electronics TODAY

3 HI-FI PROJECTS

CAN MACHINES THINK?

EAD MEN SPEAK
N TAPE?

I-POWER STROBE
O BUILD

SPECIAL
HI-FI
ISSUE

• SPEAKERS
• AMPLIFIER
• TAPE RECORDER

Got a leaning to good listening

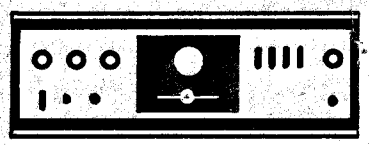
Here's a new SLANT —FRONT SONY® TAPE DECK

You'll discover a whole new realm of thrilling high-fidelity listening enjoyment when you team unique **slant-front** SONY TC-366 Stereo Tape Deck with your present sound system—or with either of the superb SONY stereo Amplifiers TA-1144 or TA-1010. Both amplifiers make ideal partners for the TC-366 and offer stereo recording and listening that will meet your highest expectations. Sony TC-366 **slant-front** design makes tape deck operation more stable and simple. **Three** separate heads—play-back, recording and erase—enable you to monitor either what you are now recording or what you have just recorded on tape. The mixing facility means you can record two sound sources—such as your voice and radio music—simultaneously. Servo-controlled tape transport reduces flutter and wow and assures incredibly smooth and steady reel drive with optimum tape tension. A tape selector allows you to record on normal tape or special high-fidelity tape such as SONY SLH. If you want good listening . . . select the amplifier that suits you, then team it with the TC-366—it's a versatile and magnificent stereo sound performer.

. . . and two superb SONY® Amplifiers to team with it:

The TC-366 and one of these amplifiers will give you **truly good listening!**

TA-1144



TA-1010

	TA-1144	TA-1010
Power Output:	Rated output, 30W per channel, both channels operating	Rated output, 15 watts per channel, both channels operating
Harmonic Distortion:	Less than 0.2% at rated output	Less than 0.5% at rated output
Intermodulation Distortion (60 Hz:7 kHz = 4:1):	Less than 0.2% at rated output	Less than 1% at rated output
Frequency Response:	15 Hz — 300 kHz ± 2 dB	20 Hz — 100 kHz
Headphone Output:	Accepts all low and high impedance headphones	Accepts all low and high impedance headphones
Tone Controls:	Bass 100 kHz ± 10 dB (10 steps by 2 dB) Treble 10 kHz ± 10 dB (10 steps by 2 dB)	Bass 100 kHz ± 10 dB. Treble 10 kHz ± 10 dB
S/N Ratio:	PHONO-1, PHONO-2, better than 70 dB (1.2 mV), TUNER, TAPE, REC/PB, AUX-1, AUX-2, AUX-3, 90 dB (150 mV)	PHONO-1, PHONO-2, better than 70 dB, 3 mV, TUNER, AUX-1, AUX-2, TAPE, REC/PB, better than 90 dB (250 mV)
Circuit:	24 transistors, 7 diodes	20 transistors, 5 diodes
Dimensions:	16 5/8 (W) x 5 13/16 (H) x 12 5/8 (D)	16 9/16 (W) x 4 7/8 (H) x 9 11/16 (D)
Weight:	17 lb 1 oz	10 lb

SONY®

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To: **Jacoby, Mitchell & Co. Pty. Ltd.**, 469-475 Kent St., Sydney, N.S.W., 2000.
Please send me information on the SONY TC-366 Stereo Tape Deck and the TA-1144 & TA-1010 Stereo Amplifiers.

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JMS/21-70

electronics TODAY

AUGUST 1971 Vol. 1 No. 5

main features

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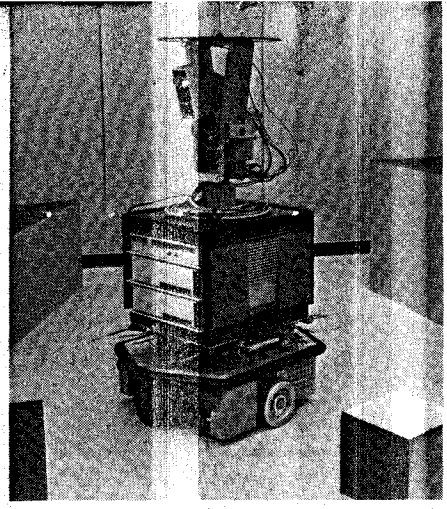
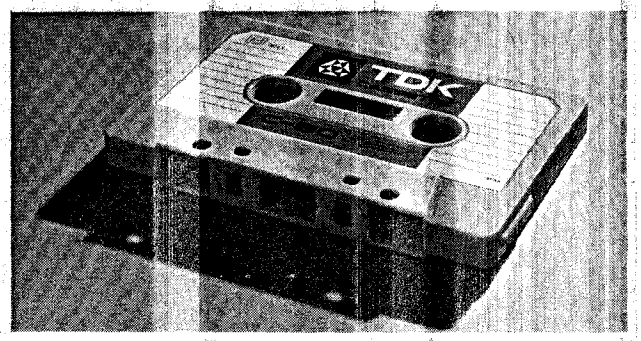
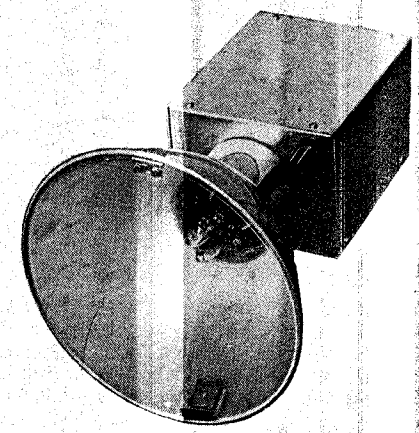
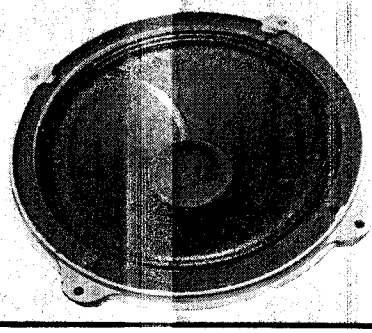
news & information

COVER: Setting up a JBL Century speaker in preparation for testing. The actual test is done in an anechoic chamber, where photography is impracticable.









