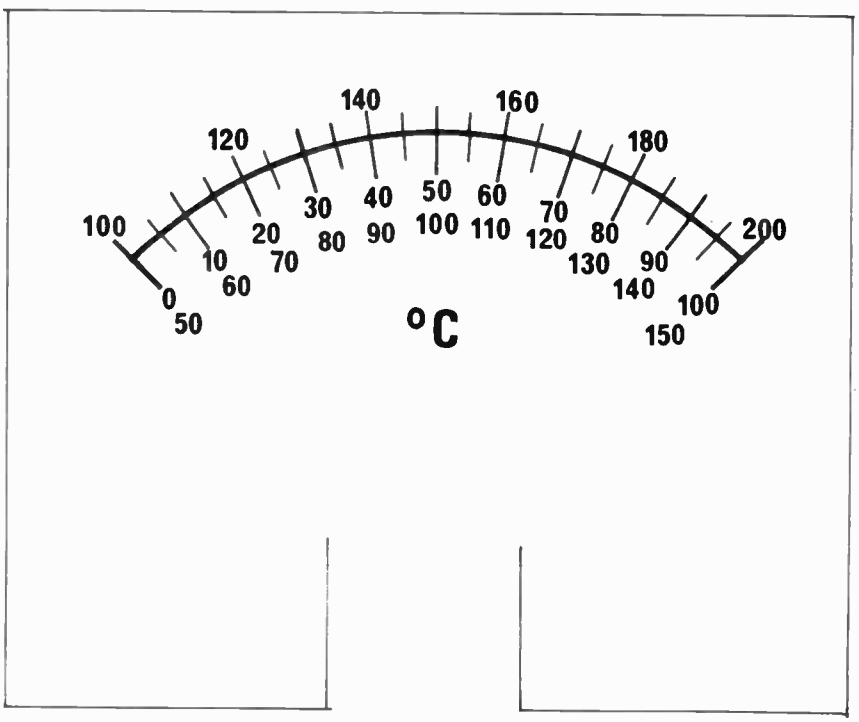


Fig. 5. Meter scale artwork.

INITIAL CALIBRATION

Following assembly, the instrument must be calibrated.

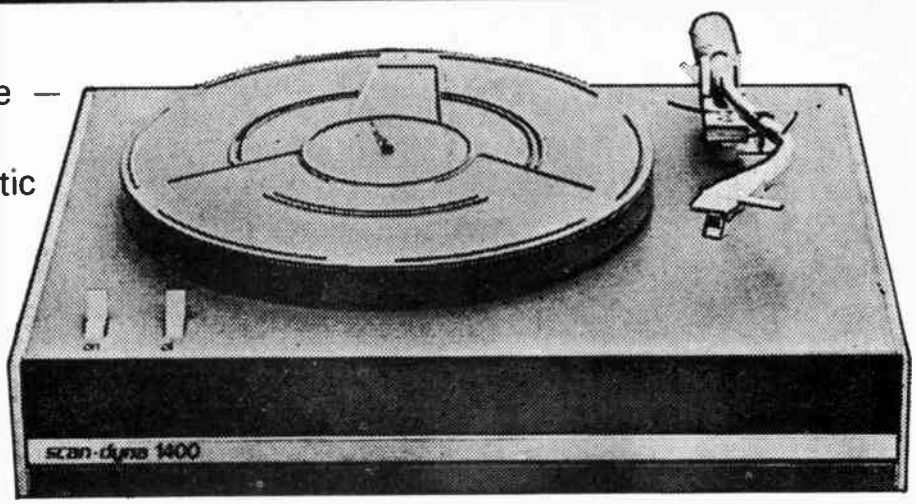
Firstly it is necessary to establish a reference standard for ambient temperature correction. This is best done by mounting an accurate mercury-in-glass thermometer, together with one thermocouple, in a small jar of oil. This jar should then be located somewhere where temperature is reasonably constant.

Leave the temperature of the reference standard to stabilize for a few hours and then connect the reference thermocouple to the

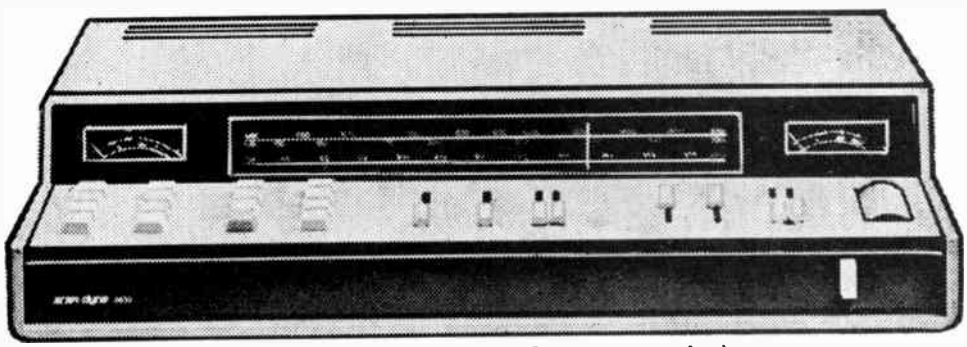
(Continued on page 100)

DANISH HI-FI
by scan-dyna

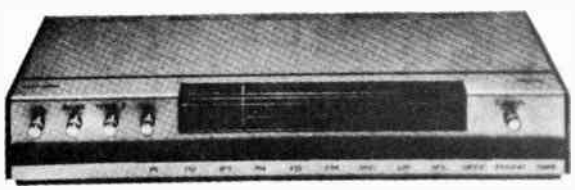
DURATONE IMPORTS
presents a whole new range — beautiful low-slung Scandinavian styling at realistic prices.



Scan-Dyna 1400 turntable with Ortofon arm and cartridge.

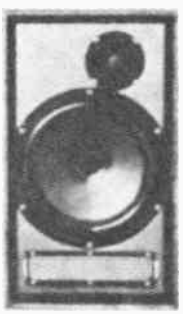


Scan-Dyna 2400 turner-amplifier 2 x 40 wts. rms. 4 ohms.

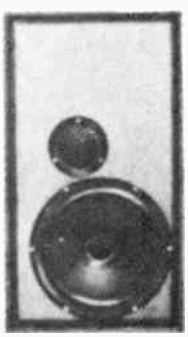


Scan-Dyna 2000 turner-amplifier 2 x 25 wts. rms. per channel 4 ohms.

Q4
Quad adaptor



A-25 x



A-30 x

Scan-Dyna loudspeakers.
A25X aperiodic enclosure.
A30X — a variation of the famous aperiodic principle for clean low-resonance bass.

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Available from:
DURATONE HI-FI, Canberra; LESLIE LEONARD, Perth; TRUSCOTTS, Adelaide;
BEL CANTO AUDIO, Hobart. P. & M. Suppliers Launceston.
Further distributors are being appointed.

You don't need another lecture on Dolby

just facts

The freedom from noise gained with the 'Dolby' system has meaning only if each and every part of the machine is designed and built to the highest standards of mechanical and electronic excellence, as all four Technics 'Dolby' cassette decks are.

To complement the Dolby system, RS279US, RS276US, and RS271US incorporate the exclusive H.P.F. ** head, which ensures superb high frequency reproduction. (10 year guarantee). The RS279US boasts of being the world's first 3 head cassette deck.

Additionally RS279US and RS276US have two motors, one of them a Direct Drive brushless low speed motor.

No belts, idlers or clutches so the deck is free from unevenness and vibrations. Wow and flutter is a low 0.*0% WRMS.

Naturally all four Technics 'Dolby' cassette decks have CR02/Normal tape selector automatic stop, memory rewind, lockable pause control and all the other advanced features that contribute to outstanding sound reproductions.

The fact is at least one Technics 'Dolby' cassette deck will fill your needs.

RS 276 US

FS 279 US

RS 263 US

RS 271 US

National Technics

DOLBY SYSTEM

Guaranteed and serviced across Australia by HACO

* Under licence from Dolby Laboratories Inc. **Trademark

WTGD13N

INTERNATIONAL THERMOCOUPLE METER

(Continued from Page 97)

reference thermocouple input of the meter.

Now connect thermocouples to all inputs – or short out those inputs that are not used – switch the front panel selector switch to any of the four 'Set Ambient' positions and adjust the 'Set Ambient' control so that the meter reads the same temperature as that shown on the reference thermometer.

Next select a thermocouple by means of the selector switch. Place this thermocouple in boiling water. Adjust RV1 for 100°C indication on the 0-100 range, RV2 for 100°C on the 50-150 range, and RV4 for 100°C on the 100-200 range.

This completes the initial calibration procedure.

CALIBRATION BEFORE USE

Before use, the reference thermocouple should be switched into circuit (any of the four 'Set Ambient' switch positions) and the meter adjusted to the temperature shown on the reference thermometer. This indication should be checked from time to time throughout the day if ambient temperature varies to any marked extent.

For some applications it is possible to set the 'Ambient Temperature' adjustment to read zero. If this is done, the instruments will indicate temperature rise above ambient. In other applications it is possible to use the reference thermocouple to establish a 'base' temperature, then the measuring thermocouples will register temperature rises above the reference level.

A thermocouple consists of two lengths of (dissimilar) metal wire. If these wires are joined together at one end, a voltage will be developed across them. This voltage will be proportional to the temperature at the point where the wires are joined.

The magnitude of this voltage depends on the types of wires used. It is not in any way related to their diameters.

Many types of thermocouple wire exist, but of these only four types are in common use. These, together with their characteristics, are listed in Table 1.

The easiest to obtain are iron/constantan, and copper/constantan. Of these, we have chosen the former because of its superior linearity.

Because most thermocouples are non-linear (i.e. do not have a directly proportional relationship between voltage and temperature) they are usually compensated over the temperature range used. However with iron/constantan the non-linearity is less than 1°C from 0 to 140°C and less than 3°C up to 200°C. If greater accuracy than this is required, the correction graph (Fig. 7) should be used. It is possible to build correction circuitry into the instrument, but this is very complex and costly.

Thermocouple wire may be bought from sources such as Leeds and Northrup Pty. Ltd, or H. Rowe and Co. Ltd, or Pyro Sales (NSW).

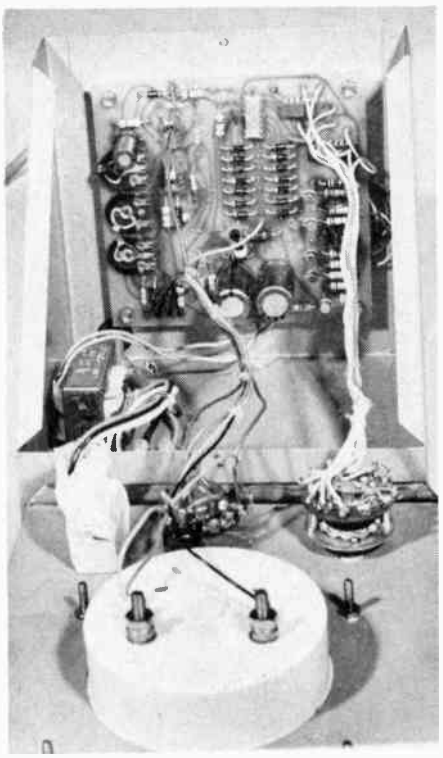
The junction should only be as long as is necessary to make a strong joint and the wires should not be allowed to touch before the actual junction.

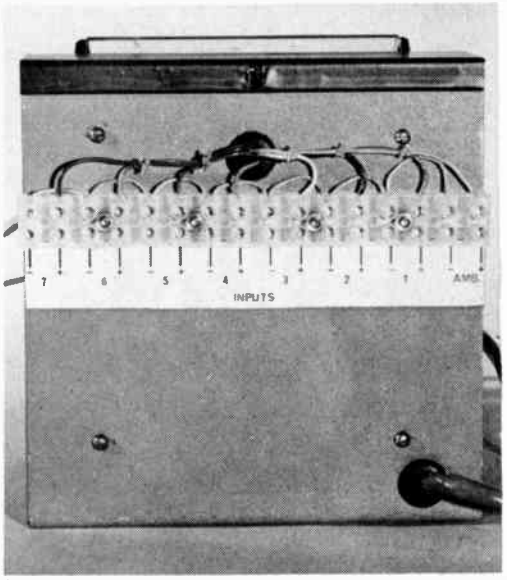
The thermocouple should be taped or glued (using epoxy resin) onto the point where temperature is to be measured.

Temperature measurements of 'live' electrical devices requires especial care if the points at which temperature are to be measured are at different potentials. For such applications, the

WARNING

The individual thermocouples are not isolated from each other. If two points, having different potentials are to be measured, the thermocouples MUST be insulated to avoid shorting the two points.





Rear of the meter – showing the thermocouple connector block.

◀ *Interior of the meter showing positioning of PC board and transformer.*

TABLE I

CHARACTERISTICS OF BASE METAL THERMOCOUPLES

THERMOCOUPLE TYPE	TEMPERATURE RANGE (DEGREES CELSIUS)				Microvolts per degree C	Error at 200°C
	MINIMUM	MAXIMUM				
		20 gauge	24 gauge	30 gauge		
TYPE J (Iron-Constantan)	–18	480	370	370	53	+2.6°
TYPE T (Copper-Constantan)	–180	260	204	204	43	+14°
TYPE E (Chromel-Constantan)	–180	538	427	427	63	+10°
TYPE K (Chromel-Alumel)	–18	982	870	870	41	–3°

Note: Soldered thermocouples may not be used above 200°C.

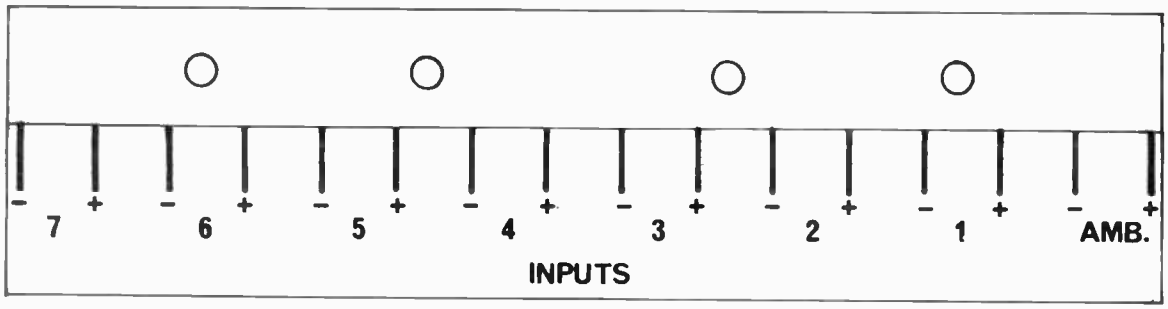


Fig. 6. Artwork for rear-panel connector.

thermocouple *must* be insulated from the device.

Thermocouple wire is available in various diameters, however for most purposes 30G is a good bet.

Ideally, the complete run from thermocouple junction right back to the meter input should be completed in thermocouple wire. In practice it is satisfactory to use copper wire between the thermocouple and the meter but it is absolutely essential that the two places where the copper wire is joined to the thermocouple wire be at the same temperature.

This is because each junction between the copper wire and the thermocouple wire forms in effect another thermocouple, however if the temperatures of these junctions are identical the voltages that they generate will be of equal magnitude but opposite polarity, and hence will cancel out. ●

TABLE II

COLOUR CODE FOR THERMOCOUPLE WIRE

TYPE	OVERALL COLOUR	POSITIVE COLOUR	NEGATIVE COLOUR
J	Brown	White	Red
T	Brown	Blue	Red
E	Brown	Purple	Red
K	Brown	Yellow	Red

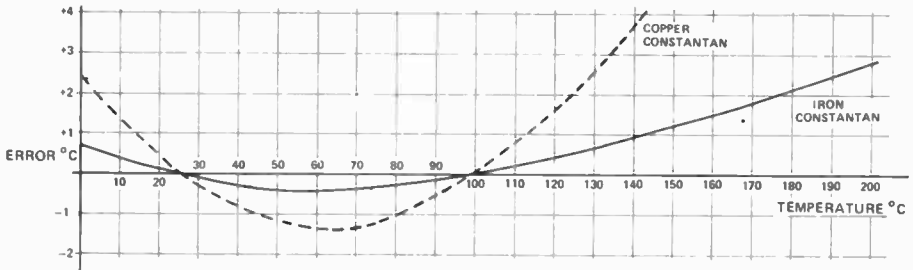


Fig. 7. Comparison of errors for copper/con and iron/con thermocouples calibrated at ambient and 100°C.

PARTS LIST

R1 resistor 10k 5% ½w
R2 resistor 100k 5% ½w
R3 resistor 100k 5% ½w
R4 resistor 10k 5% ½w
R5 resistor 47k 5% ½w
R6 resistor 3.3k 5% ½w
R7 resistor 120k 5% ½w
R8 resistor 10k 5% ½w
R9 resistor 22k 5% ½w
R10 resistor 22k 5% ½w
R11 resistor 100k 5% ½w
R12 resistor 1k 5% ½w
R13 resistor 470k 5% ½w
R14 resistor 1M 5% ½w
R15 resistor 22k 5% ½w
R16 resistor 10k 5% ½w
R17 resistor 150k 5% ½w
R18 resistor 22k 5% ½w
R19 resistor 1M 5% ½w
R20 resistor 560k 5% ½w
R21 resistor 330k 5% ½w
R22 resistor 2.2 k 5% ½w
R23 resistor 150k 5% ½w
R24 resistor 1k 5% ½w
R25 resistor 100k 5% ½w
RV1 potentiometer 500Ω trimpot
RV2 potentiometer 1k linear pot.
RV3 potentiometer 1M trimpot
RV4 potentiometer 500k trimpot
C1 capacitor 0.022uF polyester
C2 capacitor 0.022uF polyester
C3 capacitor 0.0047uF polyester
C4 capacitor 0.015uF polyester
C5 capacitor 0.01uF polyester
C6 capacitor 220uF 16V electrolytic pc mounting
C7 capacitor 3.3pF ceramic
C8 capacitor 33uF 10V electrolytic pc mounting
C9 capacitor 470uF 25V electrolytic pc mounting
C10 capacitor 470uF 25V electrolytic pc mounting
C11 capacitor 1uF 25V electrolytic pc mounting
C12 capacitor 33pF ceramic.
D1-D18 diode EM401 or similar
ZD1 Zener diode BZY88C5V6
Q1-Q4 transistor BC108 or similar
Q5 transistor BC178 or similar
Q6 transistor 2N5459 or similar
Q7 transistor 2N3643 or similar
IC1 integrated circuit 7420
IC2 integrated circuit 7420
IC3 integrated circuit AM3705C (National Semi conductors)
IC4 integrated circuit LM 301A (National Semi-conductors)
IC5 integrated circuit LM301A (National Semi-conductors).
SW1 toggle switch single probe double throw with off.
SW2 power switch MSP625 or similar
SW3 rotary switch 1 pole 11 position.
T1 transformer 240V-12.6V 150mA A & R 6474 or similar.
M1 meter 1mA FSD scaled 0-100 or scaled to Fig. 7
Printed circuit board ETI 113.

HOW IT WORKS

The output voltage from a thermocouple is of the order of millivolts. Typical sensitivities are around 40 to 60 microvolts per degree celsius.

This small dc signal must be increased in level, in order to drive a meter. This is done by chopping between the signal level and zero and amplifying the resultant square wave. The amplified ac signal is then rectified for the meter.

An 8-channel MOS analog multiplexer (IC3) is used both to select the input and to provide the chopping action. Each input is protected by back-to-back diodes, and all the negative sides of thermocouples are joined to the negative side of the reference couple the positive side of which goes to zero volts. Thus the voltage generated is proportional to the difference in temperature between the selected and the reference couples (54μvolt/dc).

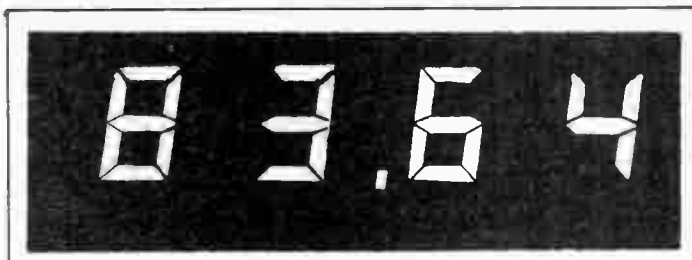
Transistors Q1 and Q2 form a 300 Hz multivibrator, the output of Q1 being fed via IC2 to an input on each of the IC2a, IC1a and IC1b. When a channel is selected by SW3, eg. channel 5, zero volt is applied to pin 1 of IC1. The gates of IC1 and IC2 are NAND gates and if any input to a NAND gate is zero its output will be high. Hence the output of IC1a will be high and the outputs of IC1b and IC2a will be low. This code when applied to pins 14, 15 and 16 of IC3 will cause it to select the input on pin 8, that is thermocouple 5.

However as the output of Q1 goes high, the output of IC2b goes low and IC2a, IC1a and IC1b outputs will all go high regardless of other inputs. The all-high state causes IC3 to select pin 5 which is zero volts, thus the signal from the selected thermocouple is chopped between signal level and zero.

This signal is amplified by approximately 300 by IC4, the output voltage of which will be centred about zero due to ac coupling. For a 75°C rise (4 mV from thermocouple) this voltage will be typically ±0.6 volts.

Transistor Q6 chops the output of IC4 so that slightly more than one half of the signal is eliminated. Thus the signal now effectively has a dc component. The first and last 150 microseconds of the half cycle are discarded to allow IC4 to settle and eliminates switching errors. The effective sampling time is therefore about 42%.

The amplified signal is then summed in IC5 with an 'ambient set' current from RV2 and an offset current from either RV3 or RV4 on the two higher ranges. The output from IC5 is then used to drive the meter.



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The front panel boasts a complete set of controls. Bass, treble, balance, and high/low filters controls are just some. A special feature is the level control that allows you to fade in or out the microphone with that professional touch. Also featured is a two tape monitor circuit that permits simultaneous recording on two tape decks or dubbing from one tape onto the other.

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YAMAHA TB 700 CASSETTE DECK

electronics TODAY INTERNATIONAL
product test

'a state-of-the art product . . . equal to the best we have heard.'

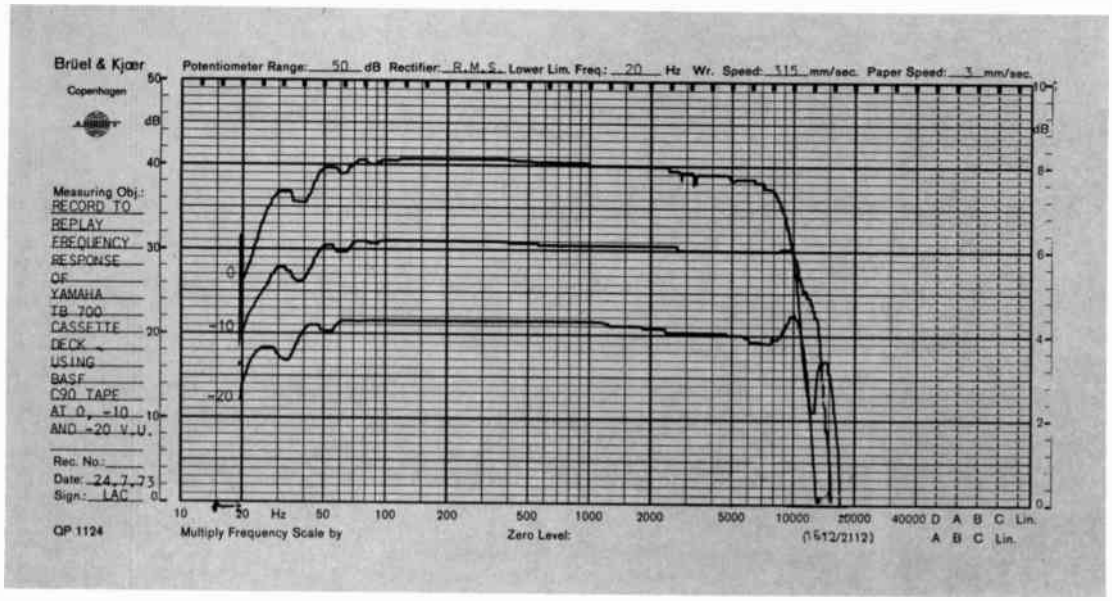
THE HISTORY of the Yamaha Company is a particularly long one, starting way back in 1887 when the Yamaha Company started producing reed organs and then pianos, thus setting them on the pathway to manufacturing a wide range of musical instruments.

Today, they produce such a wide range of musical instruments and other diverse electro-acoustic appliances that their products stretch from woodwind through to french horns, electric organs, Spanish and electrical guitars. Over the past three-quarters of a century, they have built up an enviable reputation, and have won many prizes and medals for quality. It is basically quality control, which they have utilised since the early days of the company, that has earned them this fine reputation.

The TB 700 cassette recorder is well packed in a strong carton. It is accompanied by a simple fourteen page instruction book in good English (but which does not contain a circuit diagram). The unit is also provided with a cleaning tape, a demonstration tape and a chromium dioxide tape.

The TB 700 is attractive in appearance, with brushed satin aluminium fascia, black plastic moulding on top and a veneered wooden enclosure.

The controls are set out in three



main groupings with the main operational controls, in the form of lever buttons, in front of the cassette holder. These controls are from left to right – Record – Fast rewind – Fast Forward – Play – Stop – Eject (this also opens the cassette holder cover) and a positive, and useful, pause button. The pause button is of the locking type and is a definite improvement over the non-locking type generally used.

To the left of these controls is a series of slider controls which is a feature of this deck. The first slider control for pitch or motor speed control is probably the most contentious, for its provision and its use is problematical. This control varies the dc servo-motor feedback control to provide a nominal ± 5% variation in the speed of the recorder. This feature is required by musicians to enable them to alter the pitch of recordings, but is rarely used otherwise. It could be argued that it has been provided to simplify the design of the regulator for the speed control circuit. We found that the speed stability of the motor was temperature-sensitive, and that by raising the ambient temperature, we could readily change the motor speed by + 1.5%.

The next pair of sliders are the playback volume controls. These also adjust the monitoring volume during the recording mode. Following these are two microphone input volume controls, and finally their are two line input volume controls.

In the centre of the deck, set in a line above the slider controls, is a three digit counter with integral reset button. Next along, is a button and lever switch which between them provide for three bias settings. These bias settings are firstly for standard tape, with the button depressed; secondly, for high energy tape, and thirdly for chromium dioxide tape.

After these there are three lever switches – a Dolby switch, a limiter switch to preclude overmodulation, and a mains power switch.

At the top right hand side of the deck, set into the black plastic moulding, are two accurate VU meters, calibrated from -20 to +3 VU. In between these meters are two rectangular indicator lights, the upper one being the record mode indicator light, and the lower one, the "Dolby-on" indicator light.

The front of the deck has a recessed black section in which are located a ring tip and sleeve phone-jack for 8 ohm stereo headphones and two

YAMAHA TB 700 CASSETTE DECK
SERIAL NUMBER 3503

Record to Replay Frequency Response (standard C90 tape)	0 VU – 45 Hz to 8 kHz ± 3dB
(Chromium dioxide tape)	-10 VU – 43 Hz to 11 kHz ± 3dB 0 VU – 50 Hz to 12 kHz ± 3dB -10 VU – 50 Hz to 16 kHz ± 3dB
Total Harmonic Distortion (at 1 kHz)	0 VU – 2% -10 VU – 0.6%
Intermodulation Distortion (1 kHz & 960 Hz)	0 VU – 1.8% -10 VU – 0.6%
Signal to Noise Ratio (at 0 VU, re 1 kHz)	58dB
Erase Ratio (1 kHz recorded at 0 VU)	65 dB (standard tape) 55 dB (chromium tape)
Wow and Flutter (% RMS)	0.15% weighted
Line Input Sensitivity (for 0 VU)	5 mV into 100 k
Microphone Input Sensitivity (for 0 VU)	0.4 mV
Line Output Sensitivity (for 0 VU signal level)	0.8 V
Dimensions	115 mm high 400 mm wide 250 mm deep
Weight	5.1 kilogrammes

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STEREO AMPLIFIERS

MODEL KTX-4000V
Size: 13.8" x 7.9" x 4.3"

SPECIFICATIONS:
Output Power:
25W x 25W RMS at 8 ohms
65W x 65W music power

FREQUENCY RANGE:
25 – 40,000 Hz ± 2dB

OUTPUT IMPEDANCE
4 – 16 ohms

* $126.86 Tax Inc.

DISTORTION (TOTAL HARMONIC)
At 1 watt RMS @ 1 kHz = 0.1%
At 25 Watts RMS @ 1 kHz = 0.1%
At 28 watts RMS @ 1 kHz = 0.5%

POWER SUPPLY
240 volts AC

MODEL KTX-2000V
Size: 13.8" x 7.9" x 4.3"

SPECIFICATIONS:
Output Power:
15W x 15W RMS 8 ohms
40W x 40W music power

FREQUENCY RANGE:
25 – 30,000 Hz ± 2dB

* $105.19 Tax Inc.

OUTPUT IMPEDANCE:
4 – 16 ohms

DISTORTION (TOTAL HARMONIC)
1 watt = 0.14%
14 watts = 0.16%
16 watts = 0.18%

POWER SUPPLY
240 volts AC.

MODEL KTX-1200V
Size: 13.8" x 7.9" x 4.3"

SPECIFICATIONS:
Output Power:
6W x 6W RMS at 8 ohms
15W x 15W music power

FREQUENCY RANGE:
40 – 20,000 Hz ± 3dB

* $84.79 Tax Inc.