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Peter Clark says
I guarantee that these are the . . .

Six Best Hi-Fi Systems in Sydney to-day

COMPARE what you get for your money before you buy anywhere else! You will save many dollars and many tears by hearing these first.

No need to be puzzled when buying Hi-Fi stereo systems. We've taken the confusion out by matching 10 perfect systems, $169 to $950. LESS WITH TRADE-INS.

If you can't come to our two luxurious town showrooms, 'phone for one of my experts to come to your home. Advice and quotes on the Hi-Fi system most suitable will be given at no charge. Our prices are "discount" prices! Our guarantee is for TWELVE MONTHS. We deliver and install Free! We invite free membership of our tape and cassette exchange club! And in addition to the world's top-brand equipment at bed-rock prices we also have LOTS OF "DEMO" MODELS, guaranteed "USED" MODELS, all well-nigh perfect, many at HALF-PRICE, for CASH or TERMS UP TO 2 YEARS, with tiny deposits!

1. Junior Executive, $185

"Magnetic Sound" solid-state Stereo Amplifier with scratch filter and separate bass and treble. 20 watts of music power pushed out with complete purity through a pair of matched "AKAI JET-STREAM" Speakers. The Turntable is a "Sony" manual with extra-even movement, in a very nice cabinet. $20 deposit and two years to pay.

2. Junior Executive II, $219

"Monarch" SA 400 solid-state Stereo Amplifier with 28 watts of clear music power. Has loudness control, scratch filter and tape monitor. Is fed into a pair of matched "Hi-Complianee" Speakers in a two-way walnut cabinet. BSR auto or manual Turntable. Deposit $23 and two years to pay.

3. The "International" $278

Music tape system from Japan/Europe. High Quality 3 speed 4 track stereo Hitachi 7270 tape deck—coupled with A.121 45 watt amplifier—Tremendous for a family music centre! Plus 2 M.S.I. TINA loud speakers. Up to 2 years to pay, $28 deposit, 12 months' guarantee.

4. Grayson Belvedere, $329

Studio-quality Sound at over $100 savings! "SANSUI" AU222 Amplifier with a power output of 46 watts of music power. Frequency response 20-30,000 Hz SILCRON Turntable with professionally balanced tone-arm with Magnetic Cartridge. Two "MSI 400" Matched Speakers in Teak cabinet. Deposit $33. Pay over two years.

5. The "Sony" TA 1010, $425

The completely music-matched trio: Sony Stereo Amplifier TA 1010 with a stirring yet pure-toned 58 watts of output. Fed by a Sony PS 1010 Stereo Turntable with auto return. Geared to a pair of Sony SS 103 Speakers: Ten-inch and four-inch, two-way system. $45 deposit and over two years to pay if desired.

6. The "Penthouse" $563

Fully imported from Japan/England. Combines latest Sony slope front 3 speed 3 head twin meter tape deck. Amplifier latest Kenwood 20-22000 HZ solid stat. Played through 2 world famous British Whardale Super Linton speakers. A truly super high fidelity music system. Deposit $58, up to 2 years to pay.

PLUS SYDNEY'S LARGEST RANGE OF TAPE RECORDERS!

Magnetic Sound INDUSTRIES

City at 387 George St.,
one door from Kodak, Tel.: 29-3371
Parramatta, next 0 P S M
20 Macquarie St., Tel.: 635-0830

keep the wheels turning

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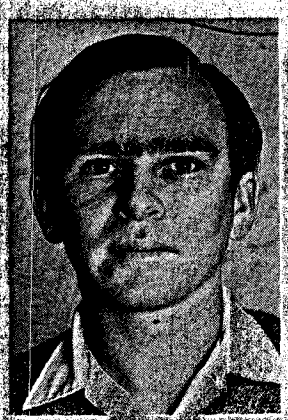


Projects Manager:
Barry Wilkinson

ECONOMIES such as ours function properly only while some people keep making things and others keep buying them.

The result is an effect known to economists as the 'multiplier' — and, in theory at least, we all end up better off than we would be if we each did our own thing.

Unfortunately, the success of the system does not depend upon the intrinsic value of the manufactured products. It really makes no difference whether factories churn out typewriters or plastic wall ducks, just so long as they churn them out and enough people keep buying them.

But in many prosperous countries, such as Australia or the U.S.A., most people already have all the typewriters and plastic ducks they want, and it has become necessary to create 'needs' which did not previously exist, or of which people weren't previously aware, in order to keep the wheels of industry turning.

A classical example of this is the automobile industry, which spends enormous sums of money every year on restyling their products, and by so doing creates a totally artificial consumer 'need'.

Wasteful? — Certainly. But there's no denying that it's good for the economy.

Some of the latest hi-fi gimmickry is an extension of this principle. A loudspeaker with a multiplicity of drive units may actually be inferior to another which has only two or three, and an amplifier with thirty-eight control knobs on the front panel does not necessarily outdate one that has only seven.

Bear this in mind when shopping around for new equipment — and if you need advice on making a choice, be sure you get it from a specialist dealer.