OUTPUT IMPEDANCE:
4 – 16 ohms

DISTORTION (TOTAL HARMONIC)
1 watt = 0.2%
5 watt = 0.31%
6 watt = 0.7%

POWER SUPPLY
240 volts AC

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YAMAHA TB 700 CASSETTE DECK

standard tip and sleeve microphone jacks, suitable for microphones from 200 ohm to 50 k impedances.

The rear panel contains a three metre cord, complete with standard earthed mains plug, and record playback DIN socket flanked by two pairs of RCA coaxial sockets for line-out on the left, and line-in on the right. To the right of the line-in sockets is a high level/low level switch for a 10 dB reduction of line level.

The internal construction of the TB 700 provides an indication of the quality and care with which the unit is constructed. On opening up the base, one is presented with a large main board from which a number of smaller boards are interconnected by neat wiring harnesses. These smaller boards are respectively, output circuit for line output and headphones, oscillator circuit board, power supply board, and the auto-stop and servo control circuit boards.

The quality of the printed circuits is to full professional standards, and they have been especially protected to resist corrosion and the effects of poor environment, which so often take their toll of less carefully produced boards.

The internal construction is equal to or better than any unit we have seen in this class, and the designers are to be commended for providing suitable test and monitoring points – which are all well labelled. In keeping with modern trends, the record-playback preamplifiers make use of four integrated circuit modules, produced by an associate company of the Yamaha Group. The preamplifiers in each stage use low noise silicon planar transistors, together with two integrated circuits, in each channel. The unit has a total of 28 transistors, 21 diodes and four integrated units.

One of the best features of the circuitry is the use of a regulated 27 volt supply for both the oscillator and preamplifier stages, and the provision of a very practical and virtually foolproof autostop circuit.

Whilst the handbook does not have a circuit diagram, the manufacturers do have available very excellent 36 page service manuals which, surprisingly, make reference to local requirements in terms of the circuitry, and carefully specify the difference between the power supply circuitry requirements for various countries.

In keeping with a large number of other reputable manufacturers, Yamaha thermally age the printed circuit boards prior to their inclusion in the final cassette deck. By so doing, intermittent problems and breakdown of components are reduced.

We took the deck home for a few weeks and used it as part of our system, to familiarise ourselves with its operation before returning it to the laboratory for exhaustive testing. This subject evaluation told us, even before we started testing, that here was a better deck than most other machines on the market. What our laboratory testing would tell us would be how much better.

MEASURED PERFORMANCE

Our first objective measurements were of frequency response. The makers claimed 30 Hz to 16 kHz using chromium dioxide tape, and 30 Hz to 13 kHz with standard tape (level unspecified). The resultant performance was nearly as claimed, the deficiency not being at the top end as we had expected, but at the low frequency end where it is unlikely to be missed.

Distortion was measured at 2% at 0 VU, and 0.6% at -10 VU with standard tape at 1 kHz. This is quite commendable, the manufacturers claim 2.5%, but do not specify level or frequency.

Wow and flutter can be a major weakness in cassette decks, as a result of the low speed tape speed used in these machines, the very thin capstan used to drive the idler wheel, and the very thin tape. Here Yamaha claim that their TB 700 is significantly better than other manufacturers'. Whilst we did not find any dramatic improvement, certainly their performance is slightly better than most (but not all) other decks we have tested. We measured 0.15% rms wow and flutter. This is significantly better than the manufacturers' claim of less than 0.5% weighted R.M.S.

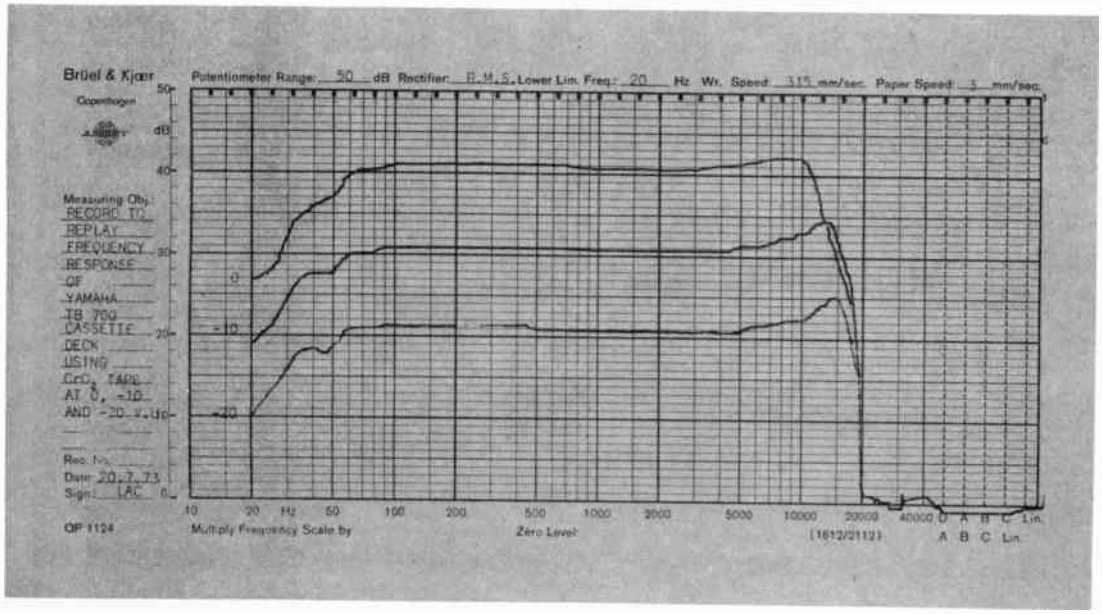
Yamaha do not quote a figure for intermodulation distortion, but this was typically 1.8% at 0 VU with standard tape.

Signal to noise ratio, without Dolby, was exactly 58 dB, as stated in the handbook, whilst with Dolby it was better than 59 dB linear, and 68 dB weighted.

The measured erase ratio was 65 dB at 1 kHz on ordinary low noise tape, and 55 dB on chromium dioxide tape.

None of our measurements showed any significant variation from the manufacturers' stated performance. This is as welcome as it is unusual, for many manufacturers of cassette decks have tended to be optimistic with their claims – particularly those of frequency response.

The Yamaha TB 700 is an excellent cassette player, and in keeping with only a small number of other machines, can lay claim to that very much abused term "High Fidelity Cassette Player". It is a "state-of-the art" product providing a performance equal to the best we have heard. ●



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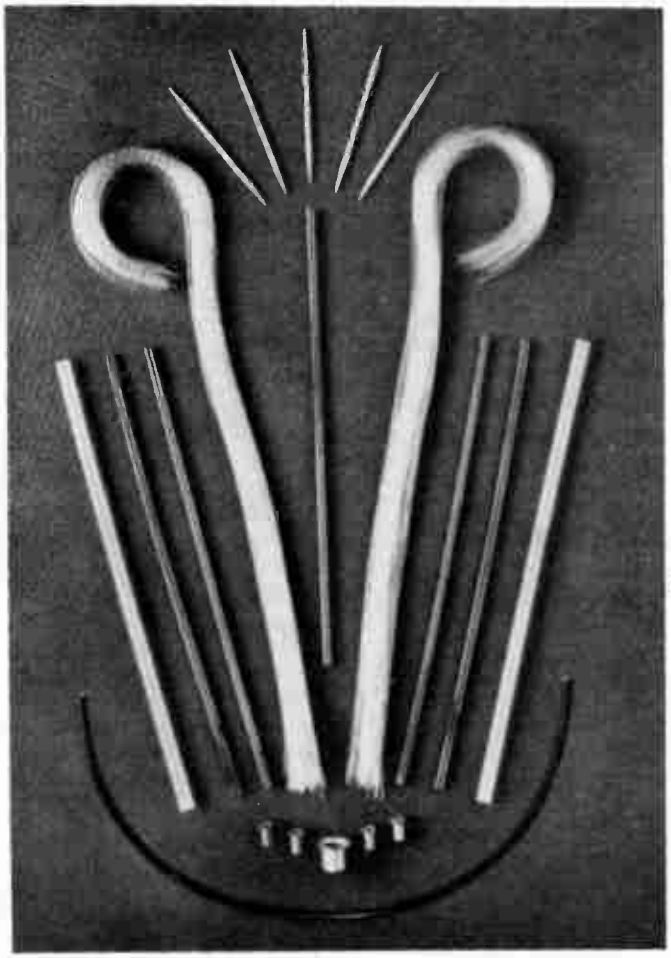
Flexible trouble light — easy! Colour organ — a snack! Alpha-numerical display — a dawdle! Strange lamps — well we've seen similar things for over $200!
If these kits go anything like the solar-cell sell out, you'd better write now or envy your friends forever.



Experimenters kit. Contains two large bundles of 15" fibres preformed to a walking stick shape (there must be many hundreds of them) plus 18" length of jacketed light guide. You also get the special eyelet terminations, conical wedges and some precision plastic tubes for building your own guides. Comes complete with a fascinating manual explaining how they work and various uses. Only needs a light source. $8.50 (P&P 30c)
Fan display. Simple, beautiful, this fan of hundreds of free-flowing 20 mil fibres only needs a lamp base to make it a real talking point (If you really want people to rave you'll also need a draught!), light source extra, $9.50 (P&P 30c)
The Umbrella. A sparkler, this one consists of 11" fibres (too many to count) in a 3/8" termination. Makes a fantastic display on Managing Director's polished rosewood desks. Creates a great impression for only $8.75 (P&P 30c) lamp extra.
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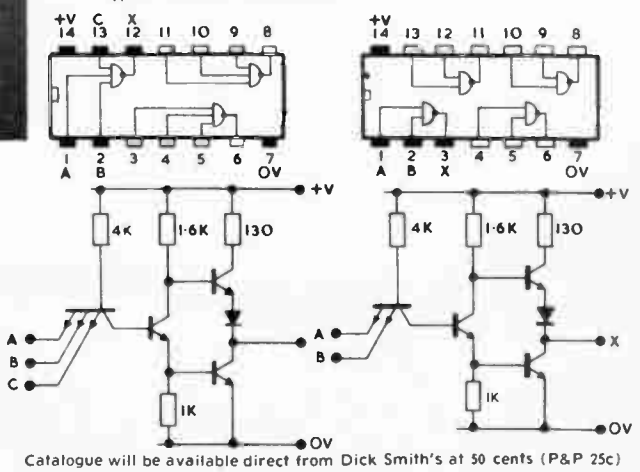

Catalogue will be available direct from Dick Smith's at 50 cents (P&P 25c)

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Yamaha TB 700
Quite simply the most advanced stereo cassette deck you can buy.
Suggested Retail Price $299.00.

Perhaps anybody could do it. Yamaha have done it.

Recording system:	4-track, 2-channel stereo.
Tape speed:	4.8 cm/sec (1⅞ ips).
Wow & flutter:	Less than 0.20% weighted RMS.
S/N ratio:	Without Dolby, better than 48 dB. With Dolby, better than 58 dB.
Total distortion:	2.5%.
Frequency response:	30-13,000 Hz (standard tape). 30-16,000 Hz (chromium dioxide tape).
Bias frequency:	100 kHz.
Max. input sensitivity:	Mic (L.R.) 0.4 mV. (impedance 200-50 kohm). Line, 50 mV/100 kohm (high level). Line, 14 mV/100 kohm (low level).
Output level & impedance:	Line, 1 V (PB Vol. max. position). Line, 0.5 V (PB Vol. centre). Headphone, 0.5 mV/ 8 ohm at OVU.
Pitch control:	±5%.
Fast wind time:	Within 100 seconds with C-60.
Head:	Rec/playback, Hot-pressed ferrite. Erase, double gap ferrite.
Motor:	DC servo motor.
Semiconductors:	4/1C, 28/Transistor, 2/FET, 21/diode.
Power consumption:	15 W.
Power source:	100 V, 117 V, 230 V, 50/60 Hz.
Dimensions:	115 mm (4½ in) H; 400 mm (15¾ in) W; 250 mm (9¾ in) D.
Weight:	5.0 kg (11.0 lb).

Specifications subject to change without notice.

Dolby B, and the tremendous improvement in cassette manufacture technology, made the production of hi-fi cassette decks worthwhile.

The Yamaha TB 700 is the latest hi-fi cassette deck. We're certain it's the best in Australia and probably in the world.

Dolby B, of course.

Hot-pressed ferrite head, essential to handle chromium dioxide tape and get the improved frequency response.

A tape selector to match the deck's performance to the characteristics of standard, chromium dioxide, low-noise, high-output, or High Energy tapes.

Input selector to match output level of the source, and individual volume controls for separate line and microphone inputs.

A limiter to adapt to very loud input signals automatically.

An auto-stop mechanism to disengage all functions automatically when tape has run through.

And perhaps the most exciting feature of all: the world's first pitch control, changing tape speed by up to ±5%.

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YAMAHA

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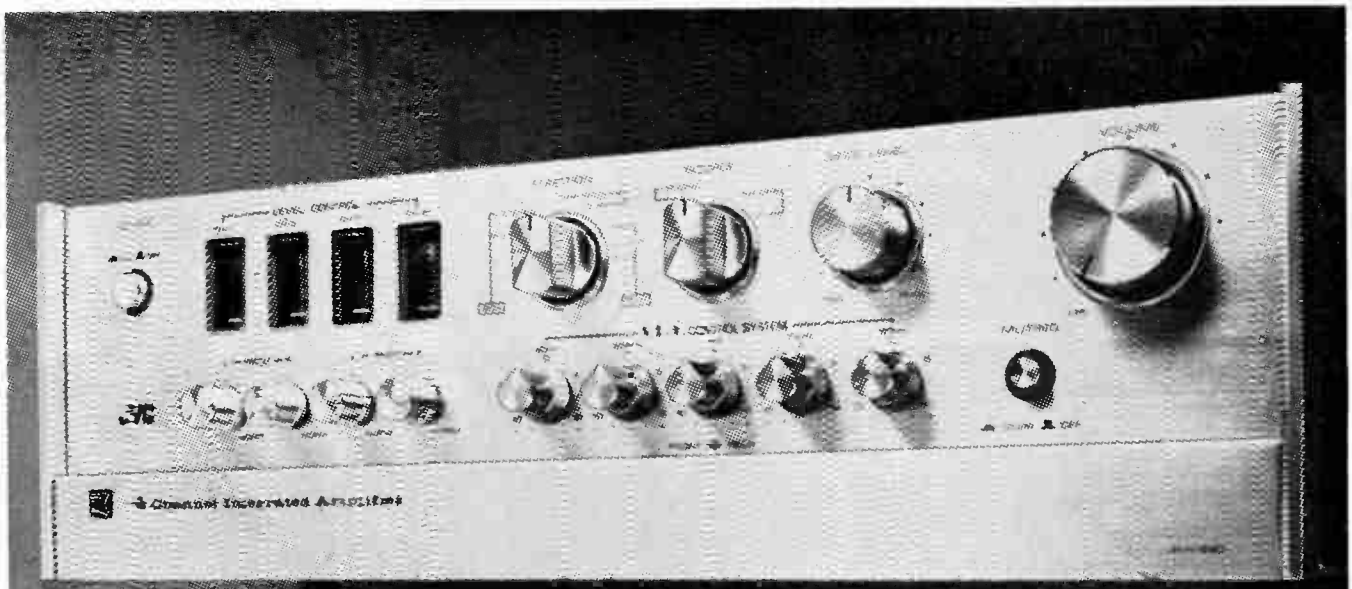

This amplifier gives you more control over Tchaikovsky's 1812 Overture than Tchaikovsky had

It's got SEA

That stands for Sound Effect Amplifier. It breaks sound into five frequency ranges instead of just the usual bass and treble. That means you can almost engineer your own sound.

If you're crazy about a certain singer but not so crazy about the band that's playing with him, you can bring up the voice and push the music into the background. The same thing can be done to emphasise a particular instrument.

And because there's not much point in having a great amplifier with not-so-great acoustics, SEA lets you compensate for the shape of your room and the furniture in it.

Another great thing about this power amplifier, the 4VN990, is that it's the top of the JVC 4-channel amplifier range. It gives you discrete 4-channel, matrix 4-channel and converted 2-channel reproduction, the last two through the Simulated Four Channel System.
You have total sound control in all four channels, and further precision is assured by four built-in VU meters with independent level controls.

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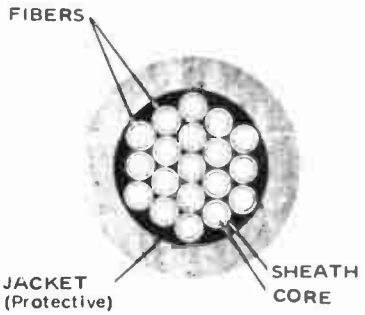

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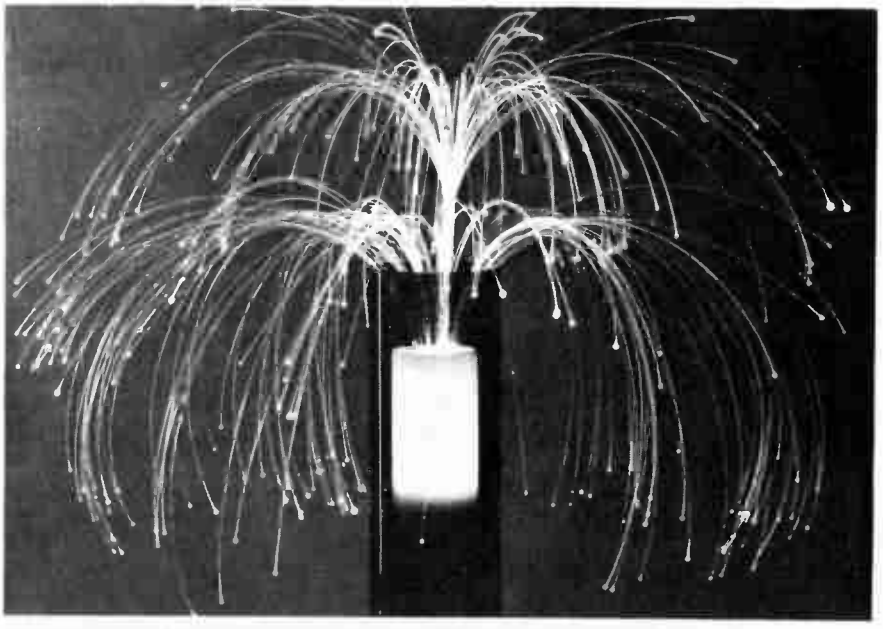

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LINEAR ELECTRIC

From heavy transport systems to laboratory chart recorders, the linear motor is revolutionizing design.

THROUGHOUT the history of technology many devices have been invented, publicised for a while and then forgotten, only to be reinvented or popularised many decades later. Looking back on their original lack of acceptance and eventual rise to dominance we can often remark (with hindsight, that is) that they were the obvious best choice in the first place and should have emerged then, not having been delayed until now.

Many examples of this phenomenon exist. The electric car is one. In the late 1890s a number were built (Porsche designed one for the Prussian army that had hub motor drives and regenerative braking). But electrics were ousted by the internal combustion engine, an alternative that rapidly became so well developed from the manufacturing viewpoint that many other undesirable factors were soon outweighed in the economic

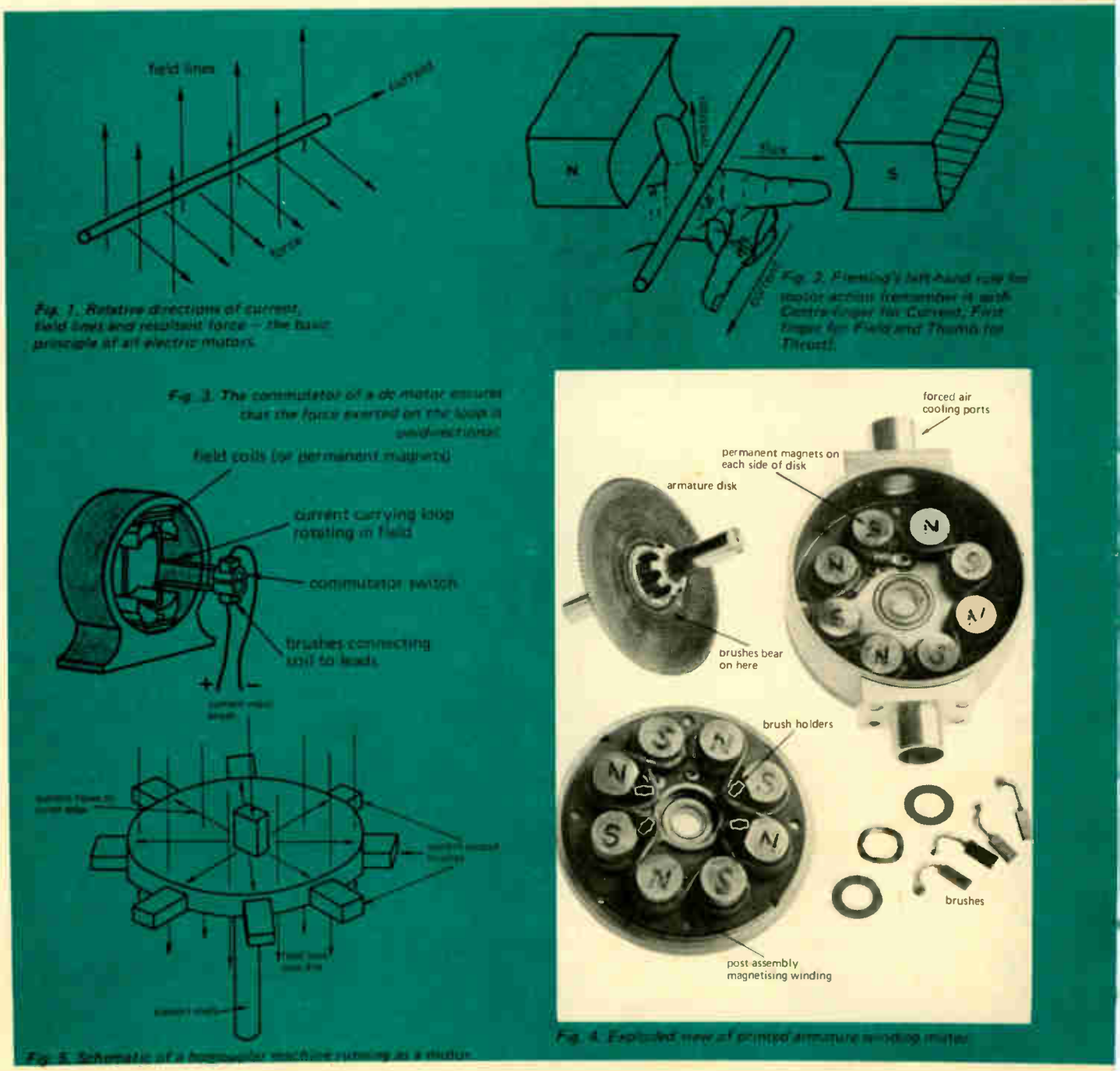


Fig. 1. Relative directions of current, field lines and resultant force – the basic principle of all electric motors.

Fig. 2. Fleming's left-hand rule for motor action (remember it with Centre finger for Current, First finger for Field and Thumb for Thrust).

Fig. 3. The commutator of a dc motor ensures that the force exerted on the loop is unidirectional.

Fig. 4. Exploded view of printed armature winding motor.

Fig. 5. Schematic of a homopolar machine running as a motor.

MOTORS

by Dr. P.H. Sydenham

decision to produce an alternative form of propelling transport vehicles.

Electric motors are another example of the absence of logical basic development – it has taken over a century for simple forms of motor to emerge like those originally proposed by the founders of electrical knowledge.

Such aberrations of logical technological progress are not always brought about by the lack of technology available to the designer. It is more a case of the designers being able to break loose from subconscious traditional design constraints, and not always assuming that a design built from sophisticated technique and deep understanding will be a winner. The seemingly impossible may, in fact, be possible even though experience *suggests* it is not. Thought processes and paper-studies are not enough – they must be combined with practice. The development of electric motors is full of these lessons.

In normal useage the term electric motor implies, without further thought, that it is a machine that provides rotary torque from a shaft – after all, electric motors providing linear force have never made the scene until recent years.

To provide a linear motion from these rotary machines it is necessary to add a mechanical, hydraulic or pneumatic converter to get from rotation to translation. Power hacksaws use a crank to reciprocate the blade; chart recorders often use a wire around a pulley, or a rotary pointer combined with a linearizing linkage; presses use a piston ram. Effort has seldom been expended on designing a linear electric motor to avoid the *need* for racks and pinions, cranks and tapes/wires around drums.

In this last decade we have become more aware of the promotion and application of various forms of linear electric motors, with the accent on their use in transportation. Principles used in linear motors are not more complex than those of rotary motors. In fact, they are the same. Furthermore, linear versions are able to realise the fundamental ideas more simply in practice. It is hard to understand why the 'obvious' remained untapped for so long.

FUNDAMENTALS OF ELECTRIC MOTORS

In order to comprehend the various styles of linear motor and their development we must get back to the basic principles invoked.

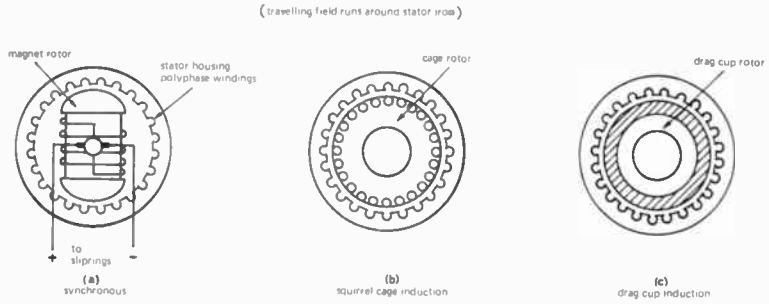


Fig. 6. The travelling field of ac machines is harnessed in various ways.

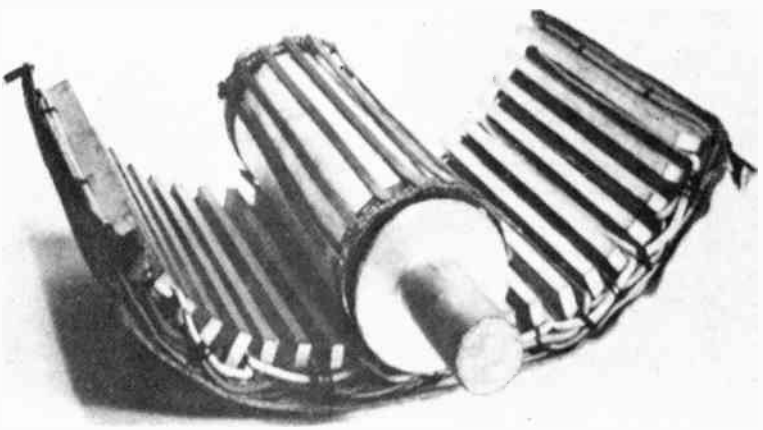


Fig. 7. Unrolling the rotary polyphase motor to yield the one-sided linear form.

In 1812 Michael Faraday showed experimentally that an electric current flowing in a wire would cause it to react against a magnetic field producing rotary mechanical motion. By 1831 (about the time that Stephenson's "Rocket" raced along at the incredible speed of 70 km per hour to win a place for steam-powered trains, and at the time when convicts formed chain-gangs in Van Diemens Land) Faraday had developed the laws of electro-magnetic induction which form the basis of understanding electro-mechanical machines. Joseph Henry also discovered the laws in the same year and he went on to build the first practical electric motor. There was nothing in the law of electro-magnetic induction that restricted its use to rotary motion. The electric motor is in fact a linear force producing mechanism.

By 1837, Davenport was using an electric motor to drive tools in a workshop. Two years later, Jacobi used one to propel a small boat along the Dnieper River in Russia – we still haven't taken up this idea except in submarines and scuba-divers' craft. There was no lacking of applications for electric power.

Early motors made use of direct current – the first use of a travelling field, made possible with polyphase ac currents, came in 1885. Regardless of whether dc or ac is used, the fundamental principle is the same – a combination of current and magnetic field produces a force, (as shown in Fig. 1). Electrical energy is converted to mechanical.

When a conductor is moved at right angles to the lines of a magnetic field (produced by permanent or electrical means) a current is induced in the conductor. Somewhere in history the Fleming right-hand rule was coined to express the relative directions of this generator effect. A left-hand version,

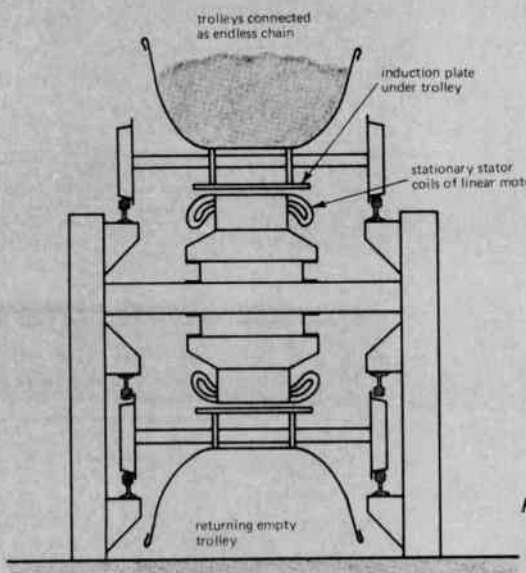


Fig. 8. Cross-section of the Gardanne coal handling plant.

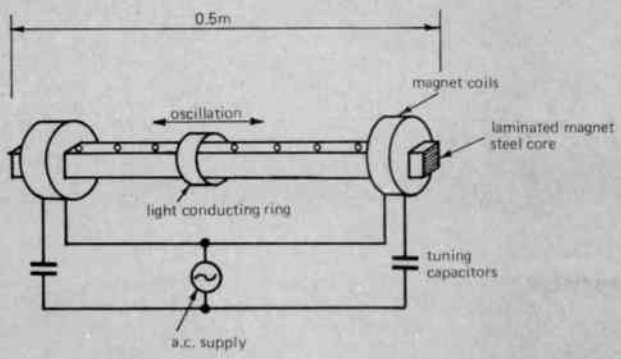


Fig. 9. Horizontal form of the ac oscillating linear motor.

LINEAR ELECTRIC MOTORS

shown in Fig. 2 works for motors. This rule, combined with a simple mathematical expression relating force produced with current, field strength and length of conductor in the magnetic field, enables electric motors to be designed and built with reasonable ease and accuracy of prediction. Although the principle of motor action is the same in all cases the practice varies considerably when it comes to harnessing it to the real world.

Actually in a motor (or generator) both motor and generator effects occur together. In the motor, the generator effect produces what is known as a back-emf (electro-motive force). Back-emf must be allowed for in the design: it does not defeat or nullify the motor action but does curtail it. The net difference, however, produces enough current to provide useful linear force. The efficiency of the energy conversion is high; back-emf is not a particularly wasteful problem.

A current-carrying conductor in a magnetic field will keep moving across that field until it leaves the area of concentrated field lines. The easiest way to provide a continuous force action, wherein the conductor is always in the field, is to have a loop of wire rotating in a circular field space, using a switch to ensure that the current flows the right way in the loop at all times. In this way a unidirectional torque is produced. The switch is called the commutator in a dc motor. It is shown in a simplified manner in Fig. 3. The simplicity of a rotary motor – ease of switching, ease of air-gap control in the magnetic circuit and ease of flux concentration – probably accounts for rotary motors having been developed instead of the linear versions that are now coming into use.

The laws of magnetic circuits show that flux is best concentrated by containing it in a magnetic circuit, where possible keeping the airgaps as small as is feasible. For this reason early motors soon incorporated a rotating magnetic support for the rotating windings, and this has been carried down to us as the normal design procedure.

It was only in the 1960s that new motors appeared, in the form of printed-wiring armature motors (one is shown in Fig. 4) using no iron in the armature. These high performance motors can also be made using a potted free-standing winding that is connected to a commutator – a method that could have been used at any time in the past. Air-cored motors, such as these, are simpler to build and have far greater ability to accelerate a load than the cylindrical forms. They are a big step forward (or is it backward) towards realisation of the basic principle. One type of dc motor – the homopolar motor (or generator) – is even more basic than these. It uses a conducting disk that has current passing from the outer edge to the centre – see Fig. 5. A field, applied through the disk, reacts with the current's field – thus providing motor action. Few motors have used this principle (that is, until recent times) for they have an extremely low resistance armature circuit resulting in a motor that is typified by very high currents and low voltages. This does not suit most sources of dc energy.

But they do exist – the biggest of all is probably the generator version used by the School of Engineering Physics at the Australian National University. Their generator consists of 10 m diameter disks of steel, 250 mm thick, that have banks of brushes at the centre and periphery. These disks are spun up to speed to store energy in kinetic mechanical form. The generator is then virtually short circuited (a field is applied through the disks) into various experiments to study effects at extremes of power. (It stores around 500 MJ and can sustain mega-amperes for durations of a second).

In this decade we have seen the manufacture of the first superconducting homopolar motor. Superconducting windings are also high current, zero voltage devices so the homopolar motor is the logical choice if cryogenic technique is to be applied. Superconducting systems seem certain to become everyday reality in this decade – we have, therefore, gone around the loop arriving right back at the motors that the nineteenth century scientists probably envisaged a century ago.

In the rotary dc design of motor the commutator is a component worth eliminating on grounds of reliability and cost. A polyphase ac supply can be used to produce a travelling field without the need for a switching mechanism. The minimum number of phases needed is two, but the three-phase system is more commonly used. The stator of a three-phase ac motor has three sets of coils embedded in the iron circuit. These are placed at 120 electrical degrees to each other, and fed with sinusoidal currents from the three supply lines (that also are

out-of-phase with each other). Field strength at a point on the stator is the total instantaneous effect of the currents in the three coil sets and it is easy to show that the maximum field force actually travels around the stator with time, moving at the synchronous speed, (for a two-pole machine on a 50 Hz supply, this is 50 revolutions a second). It is as though magnet poles are rotating in the stator space. This effect is easily demonstrated – a ball bearing placed on the inside surface of a three-phase stator (energised at a reduced safe voltage) will run around the stator following the moving poles.

It is also possible to obtain the travelling field in single-phase motors, but they need special starting arrangements to run the rotor up to speed.

There are a number of ways to harness the travelling field in order to produce torque. The most obvious, but not the cheapest, is to have an armature that consists of a magnetic pole-pair that can rotate, following the field as shown in Fig. 6(a). This is the synchronous motor – small units actually incorporate a permanent magnet, larger ones an electro-magnet fed via slip/rings. A synchronous motor, however, must be run up to speed to a point where the rotating magnet is synchronous with the travelling field 'magnets' so that it can lock in.

There is another way to utilize the travelling field. In the induction motor, a very low resistance, high current capacity, electrical conducting cage, see Fig. 6(b), is made inside the slots of the iron rotor – it is usually of copper or cast aluminium. This squirrel-cage (the popular name for this) is a short-circuited winding and it, therefore, has currents induced in it by the stator field. The induction motor operates by virtue of these induced magnets in the armature reacting with the travelling field. A most valuable feature of this method is that it can produce torque from standstill to quite close to synchronous speed. (It does not quite approach synchronism, for a lag is required to induce sufficient current to overcome the load torque).

It is polyphase motors of these types that have attracted the most attention of linear motor designers – for, to date – they seem to offer the cheapest way of obtaining linear propulsion where long fixed tracks are involved.

LINEAR MOTORS FOR TRANSPORTATION

We have spent some time describing the principles of rotating motors in order to develop a background, for this is the path through which motor designers have passed.

We will see that there are more types of linear motors than the many articles on transportation drives suggest. Firstly, then, motors for transport.

The squirrel-cage rotary induction motor normally has a distinct winding on the rotor (in the form of coils or bars) but it is also possible to use a continuous cylinder of conducting material as shown in Fig. 6(c). These are known as drag-cup rotors. Imagine a very large diameter cup type motor. This could be 'cut' and rolled-open producing a flat magnetic circuit which has imbedded stator coils and a conducting plate formed by the opened up 'cup'. Normally the latter moves relative to a fixed winding but in transport motors it is sometimes more convenient to build the conducting sheet on the track surface, and then move the coils.

Many alternatives exist – single sided (as would be produced by unrolling a rotary motor) double sided, conventional flux and, more recently, transverse flux motors. We need not dwell on these, for this issue also includes an article on transport motors by the leading British designer, Professor Eric Laithwaite of London's Imperial College.

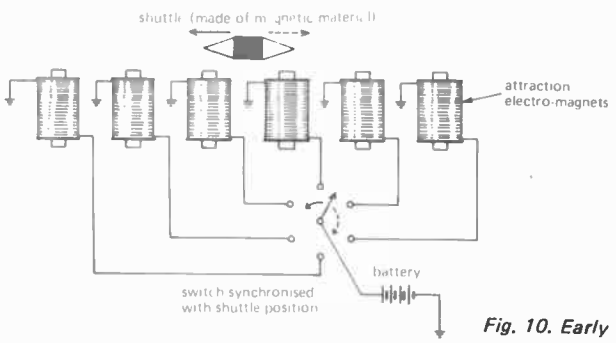
It is interesting to watch the development of motors under the direction of Laithwaite. In recent years he has written a number of papers (see reading list) that illustrate how the inventive mind operates. He has traced his ideas from the reasonably obvious step of 'unrolling' the induction motor (his model for demonstrating this is pictured in Fig. 7) through to his current topological era in which he and his colleagues visualize motors as basic interacting shapes of magnetic and current loops. This approach has led to several new designs not made obvious by normal means.

Linear induction motors have many uses. At MIRA (Motor Industry Research Association) in Britain they use one to accelerate a mass of 3500 kg, (a car body, perhaps) to impact a 50 kmh^{-1} as part of structural and impact studies. Chain-conveyors have already been made to replace the noisy mechanical units used in production lines. The French have a bulk, coal-handling, facility in the prototype stage; a coal mine in Gardanne uses it to shift several hundred tonnes of coal per hour over a distance of 500 m. A cross-sectional view of the continuous bulk-handling equipment is given in Fig. 8.

Yet another idea being worked on is to drive a flat conveyor belt via a conducting surface on the underside.

One very intriguing application summarized by Dr. Michel Poloujadoff (he is another world leader on the design and application of linear induction motors and works at the University of Grenoble) is a two-axis positioning system for automatic movement of pallets or cars in store. The proposed floor has square elemental cells in which motor windings are built to provide motive force in the two perpendicular horizontal directions. A suitably made pallet placed on the floor can be made to move over the surface to any square. It is envisaged that this could be used to store 99 cars in the space of 100 whilst retaining the same ease of access. (Have you ever tried to solve those little number puzzles where one space is left and the numbers have to be slid around to get a special order – such a car park would need to be computerized if this claim is to be met). Poloujadoff has written two excellent review articles on linear induction motors – these are also listed.

(Continued on page 116)



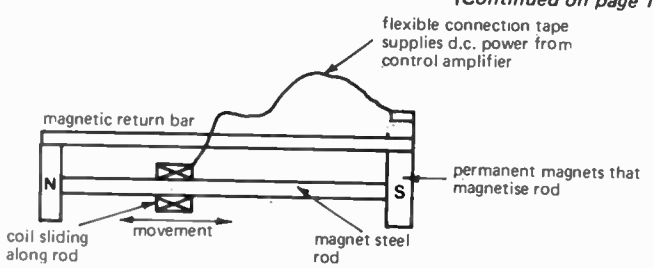


Fig. 11. Principle of the 'new' dc linear motors used in chart recorders.

Fig. 10. Early dc form of linear motor controlled with commutating switch. (1895)

LINEAR ELECTRIC MOTORS

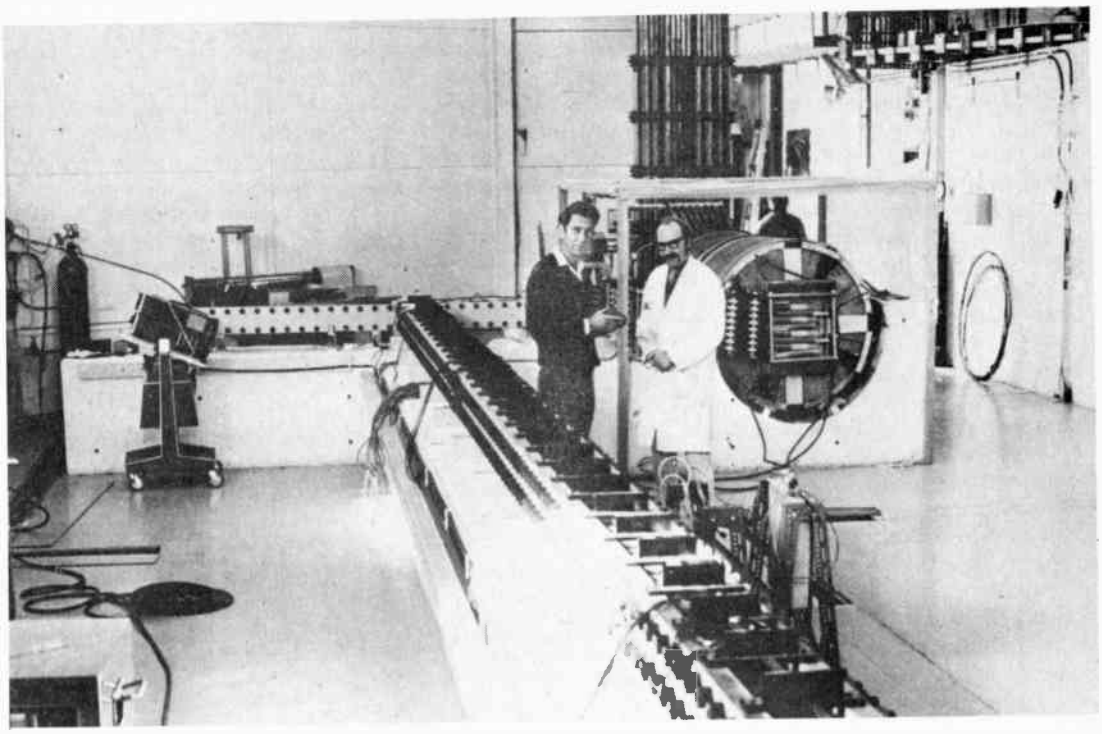


Fig. 12. Railgun for driving copper projectiles up to 2 Km.s^{-1}. The storage inductor is the round coil in the centre left. The rail switch runs across the rear with the railgun coming to the foreground.

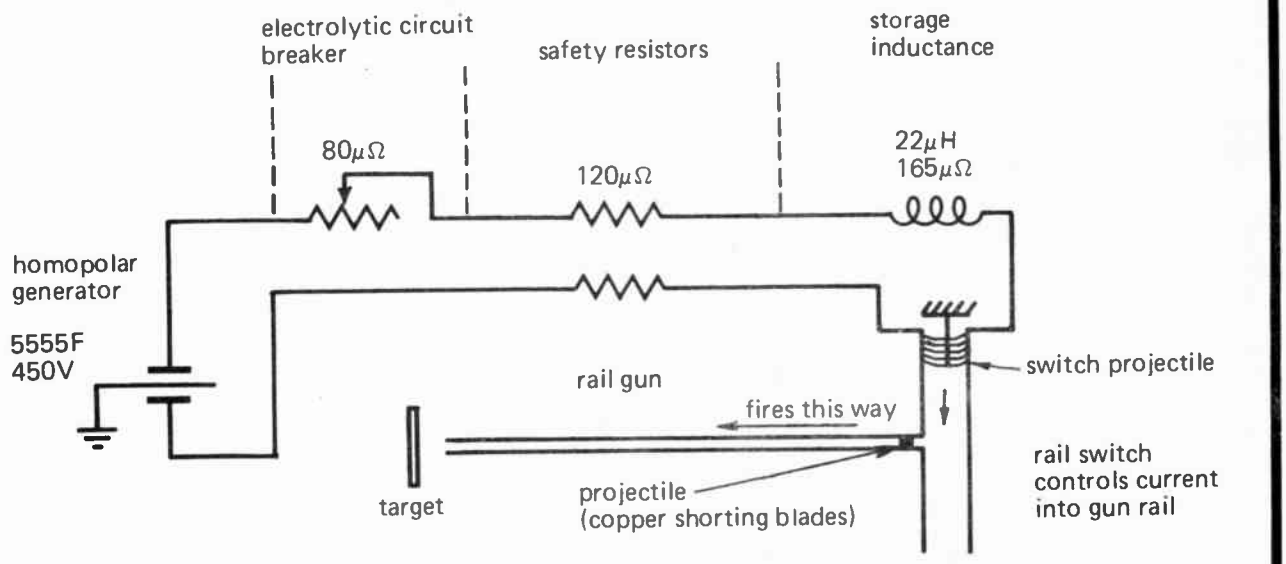


Fig. 13. Schematic diagram of the ANU railgun. Current drawn from homopolor generator is stored in 22μH inductor. Switch projectile is held back until peak current is reached. It then flies down the switching rails, crossing the rail gun opening at 300 ms. The main inductor current is thus transferred suddenly into the rail gun.
Field around rails at maximum 500 kA current is 600 k gauss. Acceleration of projectile is 50 million G!

OSCILLATING AC LINEAR MOTORS

The ac linear motors discussed so far are capable of providing infinite travel, running on until the stationary induction or plate windings end. If oscillatory motion is desired, switches are needed to reverse the thrust and this introduces more complications.

Another principle exists that provides rapid reciprocating action (for ranges to a metre or so) without the need for switching. So far, however, the method is unable to provide much power, but the principle is inherently fascinating and does find some use – applications suggested mainly include weaving shuttle drives. The construction of the motor is incredibly simple.

A vertical action motor consists of a long slender stack of magnetic iron laminations with a coil wound around the bottom. An electrically conducting ring placed over the iron will float (when the coil is energised with ac) by virtue of the induced currents producing a second magnetic field that reacts with that of the main coil. This causes the ring to lift to a stable place. This motor will not oscillate continuously, but only in a damped mode, settling to rest after a few overshoots. If, however, the coil is tuned to resonance with a capacitor, there is no stable position – the ring moves towards the coil increasing the resonance current that repels it, as it moves away resonance also falls away, reducing the thrust and so on.

The same idea works for a horizontal motor (see Fig. 9) except that a second tuned coil is placed over the other end to provide the restoring force provided by gravity in the vertical motor.

The force exerted by these motors

has been limited to-date by the heating of the short circuited ring – a higher current ring weighs more and so there is little gain. A workable motor once built by the writer to a design by West and Jayawant – see reading list – consisted of 2000 turns of 0.5 mm diam. wire tuned with 19μF to resonate the 0.7 H coils on a 50 Hz supply. The 0.5 m long core was built of laminations to a section of 25 by 25 mm. Oscillation occurs at around 100 V (where the coils draw 1 A each) and a light aluminium or brass ring reciprocates from between 400-800 traverses per minute.

There has apparently been little further development of these motors since their fortuitous discovery in the 1960s. (History has it that magnetic levitation was being studied with an untuned coil. It was decided to tune the coil to increase the current. The resulting oscillation was quite unexpected).

DIRECT CURRENT LINEAR MOTORS

Much has been and will continue to be said about the ac linear motor: this might lead the designer to assume that linear dc motors are impracticable. But study of the basic motor law of current in a field shows that the dc motor is also a distinct possibility.

Suggestions for linear motors, as depicted in Fig. 10, were dc coils switched in turn with a linear commutator. The simple idea of an electromagnet sliding along a magnetised bar escaped attention until this decade. Several chart recorder manufacturers are, right now, extolling the virtues of their new 'revolutionary' linear pen drive motors – in reality they consist basically of a coil of wire sliding on a round bar that is magnetised by permanent magnets at each end, as shown in Fig. 11. The iron circuit is closed with a flat bar. The coil is connected to the end with a printed wiring tape, through which a dc current is passed causing it to either attract or repel from the permanent field forcing it to move one way or the other. Traverse times for a 0.25 m stroke are around 200 ms. The sheer simplicity alone makes them superior to the earlier used, rotary drive systems and there is the further advantage that the drive element is directly connected to the pen, reducing backlash errors. Yet another instance where the obvious has been completely overlooked in motor development.

It might be thought that this is the simplest dc motor that can be devised. If, however, we return to basic operation we remember that a single current – carrying conductor moves perpendicular to field lines. A dc linear motor using just this has been built and it has some unusual performance figures.

It consists of two closely placed copper rails in which a sliding copper contact can run. This latter component acts as a shorting-bar. When high currents are fed to the rails a field is created around the rails and around the contact. The two react, pushing the contact along. This is the principle of the railgun, shown in Fig. 12. built at the Australian National University. The enormous energy of the homopolar generator (mentioned earlier) is stored in a 22μH inductor that releases 2.5 MJ of energy for just 150 mS. The 0.1 gm copper projectile accelerates down the rails to impact onto a target at 100 000 ms. The force on the projectile is 50 000 N. A similar 'gun' principle is used to switch the current into the gun rails. A 50×10^6 G schematic circuit of the equipment is given in Fig. 13.

Obviously these engineering-physicists are not studying new transportation motors! The experiment is to provide a test facility for creating pressures (at impact) akin to those found in the core of the earth.

The parallel of this linear version with the rotary homopolar motor is striking, for it too has basic simplicity and low-impedance characteristics that might be right for us with superconducting conductors. Perhaps this is really the form future linear transport motors will take – not the ac versions currently being popularized. Who knows, only time will tell!

THE LATEST DEVELOPMENTS

The most recent development to emerge from the Laithwaite and Eastham team is a simple method that provides both linear motor drive with magnetic levitation – with the same common magnetic circuits and coils. They have coined the phrase 'magnetic river' for their idea. In its conceptual form it appears as in Fig. 14. The U-cross provide stable levitation of the upper aluminium plate with the transverse flux propulsion motor. The magnetic river is still to be improved. Development of this form, like the discovery of the linear oscillating motor, was also largely fortuitous, for a wrong connection led to the realisation of stable levitation – which was unpredicted. This dual concept could be a rival to superconducting levitating systems.

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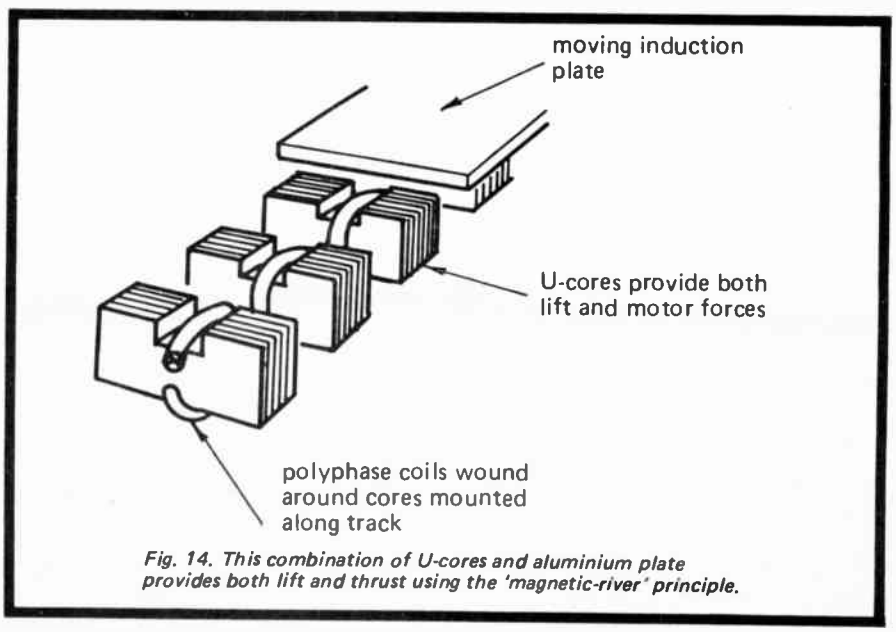

Fig. 14. This combination of U-cores and aluminium plate provides both lift and thrust using the 'magnetic-river' principle.

need we say more?

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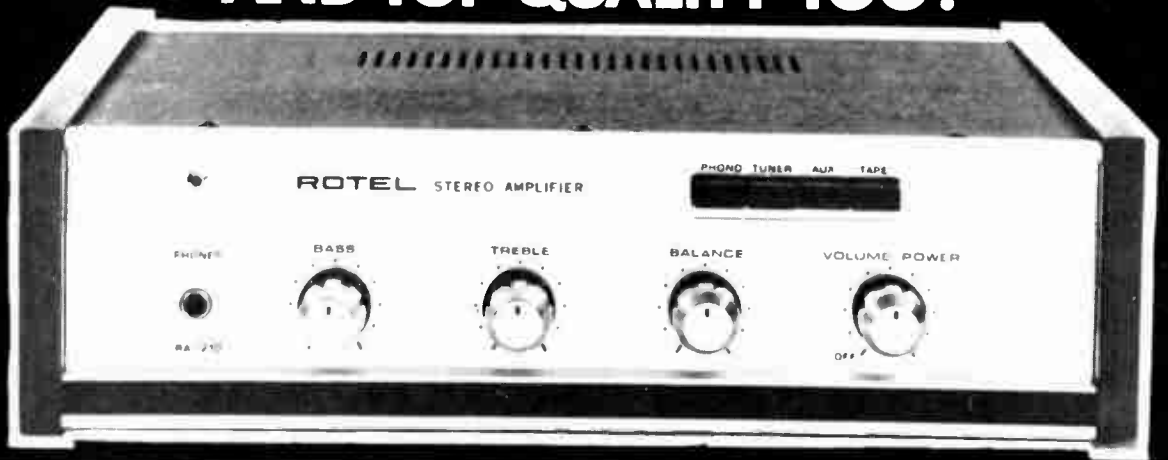

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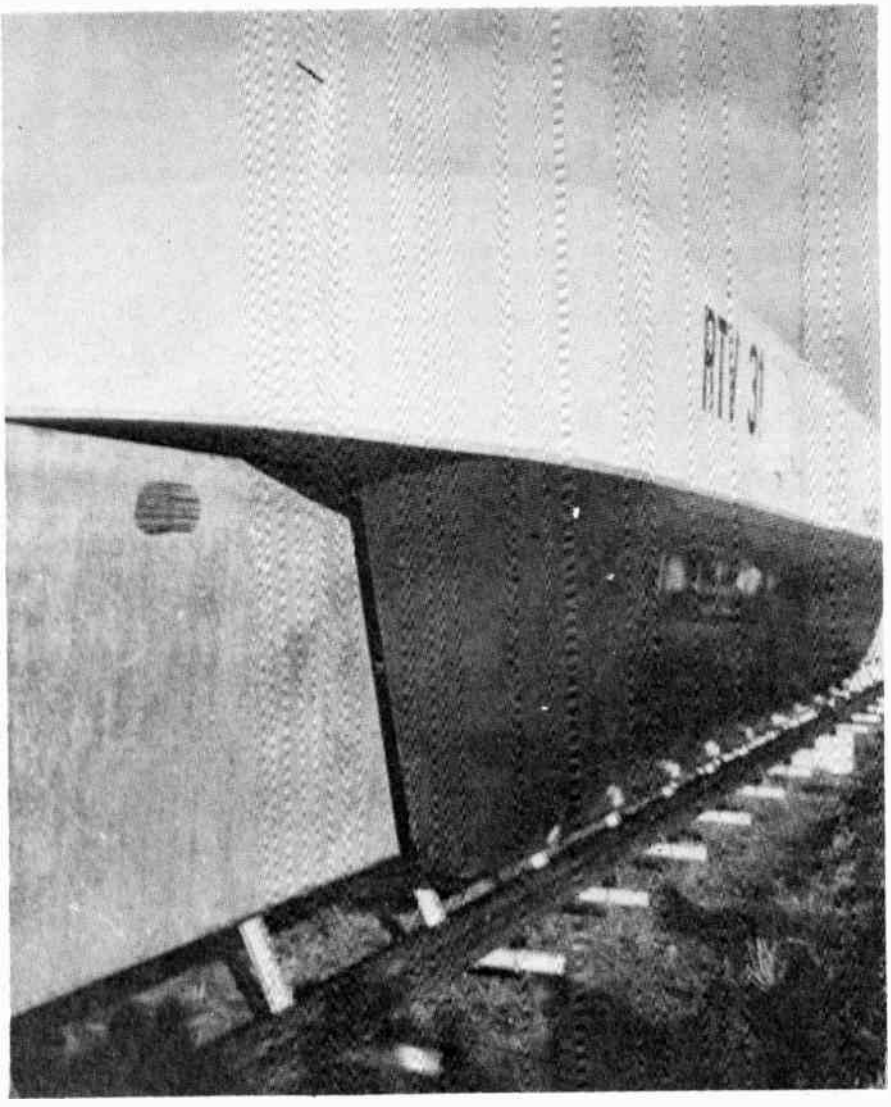
LINEAR MOTORS

by Professor E. R. Laithwaite, Imperial College of Science & Technology, London.



It is now certain that future high-speed ground transportation will be provided by magnetically levitated vehicles and as Dr Sydenham stated in his article on magnetic levitation (ETI, July 1973) the propulsive system will very likely be provided by some form of linear electric motor.

Here Professor Eric Laithwaite describes recent developments in the new and exciting technology involved in high-speed transportation research.

THE linear electric motor is believed to have been invented around the middle of last century, but it was little more than a scientific curiosity until comparatively recent times. Now many uses are being found for it, in step with marching technology. Conventional, cylindrical induction motors produce rotary motion and are easily the most popular forms of electric drive, owing to their contactless, brushless, intrinsically robust design. The linear type, which is basically a rotary motor unrolled into a flat form, has all the virtues of the cylindrical machine and functions in an equivalent way to produce a straight line drive.

The idea of effectively 'unrolling' a rotary electric motor so as to produce linear motion directly is quite an old one, in terms of the advances made in

The British experimental tracked hovercraft powered by a Laithwaite linear motor travelling at speed during trials. Early in 1973 the unmanned experimental vehicle achieved 107 mph on a one-mile stretch of track, subsequent development of magnetic levitation has subsequently caused the hovercraft principle to be abandoned (for this type of transport) but has not affected the principle of linear motor propulsion.