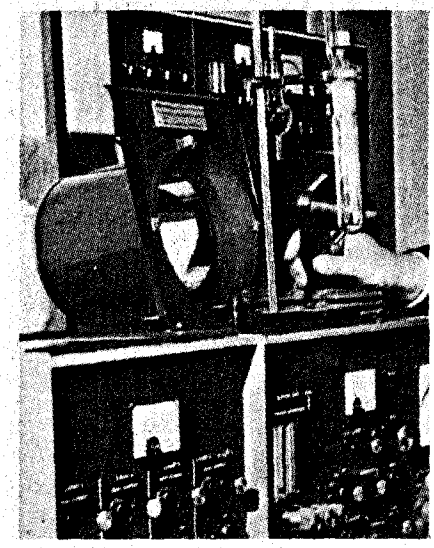
NOW to a different subject — that of face. Except for the editor, the staff of most publications remain faceless people to their readers.

We've decided to change that. From now on, we will publish a photo of a different staff member on this page each month. Not in any particular order — our method of choice is to blindfold our secretary and get her to stick a pin into a list of names.

First name she stuck was Barry Wilkinson's — so here he is at left.

news digest

DETECTING MERCURY CONTAMINATION



The EEL 240 Automatic Absorption Spectrophotometer (manufactured by Evans Electroselenium Ltd.) can quickly detect and record the mercury level in contaminated foodstuffs. The sample to be examined is placed in a test tube and a reagent is added to reduce the mercury to its metallic state; a stream of air vaporises the solution and the resultant mercury vapour is carried into the flameless absorption cell in the EEL 240. The instrument can detect amounts as small as 5 nanogrammes (ngm) of mercury.

NAVY SHELLS OUT

A Department of the Navy Engineer, has been awarded $2,150 for inventing a device to monitor naval gun performance.

The invention is a muzzle velocity indicator using a solid state radar-linked computer.

Claimed to be capable of measuring shell muzzle velocity to an accuracy of 0.06%, the device enables gunners to make checks on propellant charges, the shell and gun barrel conditions.

PLESSEY/PAIGNTON INTEGRATE

All operations of Painton (Australia) Pty. Limited are to be transferred to Plessey Ducon Pty. Limited from July 1. This follows acquisition of Painton by Plessey in the United Kingdom.

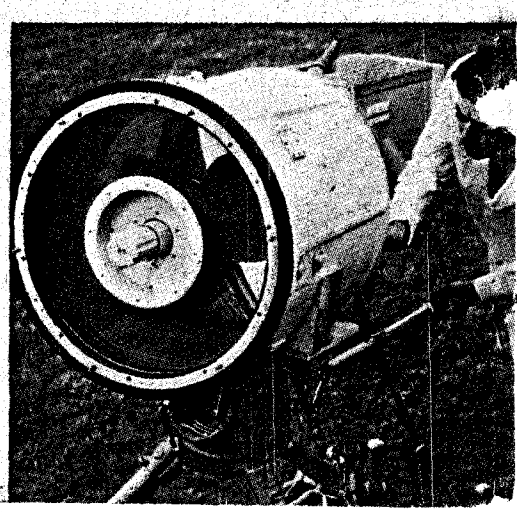
Marketing and sales of Painton products including connectors, switches, wirewound resistors and potentiometers, will be conducted through the Professional Components Department of the Plessey Ducon sales office in each State. These offices have been augmented by former Painton staff.

In Sydney, Mr Philip Hart is now directly responsible to Mr Graham G. Hall, sales manager of the Professional Components Department at Christina Road, Villawood, N.S.W.

Mr Derek Buckley and Mr Brian Ross have joined Victorian branch manager, Mr Joe E. Sullivan, at The Boulevard, Richmond, Victoria, and Mr Derek Olive has joined South Australian branch manager, Mr Kevin D. Fisher at 15-21 Coongie Avenue, Edwardstown, South Australia.

COLLECTING LIGHT AT NIGHT

One of the biggest lenses produced for use in a low light level TV system has been made by Pilkington Perkin-Elmer Ltd. for incorporation in this Marconi low light camera. The complete system transmits high resolution images on to a monitor which reproduces high contrast pictures under conditions of apparently total darkness.



Frankly, we don't know how they do it. However the remarkable Sansui Model 210 is likely to be the most popular Sansui model ever, including the record sales AU-555 and AU-222 stereo amplifiers. The Model 210 opens a bold new vista for the audio enthusiast and sets a new standard for audio equipment values.

For only $185 you get a tuner *designed specifically for Australian conditions* and a superb stereo amplifier. Although the Sansui Model 210 compares favorably with other models in the Sansui tuner/amplifier range, superfluous facilities for Australian conditions (such as F.M. and Multiplex) have been discarded. This saves some costs; further savings have been made by Sansui in arranging heavy volume production to meet the expected Australian demand.

Power output is 34 watts music power into 4 ohm speaker systems or 22 watts R.M.S. Frequency response is 25-30,000 Hz. ± 2 dB. Sensitivity suits magnetic cartridges at 3 mV. — and 180 mV. sensitivity caters for auxiliary inputs and tape recorders.

An easily read panoramic tuning dial simplifies selection of radio stations on AM/MW or AM/SW bands; a signal strength meter operates on the AM band. Selectivity is better than 25 dB. Distant stations are received with *unusual clarity* and *signal strength.*

Every desirable control is provided . . . a DIN socket for tape recorders, headphone jack, flexible bass and treble controls, a direct tape monitor switch, loudness control and a clearly marked selector switch.

Listen to the Sansui Model 210 at your Simon Gray dealer; *accept Sansui's invitation to listen critically.* You'll be agreeably surprised with the audible difference Sansui quality makes.

Trust Sansui. *You can.*

Simon Gray Pty. Ltd.

Sansui

SANSUI DISTRIBUTORS: *Australia, excepting W.A.: Simon Gray Pty. Ltd. Head Office: 28 Elizabeth Street, Melbourne. 3000. Tel. 63 8101. Telex 31904. Sydney Office: 53 Victoria Avenue, Chatswood, N.S.W. 2067. Tel. 40 4522*. Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. 2609. Tel. 95 6526. Adelaide Office: 301 South Terrace, Adelaide, S.A. 5000. Tel. 23 6219. N.T.: Plitzner's Music House, Smith Street, Darwin. 5790. Tel. 3801. Qld.: Sydney G. Hughes, 154-158 Arthur Street, New Farm, Brisbane. 4005. Tel. 58 1422. Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 7250. Tel. 21322. W.A. Distributors: Carlyle & Co. Pty. Ltd., 1-9 Milligan Street, Perth. 6000. Tel. 22 0191. Sansui equipment is manufactured by: Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-ku, Tokyo, Japan.*

Simon Gray Pty. Ltd.,
28 Elizabeth Street, Melbourne, 3000

Please send me all the facts about the Sansui Model 210 in detail . . . and the name of my nearest Simon Gray dealer.

NAME.....

ADDRESS.....

.....

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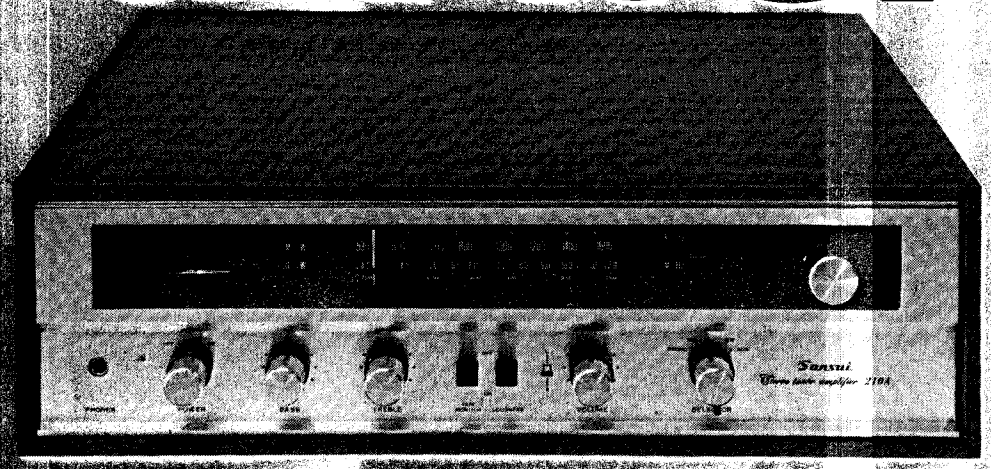
5210-771

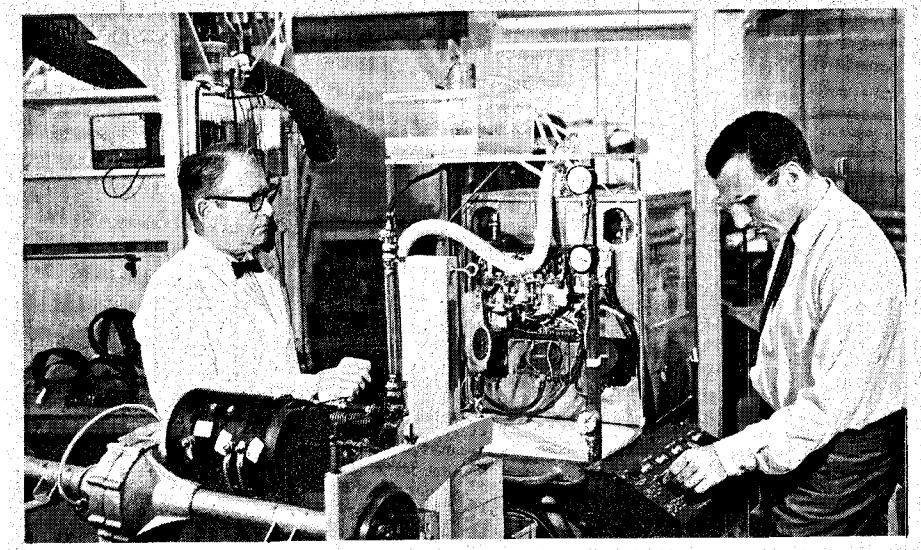
TRUST SANSUI



It takes Japan's leading audio only manufacturer ...Sansui...to design and manufacture an outstanding stereo tuner/amplifier expressly for Australia, and to keep the price down to only $185!

news digest

ZINC–AIR BATTERY



Experimental 14 kilowatt-hour prototype zinc-air battery operates drive train for a small electric-powered vehicle at General Atomic Divison of General Dynamics in San Diego, California.

Joseph Lucas Industries, Ltd., of Birmingham, England, has entered into a license agreement under which it will cooperate with General Atomic in carrying out research, development and testing of the zinc-air battery for potential use in England and various other countries.

The work at Lucas Research Laboratories will be carried forward in conjunction with the zinc-air battery development program now being carried on under the joint sponsorship of General Atomic and the Edison Electric Institute, the principal association of U.S. investor-owned electric power companies.

Because of its high energy density, the zinc-air battery system is regarded as an important potential source of economical motive power for certain vehicle applications.

HARTMANN AND BRAUN IN AUSTRALIA

Having been represented in Australia for many years, Hartmann and Braun of Frankfurt, manufacturers of instrumentation and control equipment, is now expanding its local operations. A newly established company, Hartmann and Braun (Australia) Pty. Ltd, will now assume responsibility for operations in Australia.

Hartmann and Braun manufactures a wide range of control and instrumentation items, and specializes in the application of measuring and control techniques to all types of production plant. Power generation and distribution, chemical, iron and steel, cement, glass and plastics industries are among the major fields serviced. Apart from the supply of equipment, customers are offered complete systems design and commissioning assistance.

A workshop and clean-room now being developed at the company's premises will be used for the local assembly of imported components and their calibration and servicing.

HOT TAPE

Consolidated Video Systems Corp. of Santa Clara, California, has developed a system for thermal duplication of video-tapes.