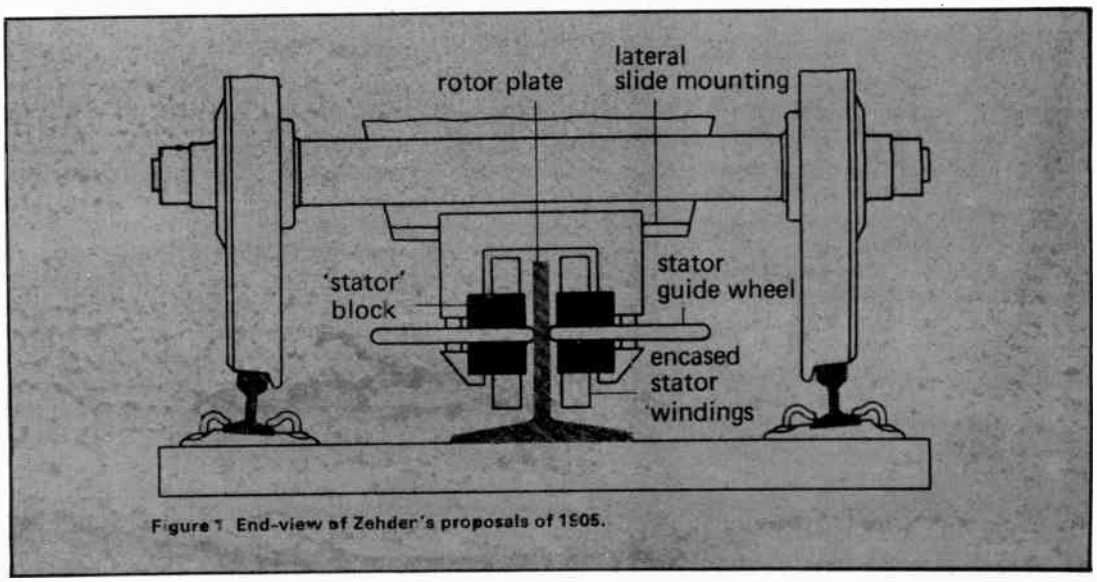


Figure 1. End-view of Zehder's proposals of 1905.

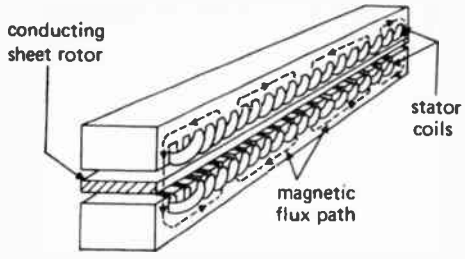


Figure 2 Double-sided sandwich motor with aluminium sheet rotor.

electrical technology in the last 25 years.

The first linear motor was probably built about 1845 and consisted of a row of coils switched on to a dc supply in sequence. The induction motor, even in rotary form, was not invented until 1888 and thereafter dominated the world of electric drives because of the intrinsic robustness of the rotor and the fact that the motion of the latter demanded no brushes or rubbing contacts and was therefore inherently reliable and required little maintenance.

The secondary member of an induction motor member ('rotor' in the case of a rotating machine) requires neither electrical nor mechanical contact with the driving member or stator. Seldom exploited in rotary machines — perhaps only in motors having gas bearings — this fact opens up exciting possibilities for driving very high speed vehicles where absence of contact with the ground is highly desirable, if not essential, It may be achieved by the use of the 'hovercraft' principle, by an amplifier-fed set of electro-magnets attracted to steel strips in the track or by currents induced in a conducting sheet on the track, either by superconducting dc magnets, or by ordinary ac electro-magnets in the vehicle itself.

Use of linear motors to propel railway vehicles was first proposed by Zehden in 1905 and it is interesting that his proposed layout was almost identical to those being currently developed in the United States of America, Japan, France and Germany.

A cross-section of this layout is shown at Fig. 1, in which the following points should be noted particularly:

(i) The primary member, consisting of rows of coils set into laminated steel blocks, is carried on the vehicle, whereas in rotary motors the primary member is the stationary part or 'stator'. The reason for this is fairly obvious, for the costs of providing a precise coil system and of feeding it with power, possibly for hundreds of miles, is clearly prohibitive unless the traffic density is extremely high — for example a vehicle passing any one point every 15 seconds.

(ii) The secondary member, which is secured to the track, has been made as simple as possible, containing no ferro-magnetic material but consisting of a simple aluminium plate mounted on its edge. The magnetic circuit is closed by having two primary rows of coils (as opposed to one only in the conventional rotary induction motor) arranged as shown at Fig. 2 (a plan view of the system). At any instant in time, a N-pole on one side of the sheet is opposite a S-pole on the other and the two sets of coils assist each other in forcing the magnetic field pattern through the conducting aluminium. Such an arrangement is now known as a 'double-sided sandwich motor' or 'sheet rotor motor'.

A FIFTY YEAR GAP

Zehden's patent was not exploited, presumably because of the high capital cost even of conducting initial experiments, or because the engineers of the day did not believe it possible to design machines of high efficiency with a large gap in the magnetic circuit — or both (the magnetic gap includes the thickness of the secondary plate, which is non-ferrous).

Linear motors reappeared, this time successfully, as liquid-metal pumps designed to pump sodium/potassium mixtures required in nuclear power stations, but so far as high speed transport systems were concerned there were but two landmarks between 1905 and 1957. In 1914 a Frenchman named Bachelet showed how to levitate and propel a conducting sheet by electro-magnetic induction and he formed a company of America developed a linear motor for launching aircraft. This machine ('Electropult') was built and accelerated aircraft to a take-off speed of 225 miles/hour (360 km/h). Up to the present it remains the fastest man-carrying linear motor built, though this record is likely to be smashed in 1974 if not in 1973.

The 'Electropult' is interesting from another viewpoint, however, in that it was not a sheet rotor motor but was single-sided and carried a ladder-network of copper bars in slots in a laminated steel slab in the track. The arrangement is shown at Fig. 3. The penalty for carrying the primary coils on the vehicle is that high power must be fed to the moving part via brushes and slip tracks, but the penalty for not doing so is many times greater.

The late 1950s and early 1960s saw a revival of interest in linear motors, especially for driving tracked vehicles such as railway coaches. The double-sided sandwich motor was developed to a state where its properties were comparable with those of a rotary motor of equal power, because theoretical studies culminating in the concept of a factor of 'goodness' had shown that a large airgap was not per se responsible for low efficiency but that 'goodness' increased with increase in speed. By 1966 engineers had accepted the idea that the sheet rotor motor was the only possible shape for vehicle traction, for only the simple aluminium sheet was possible, economically, for hundreds of miles of track.

INVESTIGATION

In 1967, a British company known as Tracked Hovercraft Limited (THL) was set up to investigate the possibilities of combining linear motor drive with air-cushion suspension and guidance. Following design studies by two large manufacturers, also in Britain, it was realised that a frequency higher than the industrial 50 Hz was needed for motors whose speeds were in excess of 150

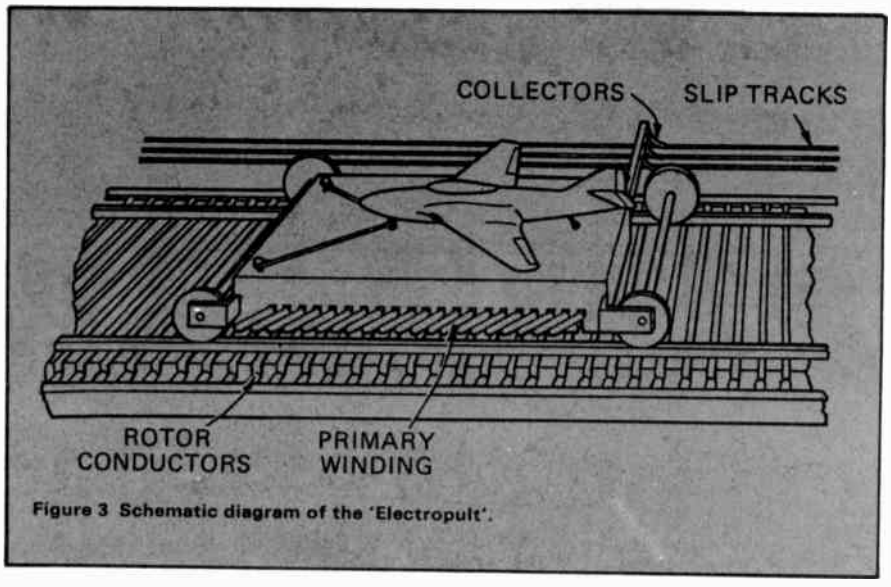


Figure 3 Schematic diagram of the 'Electropult'.

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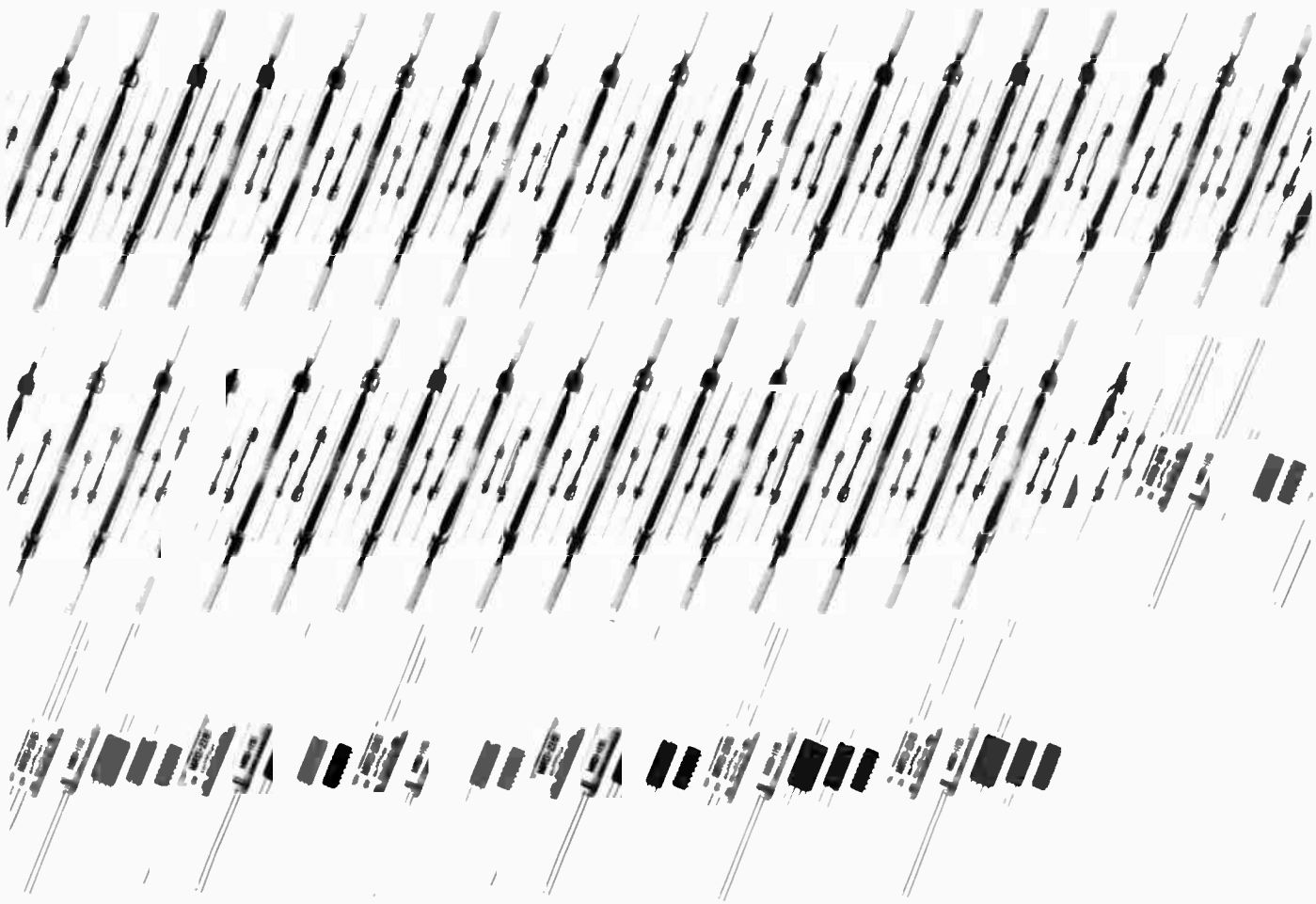

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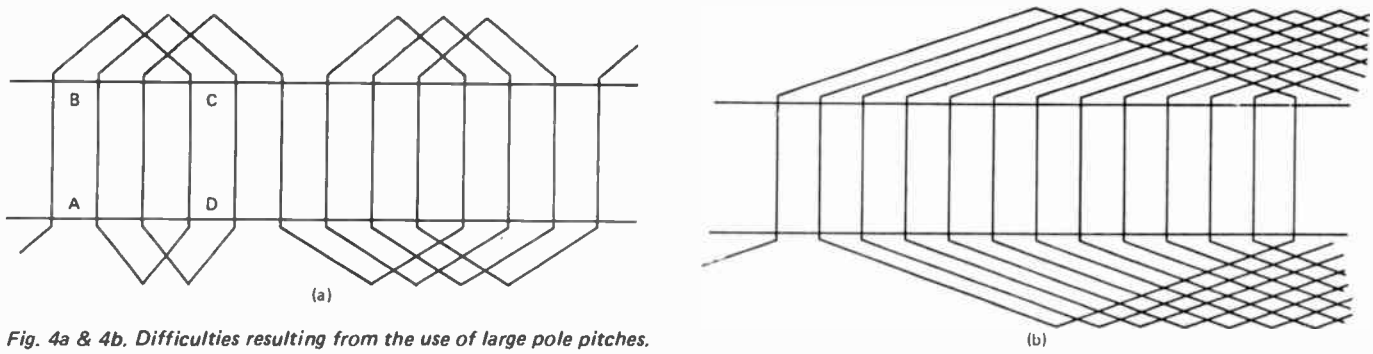


Fig. 4a & 4b. Difficulties resulting from the use of large pole pitches.

miles/hour (240 km/h), and this for the following reasons.

Reference to Fig. 2 shows that the whole of the flux emanating from one complete pole pitch of the motor surface must pass longitudinally (in the direction of motion) through the iron core of both sides of the primary. The depth of iron (d) behind the slots is therefore required to be of the order of half a pole pitch (assuming equal widths of slot and tooth). The speed of the travelling field, and therefore the terminal speed of the machine, is such that the magnetic field traverses two pole pitches in one cycle of the supply. Thus for supply-frequency f, the speed v is given by $2pf$ where p is the pole pitch. For 250 miles/hour (400 km/h) the value of p for $f = 50$ is about four feet (1.2m).

Examination of the method of winding primary coils in slots shows at once one of the difficulties resulting from the use of large pole pitches (Fig. 4). In (a) the use of roughly square poles means that the useful portions of the electric circuits such as AB and CD are nearly as long as the useless end-portions BC and DA, and the latter are not so long as to produce a great deal of leakage field, which would otherwise manifest itself as a low power factor of the machine overall. Moreover the coils can be laid one over the other by a relatively easy shaping of the 'elbows' in a plane perpendicular to that of the pole face.

Contrast this with the corresponding geometry of Fig. 4(b) where the motor is one foot (30cm) wide and has a pole pitch of four feet (1.2m). The end winding power losses are some five times those of the useful conductor, and the leakage field dominates the performance in that the equivalent primary reactance rivals the main magnetic circuit reactance; but, worst of all, it is virtually impossible to find space to accommodate the enormous bunch of overlapping end-sections.

The second difficulty with regard to large pole pitches can be seen from Fig. 2 in that even if each primary slot is three times as wide as a tooth, the dimension (d) is more than one foot (30 cm), making the motor excessively heavy.

The penalty of using a higher frequency to reduce the value of p is that of carrying a frequency-changer onboard, whose weight may be 10 tons or more, or that of a transmission and pick-up system at high frequency with all its attendant cost and fundamental limitations.

PROBLEMS ENDED

Until 1969 it appeared that there was a maximum speed for mains-fed linear motors which could have been as low as 100 miles/hour (160 km/h). The invention of the transverse flux motor, in February of that year, removed all the major problems of mains-fed linear motors up to 250 miles/hour (400 km/h) or more. Fig. 5 shows the almost philosophical arguments which led to the invention. In (a) the electric and magnetic circuits are seen to be in planes which intersect at right-angles, which is a necessary condition for the generation of force by electro-magnetism. But considering the direction of this force — that is the direction of travel — both circuits are seen to be elongated unprofitably and if one of these be turned through a right-angle, as in (b), it is immediately shortened and improved. What is more, its length is now independent of pole pitch. The magnetic circuit of a machine is 'weaker' than the electric for there is no magnetic equivalent of an electric insulator and therefore the benefits of a shorter circuit are properly assigned to the magnetic.

What this means in practice is that cross-sections of transverse flux machines (TFM) are as shown at Figure 6, some of which are single and some double-sided. The improvement in magnetic circuit is twofold. First, the core depth d is now only half a tooth width so that single-sided motors become technically feasible, even for tracks hundreds of miles in length. Second, the lower reluctance means that liberties may be taken in design so as further to cheapen the track cost — that is the core iron can be run well into saturation until its effective value of μ falls from 1000 to perhaps 50. It now becomes possible to run 250 miles/hour (400 km/h) motors from 50 Hz supply on a sheet of aluminium on the track backed by a solid sheet of boiler plate. ●

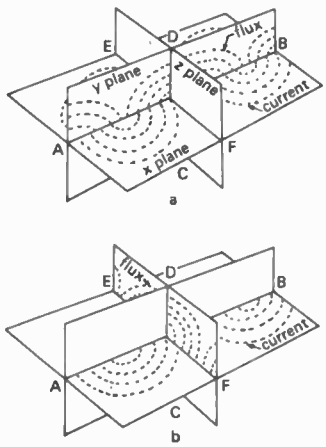


Figure 5 Topology of linear machines:
(a) 'Conventional' linear motor.
(b) Transverse flux machine.

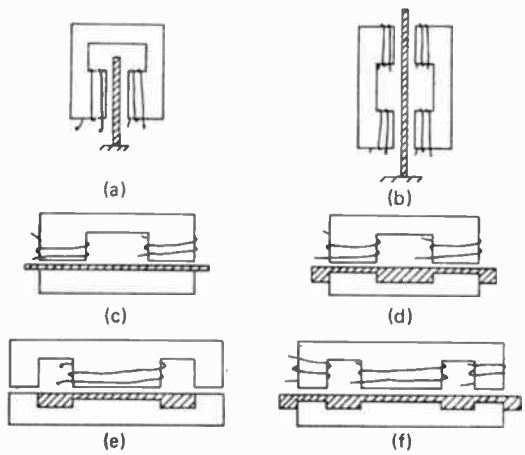
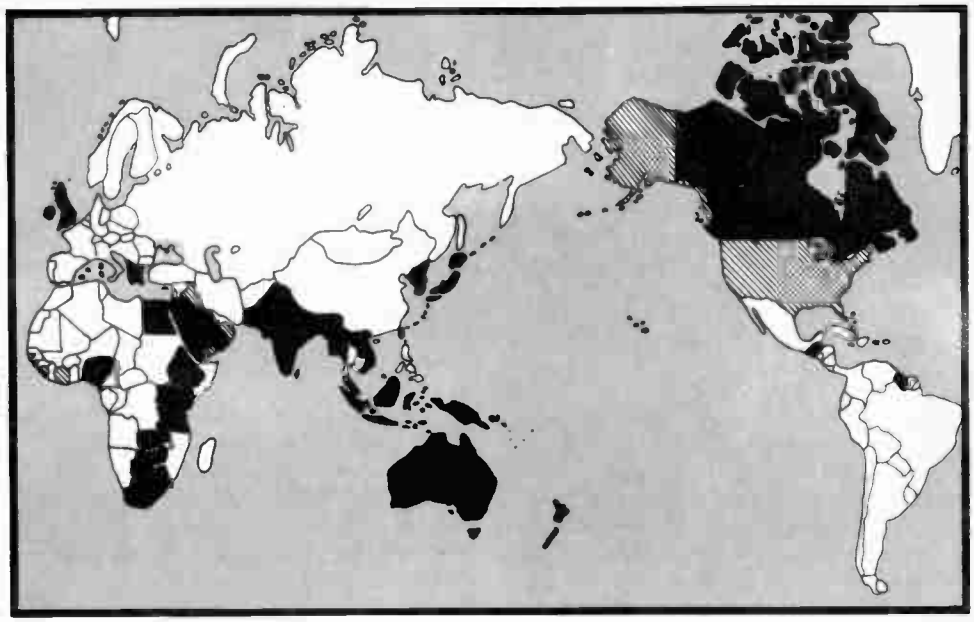


Figure 6 Cross-sections of transverse flux machines:
(a) and (b) Double-sided motors
(c)—(f) Single-sided motors with composite secondary.



This world map shows in shaded tones the countries which have not yet made plans for conversion to the metric system of measurement. The white areas are those countries which have converted and the solid areas are those countries in the process of conversion.

METRIC UNITS -revolution or evolution

15 McGregor St,
Kippa-Ring,
Q. 4020,
31.5.73.

Dear Sir,

I notice that a number of times you make mention of SI units but why do you as a scientific journal not use them. Some articles have a mixture of SI, non-SI metric and even British units. As a high school science teacher I insist on the exclusive use of SI units in my classes. I feel that magazines such as yours should be giving a lead in the use of such units. May I suggest that you present the magazine using nothing but the SI units and to facilitate this that you incorporate in the first such journal an article explaining the units, should any readers not be conversant with them already.

However it was not this when prompted my writing to you but rather the incorrect use of units. A common fault is the unit for force. The unit for forces of all types is the newton. Why is it then that you use the unit for mass (kilogram) for stylus force and for weight which is after all a force. Kilogram weight (not kilogram) is I realise a gravitational unit of force (but non-SI) but this is not what you use.

I firmly believe that units in physics are very important and that the SI is an extremely good system of units. I can see absolutely nothing to be gained in a technical or scientific magazine in the incorrect use of units or in any use on reference to British units whatsoever.

Yours faithfully,

E. A. Archer.

E.A. Archer

THIS letter received from Mr. Archer was most timely for it arrived just as we were planning an article on Australia's ever-increasing adoption of metric units.

There are however some points about which we must disagree.

The change to decimal currency for instance took less than the expected two years — people just did not want two systems going together, but things are not so easy when changing to numerous other metric units.

Manufactured articles and practices conforming to the old units cannot be replaced or modified overnight — that is too costly. To ease financial and educational burdens the changeover is to take about ten years — hopefully being complete by 1980. We must, therefore, all do our bit to help by compromising, by educating, by learning and by being neither impatient nor resistant to change.

Not all circumstances can

IN 1967 a committee was created in Australia to investigate the pros and cons of adopting the metric system. In 1970 the decision to go metric became law, and mechanisms to implement the change went into action with the intention of completing it over a ten year period – by 1980.

Why should Australia use metric units?

The reasons for adopting the metric system are manyfold. It is easier to use because of the uniform use of a base ten number system. It is easier to teach for the same reason. The major part of our export and import trade is with countries using or starting to use metric units. Less stock lines need to be carried due to the rationalisation of standard sizes adopted. Many migrants (who now constitute a large part of the population) are spared the need to learn an illogical system. It is the universal system used by science (scientists in the United States report their work in metric units even though their products are in Imperial sizes with those awkward fractions.) And, invaluably, it offers the chance to overhaul the units in use, using past experience to avoid the mistakes made before.

There are disadvantages, but they are all outnumbered. During the conversion period, and for some time afterwards, the main disadvantage will be trying to learn and use two systems together. Spares must be made to replace components of machines etc made before the changeover. Extra cost is involved but, taken all round, by gradually phasing out the old and replacing with the new it should be an easy cost to bear. Programs for conversion take this obsolesence into account.

Australia is not the first country to change from Imperial and other non-metric systems. South Africa, Britain, Canada, New Zealand and Japan are all on the way. In fact, the last count showed 136 countries are on the way, or soon will be. Figure 1 shows the state of metrication across the globe. The Americans have not legislated for the change but the general informed opinion is that they soon will, for their export trade is feeling the pinch more and more due to the lack of ability to supply metric measurement goods.

THE ORIGIN OF METRIC MEASUREMENT

In 1875 Stevin proposed a decimal units system but it was not until just after the French Revolution that a country (France) adopted the idea in a serious way. By 1800, ten nations were using it.

In 1875 the BIPM (International Bureau for Weights and Measures) was formed to maintain and improve the units of the metric system. This body is still in existance, and directives and resolutions from their laboratory (situated in the suburbs of Paris) originate as the collective wishes of forty-odd member nations who form the committees concerned with each of the units used.

Originally, the metric system was based on the units metre (for length), the gram (for mass) and the second (for time). In 1873, the centimetre was adopted instead of the metre thus forming the CGS system. But units of the CGS system were often too small, resulting in large numerical values in many calculations. There was also little provision for electrical or thermal units.

In 1948 the member nations agreed upon an improved set of units that were more practical to use. This became known as the SI system (Systeme International).

The base units of the SI are the metre (for length), kilogram (for mass), second (for time), ampere (for current), kelvin (for temperature), candela (for luminous intensity) and mole (for amount of substance). These units can be combined to obtain other, so called, SI derived units. To obtain larger or smaller values of a given unit, prefixes are used . . . kilo, pico, nano etc – rather than another unit, as was common practice in earlier systems.

It is important to realise that metrication does not necessarily imply adoption of SI units solely.

For example, the Systeme International would require the hour to be defined in megaseconds – so far no country has done this – or is even planning so to do.

Nevertheless the SI is gaining popularity and a number of 'metric countries' are actively changing to SI units.

Australia has chosen to retain a few other non-SI units already in use. Angular degrees, minutes and seconds, the millibar for meteorological pressures, the nautical mile and the knot are all to be continued, as before. The adoption of kilometres per hour for speed in transportation is another example of the adoption of a non-SI unit.

ORGANISATION FOR METRICATION IN AUSTRALIA

Metrication involves far more than change of units in science teaching and technology. Its effects (for measurement is vital to virtually all pursuits of developed nations) range from primary production through to recreation and health. It is no easy matter to convert a country of 14

tolerate such rigidity as total insistence. Our correspondent had to write his letter on Imperial size foolscap paper because, no doubt, he was unable to obtain the metric A4 size that is now the recommended standard. Data sheets, repair manuals, text-books, measuring instruments, etc. cannot be discarded because of the lack of metric units. Conversion must be evolutionary, not revolutionary, if it is to be accepted easily.

As our correspondent notes, our articles do use mixtures of old and new units – this is deliberate. We use new units because this is our way to give a lead. But we cannot use such units throughout, because a popular magazine must satisfy a wide range of interests and educational levels. Another difficulty that often arises is maintaining an adequate description in lay terms. For example, to quote measurements of components made in Imperial sizes in their metric equivalents can often cause confusion. ETI policy is for a gradual change to metric.

But it is not true to say that ETI uses units *incorrectly* by common useage standard. Mass and force units have been so curly that even the Metric Conversion Board recognises that confusion has and will continue to exist for some time.

We must not lose sight that units are for our convenience not our hindrance. There is little practical reason at this time for insisting on newtons when describing tracking and vertical stylus forces. The figures themselves relate to little else of the enthusiast's field of interest – they are used only for comparison between cartridges.

ETI will not be changing over exclusively to metric units right now but will follow the recommendations of the MCB. Only they have the right to specify the correct units to use and to decide the time of their introduction. In time it will be seen that a changeover is possible by less painful methods than overnight revolution.

METRIC UNITS

million people to a new system involving many new units.

The conversion of Australia is handled by several committees, Each committee is reponsible for metrication of specific slices of our life.

In 1970 the Metric Conversion Board (MCB for short) was established, and it, in turn, appointed eleven advisory committee Chairmen. Each advisory committee controls a number of sector committees so it is apparent that many responsible people are involved in organising the change. In fact over 900 people assist this way, meeting at the rate of one committee meeting somewhere each working day.

The Board has been responsible for the many posters and booklets sent throughout the country in recent months. Most households have received one, entitled "To the householder – metric conversion and you". This booklet was written to satisfy the domestic need and is, perhaps, not entirely suited to the more technical person's requirements. Included, as Fig. 2 is a concise technical list that suffices for most circumstances. Perhaps you have seen this as a large, A2 size, green and white poster, (paper sizes also go metric replacing foolscap and quarto).

A booklet, "Metric Practice", was released this year (obtainable from the sources quoted at the end of this article). It is a useful technical work and includes a comprehensive list of the names and symbols of metric units to be used (arranged alphabetically). It lists prefixes and shows how the appropriate prefix should be selected, how to arrive at the derived units and how to write them in the recognised form. A list is also given of the now non-preferred (or deprecated) metric units . . . that is, recognised form. A list is also given of the now non-preferred (or deprecated) metric units . . . that is, those that should *not* be used in Australia.

Common units, such as the Angstrom, atmosphere, calorie, dyne, erg, gauss, kilogram force, Maxwell, micron, oersted, phot, stilb and torr should not be used in newly prepared literature, presentations or products. Also worth reading is a section on pronunciation and usage of the new units. We hear many arguments on how to pronounce the names or spell the words such as, the tonne, kilogram and metre – guidance comes from this section.

During the changeover period it will often be necessary to convert from the old to the new. In many instances an approximate conversion factor suffices, but for legal purposes, trade, and accurate design calculations the legally correct conversion factor must be used. These are listed in this booklet, several pages being devoted to getting from a unit to its equivalent. Have you heard of a tex, grade, fermi, bar or langley? The list is exhaustive.

Finally presented in the booklet are a number of nomograms enabling one unit to be graphically read-off from its replacement equivalent.