The process which can only be applied to chromium dioxide coated tape is made possible by the unique Curie point properties of the material.

Chromium dioxide has a Curie temperature of 125°C which is well within the safe temperature limits of the tape's polyester base. At temperatures above the Curie point, chromium dioxide becomes paramagnetic and is unable to accept magnetization from an external source. However, below this temperature, in the range between 125°C and 105°C, the material can accept external magnetic fields with ease.

In the new process a pre-recorded magnetic master tape is brought into direct (high speed) contact with the tape onto which the data is to be impressed. During the contact period the temperature of the slave tape is

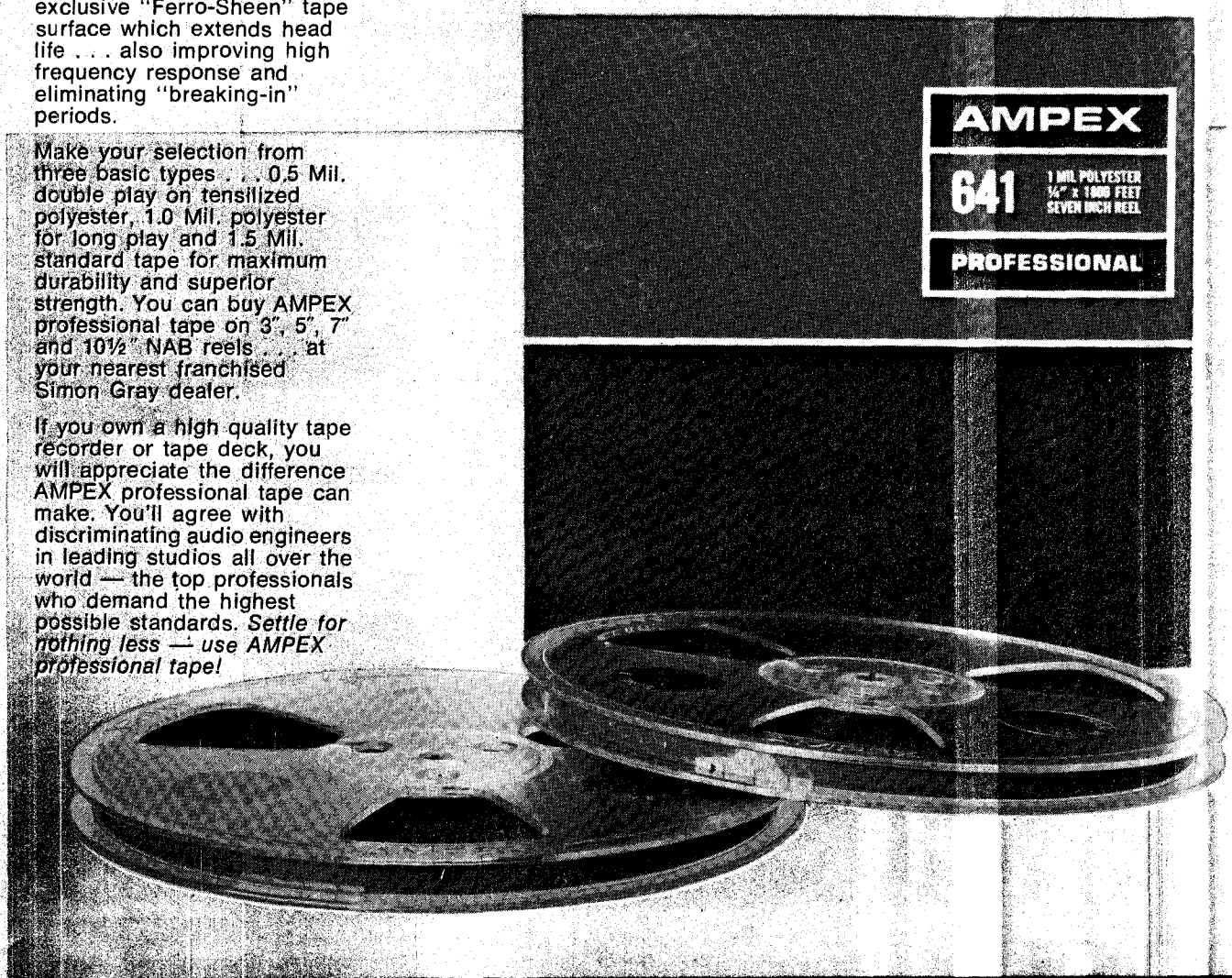
Now AMPEX "600 Series" professional tape, previously available only to TV, broadcasting and recording studios, is available to you for home use through your franchised Simon Gray Dealer.

Ever wondered why professionally recorded tapes sounded better? While equipment plays a major role, the importance of tape in professional use cannot be over emphasized. Now, for the first time, AMPEX professional audio tape is available to the consumer. That's not all the good news. Because production has been substantially *increased,* the price has been *reduced.*

What are the big advantages of AMPEX professional tape? Precise oxide formulation, maximum dynamic range, uniform tape output and the exclusive "Ferro-Sheen" tape surface which extends head life . . . also improving high frequency response and eliminating "breaking-in" periods.

Make your selection from three basic types . . . 0.5 Mil. double play on tensilized polyester, 1.0 Mil. polyester for long play and 1.5 Mil. standard tape for maximum durability and superior strength. You can buy AMPEX professional tape on 3", 5", 7" and 10½" NAB reels . . . at your nearest franchised Simon Gray dealer.