SOME METRIC UNITS FOR EVERYDAY USE

Quantity	*Imperial Unit*	*Metric Unit*	*Conversion Factors (Approximate)*	
			Imperial to Metric Units	*Metric to Imperial Units*
LENGTH	inch (in)	millimetre (mm) or centimetre (cm)	1 in = 25·4 mm	1 cm = 0·394 in
	foot (ft)	centimetre or metre (m)	1 ft = 30·5 cm	1 m = 3·28 ft
	yard (yd)	metre (m)	1 yd = 0·914 m	1 m = 1·09 yd
	furlong (fur)	metre (m) or kilometre (km)	1 fur = 201 m	1 km = 4·97 fur
	mile	kilometre (km)	1 mile = 1·61 km	1 km = 0·621 mile
	(for navigation)	international nautical mile (n mile)	1 n mile = 1852 m	
MASS	ounce (oz)	gram (g)	1 oz = 28·3 g	1 g = 0·0353 oz
	pound (lb)	gram (g) or kilogram (kg)	1 lb = 454 g	1 kg = 2·20 lb
	stone	kilogram (kg)	1 stone = 6·35 kg	1 kg = 0·157 stone
	ton	tonne (t)	1 ton = 1·02 t	1 t = 0·984 ton
AREA	square inch (in^2)	square centimetre (cm^2)	1 in^2 = 6·45 cm^2	1 cm^2 = 0·155 in^2
	square foot (ft^2)	square centimetre (cm^2) or square metre (m^2)	1 ft^2 = 929 cm^2	1 m^2 = 10·8 ft^2
	square yard (yd^2)	square metre (m^2)	1 yd^2 = 0·836 m^2	1 m^2 = 1·20 yd^2
	perch (p)	square metre (m^2)	1 p = 25·3 m^2	1 m^2 = 0·0395 p
	rood (rd)	hectare (ha)	1 rd = 0·101 ha	1 ha = 9·88 rd
	acre (ac)	hectare (ha)	1 ac = 0·405 ha	1 ha = 2·47 ac
	square mile	square kilometre (km^2)	1 square mile = 2·59 km^2	1 km^2 = 0·386 square mile
VOLUME	cubic inch (in^3)	cubic centimetre (cm^3)	1 in^3 = 16·4 cm^3	1 cm^3 = 0·0610 in^3
	cubic foot (ft^3)	cubic metre (m^3)	1 ft^3 = 0·0283 m^3	1 m^3 = 35·3 ft^3
	cubic yard (yd^3)	cubic metre (m^3)	1 yd^3 = 0·765 m^3	1 m^3 = 1·31 yd^3
	bushel (bus)	cubic metre (m^3)	1 bus = 0·0364 m^3	1 m^3 = 27·5 bus
VOLUME (fluids)	fluid ounce (fl oz)	millilitre (ml)	1 fl oz = 28·4 ml	1 ml = 0·0352 fl oz
	pint (pt)	millilitre (ml) or litre (ℓ)	1 pt = 568 ml	1 litre = 1·76 pt
	gallon (gal)	litre (ℓ) or cubic metre (m^3)	1 gal = 4·55 litre	1 m^3 = 220 gal
	acre foot	cubic metre (m^3) or megalitre (Ml)	1 acre foot = 1230 m^3 = 1·23 Ml	1 Ml = 0·811 acre foot
FORCE	pound-force (lbf)	newton (N)	1 lbf = 4·45 N	1 N = 0·225 lbf
	ton-force (tonf)	kilonewton (kN)	1 tonf = 9·96 kN	1 kN = 0·100 tonf
PRESSURE	pound per square inch (psi)	kilopascal (kPa)	1 psi = 6·89 kPa	1 kPa = 0·145 psi
	atmosphere (atm)	kilopascal (kPa) or megapascal (MPa)	1 atm = 101 kPa	1 MPa = 9·87 atm
	ton per square inch (ton/in^2)	megapascal (MPa)	1 ton/in^2 = 15·4 MPa	1 MPa = 0·0647 ton/in^2
	(for meteorology) inch of mercury (inHg)	millibar (mbar)	1 inHg = 33·9 mbar	1 mbar = 0·0295 inHg
			1 mbar = 100 Pa	
VELOCITY	mile per hour (mph)	kilometre per hour (km/h)	1 mph = 1·61 km/h	1 km/h = 0·621 mph
	(for navigation)	knot (kn)	1 kn = 1·85 km/h	
TEMPERATURE	temperature (°F)	temperature (°C)	$°C = \frac{5}{9}(°F - 32)$	$°F = \frac{9 \times °C}{5} + 32$
DENSITY	pound per cubic inch (lb/in^3)	gram per cubic centimetre (g/cm^3) = tonne per cubic metre (t/m^3)	1 lb/in^3 = 27·7 t/m^3	1 t/m^3 = 0·0361 lb/in^3
	ton per cubic yard	tonne per cubic metre (t/m^3)	1 ton/yd^3 = 1·33 t/m^3	1 t/m^3 = 0·752 ton/yd^3
ENERGY	British thermal unit (Btu)	kilojoule (kJ)	1 Btu = 1·06 kJ	1 kJ = 0·948 Btu
	therm	megajoule (MJ)	1 therm = 106 MJ	1 MJ = 9·48 × 10^{-3} therm
	(for electrical energy)	kilowatt hour (kWh)	1 kWh = 3·60 MJ	
POWER	horsepower (hp)	kilowatt (kW)	1 hp = 0·746 kW	1 kW = 1·34 hp
TIME		second (s)		
		minute (min)	1 min = 60 s	
		hour (h)	1 h = 3600 s	
FREQUENCY	cycle per second (c/s)	hertz (Hz)	1 c/s = 1 Hz	1 Hz = 1 c/s
ANGULAR VELOCITY	revolution per minute (rpm)	radian per second (rad/s) revolution per minute (rpm)	1 rpm = 0·105 rad/s	1 rad/s = 9·55 rpm

UNITS RELEVANT TO ELECTRONICS

To complete this brief survey of metrication we now take a look at those units relevant to electronics in particular. Fortunately, most electronic units are SI, or derived SI, so there are few changes to remember. The volt ampere, ohm, farad, henry, coulomb and watt are not changed.

The unit for conductance, "mho", is now out, being replaced identically by the "siemens" (symbol S and always spelt with the final s). The magnetic unit, "gauss", is also deprecated being non-SI one should now use the "tesla" a derived SI unit (10^4 gauss = 1 tesla or 1T).

Other changes include dropping "horse-power", using its equivalent 'watt" value instead and dropping "centigrade" in favour of Celsius (the former is the same name as an angular unit used extensively in European countries).

To resolve the force and mass confusion existing with the previous *synomomous* use of "pounds-mass" and "pounds-force", a new unit has been introduced into the metric system. This is the "newton" which is the unit of force. Kilogram is reserved for mass.

When expressing the value of the temperature of everyday objects such as the maximum temperature allowable for a transistor then the value should be quoted in degrees Celsius (e.g. 60°C). But if a temperature *difference* is being stated, such as the temperature differential between the junction and the case of a transistor, then the thermodynamic

SPELLING, PRONUNCIATION AND USAGE

KILO

Used as a prefix with any unit, the pronunciation should be 'kill-o' with the accent on the first syllable and 'o' pronounced as 'oh'. The term 'kilogram' is often abbreviated (unofficially) as 'kilo' pronounced 'kee-low' with the 'ee' as in heel' and the accent on the first syllable. It has no legal standing and its use other than in casual speech should be avoided.

GRAM

The spellings 'gram' and 'gramme' are both allowed under Commonwealth weights and measures legislation, but the Metric Conversion Board prefers the shorter spelling for all units which embody the term.

KILOGRAM

Although a base unit, the name of this unit contains the prefix 'kilo'. Names of decimal multiples and sub-multiples of the unit are formed by attaching prefixes to the word 'gram'.

METRE

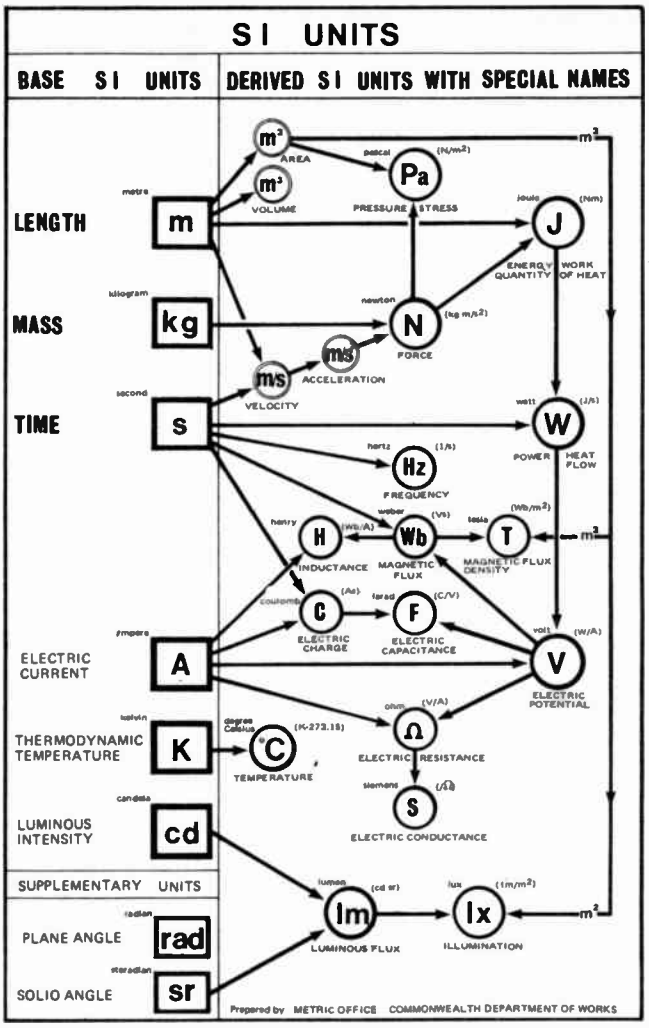
The spelling 'meter' is not acceptable, for the name of the base unit of measurement of length.

KILOMETRE

The correct pronunciation is 'kill-o-metre' not 'k'lom-etre'.

LITRE

This unit is used mainly for volumes of liquids and gases. The spelling 'liter' is not legally acceptable. The symbol for litre is lower case l (ell) and if properly separated from the numbers by a full space is unlikely to be confused with the number one (1). If not correctly spaced the number may appear to have no unit of measurement. Where there is any risk of confusion with the number one (1) the word 'litre' should be spelled out in full or a script ℓ used.



temperature scale (kelvin) should be used. In the written form the unit is expressed just as "kelvin" — degrees are not mentioned. In abbreviated form it is written just as K.

Another change that we have more or less already adopted is the use of "hertz" instead of "cycles per second". Kilowatt-hour and watt-hour are retained but should now be used only for expressing electrical forms of energy. Pressure and stress units have been given a specific name — the pascal (1 Pascal = 1 N/M^2 or NM^{-2}).

Another former practice that should not be adhered to is the use of multiple prefixes. For example micro microfarad, or uuF, is not correct, it should be expressed as picofarad (pF).

The MCB publish a monthly document called the "MCB Newsletter". In this the Board keeps us informed of progress of conversion, peoples' reactions to it, how to go about metrication, and committee reports. It also gives useful information on who is producing metric products in Australia, what is to be the adopted unit in cases not defined by the rules etc. For example, the unit of fuel consumption in car testing is to be litres per hundred kilometres, (1/100km), the Joe Bloggs company is making metric tape measures, road signs to be metric by 1976. ●

PREFIXES

A prefix is attached to a unit to indicate a multiple or sub-multiple of the unit —

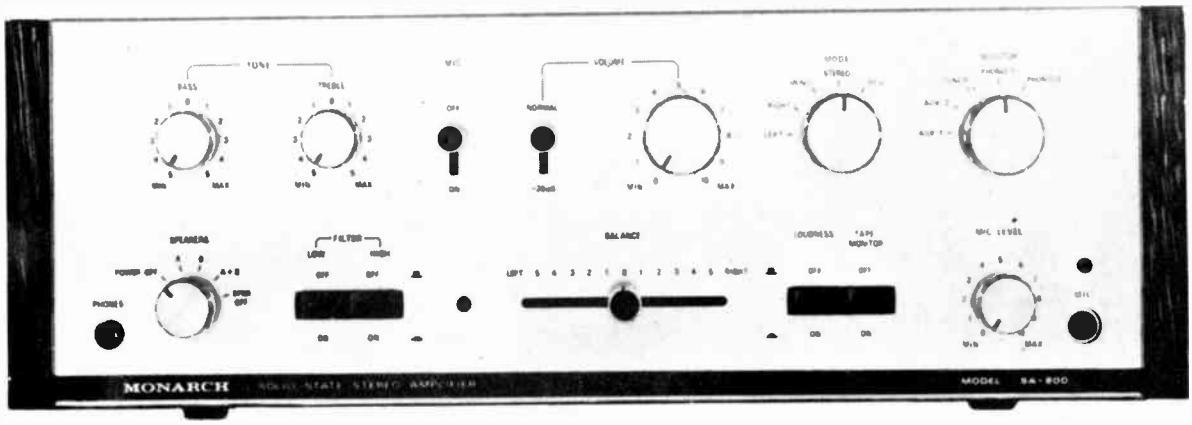
millimetre is one thousandth of a metre
kilometre is one thousand metres

The following table shows the factor by which the prefix multiplies the unit to which it is attached.

PREFIX	SYMBOL	MEANING	FACTOR BY WHICH UNIT IS MULTIPLIED	
+tera	T	one million million	10^{12} =	1 000 000 000 000
+giga	G	one thousand million	10^{9} =	1 000 000 000
mega	M	one million	10^{6} =	1 000 000
kilo	k	one thousand	10^{3} =	1 000
+hecto	h	one hundred	10^{2} =	100
+deca	da	ten	10 =	10
+deci	d	one tenth	10^{-1} =	0·1
centi	c	one hundredth	10^{-2} =	0·01
milli	m	one thousandth	10^{-3} =	0·001
micro	μ	one millionth	10^{-6} =	0·000 001
+nano	n	one thousand millionth	10^{-9} =	0·000 000 001
+pico	p	one million millionth	10^{-12} =	0·000 000 000 001

+ not generally encountered

Three Kings



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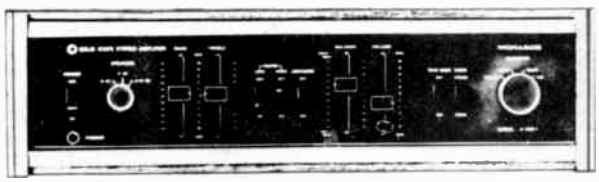
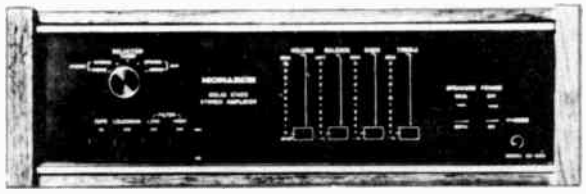


MONARCH SA 5001 (60 watts RMS)
Recommended retail price $189



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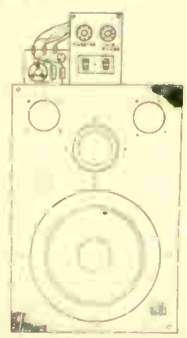

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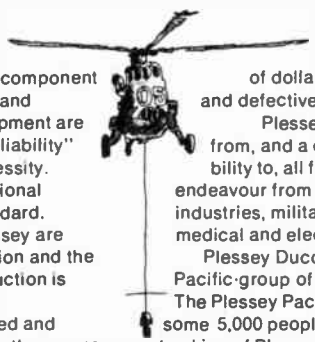

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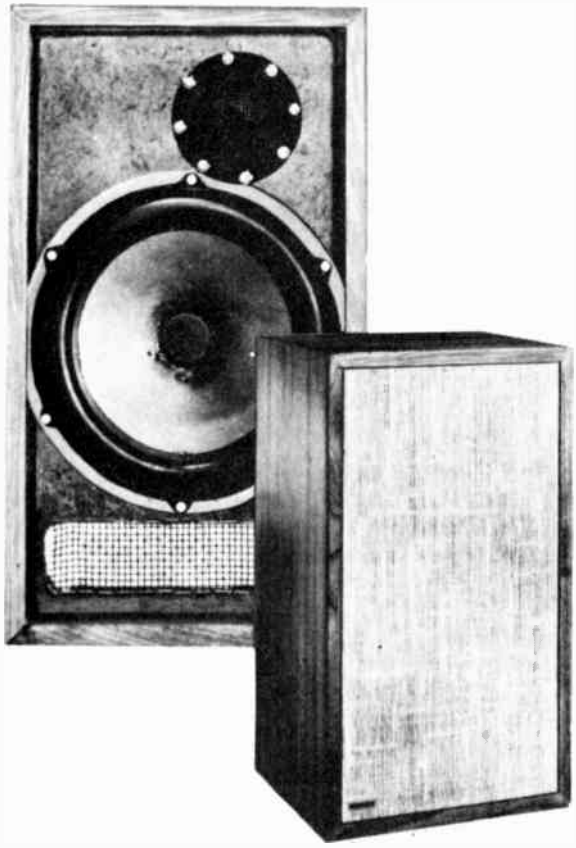

"...you'll have a hard time buying more musical naturalness at any price."

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

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AMATEUR RADIO

Roger Harrison VK2ZTB

THE STATE OF THE ART

CONTINUING in the same vein as last month, but on a different topic, this month I am going to discuss propagation.

There are some modes of HF radio propagation that remain little used or indeed, entirely unexploited. One in particular, chordal hop propagation, could be used to great advantage by many HF stations. VHF stations exploit this mode to work Transequatorial Propagation (or TEP) (see ETI June 1973, p.88) on the 52 MHz band. Chordal Hop propagation occurs when a radio wave is reflected from two or more places in the ionosphere without intermediate ground reflection. This is illustrated in Fig. 1.

The ionosphere is not always concentric with the earth, 'Tilts' occur at various times and places and it is these tilts that can assist chordal hop propagation. The tilts that regularly form symmetrically about the magnetic equator are well known and account for class 1 TEP. Tilts also occur in the F-layer along the sunrise/sunset line. Chordal hop propagation can be launched into the night-time F-layer using the sunrise/sunset tilt with remarkably low attenuation and consequent increase in signal strength at the receiving end. The reduced attenuation is a result of two factors; the signal spends less time in the absorbing D or E layers and is reflected from the F-layer at a low angle which is a very efficient reflection as the number of electrons that can be involved in power wasting collisions is less than for a wave reflected at a higher angle of incidence. This mode of propagation across the sunrise/sunset tilt is illustrated in Fig. 2.

This mode of propagation has a number of advantages. Provided the signal is launched at a low angle (generally 5^{o} or less) the signal strength at the receiving end is considerably above what could normally be expected. Amazingly, the signal improvement over conventional propagation may be as much as 30 dB! Secondly, frequencies much higher than the predicted MUF can be used. In any event, classical theory suggests that low radiation angles are an advantage in ionospheric propagation. Elevated sites are favourable for low radiation angle working, as are sites on flood plains or near the sea. Details of low radiation angle antennas are included in most of the standard amateur texts. However, some different, and more efficient designs have appeared from time to time in such journals as IEEE Transactions on Antennas and Propagation; Proceedings of the IREE (both Australian and American editions); Nature, Physical Sciences as well as QST and Ham Radio. The RSGB journal 'Radio Communications' has reported from time to time the activities of a number of British and Australian amateurs who appear to be exploiting the sunrise/sunset tilts in establishing contact at unexpected times. Several British stations run very low powers (several watts or less) and are heard consistently to outperform stations running high power and good beam antennas. Located at seaside sites and using low radiation angle antennas these stations show what can be done when traditional HF station setups and operating is ignored and other methods investigated.

SURFACE WAVE ANTENNAS

The reliability of relatively short paths that presently rely on high angle ionospheric reflection can be substantially improved with the use of surface wave antennas. These antennas launch radio waves such that they are 'guided' by the surface of the earth. A 1971 paper by A. F. Wickersham in Nature, Physical Sciences (reported in

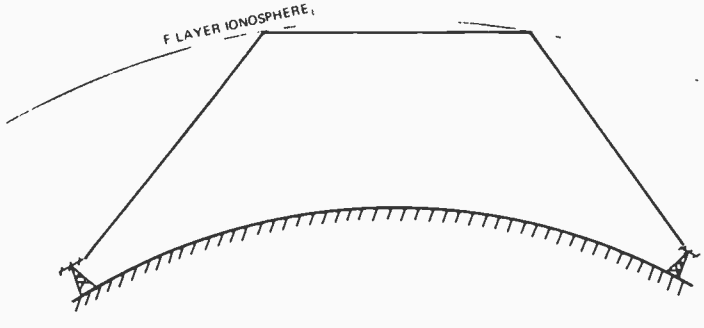

Fig. 1. Chordal hop propogation.

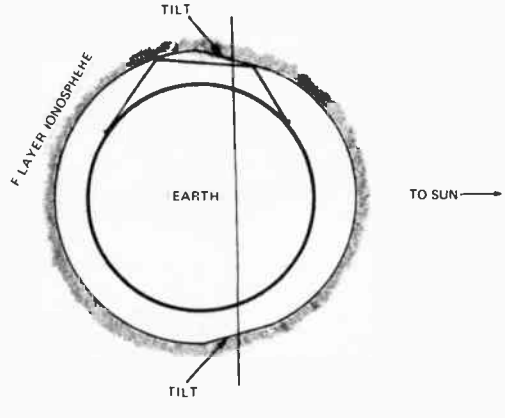

Fig. 2. Sunset/sunrise tilts in the F-layer, and chordal-hop propogation using the tilt.

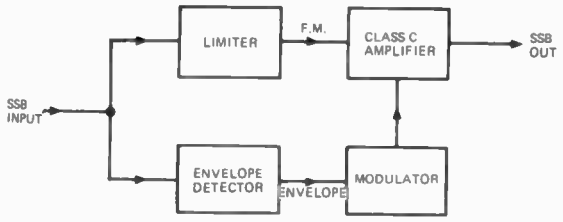

Fig. 3. Separation of SSB signal into FM and envelope components enabling the signal to be treated as if it were FM, SSB is restored by remodulation with the envelope.

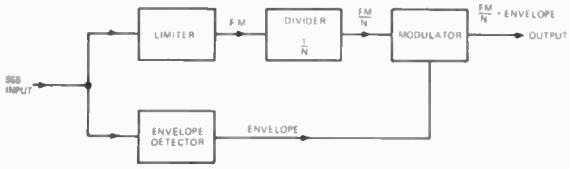

Fig. 4 (a). Processing of an SSB signal in preparation for multiplication by a factor N.

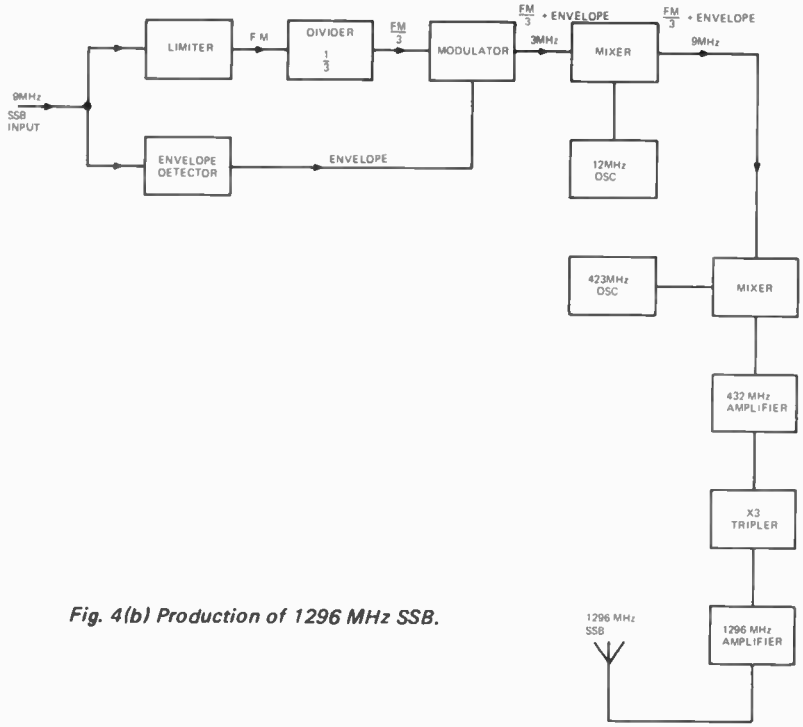

Fig. 4(b) Production of 1296 MHz SSB.

ETI October 1971, p.77) details experiments carried out in California on both HF and VHF surface wave antennas. Wickersham predicted that using a power of 100 watts and a surface wave launcher, received power over a distance of 3700 miles over seawater would be at a level of 105 dBm. This is readily detected, as most modern communications receivers can detect a signal at 140 dBm. No fading is experienced on circuits employing surface wave antennas at each end. Using surface wave antennas allows prediction of the received signal strength at a given range with a given transmitter output power.

Obviously, many locations are unfavourable for launching surface waves but surface wave antennas can still be employed to advantage as low radiation angle antennas with the advantages discussed above. It's worth looking at . . . especially if you're confined or addicted to low power operation.

SSB SIGNAL PROCESSING

Further to last month's material on the subject of SSB signal processing I think that it's about time an idea that has been discussed in various journals recently gets a wider airing. An article in UKW-Berichte (the German language edition of VHF Communications) by DK1PN, December 1969 proposed a method of processing an SSB signal such that it could be multiplied in frequency, without attendant distortion problems, by class C multipliers or varactors. A subsequent article by Carl Meinzer DJ4ZC in QST, October 1970, P.32 further discussed this technique giving a circuit and discussing the results.

The technique involved was prompted by a technique that was investigated in the 1950's this being SSB generation by envelope-elimination-and-restoration. (see Proc. IRE (America) December 1956, Kahn, 'Comparison of Linear Single Sideband Transmitters with Envelope-Elimination-and-Restoration Single-Sideband Transmitters").

As SSB signal can be separated into FM and envelope components. The envelope of an SSB signal does not resemble the original audio, but is a complex result of the sideband-generating process. The two components can be separated as shown in the block diagram Fig. 3. The SSB signal is passed simultaneously to a limiter and envelope detector. The limiter removes all amplitude components leaving the frequency components which actually resemble an ordinary FM signal. The FM components can be amplified in a conventional class C amplifier. A modulator is then used to add the envelope component and the original SSB is restored. Strangely enough the envelope component contains frequencies from 0-20 kHz which is rather more than the voice bandwidth set by the generating method of the SSB.

We know that a frequency multiplier also multiplies the deviation of an FM signal; hence the bandwidth is also multiplied. Multiplication destroys the original signal when any form of amplitude modulation is used. Thus an SSB signal cannot ordinarily be multiplied without destroying it. But, if we treat the SSB signal as a combination of amplitude and frequency components, separating the two modes, we can utilise the process shown in Fig. 4.

If the FM component is passed through a divider, and the resultant then modulated with the envelope component of the original signal, the end product can be passed through a multiplier and the original SSB restored.

If the processed SSB is heterodyned to one of the VHF or UHF bands and then multiplied by the required amount, SSB can be obtained somewhat more easily than by the conventional heterodyning technique. For example, if a 9 MHz SSB signal is separated as shown in Fig. 4, the FM component divided by three; the resultant, heterodyned back to 9 MHz, can then be heterodyned up to 432 MHz in a conventional fashion. The 432 MHz can then be tripled to 1296 MHz, restoring the SSB and producing an SSB signal on UHF without the attendant problems associated with the heterodyne method — as well as being considerably simpler.

Carl, DJ4ZC, has used such a method to produce 1296 MHz SSB which exhibits a measured overall system distortion (third order) of 25 dB. Stations worked have reported that the resulting signal sounds completely normal, and in no way shows effects of the processing it underwent.

The method shown is not the only way of obtaining SSB with divided FM components. Phase Locked Loops in the divide mode or regenerative dividers could be used, without the necessity of using limiters to remove the envelope. ●

Maxell cassette tapes The answer for the sound you're after

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N1651/1

SENSORS ON

A new, regular monthly feature by 'Talus'

MEASURING THE RATE OF RETURN

IN SCIENTIFIC research it is amazing how far a little idea can go when it comes to suggesting theories at the frontier of knowledge. If only we could evaluate the worth of scientific ideas and theories at the time of conception!

Reports that are of doubtful use or validity are forever being published in learned journals. For example, recent papers to appear in print in highly recognized periodicals include, a study of the apparent rotation of the great Pyramids that has been attributed to an effect of continental drift – they point just a few minutes of arc away from true north so it is thought they were originally set to the true north and have moved relative to the stars. Another report, a Russian one, claims that tests indicate that biological cells transmit information to each other by ultraviolet radiation. A third report was that a specific type of molecule decides the specific behaviour patterns in animals – another paper soon appeared pointing out that the experiment was highly suspect and that the wrong conclusion had been drawn from the test performed with a rat.

Each example could be a reality: we cannot tell without resorting to the application of more funds and expert time. So the literature grows and grows with new ideas all waiting to be shot down or proven correct and useful.

What would happen if we confined our financial support of research to more obviously measureable programmes? Industry is far more cautious than governments in this respect. For example, we need a crash programme to produce the electronic components right now.

Perhaps you don't realise it, but we do not always get complete facts about the larger research programmes. They often start with a fan-fare of trumpets and any amount of publicity in the mass media. What we don't hear very often is that many fail to realise anything obviously worthwhile. One that comes to mind is the rain-making experiments. A "little birdy" tells me that decades of CSIRO research on this had led to a situation where one statistician says his analysis shows slight gain, another says his method can't detect a change. (No doubt other programmes report the same way.) Another "birdy" recently related to me that the location cone system designed to re-enter a deep sea drill rig bit (by ultrasonic guidance) is a flop.

Some progress is always gained – even the apparently unsuccessful projects contribute something – but as the gains are highly subjective perhaps many are not worth the cost in most people's estimation.

Pure research programmes are needed, there is no denying that. So to be on the safe side, we pour resources into them in the hope of a breakthrough. The control of this spending varies from country to country. Here in Australia, public criticism is scant. People just don't seem to care how much is spent this way, on what, and for what return. In my view, a lot more should be spent on technological research so that we get more out of our scientific expertise. They call it Engineering Science overseas; but such multi-disciplinary approaches are hard to organise in the Australian way of pigeon-holed subjects.

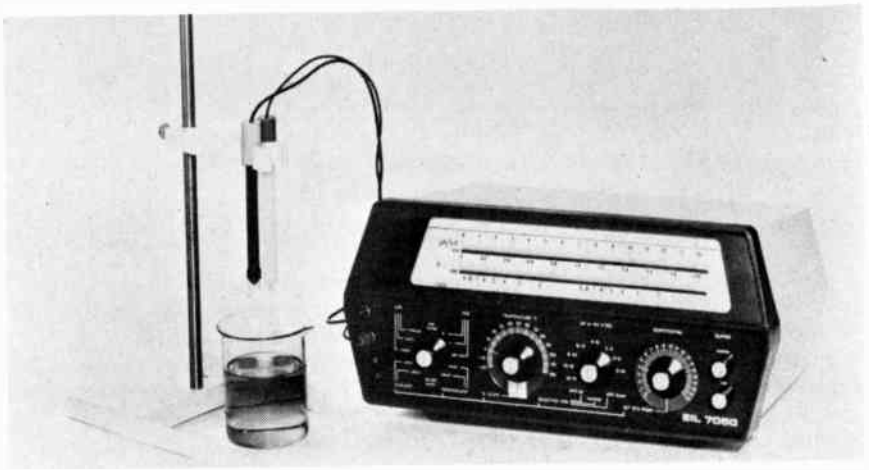
A final point to ponder on! What would happen if we withheld the publication of new theories and ideas for a decade or so and only published material anonymously (no glory, no publish or perish attitude – only genuine willingness to contribute to the other person and not one's career)? The outcome could be quite surprising!

In Britain, technological centres have just been created to inform industrial management of what is already known in fields of relevance to their operations. It has been estimated that nearly \$3000 10^6 p.a. could be saved by U.K. industry if they applied the already known knowledge in fields of corrosion, lubrication and tero-technology (the effective use of manufacturing plant). That's hardly peanuts – what pure research programme can boast such large and immediately seen gains?

One big question we should all ask ourselves is, are we really much better off than our forebears who lived before the information explosion. I'm not entirely convinced we are – we have lost the ability to appreciate the finer, inexpensive, things of life; much of our personal freedom is gone; there are too many decisions to make; urban life is hardly utopia in the bigger cities. If only we could hang up a transducer that would measure the rate of a return for daily progress. ●

EQUIPMENT NEWS

SPECIFIC ION PLUS pH METER USES LINEAR MOTOR INDICATION



A new specific ion expanded-scale laboratory pH instrument has been introduced by Electronic Instruments Limited, the George Kent Group Company specializing in analytical instrumentation.

The new instrument, known as the E.I.L. Model 7050, can be used to measure pH, Redox (O.R.P.) and millivolts, and is also capable of direct activity or concentration measurements with every ion-selective electrode available today. A scaling feature claimed to be unique removes the need for calibration curves, even in complex analyses where standard addition methods are used.

The Model 7050 incorporates a new form of indicator – a servo controlled linear motor – which ensures parallax-free readings on a clear flat 200 mm long scale.

The Model 7050 has the usual zero to 14 scale for pH and Redox (O.R.P.) measurements in the zero to 14 pH and zero to 1400 mV ranges. In addition, the scale can be expanded to cover any 2 pH or 200 mV section of the range, selectable in seven steps from zero to 2 up to zero to 14. For more precise pH measurements, the sensitivity of the instrument can be doubled – giving a 1 pH span for full scale – by using the mode selector switch provided for divalent ions. Accurate backed-off steps ensure that calibration remains valid whichever switch position is selected.

The isopotential control is fully adjustable over the range 0 to 20 pH so that the instrument can be matched to any glass/reference electrode pair.

In addition to the pH scale the Model 7050 also has a parallel logarithmic scale which gives direct indication of ion concentration and thereby eliminates the need for calibration curves, even in determinations where standard addition/substraction methods are used.

Another feature of the Model 7050 is the fully adjustable isopotential – and slope – controls, which allow the calibration settings to be selected to suit the available standard solutions. Any two standards may be used provided that they define the range of concentration in which the unknown sample is expected to lie.

Further details: Kent Instruments (Australia) Pty Ltd, 70-78 Box Rd, Caringbah, NSW 2229.

TV SWEEP GENERATOR

A new TV sweep generator, the PM 5334, has been added to Philips range of TV and radio-service instruments.

Mr. Bill Robbie, Philips Test & Measuring Instrument manager, claims a high-frequency-setting accuracy of better than 1.0% over a broad frequency range extending from 3–860 MHz.

The PM 5334 can also be employed in TV-set and FM radio-receiver production and laboratory work as well as in the educational field.

Featuring eight front-panel selected sweep ranges that employ individual oscillators, the PM 5334 covers all the frequencies needed for TV-set IF, chroma and sound alignment work, those for similar FM-receiver IF work, and TV bands I, III, IV and V, and FM band II. Fixed frequency markers are also employed at important frequencies (5.5, 10.7 and 38.9 MHz) and a variable one is available for use on any of the ranges.

The instrument provides a continuously-adjustable sweep width on each range with an additional control permitting the selected frequency width to be centred on the range scale. Use of this facility is, for example, very useful when checking wide band amplifiers employed in cable-TV systems. A further facility permits the sweep frequency to be adjusted in the range 8-50 Hz.

The output on the PM 5334 is electronically stabilized and can be adjusted 80 dB down from a maximum of 200 mV, with the additional possibility of modulating this output with a 1 kHz signal. It is also possible for signals to be provided at this output which represent any of the fixed marker frequencies ± the variable-marker frequency (modulated or unmodulated). A further output provides just the fixed marker frequencies as carrier signals. A further feature of this instrument is its built-in bias-voltage source (0-30 V floating) which eliminates the need for a separate supply for this purpose in radio or television (both monochrome and colour) alignment work. It basically means that only the PM 5334 and a dual-trace oscilloscope, are needed for complete alignment of, for example, CTV-set IF and sub-carrier stages.

WHO HANDLES WHAT?

Tecnico Electronics have produced a handy six-inch two-colour pocket rule. The rule lists 34 of the agencies currently handled by Tecnico Electronics in the component and instrument fields. The item is primarily designed to help Purchasing Officers who frequently have difficulty keeping up with the latest changes in agency arrangements. The rule also gives Fahrenheit and Centigrade conversions.

The rule is available free of charge by applying on business letterheading to Tecnico Electronics, P.O. Box 12, Marrickville NSW 2204.

NON-CONTACTING COMPONENTS GAUGE FLOATS ON AIR

A linear transducer for gauging components with highly polished surfaces features a measuring anvil which 'floats on air' at a controlled distance above the component being checked.

The sensor is claimed to be particularly suitable for gauging thin and delicate materials with surface finishes that must not be marred by touch – for example, silica slices and coated or plated products.

Basically, the 'Hoverprobe' comprises a conventional spring-loaded electronic transducer with its measuring anvil modified to permit a flow of compressed air to pass through a central orifice, normally of about 0.5 mm diameter, and out across the anvil face. The latter features a recess to ensure that sufficient reaction is obtained from the

pressurised air to cause the transducer to hover just above a component's surface.

Anvils are offered in three sizes with diameter of 2 to 4 mm, 6.5 mm and 25 mm respectively. Depending on anvil size and airline pressure, which normally varies between about 69 N/m^2 and 140 N/m^2, air gaps between component surface and sensor of from 0.02 mm to 0.12 mm can be obtained.

The unit is for use with the manufacturer's meter gauge and is supplied complete with integrally mounted pressure regulator and a mounting bracket with levelling facilities. For installation, a customer has to fit only a high-quality airfilter and connect the unit to electrical and air supply lines.

Standard transducers are supplied with body diameter of 8 mm and 9.5 mm, and both normal and extended ranges are offered.

Although standard units are designed for gauging flat surfaces, the manufacturer will, on request, provide transducers with specially formed anvils as well as modified units to fit into custom-made inspection machines or fixtures.

Further details: Brenco Sales Pty. Ltd., 434 Clarendon Street, Melbourne, Vic. 3000.

LOW PRICE CALCULATOR

The Rang Mini 80 electronic calculator is manufactured in Singapore.

The calculator features an eight-digit LED display, four function operation, floating point or 2, 4, 6 fixed point decimal operation together with a constant facility.

Ten hours operation with conventional dry cells is possible, a low battery condition being indicated by all decimal points coming on. The calculator is based on the latest Texas Instruments four-function chip which features full sixteen digit calculation for an eight digit display. Thus perfect overflow characteristics are provided, that is, overflow in both registers for the multiplication of two numbers will provide an eight digit answer with the decimal point positioned eight places to the left of its true position. All three overflow conditions are indicated by means of a symbol on the left of the display

The horizontal format of the calculator is very convenient, it being very easy to use whilst held in the hand. It is supplied complete with leather case, batteries and a 12 months guarantee. Service facilities are provided for the calculators by the distributors. Recommended retail price is $89 which makes it excellent value for money.

Sole Australian stockist is MS Components, 182-192 Pacific Highway, Gore Hill, NSW, 2065.

LINEAR MOTOR DEMONSTRATOR

A linear motor apparatus has been designed to demonstrate the electro-magnetic characteristics of linear induction motors. It is equally suitable for teaching engineering students and for practising engineers to use in certain industrial applications.

The apparatus, developed by Tecquipment Ltd (Nottingham, England) also permits the effects of varying certain parameters to be studied, and can be employed in conjunction with either an experimentation kit or a test rig.

A supporting textbook by Professor E.R. Laithwaite is supplied with the apparatus or may be purchased separately. Entitled 'Experiments with a Linear Induction Motor', the book outlines experiments to be performed with permanent magnets in the moving three-dimensional electro-magnetic field generated by an energised linear motor.

The basic unit comprises a standard three-phase linear induction motor thrust unit coupled to a control unit. All connections for the motor, variable transformer and protection circuits are made to insulated terminals on the front panel of the apparatus. Additional measuring instruments can easily be connected and circuit changes be made.

Among other features are a range of reaction plates of different metals and dimensions; an adjustable air gap between the thrust unit and reaction plate; and simple means of measuring the forces of thrust and attraction.

The control unit requires an electrical supply from a three-phase variable transformer normally capable of providing 0 to 415 V to 15 A. If required, the manufacturer will supply a suitable transformer or equipment for operation off other voltages.

A trolley mounted on three low-friction rollers to which the linear motor is fastened comprises the basic test rig. The rollers can easily be adjusted for height. The rig assembly is mounted on a steel baseplate, to which any one of the various reaction plates can be attached.

At one end of the baseplate is a column carrying a spring balance attached through a wire and pulley system to the linear motor's trolley. This arrangement permits measurement of the linear thrust and attraction forces for various power inputs to the motor. The effects of different reaction plates and air-gap widths or motor performance can also be studied.

Further details from: H.B. Selby & Co. Pty. Ltd., 352-368 Ferntree Gully Road, Notting Hill, Vic. 3168.

HIGH PRECISION DVM

A new digital multimeter, model 8350A, designed specifically for high precision bench and lab use, has been announced by John Fluke Mfg. Co., Inc. Seattle, Washington manufacturer of precision electronic measurement instruments and systems.

The new multimeter offers 5-1/2 digits with autoranging, autopolarity and a measurement accuracy up to 0.005%. Dc volt range is from 1 microvolt to 1100 volts

(Turn to next page)

in five ranges, ac volts from 10 microvolts to 1100 volts rms in five ranges and resistance from 10 milliohms to 12 megohms in five ranges.

The new Fluke 8350A uses the company's patented recirculating remainder A-to-D conversion design lowering the parts count, decreasing power consumption, increasing reliability and simplifying service. Demonstrated MTBF is over 10,000 hours.

Further details: Elmeasco Instruments Pty. Ltd. P.O. Box 334, Brookvale, NSW 2100.

COMPACT COUNTER TIMER IMPROVES LF RESOLUTION BY 10^3

A compact, lightweight, digital counter timer developed by Racal Instruments employs a reciprocal computing technique at low frequencies to improve frequency measurement resolution up to 1000 times in four ranges covering 0.1 Hz to 1 kHz.

Its makers say that, for example, a 50-Hz signal would be displayed to two decimal places in little more than a second, or to three decimal places in about ten seconds.

The VLF Countertimer measures frequency, frequency ratio, time interval and totalised counts in the 0.1-Hz to 10-MHz range. Its fully variable digital timebase renders it suitable for a wide variety of industrial applications where presentation of measurements in engineering units is often vital. Direct readings in terms of rpm, litres per minute, mph and so forth can be obtained by selecting the correct gate time.

Three input channels are provided, two for direct frequency and frequency ratio readings and the third for vlf measurement and as a gating channel for time interval measurements. In timer applications, the start/stop signals may be electrical impulses or contact closures with incorporated circuitry to avoid false operation due to contact bounce.

The instrument, of half-rack dimensions, is only 100 mm high and weighs 2.7 kg.

Optional extras include BCD data outputs and rear-mounting input sockets.

Further details: Racal Electronics Pty. Ltd., 47 Talavera Road, North Ryde, NSW 2113.

NEW KEPCO POWER SUPPLY CATALOGUE

Kepco, Inc. has published, and offers to all engineers interested in stabilized Power Supplies, a new 52 page "short form" catalogue.

This new catalogue no. 146-1277 devotes eight sections to the diverse Kepco line of voltage and current stabilized power supplies. Included are 10 pages devoted to OEM modular packages including ferroresonant types, programmable units, slot supplies and automatic crossover power modules. Eight pages describe the company's operational power units including bipolar models, fast programming high voltage power supplies, precision lab and systems units (from 50 watts to 3600 watts), logic power supplies, digital programmers and a variety of hardware systems.

To obtain your copy of the new Kepco catalogue write to: Elmeasco Instruments Pty. Ltd., P.O. Box 334, Brookvale. N.S.W. 2100.

PORTABLE TWO CHANNEL RECORDER

A new Gulton Techni-Rite TR-222 portable two channel recorder accepts interchangeable plug-in preamplifiers, weighs less than 30 lbs. and has eight electrically selectable chart speeds of 0.5, 1, 2.5, 5, 10, 20, 50 and 100 mm/sec. Frequency response is dc to 30 Hz at 50 chart divisions and dc to 100 Hz (-3 dB) at eight divisions. Each channel is 50 mm wide.

A number of preamplifiers are available to adapt the TR-222 to a wide variety of applications. For instance, preamplifiers with gains of 10 mv/div. are offered as well as preamplifiers that convert signals from strain gauges, thermocouples, and other types of transducers. Time required to change any preamplifier is approximately 10 seconds.

Integrated circuit pen motor/amplifiers provide exceptional reliability. Stylus limiters are included to limit the excursions of the styli, and to protect them from signal overload.

The TR-222 utilizes heated styli to provide inkless writing. Additionally, it will write in any orientation (i.e., horizontal, vertical, upside down).

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

PRECISION SINE WAVE OSCILLATOR

B.W.D. Electronics Pty. Ltd. have added a new precision sine wave oscillator to their extensive range of signal and function generators. The model BWD 131-02 provides a very constant output level over the range 5 Hz to 600 kHz. Two attenuators and a vernier monitored by a meter enable the output to be accurately set from 2.5 V to 1 μV rms into 600 ohms.

The output level is claimed to be unaffected by temperatures from 0 to 50°C or line voltage from 195 to 265 V, enabling it to be used as an unattended signal source. In the event of power failure, internal rechargeable batteries provide 20 hours operation. This also permists use where ac power is unavailable, or provides for isolated ground operation. An external centre-tapped 600 ohm resistor will convert the single ended output to a balanced output.

The sine wave output is claimed to have less than 0, 1% distortion over the range 200 Hz to 50 kHz, rising to 1% at the limits of the range. Capacitor tuning provides virtually infinite resolution, and frequency stability is less than 0.01%/10°C.

Further details: BWD Electronics Pty Ltd., 331-333 Burke Rd., Gardiner Vic 3146

UNIVERSAL DIGITAL METER FROM YEW

Recently released and now available in Australia is the YEW Model 2502 digital measuring instrument.

High accuracy (0.02%) with high sensitivity (10μV/digit) (10 Mohm/digit) are claimed features. Dc voltage range is 100 mV to 1000 V and the resistance measurement range extends from 100 Ohm to 100 Mohm.

Three optional easily inserted plug-in cards extend the capability of the instrument to measure ac voltage – mean value calibrated to rms value, true rms voltage measurement and high frequency ac voltage to 300 MHz. BCD output and remote control are provided as standard items.

The instrument is claimed to have outstanding noise immunity and stability and employs the "feedback pulse width modulation counting system" as do other YEW digital meters

Further details: Parameters Pty Ltd, P.O. Box 480, Crows Nest, NSW 2065.

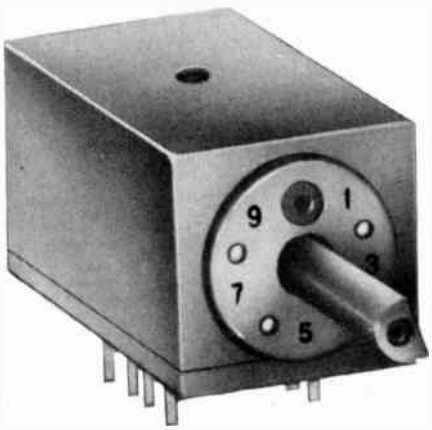
COMPONENT NEWS

MS COMPONENT CATALOGUE

Our lynx-eyed readers will have noticed that the 20-page MS Components catalogue, inserted in the centre of this issue, is numbered in an apparently strange fashion.

This has been done because MS Components will be taking a further 20-page insert in the near future and this latter section is designed to fit into the centre of the first section.

MINIATURE BCD SWITCH



British Merchandising Pty Limited announce that a tiny binary-coded decimal switch, scarcely larger than standard Dual Inline Packaged discrete components, can now be plugged directly into a circuit board to set up codes behind a panel.

The new 'DIGIDIP' shaft-driven switch is designated the Series 26000, and measures less than a half-inch square by under one inch in length. The tiny DIP switch is designed for infrequent code setting or programming, and will be available in either BCD or single-pole 10-position styles. Unit weight is less than 1/4 ounce per switch.

While designed for direct mounting on a circuit board, the new Series 26000 DIGIDIP can be PC mounted for front-panel application where only minimal space is available. It is currently available with a flatted shaft for a setting knob, though screwdriver-setting will be available for special requirements.

Rated at 200 000 detent operations at −40°C to +71°C, the tiny DIGIDIP has rated loads of 28 Vac or 28 Vdc at 126 mA resistive. Contact resistance is less than 500 milliohms original value between common terminal and output terminal.

Further details: British Merchandising Pty Limited, 49–51 York Street, Sydney, NSW, 2000.

PRECISION RESISTORS

Vishay Resistor Products announces the release of an 8-page brochure (R-200) describing their line of Bulk Metal R film precision resistors. The brochure describes new designs and techniques used to produce resistors with a combination of standard features that include: temperature coefficient of 0 ±1ppm/°C, tolerance to 0.005%, stability to 25ppm/year, and non-measurable noise and inductance. Thus, the user is not forced to compromise performance as is necessary when using other precision resistors, claims the manufacturer.

An informative chart compares the performance of Vishay resistors to wirewound and metal film units when tested against MIL-R-10509E and MIL-R-93C. Another chart outlines various styles available, their dimensions in both decimal and metric units, value ranges, wattage ratings, and working voltages.

The brochure discusses the excellent shelf and load life stability; and high frequency, non-measurable noise characteristics of the resistors.

A final section describes resistance temperature characteristics and how and why Vishay resistors are able to track to extreme accuracies, even if they differ in size and range. This designed in uniformity is made possible because all are made of the same alloy and are of identical thickness. Many useful and informative diagrams are used to illustrate salient points.

Further details: Total Electronics, P.O. Box 103, North Brighton, Victoria, 3186.

DICK SMITH INTRODUCES NEWSLETTER FOR CUSTOMERS

Catalogue holders on the mailing list of Dick Smith Wholesale will now be kept in touch with all the latest developments in the component business by a regular Newsletter.

The newsletter will give information on new products, kits, books etc including all the circuits described in Electronics Australia and Electronics Today International. There will also be a 'Special' section covering bargain items.

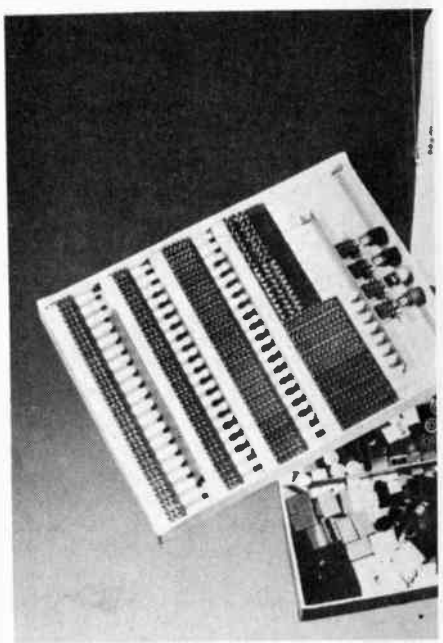
The first Newsletter has already been mailed. Catalogue holders who are not already on the mailing list should send two catalogue vouchers (or 50c) with their name and address clearly printed to Catalogue Section, Dick Smith Wholesale Pty. Ltd, 162 Pacific Highway, Gore Hill, NSW 2065.

TTL-COMPATIBLE OP AMP

Ability to operate with any supply voltage from 2 V to 20 V, and to deliver output voltages within 0.1 V of the supply voltage, are salient features of Philips TCA520B operational amplifier. Typical slewing rate is 50 V/μs. A principal application foreseen for the new op amp is as a TTL-compatible comparator. Encapsulation of the TCA520B is 8-pin DIL.

Further details: Elcoma Pty Ltd., Mars Rd., Lane Cove, NSW.

PUSH-BUTTON PROTOTYPE KIT



A comprehensive kit containing all the hardware required by designers to develop prototype push-button switch banks is now available in Australia.

The ISOSTAT kits are now available from McMurdo (Australia) Pty. Limited, electronic component manufacturers.

Contents of each kit includes: 2, 4, 6 and 8 change-over modules, together with ac modules, springs, circlips, brackets and a range of illuminated and plain buttons in a variety of styles.

LOW-NOISE DUAL OP AMP

Output noise voltage amounting to only a fraction of a millivolt makes Philips TCA390 suitable for applications ranging from industrial control systems to low-distortion stereo preamplifiers.

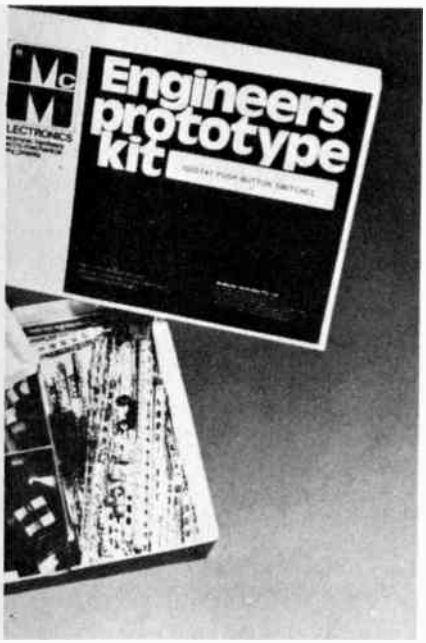
Available with specified output noise voltage limits of 125μV, 250μV, or 400 μV rms, the dual op amp has a typical voltage gain of 15 000 and a typical common mode rejection ratio of 100 dB. Distortion at 1 kHz and 60 dB gain is less than 1.5%.

Other features of the TCA490 include integral short-circuit protection and freedom from latch-up; the envelope is 14-lead dual in-line.

Further details: Elcoma Pty Ltd., Mars Road, Lane Cove, NSW.

PLESSEY DUCON APPOINTS K.D. FISHER FOR SA

K.D. Fisher & Company, of Kent Town, South Australia, have been appointed sole distributors for South Australia for the Plessey Ducon Pty. Ltd. professional



A demonstration switch bank and complete instructions for assembly are also included. Approximately 450 parts are included in the kit.

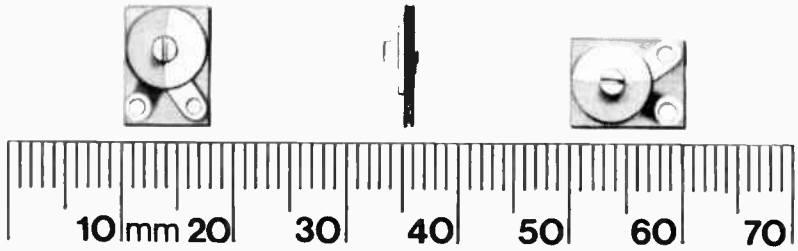
The prototype kit is intended as an aid to design engineers involved in the radio, television, electronic test equipment and electrical appliance manufacturing industries.

Further details: McMurdo (Australia) Pty. Limited, P.O. Box 321, Clayton, Vic. 3168.

components division. The appointment is effective on and from July 1, 1973.

The company carries adequate stocks of the more popular components in order to ensure prompt service in South Australia.

NEW JACKSON TRIMMING CAPACITORS



Jackson Brothers (London) Limited, announce a new range of miniature trimming capacitors, which are believed to have the lowest profile available in the world; the thickness being only 2.8 mm.

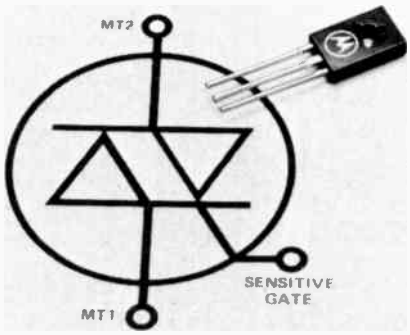
The base of the trimmer is a glass fibre board 10.5 mm x 8 mm. Terminations can be direct to the board, alternatively pins are supplied so that the user may mount the device onto printed circuit boards, the mounting centres are 5.1 mm (.2").

The nominal capacitance ranges offered are from 2.5 to 10 pF, 3.5 to 14 pF, 6 to 25 pF and 8 to 40 pF. Operating temperature is form −20°C to + 70°C and the devices have a breakdown voltage of 1.5 kV at maximum capacitance.

Essentially a low cost device, the new trimmer will appeal to manufacturers of low cost high volume equipment where size and cost are of paramount importance.

Further details: British Merchandising Pty Limited, Shaw House, 49-51 York Street, Sydney 2000.

SENSITIVE GATE TRIAC



Motorola Semiconductor Products Inc. has just introduced a sensitive-gate triac in plastic packaging. The 2N6068 series will operate directly from most logic types and op amps.

Further details: Motorola Semiconductor Products, Suite 204, Regent House, 37–43 Alexander St., Crows Nest 2065.

RATED TEMPERATURE WINDOWS

Model 110 temperature recorder contains six sealed, silver-coloured windows which turn irreversibly black when exposed to a precalibrated value. The 19 mm x 44.5 mm strip with self-stick backing withstands thermal cycling, solvent, water, oil, and steam, and can be stored indefinitely. Six-increment temperature ranges are offered from 100-1506F to 300-350°F and equivalent centigrade readings. Each window has an accuracy within 1% and response time of 1 sec.

Further details NS Electronics Pty. Ltd., Cnr. Stud Road & Mountain Highway, Bayswater, Vic 3153.

64-BIT MEMORIES

Joining other memories in the MECL 10,000 high speed logic family are two 64-bit random access memories. Both are specified for operation over the broad industrial temperature range (-30°C to +85°C), but differ in load driving capability. One, the MC10140, is specified for driving 90 Ω loads, while the other (MC10148) is for 50 Ω loads.

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

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These transformers comply with requirements of Australian Standard C126, where applicable with respect to insulation and winding construction.

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The type numbers are designed to indicate the rating data eg Type TS12/30VA is a 12 Volt transformer rated 30VA.

All the transformers in this range are suitable for connecting to a 240 Volts 50Hz single phase supply and are provided with a terminal block for a simple "Screw Driver" method of connecting.

TYPE NO	SECONDARY VOLTS	VA	AMPS
TS12/30VA	12	30	2.5
TS12/60VA	12	60	5.0
TS24/30VA	24	30	1.25
TS24/60VA	24	60	2.5
TS24/125VA	24	125	5.2
TS24/200VA	24	200	8.33
TS32/30VA	32	30	.94
TS32/60VA	32	60	1.88
TS32/125VA	32	125	3.9
TS32/200VA	32	200	6.25
TS115/30VA	115	30	.26
TS115/60VA	115	60	.52
TS115/125VA	115	125	1.09
TS115/200VA	115	200	1.74
TS115/300VA	115	300	2.61

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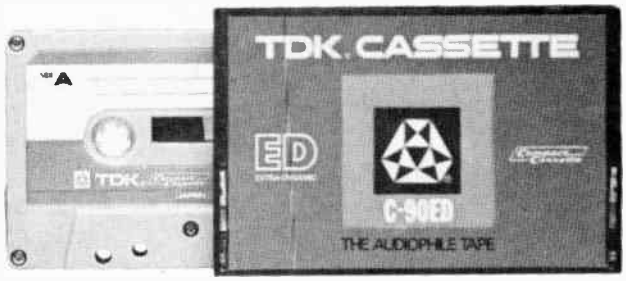
EXTRA-DYNAMIC

THE AUDIOPHILE TAPE



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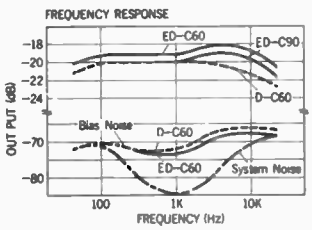

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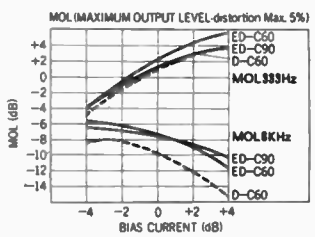
The bias required is normal, that is the target for any magnetic tape. ED is the dynamic tape which suits almost every cassette recorder. No necessity for special bias settings. The superior performance of ED is achieved by the highest and even the lowest priced recorders.