If you own a high quality tape recorder or tape deck, you will appreciate the difference AMPEX professional tape can make. You'll agree with discriminating audio engineers in leading studios all over the world — the top professionals who demand the highest possible standards. *Settle for nothing less — use AMPEX professional tape!*



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Adelaide Office: 301 South Terrace, Adelaide S.A. Tel. 23 6219

INTERSTATE REPRESENTATIVES:

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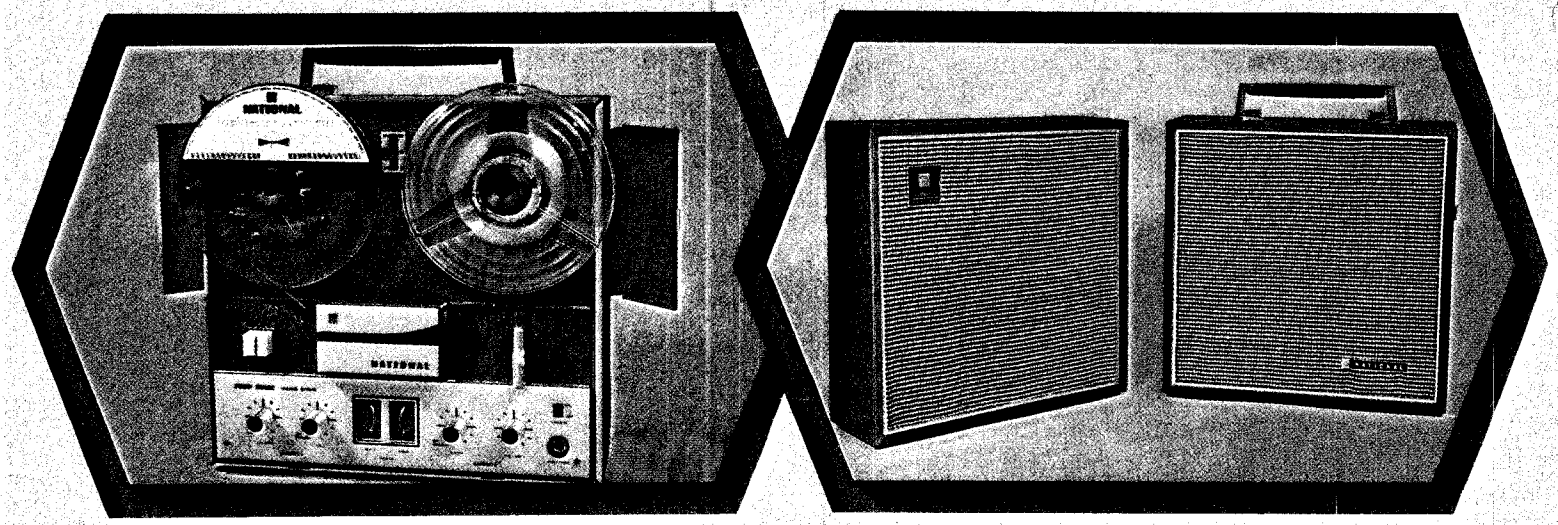
Selling sound to Australia — and selling for less!

Here's positive proof that Douglas Trading gives you extra purchase power . . .

$200 OFF

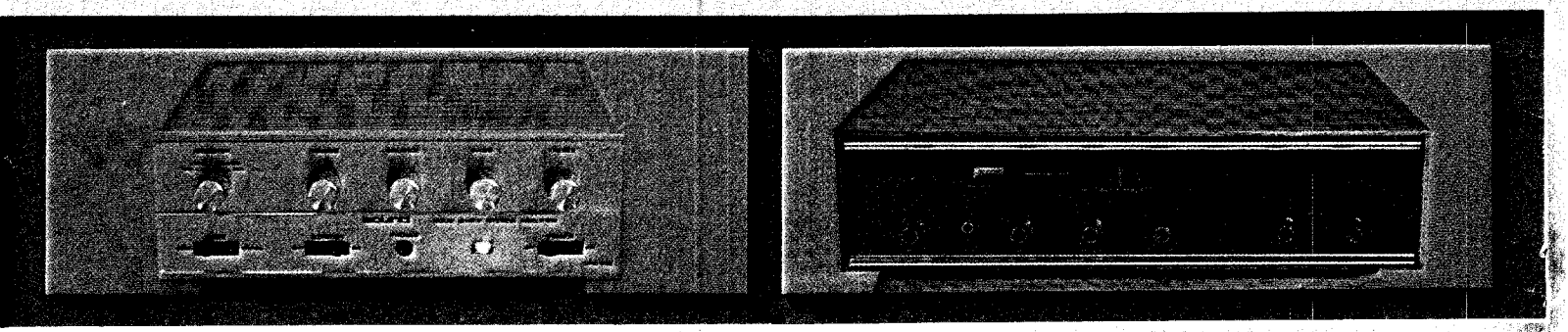
TEAC bi-directional, 4 track, 3 speed, stereo tape recorders. Brand new in sealed cartons! Full 12 MONTHS warranty!
These superb recorders give you continuous recording and playback in both tape directions. Enjoy up to eight hours of continuous music. Enoy the amazing quality of reproduction that stems from TEAC's unique features . . . Hysteresis Synchronous Motor Drive, symmetrically controlled operation, four TEAC Techno-Built precision heads, built-in hi-fidelity amplifiers and speaker systems.

Normally priced at $499. **OUR PRICE $299**



A Douglas Trading double-barrelled bargain!

Latest model NATIONAL 3 speed stereo tape recorder, complete with extension speakers, microphones, tapes, etc. Brand new in sealed cartons. Full warranty. Rush your order and cheque! **$169 COMPLETE**



SOUND HI-FI AMPLIFIER. 12 watts RMS power, bass and treble control, magnetic input, ±1db, 30-20,000Hz. Lowest priced high quality amplifier to be offered in Australia. **ONLY $74.50**

PIONEER HI-FI STEREO TUNER AMPLIFIER. Model AX330. Bass/treble/loudness control, tape monitor, AM tuner with tuned RF stage, black light dial, 12 watts RMS power. Brand new in sealed cartons. Full warranty. **Rush these . . .** **ONLY $139**

Don't hesitate to write for further information. Post your order and cheque direct . . .

Douglas Trading
CITY HI-FI CENTRE
191 BOURKE ST.
MELBOURNE
—63-9321

news digest

rapidly brought down through the Curie point, and thus the magnetic signal from the master tape is transferred to the slave tape under ideal conditions.

The master tape regains its full magnetic properties as it regains normal ambient temperature.

IR GEOPHYSICS

Sophisticated infra-red scanning equipment which can be used for three dimensional topography, photography, pollution, and geological studies, is now available from DC Industries Pty. Ltd., a Melbourne computer peripheral and electronics manufacturer and distributor.

The first of these units to be used in Australia has been field tested during the past twelve months by the Physics Department of the University of Newcastle.

Pollution studies in Melbourne, Sydney and Newcastle have been completed, as have geological studies of the Mt. Isa region, King Island, and areas at Cobar and Narrabri, N.S.W.

The Daedalus scanner detects far infra-red radiation in the 8-14 micron band using a Hg—Cd—Te detector which is cooled by liquid nitrogen to reduce background electrical noise.

Viewing is made downwards from the floor opening in a twin-engine survey plane. A mirror rotating at 3,600 rpm permits a viewing angle of 120°. A strip out of this angle is seen along the flight line of the aircraft. A system of mirrors focuses the individual heat points on to the detector.

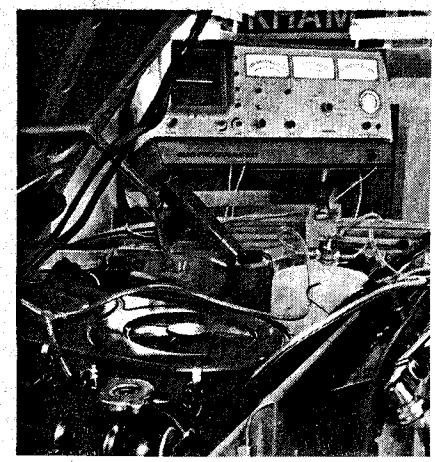
Information is fed to a tape deck in frequency modulated form with control pulses and a voice channel.

After the flight, the tape is played back through a viewer-printer, which presents the information on a television-type display as a series of different density points of light along a horizontal line. This is viewed by a camera with a continuously moving 70 mm film resulting in the detailed 'heat picture'. It is claimed that temperature differences of 0.3°C can be detected.

AUTOMATIC ENGINE TUNER

The first stage to full computerized diagnosis of motor vehicles has been introduced jointly by the Bosch and BMW organisations.

All BMW cars are now factory wired, ready for diagnosis, and the Bosch electronic tuning equipment is connected to the vehicle by one multiway plug and socket.



The Bosch equipment is programmed to a set sequence of checks so that the diagnosis can be completed very much faster than normally feasible and, at the same time, reduces the possibility of operator error to the minimum.

$25,000.00 SUNDIAL

This desk clock has one thing in comm common with a sundial . . . there are no moving parts. This unique time piece was built by Motorola at a cost of about $25,000 to demonstrate what could happen with the clocks and watches of the future.

This clock represents three departures from the conventional design. First, there are no moving hands; instead, there are 72 light-emitting diodes arranged in two circles. The outside circle is made up of 60 diodes and marks the seconds and minutes. Each second or minute is marked by an apparently moving red light as the circuit switches power to the appropriate diodes in sequential fashion. The inside circle of 12 diodes marks the hours in the same fashion. With this arrangement, only three diodes are turned on at any one time. With this system, it is expected that two small batteries can drive the clock for about one year before needing replacement.

The second departure is that the mechanical movement has been replaced by tiny integrated circuits. These circuits provide the signals that turn on the appropriate diodes to indicate hours, minutes, and seconds.

The third departure is that the time device is a quartz crystal instead of a tuning fork or a circular balance staff. A quartz crystal is one of the most accurate frequency generating devices known to technology and is expected to give this time piece unsurpassed accuracy.

news digest

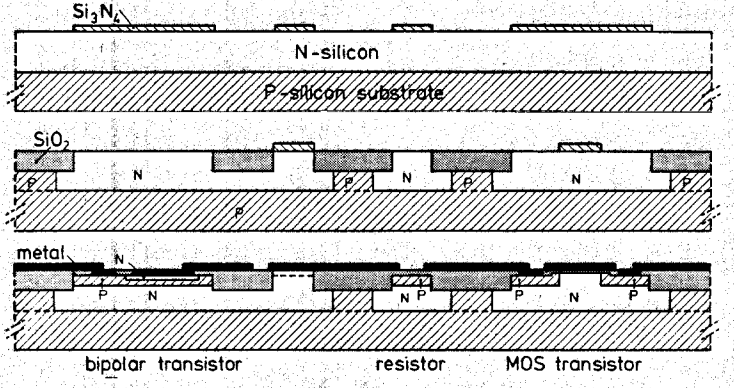
The light-emitting diodes are small pieces of special solid material (gallium arsenide phosphide) that glow bright red when a voltage is applied to them.

Although currently only in the research phase, it is almost certain that the electronics inside will be commercially adopted not only in clocks but wrist watches as well. It is expected that a full integrated form of the clock circuit will exist within the year. Further work is being done to increase the efficiency of the light-emitting diodes so that the small battery of a wrist watch will be able to operate it.

LAYER-CAKE TRANSISTORS

A new technique developed by Philips Research Laboratories in Eindhoven, Holland, enables three different devices — such as a bipolar transistor, a resistor, and a MOS transistor, to be formed on one silicon slice.