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INPUT GATE

LETTERS FROM OUR READERS

CONGRATULATIONS TO AN ADVERTISER

May I congratulate Bang & Olufsen for the striking yet restrained advertisement that graced your centre pages last month, in particular the most effective use of the second colour.

– K. S. Perth, W.A.

WHICH IS THE BEST?

I enjoy reading your audio equipment reviews, and in fact found them to be an accurate guide when I recently purchased some hi-fi gear.

But there is one thing about them that bothers me. That is that on several occasions you have stated that such and such an item is the best that you have heard. They can't all be the best surely!

Our correspondent has a very valid point; unfortunately it is also one that will inevitably re-occur.

Equipment development is an ongoing process. An item of equipment that was excellent by the standards of say, 1971, may be somewhat less than excellent by the standards of today. This is particularly true of medium priced speakers where there have been some quite dramatic developments in recent years.

Apart from that, neither we, nor any other magazine or testing body, has tested every item of audio equipment on the market. Hence we can only establish some order of excellence progressively – and this order will inevitably need to be revised from time to time.

Because of this do bear in mind that we do not state that such and such a device is the best there is – merely that it is the best of which we have experience.

ON-SALE DATE

I would appreciate knowing at what stage of each month I can expect your magazine to be available in this area. Initially "E.T.I." was available early in the last week of the previous month but the situation has deteriorated to the extent that in recent months "E.T.I." has not been available until the 14th of the month of issue.

I have only today received the August issue.

Keep up the good work and let us have your journal more promptly.

– K.C.M.

Our normal publication time is the third Thursday in each month – unfortunately the recent electricity restrictions have upset our printing schedule and the next few issues will be later than normal.

ERRATA

There is a printing error in our review of the Shure V15 MkIII Cartridge (page 33, ETI, August 1973).

The figure quoted for sensitivity i.e. 1.75 V at 5 cm/sec is incorrect. This should read 3.7 mV at 5 cm/sec.

READERS' LETTERS

It is our policy to reply to all readers' letters – but not necessarily via these columns. Please ensure that you write your full name and address on your letter. We have a number of letters – mostly from our younger readers in which not even the writer's initials are included.

We try to reply to letters as quickly as possible – however on occasions there may be some delay. But please don't think that your letter has been ignored.

ELAC PUZZLE COMPETITION

Prize – An Elac STS. 244.17 Cartridge

Awarded to the first correct entry opened on

Publishing date of Next Issue of Electronics Today International.

SOLUTION TO COMPETITION NO. 4

January 1, will fall more times on a Tuesday: The structure of the Gregorian calendar is such that in every 400 year period, January 1, will fall 56 times on Monday, 58 times on Tuesday, 57 on Wednesday (and 57 on Thursday, 58 on Friday, 56 on Saturday, 58 on Sunday).

This puzzle obviously stumped most readers as we received only a small number of entries. The first correct one opened proved to be a beautiful piece of calculation which was equally well presented by:

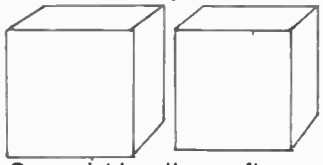
Mr. J.C. Thayer
48 Alawa Street
Waramanga, A.C.T.

Our congratulations and prize of an Elac cartridge go to Mr. Thayer.

The last few puzzles were rather stiff, so here is one a little easier.

ELAC PUZZLE NO. 6

I had two solid cubes of lead, one very slightly larger than the other, just as shown in the illustration.



Through one of these cubes, I cut a hole without destroying the continuity of its four sides, so that the other cube could be passed right through it.

On weighing them afterwards, it was found that the larger cube was still the heavier of the two. How was this possible?

Post entries to: **ELAC PUZZLE COMPETITION No. 6,** P.O. Box 150, Crows Nest, N.S.W. 2065

Permit No. T/C4108

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Syntron Sarkes Tarzian	Surge Stop Klip Volt	SD1544 - - 2KV26 - - -	SD2650 - - 5KV26 - - -	SD2411 - - 7KV26 - - -	SD2452 - - 10KV26

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Never have your records sounded so quiet between tracks.

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1. A high torque synchronous motor
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3. A finely balanced 4lb. platter
4. A unique floating suspension to reduce acoustic feedback.
5. A superb transcription tone-arm (see specifications)
6. A Shure M55/E cartridge
7. Magnetic anti-skate adjustment
8. A smooth hydraulic lifting device
9. A handcrafted walnut plinth and lid
10. A two year guarantee.

All this for $139.00. Can it be any good? You bet ya!!.

See the Linear Design Turntable at your nearest HI-FI dealer NOW!!

SPECIFICATIONS

Turntable: Aluminium alloy cast 4lb platter.
Drive: Hysteresis synchronous motor via neoprene belt

Wow & Flutter: ±0.05%.
Rumble: Better than 56db.
Speed Deviation: Less than 0.9%
Tone Arm: Static-balance type with lateral balancer, overhang and height adjustment levers. Heavy elements are close to the fulcrum and provides low inertia.
Tracking error: Less than 1 degree.
Stylus Pressure: 1¼ grams (with Shure M55/E).

Arm Lifter: Smooth hydraulic type lift.
Antiskate: Magnetic replusion of direct reading type.
Weight range: Any cartridge 5-30 grams.
Plinth finish: Oiled walnut only.

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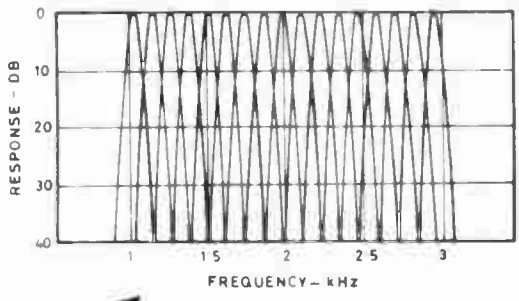

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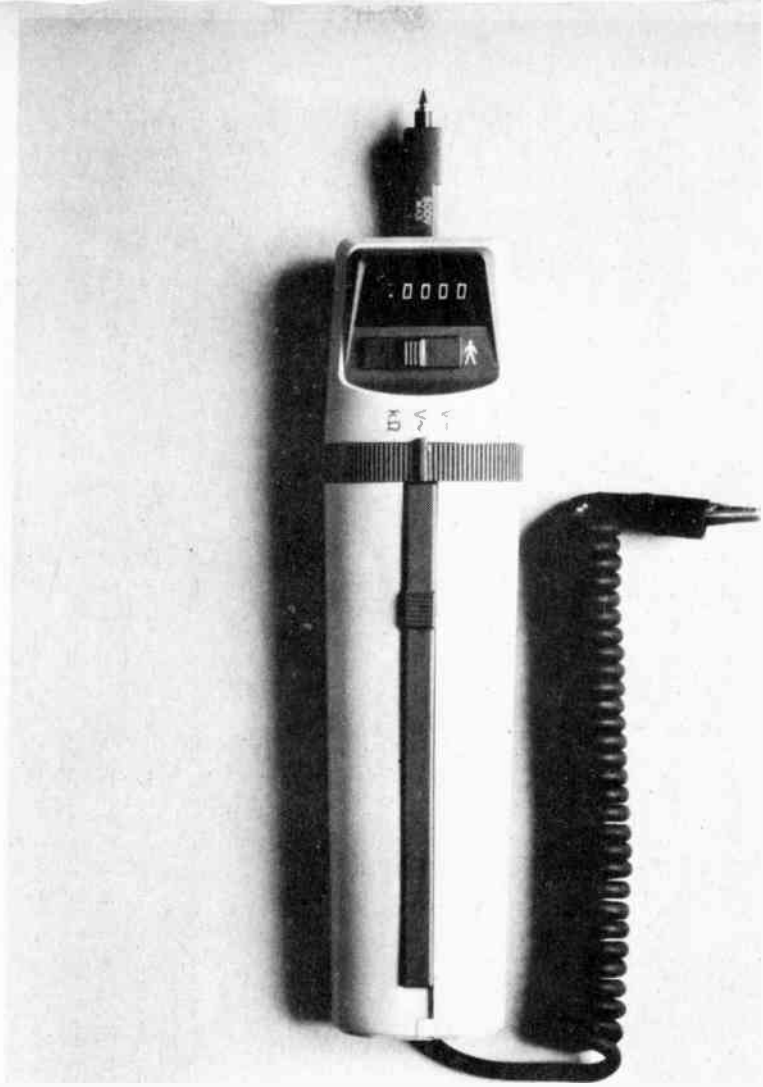


Hewlett Packard's new digital multimeter is the size of a fountain pen.

PROBE DIGITAL MULTIMETER

by Paul Febvre, Hewlett Packard, Grenoble, France.

ALL else being equal, interconnection of components is one of the most expensive costs in assembling electronic instruments. The concept of large scale integration has the advantage of minimizing the cost of interconnection. It is, therefore, no surprise that Hewlett Packard's 970A is a custom LSI-MOS chip. Design features of the MOS Chip include the logic circuit of the dual slope A/D converter, auto-zero, auto-polarity, auto-ranging and display decoding.

All the analog switches necessary for auto-ranging, auto-zeroing, and converting, etc. are MOS switches on the chip itself. MOS switches allow many circuit innovations in the 970A analog circuitry. They allow for a considerable saving in component count and wiring, and an improvement in performance because all the switches were made to track as a function of temperature and battery voltage.

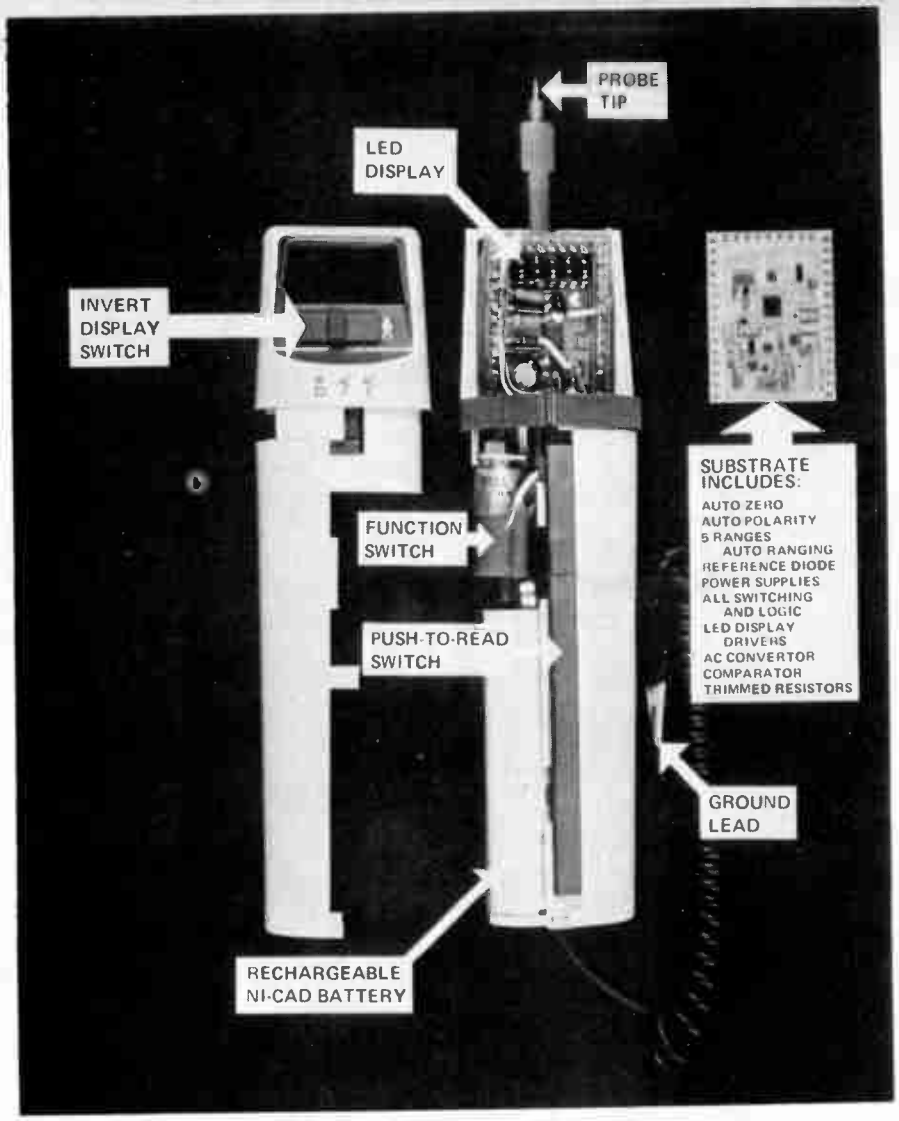
After combining the circuits and switches into the LSI-Mos Chip, what was left of the voltmeter was so small that it became possible to put it all on one hybrid package: three operational amplifiers, one voltage regulator and a custom design, display-driven chip. The whole calibration process is automated from beginning to end, with an HP 2100 computer.

Rather than package the MOS Chip separately, HP engineers put it directly on the hybrid substrate. The savings in interconnections were considerable, a complete digital multimeter on a 28 x 38 mm hybrid substrate thus became a reality. Certain components such as display, power function and display switches, high voltage input resistors, integrating capacitor and reference zener, are mounted on a printed circuit board.

THE PROBE MULTIMETER

Industrial design is the key. Initially, designers had a number of reservations. The first item to be considered was the basic shape of the probe. Would a pen-shaped device with a probe tip at one end and a readout at the other be the ideal approach?

In order to determine the optimum shape, several full-scale adequately weighted mock-ups were built and tested by a large number of potential users. In the course of the study, the full complexity of the problem became obvious. Not only was the number of probing situations very large (P.C. boards, breadboards, computer bays, machines of all kinds,



appliances, chassis of all shapes, etc.) But it was found that for a given shape, people would adopt very different hand positions. For example, in the case of a flat P.C. board resting on a bench, some people would point the probe in front of them, others would approach the work from behind, and yet others would probe from one side or the other. The conclusion was that the model 970A, should ideally give the user maximum amount of freedom. Thus, final design included a foldable, telescopic tip, a 'push-to-read' bar that can be triggered along its length, and a display that can be electronically inverted at the touch of a switch.

Every detail had to be considered, analysed in depth, and often designed from scratch. A good example of the kind of in-depth design that went into the probe is the function switch. The need was for a knob that performs well mechanically. That would not break if the probe accidentally fell on a hard surface, that could be operated by a right or left-handed person and blended with the overall style of the instrument while taking a minimum amount of internal space. The 'watchband' knob, selected for the proble, passed all the tests.

The task of implementing mechanically the shapes that had been defined for humans turned out to be very challenging for the engineer, for example, no metallic parts could be exposed on the case since they could cause a short circuit if the probe were dropped into a live circuit: all the external dimensions had to be such that the product met or exceeded rigid safety requirements. The assembly had to be simple enough so as to not create excessive manufacturing time.

A striking feature of HP's 970A is its simplicity; just a few plastic parts snap together without a single screw or metallic fastener. Probes can be assembled or dismantled in a very short time. All the necessary functions satisfy most esthetic requirements.

HP's 970A is not only an attractive looking, inexpensive, high versatile hand multimeter, it also has very respectable performance: 100 microvolt resolution, five fully automatic ranges of ac volts, dc volts and ohms, auto-zeroing and full ac and dc input protection to 1 kV (250v rms on ohms).

The 970X sets new standards in electronic measuring convenience. This product is representative of a new breed of electronic test instruments which use the most advanced technology to respond to the user's needs. ●

Hear. Here.

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

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

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

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RECORDINGS POP

REVIEWER: Mike Delaney

"LIVING IN THE MATERIAL WORLD" – George Harrison. E.M.I. Stereo. PAS.10006. "Love. Devotion. Surrender." – Carlos Santana & John McLaughlin. C.B.S. Stereo. SBP. 234340. "Devotion" – John McLaughlin. C.B.S. Stereo. SBP.234231. "My Goal's Beyond" – John McLaughlin. C.B.S. Stereo. SBP.234282. "Cosmic Wheels" – Donovan. Epic/C.B.S. Stereo. ELPS.3662.

"So where do you turn when you've had your fill of ambi-sexual pop tart rock, when the moaning L.A. pseudo-bumpkins get on your nerves, the soul sisters and brothers start to sound re-packaged and your brain is beaten by the latest attempt to set the pre-pubes on the rock 'n' roll warpath? What's left that has any 'quality' and still has the guts to rock on?" Stephen Davis ('Rolling Stone') on John McLaughlin's Mahavishnu Orchestra.

So where *do* you turn when you've been told that the dream is over, that Miss American Pie has spent the last two decades deluding herself, that the rock 'n' roll revolution was (a) still born, (b) died from infantile paralysis, (c) is in danger of extinction at the hands of its own renaissance.

The question is simple: where do you go from up?

Stylistically, albeit musically, rock 'n' roll started out with neither direction nor purpose. It was a function of itself – a long, ecstatic blow job with no tomorrow. It was loud and vulgar and aggressive and dirty. No class. No sophistication. Just lots of noise, sweat and action. It *did* have personality, though not of its own accord.

Nik Cohn summed it up admirably: 'A-Wop-Bop-A-Loo-Bop-A-Lop-Bam-Boom' – the one and only definitive rock 'n' roll statement. It's just there – THERE!

Basically, that's all rock 'n' roll ever was – all of a sudden . . . THERE!

Two decades on and the thing looks like blowing it clean away, the thing that could very well nail down the lid, is rock's own negativity – lack of constructiveness.

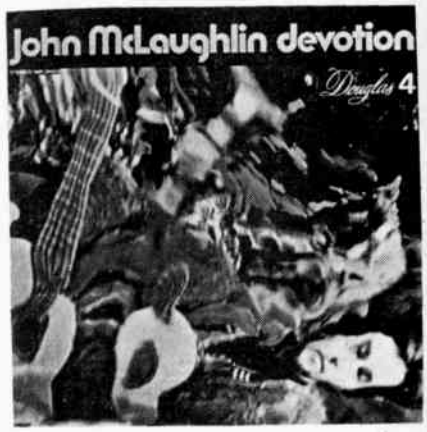
As a style, rock 'n' roll promised revolution followed by its own brave new world – a kind of sensual nirvana. But the thing is, it simply didn't follow through. Rock became the greatest money making proposition in 20th century art/entertainment. And the whole crux of the matter, the one thing that nobody ever really accounted for, was its business affairs. The rock 'n' roll machine. Not art or music – rock 'n'

It is invidious to single out individuals at this inevitably involves

Rock 'n' roll show business versus consumer demand versus media representation versus marketing psychology versus rock 'n' roll music.

Place your bets!

These days, to be a successful rock 'n' roller, you've got to be a shrewdie – a real sharp businessman. It's a question of strategy – tactics. And to be able to *afford* all this, to guarantee that you've got everybody along the line pulling for you . . . *MONEY*. And then, to be able to *cope* with it all, you've got to have absolute confidence in your own capabilities.



It's tough, but that *IS* the way.

Rock 'n' roll, just like all the other parts of our 20th Century dream machine, is now a process. It requires packaging, presentation, marketing, publicity/promotion, product and product deadlines. to be runners-up in the Australian Premiership. Great credit is due also to our juniors

Yes. It is my biggest wish that we can recruit lots more like them in the next few months. ego versus huge ego, depending on how much you sell yourself and/or want yourself to be sold. The unspoken requisite should be quite clear: you do not rule the rock roost by being humble – the Stones, David Bowie, T. Rex, Paul MacCartney, Roxy Music, Alice Cooper and even Bob Dylan: they'll tell you he same thing. It's always been the same, though nowhere near as obvious (crass) as it is now.

And it's all necessary – everybody's got to earn a quid; everybody's got to earn more than the quid they're getting. All the bizazz and brouhaha is as much a part of the score as the music. Simply, it's back to the survival of the fittest – mass media consciousness is the way to your first slew of gold discs. Make out for the largest audience response/attachment – NOW. Ship that product – NOW. Bring in all that media psychology and GO!

That's the way it's done.

Tactics!

Strategy is the thing that makes management agencies and record companies into BIG management agencies and BIG record companies. The same goes for their talent roster.

And the rock 'n' roll mentality?

NEGATIVE.

Either it's more aggressive or more decadent or more egotistical or more sexual or more nostalgic or more emotional.

But then, in the midst of all this, comes George Harrison, John McLaughlin and Donovan. Carlos Santana too.

(Continued on page 154)

(Continued from page 152)

Musically, they're all quite masterful – this we know. But lyrically, as far as motivation goes, they're all offering something quite different: Each is documenting his Spiritual Philosophy using the album concept.

No, it's not new – just timely!

The theme behind all their music is simple: Spiritual fulfillment/realization.

Harrison approached it generally with his "Living In The Material World" – 'All Glories To Sri Krishna'; Carlos Santana and Mahavishnu John McLaughlin titled their set in a more thematically defined way: "Love. Devotion. Surrender".

And what they're saying: I am here but "I" am not here; ego destroys so destroy ego; Consciousness equals Energy equals Love equals Awareness equals Light equals Wisdom equals Beauty equals Truth equals Purity. It's all the SAME.

The message: Remember Be Here Now.

It's interesting – Harrison, Santana, McLaughlin and Donovan – four separate entities, each with the same motivation. Each with the same basic belief – the same. Then there's Roger McGuinn and Seals & Crofts. Many more. But it's all the same: I am here but "I" am not here.

Jesus Christ said: "Let Thy will, not mine, be done" – all four of the above are simply into that – nothing more.

Simple?

"Love is sweet, devotion is sweeter, surrender is sweetest. St. Augustine has blessed us all with a profound message: 'Love and then do what you like.' Love, devotion and surrender. These are the three rungs on the Spiritual ladder, or should we say, the ladder of our evolving consciousness. A tiny drop enters into the ocean and becomes the mighty, boundless ocean."

Simple.

The potter becomes his pot.

"Unfortunately, in the West, surrender is misunderstood. We feel that if we surrender to someone, he will then lord it over us. We will have no individuality or personality. From the ordinary point of view, the human point of view, this is true. But from the Spiritual point of view, it is absolutely wrong. When the finite enters the Infinite, it becomes the Infinite all at once.

"Each moment we are given ample opportunity to love mankind. And if we really love mankind then we have the feeling of wanting to offer devoted service to mankind. And when we really want to enlarge our existence, expand our consciousness and be one, inseparably one with the Vast, then surrender is the only answer."

Sri Chinmoy wrote this – McLaughlin and Santana have it as liners for their album "Love. Devotion. Surrender".

"To serve and never be tired is love.
To learn and never be filled is devotion.
To offer and never to end is surrender."

All four are saying the same thing: see past yourself – throw 'YOURSELF' away; Surrender – by giving it all away, you can have it all; you are all the Energy and You are He.

Eastern in origin, Universal in its profundity – "I am here but 'I' am not here". Everybody's a Guru; everybody's living in the material world.

Thematically, Harrison offers definitive attachment. Titles from his "Living In The Material World" speak largely for themselves: "Give Me Love (Give Me Peace On Earth)", "The Light That Has Lighted The World", "The Lord Loves The One (That Loves The Lord)", "Be Here Now".

Santana & McLaughlin do like-wise within an instrumental frame: "A Love Supreme", "The Life Devine", "Let Us Go Into The House Of The Lord". McLaughlin's solo work in conjunction with his two Mahavishnu Orchestra recordings is truly music to be inspired by – "The Inner Mounting Flame", "Birds Of Fire" and the less complex "Devotion" are the picks.

And Donovan – wonderful, gentle, utterly natural Donovan; all the way through his career he's been the same – so much at peace, so much calm within the chaos. These days, much more worldly wise: "God is playing marbles with His planets and His stars/Creating havoc through my life with His influence on Mars/That's why I'm stumbling down the highway on my boots of steel/I should be rolling down the sky-way on my cosmic wheels."

The message is clear: get back out of the material world.

Fast!

It's already half-stonkered rock 'n' roll – don't let it do the same to you! ●

SUPER-TRACK "PLUS" CARTRIDGES

For ¾ to 1¼ Grams Tracking

SHURE

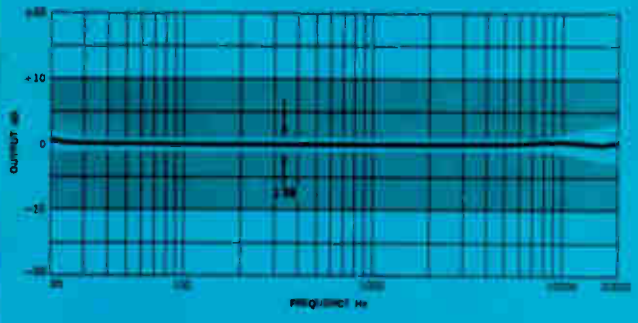
V-15 TYPE III SUPER-TRACK "PLUS" PHONO CARTRIDGES

THE SOUND OF THE V-15 TYPE III

The sound of the V-15 Type III, paradoxically, is due in no small part to an absence of a sound of its own. In no way does it interpose itself upon the music. Thus, the resultant sound of the Type III is not "sweet," "mellow," or "brilliant" . . . it is the sound of the recording itself! It's truly flat, unaccented frequency response and extended dynamic range mean a hearable difference in all your recordings, old and new.

In extended listening, the uncolored neutral timbre and tonality of the Type III results in a remarkable listening experience in which complex melodic lines from every conceivable kind of music — from baroque to rock — utilizing a wide variety of recording techniques and playback equipment, are delineated with startling and hitherto unheard clarity.

ABSOLUTE UNIFORMITY OF PERFORMANCE



Shown above is a graphic representation of the audible spectrum, which illustrates the uniformly flat response you will achieve with your V-15 Type III cartridge. Under the Shure Quality Control Program, every Type III cartridge, whether it is purchased now or next year, in Chicago, London, Hong Kong, or Sydney, must produce a flat response curve that fits within the extraordinarily narrow limits of the Type III response "output envelope" (the unshaded area above) before shipment! The Curve shown was made by a typical Type III, mounted in a SME tone arm, and tracking the STR100 test record, response corrected for 6 dB/octave below 500 Hz.

V-15 TYPE III and V-15 III-G SPECIFICATIONS

Typical Trackability (at 1 gram in Shure-SME Tone Arm). Reference: Shure TTR103 Laboratory Test Record.

400 Hz — 26 CM/SEC 5000 Hz — 35 CM/SEC
1000 Hz — 38 CM/SEC 10,000 HZ — 26 CM/SEC

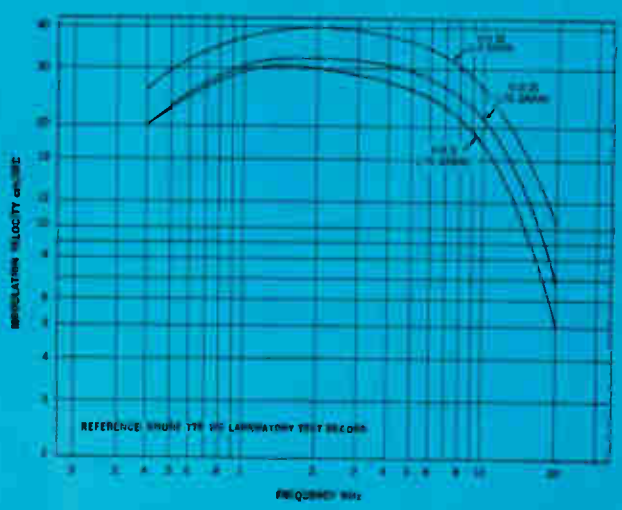
Frequency Response (using Optimum Load): 10 to 25,000 Hz
Output Voltage: 3.5 mV per channel at 1000 Hz, 5 CM/SEC peak recorded velocity. Output from each channel within 2dB.

Channel separation: Nominally 28 dB at 1000 Hz
Nominally 20 dB at 10,000 Hz

Tracking Force Range: ¾ to 1¼ grams.
Optimum Load: 47,000 ohms resistance in parallel with 400 to 500 picofarads total capacitance per channel. Load resistance can be up to 70,000 ohms with almost no audible change in frequency response. Total capacitance includes both the tone arm wiringand amplifier input circuit. (Most amplifiers and tone arms meet this requirement).
Inductance: 500 millihenries nominal
D.C. Resistance: 1350 ohms nominal
Output Terminals: 4 terminals
V-15 Type III Styli Available:
VN35E Biradial Elliptical Stylus (as supplied in V-15 Type III Cartridge) Diamond Tip
18 microns (.0007 inch) frontal radius
5 microns (.0002 inch) side contact radii
25 microns (.001 inch) between record contact points
VN3-G Spherical Stylus, (as supplied in V-15 III-G Cartridge) Diamond Tip [15 microns (.0006 inch) radius].

EXTRAORDINARY TRACKABILITY

Its exceptional trackability enables you to use ultra-light tracking forces that will significantly increase the life of recordings and stylus tip. Further, it enables you to use the most advanced light-tracking tone arms and precision turntables available, and to use the newer, ever more sophisticated turntables and arms now under development.



The trackability chart above shows the unmistakable superiority of the V-15 Type III in the single most important measure of overall cartridge performance: trackability. These curves were produced by Shure V-15 cartridges tracking in a Shure SME tone arm. The Type III effortlessly tracks the highest modulated levels of modern recordings.

VN78E Biradial Elliptical Stylus, Diamond Tip for monaural 78 rpm records
Tracking Force Range: 1½ to 3 grams
63 microns (.0025 inch) frontal radius
13 microns (.0005 inch) side contact radii
89 microns (.0035 inch) between record contact points

NOTE: A small .8 gram weight on the moulded grip of the VN78E Stylus Assembly allows it to be substituted for a VN35E or VN3-G. This .8 gram weight achieves the proper tracking force for 78 rpm records automatically and normally requires no manual adjustment of the tone arm's tracking force setting.
Mounting: Standard ½ inch (12.7 mm) mounting centers.
Weight: Net Weight — 6 grams.
MODEL V-15 Type III Super-Track cartridge.
MODEL V-15 III-G Super-Track cartridge with .0006" spherical stylus.
MODEL VN35E Biradial Elliptical stylus fits V-15 Type III and V-15 III-G cartridges.
MODEL VN3-G .0006" Spherical stylus fits V-15 Type III and V-15 III-G cartridge.
MODEL VN78E Biradial Elliptical stylus designed for monaural 78 rpm recordings. Fits V-15 Type III and V-15 III-G cartridges.

DELUXE HIGH TRACKABILITY CARTRIDGE

For ¾ to 1½ Grams Tracking

Optimized design parameters in the stylus assembly give this new Deluxe cartridge superb high frequency trackability, and overall performance second only to the incomparable V-15 Type III.

SHURE

M91ED Elliptical Stylus
Deluxe high trackability cartridge

Optimized design parameters in the stylus assembly give this new Deluxe Series cartridge superb high frequency trackability, and overall performance second only to the incomparable V-15 Type III. By mounting an ultra-lightweight diamond tip directly on the stylus bar and eliminating the small metal bushing, Shure engineers have materially reduced stylus tip mass. The result is a smooth, peak-free frequency response and a level of overall performance not previously available in this price class. The excellent performance characteristics of this cartridge make it a suitable choice for use in four-channel encoded (matrix) playback systems.

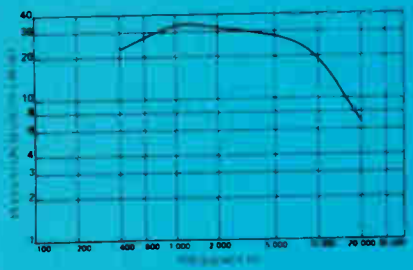
M191ED SPECIFICATIONS

Trackability at 1 gram tracking force using a Shure/SME Arm:

22 CM/SEC at 400 Hz	28 CM/SEC at 5,000 Hz
33 CM/SEC at 1,000 Hz	19 CM/SEC at 10,000 Hz

Tracking Force: ¾ to 1½ grams
Frequency Response: From 20 to 20,000 Hz

TRACKABILITY CHART (at 1 Gram)



Optimum Load: 47,000 ohms resistance in parallel with 400 to 500 picofarads total capacitance per channel. Load resistance can be up to 70,000 ohms with almost no audible change in frequency response. Total capacitance includes both the tone arm wiring and amplifier input circuit. (Most amplifiers and tone arms meet this requirement).

Output Voltage: 5.0 mv per channel at 1,000 Hz at 5 CM/SEC peak velocity
Channel Separation: Nominally 25 db at 1,000 Hz
Channel Balance: Output from each channel within 2db
Stylus: N91ED Biradial Elliptical with nude diamond tip
.0007 inch (17.8 microns) frontal radius
.0002 inch (5 microns) side contact radii
.0010 inch (25 microns) wide between record contact points
Inductance: 720 millihenries D.C. Resistance: 630 ohms Weight: 5.5 grams Mounting: Standard ½ inch (12.7 mm) mounting centers
Model M91ED Deluxe Hi-Track Cartridge with Biradial Elliptical stylus
Model N91ED Biradial Elliptical replacement stylus

NOTE: Owners of M91E or M92E cartridges may upgrade their present systems by using an ND1ED stylus.

NOTE: To play 78 rpm records with the M91ED cartridge, use a Model N91-3 .0025 inch spherical stylus.

TONE ARMS

SHURE

SME SERIES II IMPROVED
"the best pickup arm in the world"

The ultimate in independent tone arms — now redesigned for significantly superior performance. The Shure-SME Series II Improved combines the flawless craftsmanship and unmatched precision of its predecessor (the SME Series II) with design improvements that reduce tone arm/cartridge system mass and friction to significantly lower levels.
Ultra-low friction pivot points, with high-precision, protected ball and knife-edge bearings; arm deflects either vertically or horizontally with less than .020 gram force applied at stylus tip. Very low overall mass, with heavier elements positioned near the arm fulcrum. Low distortion geometry.

Precisely accurate adjustments for every factor related to perfect tracking, including height, overhang, length, tracking force and bias (anti-skating). Accepts cartridges weighing four to nine grams, and allows positive tracking force adjustment in ¼-gram increments from 0 to 1½ grams. Deluxe hydraulic cuing control.

Recommended for use with all Shure high trackability cartridges, and when teamed with the super-trackability Shure V-15 Type III, the result is a tone arm/cartridge system that is, quite simply, unsurpassed for precision record playback. Highly recommended for connoisseurs' component systems in which quality requirements are uncompromisingly high.
MODEL 3009 Series II Improved (non-removable shell)
MODEL 3009/S2 (removable shell

WEIGHT WATCHER — PAR EXCELLENCE

SHURE

SFG-2 Stylus Force Gauge

Low-cost, precision stylus force gauge is a must for the serious audiophile. Detects excessive or insufficient tracking force; allows precise resetting of stylus force to maintain optimum trackability and sharply reduce wear on records and stylus tip. Especially valuable when cartridges are switched. Accuracy to within 1/10th of a gram in ½ to 1½ gram primary operating range; extended range to 3 grams. The SFG-2 uses friction-free, stainless steel pivot points and easy-to-read reference bars in a permanently accurate "balance" system — no springs to weaken or wear out. Special tilted mirror reflects reference bar positions for effortless, accurate reading. Greater accuracy in measurement is obtained because the SFG-2 is used with the tone arm in actual playing position.

MODEL SFG-2 Stylus Force Gauge.

EXTRA DURABILITY HIGH TRACKABILITY CARTRIDGES

Economy priced, but fine performance when used in moderately priced record changers. Extra durable stylus assemblies for heavy use by the whole family. These cartridges are well suited for institutional (school) and broadcast applications where durability is a performance consideration.

For 1½ to 5 Grams Tracking

East-Mount Design

Clip-on easy-mount design cuts cartridge mounting time in half. First mount the specially designed retaining clip in the tone arm head — there's plenty of room for your fingers and a screwdriver. Then connect the leads and simply snap the cartridge into the retaining clip. Alignment is precise and positive. Stylus replacement is greatly simplified, too.

SHURE

M93E Elliptical Stylus Hi-Track Cartridge

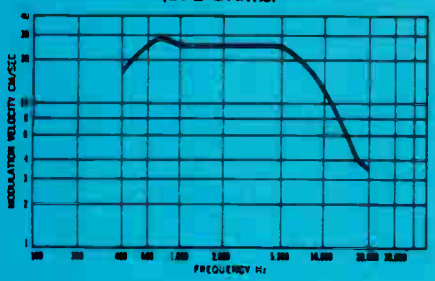
SHURE

M75-6S M75CS Spherical Stylus Hi-Track Cartridges

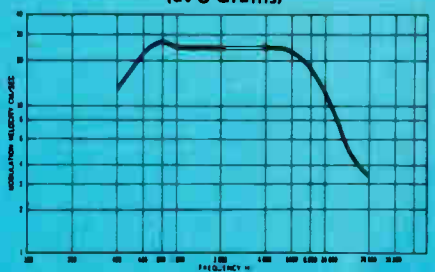
This high performance series of cartridges was designed to give heavy duty performance at moderate prices in all modern turntables and tone arms. Three High Trackability Cartridges in a choice of tracking force ranges from 1½ to 5 grams — and all feature "snap-in" design for fast, effortless installation.

CARTRIDGE MODEL	STYLUS CONFIGURATION	TRACKING FORCE	Replacement Stylus
M93E	.0004" x .0007" Biradial Elliptical	1½-3	N93E
M75-6S	.0006" Spherical	1½-3	N75-6
M75CS	.0006" Spherical	3-5	N75C

TRACKABILITY CHART for M93E and M75-6S (at 2 Grams)



TRACKABILITY CHART for M75CS (at 3 Grams)



M93E, M75-6S, M75CS SPECIFICATIONS

Trackability using a Shure/SME Arm:

- M93 and M75-6S at 2 grams tracking force:
  18 CM/SEC at 400 Hz — 24 CM/SEC at 5,000 Hz
  25 CM/SEC at 1,000 Hz — 13CM/SEC at 10,000 Hz
- M75CS at 3 grams tracking force:
  14.3 CM/SEC at 400 Hz — 24 CM/SEC at 5,000 Hz
  24 CM/SEC at 1,000 Hz — 13 CM/SEC at 10,000 Hz

Frequency Response: From 20 to 20,000 Hz
Output Voltage: M93E and M75-6S, 6.2 mV per channel at 1,000 Hz at 5 CM/SEC; M75CS, 9.0 mV per channel at 1,000 Hz at 5 CM/SEC.
Channel Separation: More than 25 dB at 1,000 Hz.

Channel Balance: Output from both channels within 2 dB.
Stylus: N93E Biradial Elliptical with diamond tip, 1½ to 3 grams tracking force
- .0007 inch (17.8 microns) frontal radius
- .0004 inch (10 microns) side contact radii
- .0010 inch (25 microns) wide between record contact points

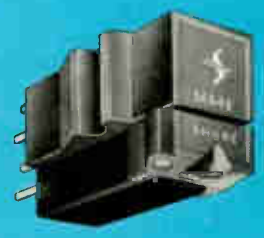
N75-6 Spherical .0006 inch (15 microns) radius with diamond tip, 1½ to 3 grams tracking force
N75C Spherical .0006 inch (15 microns) radius with diamond tip, 3 to 5 grams tracking force

Optimum Load: 47,000 ohms resistance in parallel with 400 to 500 picofarads total capacitance per channel. Load resistance can be up to 70,000 ohms with almost no audible change in frequency response. Total capacitance includes both the tone arm wiring and amplifier input circuit. (Most amplifiers and tone arms meet this requirement).
Inductance: 720 millihenries
D.C. Resistance: 630 ohms
Weight: 6 grams
Mounting: Snap-in type; standard ½" (12.7 mm) mounting centers on retaining clip

MODEL M93E Hi-Track Cartridge with Biradial Elliptical stylus
MODEL N93E Biradial Elliptical replacement stylus
MODEL M75-6S Hi-Track Cartridge with Spherical stylus
MODEL N75-6 Spherical replacement stylus
MODEL M75CS Hi-Track Cartridge with Spherical stylus
MODEL N75C Spherical replacement stylus

NOTE: To play 78 rpm records with the M93E, use an N91-3 .0025 inch spherical stylus. Use an N78-3 .0025 inch spherical stylus to play 78 rpm records with the M75-6S, or M75CS.

STANDARD SERIES OF STEREO DYNETIC CARTRIDGES



SHURE

M44E
For Heavier Tracking Forces
1¾ to 4 Grams

SHURE

M55E
For ¾ to 2 Grams Tracking

A popular cartridge that gives professional performance within a moderate budget. Incorporates Bi Radial elliptical stylus. Note the wide variety of features and impressive specifications:

SPECIFICATIONS

Tracking Force: ¾ to 2 grams
Frequency Response: From 20 to 20,000 Hz
Output Voltage: 6.6 millivolts per channel at 1,000 Hz at 5 CM/SEC
Channel Separation: Nominally over 25 db at 1,000 Hz.
Channel Balance: Output from each channel with 2 db
Compliance:
Horizontal } 15.0 x 10^{-6} CM/dyne
Vertical }
Effective Stylus Tip Mass: 1.2 milligrams
Stylus N55E: Elliptical shaped diamond tip
.0007 inch (17.8 microns) frontal radius
.0002 inch (5 microns) side contact radii
.0010 inch (25 microns) wide between record contact points
Optimum Load: 47,000 ohms resistance in parallel with 400 to 500 picofarads total capacitance per channel. Load resistance can be up to 70,000 ohms with almost no audible change in frequency response. Total capacitance includes both the tone arm wiring and amplifier input circuit.
Inductance: 720 millihenries
D.C. Resistance: 630 ohms
Weight: 7 grams
Mounting: Standard ½" (12.7mm) mounting centres
MODEL M55E Cartridge
MODEL N55E Stylus.

NOTE: To play 78 RPM records with any of the M44 Series or M55E cartridges, use Model N44-3 .0025 raduis, spherical tip stylus.

All the advantages of a Bi Radial elliptical stylus for older turntables that track at heavier forces: Good performance at a moderate cost.

SPECIFICATIONS

Tracking Force: 1¾ to 4 grams.
Frequency Response: From 20 to 20,000 Hz
Output Voltage: 9.3 millivolts per channel at 1,000 Hz at 5 CM/SEC
Channel Separation: More than 25 db at 1,000 Hz
Compliance:
Horizontal } 15.0 x 10^{-6} CM/dyne
Vertical }
Effective Stylus Tip Mass: 1.4 milligrams
Stylus N44E: Elliptical shaped diamond tip
.0007 inch (17.8 microns) frontal radius
.0004 inch (10 microns) side contact radii
.0010 inch (25 microns) wide between record contact points
Optimum Loads: 47,000 ohms resistance in parallel with 400 to 500 picofarads total capacitance per channel. Load resistance can be up to 70,000 ohms with almost no audible change in frequency response. Total capacitance includes both the tone arm wiring amd amplifier input circuit. (Most amplifiers and tone arms meet this requirement.)
Inductance: 720 millihenries
D.C. Resistance: 630 ohms
Weight: 7 grams
Mounting: Standard ½" (12.7mm) mounting centres
MODEL M44E Cartridge
MODEL N44E Stylus

SPHERICAL STYLUS CARTRIDGES

SHURE

M44 Series
Combines Quality and Economy

Three budget-priced cartridges to fill the needs of the hi-fi hobbyist who wants the most for his money in this price range. All have received ample critical acclaim as the best in their price class. Note: All M44 series styli are interchangeable.

SPECIFICATIONS

Frequency Response: From 20 to 20,000 Hz.
Output Voltage: At 1,000 Hz at 5 CM/SEC
Model M44G, 7 millivolts per channel
Model M44-7, 11 millivolts per channel
Model M44C, 9.3 millivolts per channel
Channel Separation: More than 25 db at 1,000 Hz.
Optimum Load: 47,000 ohms resistance in parallel with 400 to 500 picofarads total capacitance per channel. Load resistance can be up to 70,000 ohms with almost no audible change in frequency response. Total capacitance includes both the tone arm wiring and amplifier input circuit. (Most amplifiers and tone arms meet this requirement).
Inductance: 720 millihenries
D.C. Resistance: 630 ohms.
Weight: 7 grams
Mounting: Standard ½" (12.7mm) mounting centres.

For Light Tracking ¾ to 1½ Grams
MODEL M44G Cartridge. With .0006-inch radius spherical diamond stylus.
MODEL N44G Stylus .0006-inch radius spherical diamond.

For Heavier Tracking 1½ to 3 Grams.
MODEL M44-7 Cartridge. With .0007-inch radius spherical diamond stylus.
MODEL N44-7 Stylus. .0007 inch radius spherical diamond.

For Heaviest Tracking 3 to 5 Grams.
MODEL M44C Cartridge. With .0007-inch radius spherical diamond stylus.
MODEL N44C Stylus. .0007-inch radius spherical diamond stylus.

Australian National Distributors

AUDIO ENGINEERS PTY LTD

342 KENT STREET, SYDNEY 2000.

Queensland:
RON JONES PTY. LTD.
57 Castelmaine St,
Milton 4064.

Victoria:
AUDIO ENGINEERS (VIC)
2A Hill St.,
Thornbury 3071

Western Australia:
ATHOL M. HILL P/L.,
1000 Hay St.,
Perth 6000

RECORDINGS classical

REVIEWER: John Araneta

VERDI – Requiem. Mirella Freni, Christa Ludwig, Carlo Cossutta, Nicolai Ghiaurov, Wiener Singverein, Berlin Philharmonic, H. von Karajan (cond.) 2 DGG 2707 065

Not a single recorded version of Verdi's Requiem is uninteresting. Standards of performance and recording vary but always at the very least the *Requiem* seems to draw forth the deepest sense of commitment from each one concerned. My own particular favourite recordings of this work are: Solti with its tremendous energy and excellent recording (DECCA), the Reiner which despite some slowish tempos from Reiner and rather low-level recording preserves to my mind the finest quartet singing on records from Price, Elias, Bjorling and Tozzi (Ace of Diamonds), and the now ancient Toscanini (RCA) with its Studio 8H sonics and second rate quartet but still perhaps the most remarkable recording I know. More conductors seem to adopt an understandably dramatic approach to this work (Bernstein, Leinsdorf, Ormandy, Markevitch, Solti); others are surprisingly devotional (Barbirolli, Giulini); only the Toscanini and (so it seems to me) the Reiner manage to present both aspects of this work uniquely. The present Karajan recording is quite unusually, for this conductor, more devotional than dramatic. This impression is not only gained from the very smooth and well-blended sound Karajan elicits from his forces: until the Offertorium and in the final Libera Me, the phrasing does not seem to be forward-moving enough. There is in fact the same curious reticence about this performance as a whole which characterized the Barbirolli (HMV) recording. Only in the Tuba Mirum did I feel the more violent quality of the music coming across. Predictably then, the more successful moments in this recordi are from the Offertorium onwards. The more technical aspects of this recording seem to emphasize Karajan's intentions. There is often a muffled sound here: note the highly uncoloured reproduction of the tympani, the trumpets do not seem to emerge freely and at louder moments the singing is often obscured, there seems in short very little effective resonance here (see especially the opening Dies Irae). No mistake about it, though, if this is the way you want the *Requiem* this performance is certainly not negligible: the Offertory and Communion sections are certainly even beautiful renditions. My personal feeling, however, is that a little more fire would not go amiss. Karajan's quartet is quite definitely on par with Giulini's as to quality and the singing is always refined and intelligent but I do feel there should be a greater sense of the operatic, a more distinguished use of *portamento*. Compare what this quartet does in the more reflective sections after the Dies Irae with Reiner's and the difference will immediately become obvious: the one certainly commands respect but Reiner's quartet is not only more idomatic, it moves. – J.A.A.

GUILLAUME DE MACHAUT – Notre Dame Mass. Perotin – Graduale "Sederunt Principles". Anonymous – Conductus "Pater Noster commisserans" – Conductus "Dic Christie veritas" – Deller Consort & Members of the Collegium Aureum. BASF 25 29 377–7

The *Notre Dame Mass* of Guillaume de Machaut (c.1300-1377) is the first known instance of a complete setting of the Mass Ordinary by one composer. As such it is prophetic of the vogue the Mass had as *the* musical high art form of the fifteenth and sixteenth centuries. It also includes certain features which were to become conventions of future settings of the Ordinary, such as the use of a unifying device or motif and the dramatic slowing of tempo at the words "Jesu Christie" in the *Gloria* and "Ex Maria vergine" in the Creed. But it is not just musicological interest which makes this setting of the Mass (surprisingly enough) the most recorded Mass before Mozart. Machaut's work reveals at once a most refined taste and an almost flamboyant majesty seldom surpassed by later settings. This music can also seem disturbing or startling not simply because of the strong presence of the secular spirit but also for the daring, rather modern textures and sounds. No wonder twentieth century composers like Stravinsky have found this Mass fascinating.

The present recording of the *Notre Dame Mass* by the Deller Consort and members of the Collegium Aureum has been available for some time now on the Harmonia Mundi label, and one hopes that in its BASF format it will be more readily available than it has been previously. This is a tremendously exciting and extrovert performance, by far the best version of the work I have come across. The more recent Telefunken recording is by comparison curiously bland and the different taleae (rhythmic schemes) are often smoothed over in a way inconsistent with the nature of this music. The driving force behind this performance is undoubtedly Alfred Deller, whose virtuoso singing here is nothing less than remarkable. I am in fact almost tempted to say that his performance here surpasses any of his efforts in the more familiar Elizabethan and Jacobean literature. His sense of melodic line and rhythm makes one notice things not usually encountered in live or recorded instances of this music. I need only cite his rendering of "Propter magnam" from the Gloria and "Ante omnia saecula" in the Creed. It is also undoubtedly his drive which propels everyone into an ecstatic delivery of that evocation of the dance at the end of the Gloria. The "Ex Maria vergine" is very movingly done. In the face of such general excellence it seems a pity to object to certain features of the performance. Microphone placement may very well be responsible for the prominent highiighting of Deller's voice. Or it may also well be that the rest of the quartet is not just up to the calibre of Deller's delivery. The *motetus* should have perhaps been strengthened instrumentally. The plainsong portions are admirably included in this performance but they are not as well sung as the rest of the Mass. The somewhat nasal delivery here may well reflect the idea that the vocal quality of the plainsong must be similar to the dissonant character of the polyphonic portions. In fact the rendering of the polyphony is seldom harsh despite the always extrovert nature of its delivery, and in any case a more refined singing of the plainsong would make a finer contrast between monophonic and polyphonic sections. On the whole, however, and despite the shortcomings, this performance remains as I said perhaps the finest version of the Mass available. The instrumental playing of the Collegium Aurem is also no less responsible for the success of this recording.

This disc includes a performance of the *organum quadruplum* "Sederunt Principes" by the 13th century composer Perotin and two examples of anonymous conductus: "Pater noster commisserans" and "Dic Christi veritas". The performances here may well strike some as being rather fanciful and somewhat barbaric. Once again and especially in *Sederunt Principes*, I feel the plainsong should not be delivered in so nasal a manner. The secular rhythms in these pieces are strongly emphasised and there is nothing intrinsically wrong in this. There is little hiding of the dissonances in the Perotin though I dare say some of these are the result of lapses in the performance. I do especially like the exciting rendition of the "dancelike" end in the Perotin. But whatever reservations one may have about these realisations, these performances make an exciting accompaniment to the Machaut. Very highly recommended. – J.A.A.

DANCE MUSIC OF THE RENAISSANCE. Ulsamer-Collegium, Konrad Ragossnig (lute). DGG Archiv 2533 111.

Record collectors who are already familiar with Archiv's previous recording of Preatorius and Schein dances on DGG ARC 198166 will understandably take to this record with interest. That recording not only presented intelligent arrangements but performances of infectious verve as well. This record presents dances from an earlier period, the fifteenth and early sixteenth centuries, though the first five dances, including the ubiquitous Lamento di Tristano and Rotta, actually date from at least the fourteenth century.

While in the case of the Praetorius and Schein Dances there are numerous indications and directions, notably from

(Continued on page 161)

CLASSICAL

Praetorius himself, as to how those dances should be performed, in the case of dances from earlier periods, there are fewer and less precise directions available and these must be gleaned from the available materials in true scholarly fashion if the realisations are to be highly successful. It must be borne in mind after all that many of these dances need to be invested with rhythm, combination, decoration, and then the question of proper instrumentation arises. As in the case with many other recordings of ancient dances, one always has the feeling there is little more than a superficial knowledge of the performance practices relevant to the material at hand. In the case of most recordings of medieval dances, for instance, it usually is obvious that an only superficial knowledge of Arabic music is used for realisation. The first five dances on this record, which are in fact medieval dances certainly are less than highly satisfying for this reason. The practice of adding organal passages is necessary but again one feels that only a superficial grasp of the problems involved are in operation here. The later dances fare much better precisely because the knowledge relevant to the material is that more readily available or obvious.

Be that as it may, it is none the less a very enjoyable record and the examples are chosen so as to demonstrate the more common dances in these periods, as well as the unusual uses possible like musical caricature in Neusiedler's "Judenstanz". The recording is excellent but I have been noticing for some time now a rather disconcerting number of DGG and Archiv records with less than immaculate pressings. Let us hope this is not a sign of things to come. – J.A.A.

MOZART – Violin Concerto in G (no. 3) K.216 Concertone in C for 2 violins & orch. K. 190. Academy of St. Martin-in-the-Fields, Neville Marriner (cond.) ARGO ZRG-729.

There are already a number of recordings of K.216 and K.190, and most of these recordings feature several of the finest violinists of our time, what then is the reason for yet another recording of both these works? But to tell the truth, however, I, for one, have been capable of listening to only the NONESUCH recordings of these works and precisely because they feature lesser known violinists such as Makanowitzky and Hendel and the idiomatic conducting of the late Ristenpart. These works require not only the right performance practice (preferably with original instruments) but restraint as well. Performed by most virtuosi conductors, orchestras and violinists, these works only too often sound over-inflated and too saccharine as a result. These pieces are not violin concerti in the style of Brahms, or Tchaikovsky let alone a Viotti.

The preference for hearing early baroque violin concerti, including those of Bach in more suitable performances has greatly increased in the last five years or so, and it surely is about time those of Mozart were treated in a similar way. More to the point, these concerti are not important statements in the sense that most other violin concerti of the 19th century are. Nor are they even among Mozart's important achievements and in any case they are stylistically more divertimenti than virtuoso works. A smallish group using original instruments would be ideal for these works but barring this a performance such as we get on this record is more than welcome.

In the concerto, violinist Alan Loveday avoids the self-conscious stance of better known virtuosi in this music and makes no attempt to enhance the music with any more feeling than is already in the piece. Marriner (and the engineers) have also seen to it that a more democratic balance between soloist and members of the orchestra is always maintained. For once, cadenza sections are presented as lyrical extensions of the concerted sections and this all to the good of the music. The Academy performs with fine *galant* spirit, with attention to accents and fine phrasing from everyone, not just the soloist. If you think all this means unfeeling Mozart, the second movement will certainly dissuade you from any such idea. I have not heard a more moving yet integrated performance than here. The advantages of performing in true chamber style can be better appreciated in the Concertone K.190. There can be no question about the calibre of violinists Iona Brown and Carmel Kaine but they share equal placement with Kenneth Heath's cello and Tess Miller's oboe. The Concertone is really a concerto grosso and Marriner and his forces approach it as such. Once again feeling for the music is hardly neglected but it is the right kind.

A very fine record, beautifully recorded. – J.A.A.

DULCE MEMOIRE – Soloists, Purcell Consort (Grayston Burgess, cond.). Elizabethan Consort of viols, Andrew Davis (harpsichord). David Munrow & Richard Lee (flutes & recorders). James Tyler (lute). ARGO ZRG-667.

There are a number of recordings of Renaissance French chansons available but none as finely executed as this. The examples are well chosen to provide a very wide variety of styles. In addition, examples of transcriptions of some of the chansons are included as well. It is rather a pity that in the case where transcription and original chanson have been presented (ie. Doulce Memoire by Sandrin, and arr. Cabezon and Manchicourt) these have not been grouped together. No doubt, the need felt for variety was instrumental for this but no matter, the performances here and the realisations are consistently a joy to hear.

A very useful record for the educator and the listener who no doubt should find this refined and pleasing music to his taste. – J.A.A.

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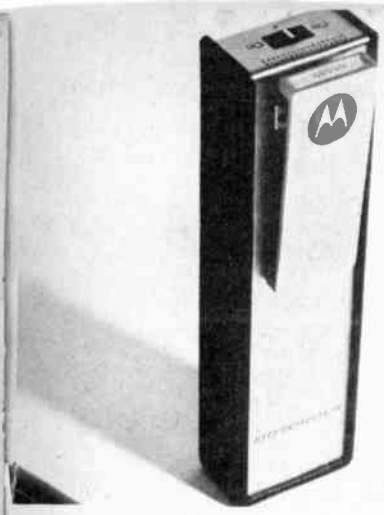

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Personal paging service shortly to be introduced throughout Sydney and Melbourne area.

THE Australian Post Office is soon to provide city wide personal paging services.

The first two systems, covering Sydney and Melbourne, are scheduled to commence operation simultaneously on September 17th.

The paging unit supplied to subscribers is a small compact unit that fits snugly into a shirt or jacket pocket.

When the subscriber has to be paged, his secretary or receptionist simply dials a discrete seven digit code on the normal telephone.

The subscriber, carrying the receiver in his pocket will be alerted by his pager emitting a high pitched "beep-beep" tone which he can conveniently cancel. He then phones his office or base to receive the message.

The receiver makes allowance for the man who may be in a situation where he does not want to receive a "page", by providing a third position on an "ON-OFF" switch which allows a "page" to be stored until he wishes to check the receivers' memory.

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In the latter half of 1972, the Australian Post Office acquired the telephone network — connected Telmar radio paging system operated by Telmar Pty. Ltd. and its associated company, Farrell Medical Alarm Radio Service Pty. Ltd.

The Telmar system will continue to operate as an independent and parallel system to the new system, gradually phasing out as receivers become obsolete or leases expire.

The APO has code named the new system "Telefinder". A contract for $253,000 was placed with Motorola Communications Australasia last year for the supply of terminal equipment, encoders and base transmitters for the system.

Reception is claimed to be excellent throughout the service area; the unit, say Motorola, will even work inside motor vehicles and steel framed buildings.

Full details of the service may be obtained from Motorola Communications (cnr. Grant and Clarke Sts., Sth. Melbourne, Vic., or 21 Cosgrove Rd., Enfield, NSW) or from the Australian Post Office Telecommunications Advisory Centres in each State. ●

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