Basically, the technique involves the use of a silicon nitride mask to make well defined patterns of thick oxide on the silicon slice. When required, the oxidation stage is combined with a diffusion stage. The top figure shows the nitride mask on a thin N-type silicon layer which is grown epitaxially on the P-type silicon substrate. In the centre figure, which shows an intermediate step, the silicon oxide layer is embedded in the N-silicon, on top of P^+ diffused areas. N-type islands are thus formed, separated by the oxide walls. The nitride is then removed from those areas where P-diffusion is carried out. This is followed by oxidation and N-diffusion steps. During these, the N-type surface area of the MOS transistor continues to be protected by the nitride. This area still needs a thin oxide layer, which is made after the remaining nitride has been removed. Then contact windows are defined and an interconnecting metallized pattern is applied. The bottom figure shows the devices in their final form.



SAFER MEDICAL ELECTRONICS

The chances of being electrocuted in hospital are quite high, according to a recent US report that showed that nearly 50% of all medical electronic instruments had leakage currents greatly in excess of 10 microamps.

This is somewhat less than reassuring as patients with embedded electronic probes are known to have been electrocuted by currents as low as 20 microamps.

And isolation transformers have been found to introduce yet further hazards.

The only complete answer is total electrical isolation between the electronic instrumentation and the patient.

This has now been achieved in an ingenious system developed by the USA's Gilson Medical Electronics Inc. Their solution is to use telemetry to transmit both power and electrical signals.

The main power source is an incandescent globe energized by the normal mains supply. Light energy from the globe is received by a bank of photo-voltaic cells located in the same housing as the globe but spaced about an inch away. The resultant electrical energy powers the patient's electronic probe circuits.

Data from the probes frequency modulates a simple telemetry transmitter, the power for which is derived from the photo-voltaic cells.

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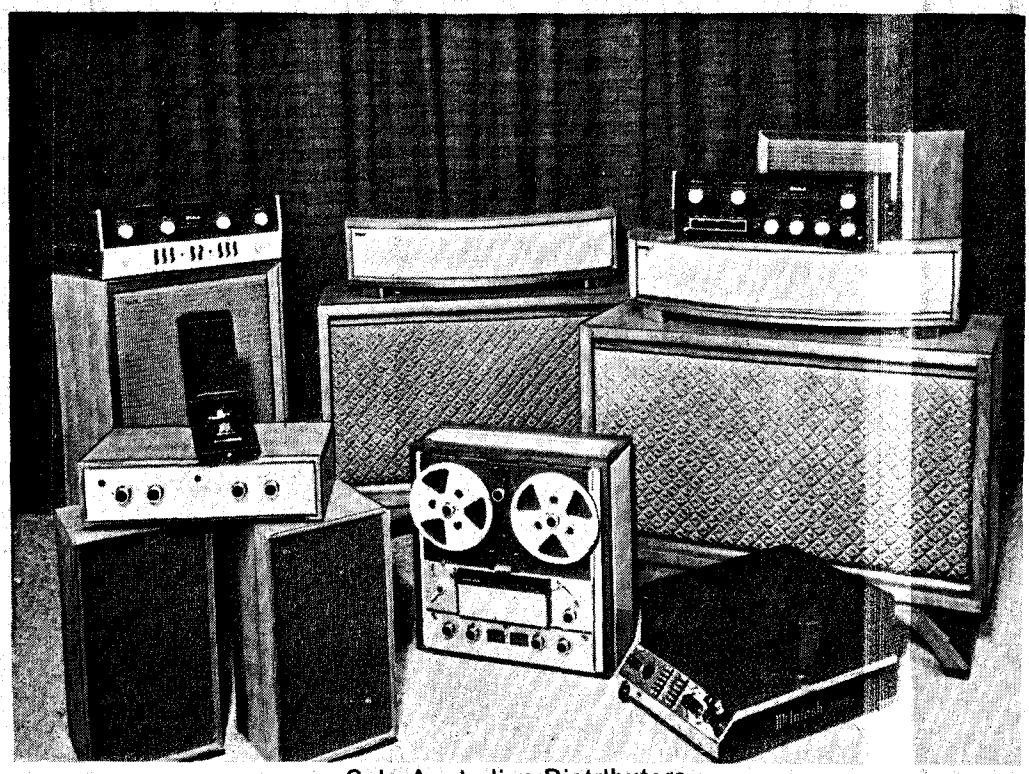

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news digest

The signals are received by a unit which is located by the bedside.

The system has been designed to interface with existing instrumentation and following clinical evaluation, (at the University of Wisconsin) will be marketed as a complete isolation unit for around $400.

BRAIN CONTROLLED WHEELCHAIRS

One of the most important developments in artificial limb technology in recent years, has been that the so-called myo-electric hand, which can be controlled directly from the brain. The hand is powered by devices which pick up the tiny electric current flowing in the remains of muscles, amplifies them and feeds them to the motors in the artificial hand.

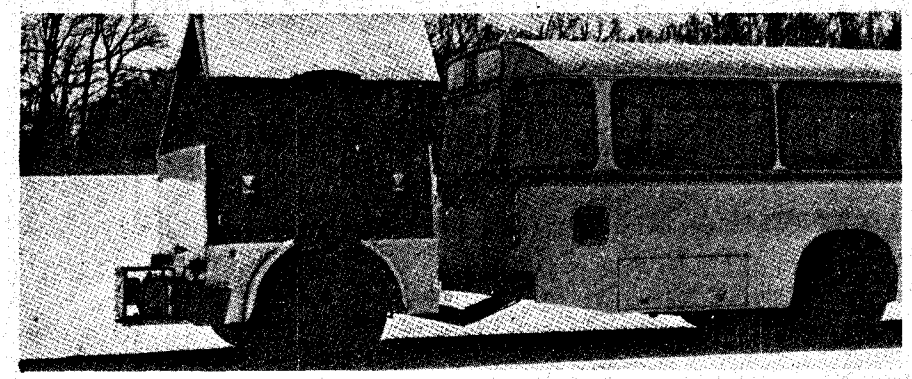
Mr. Robert Reilly, one of the electronic experts who originally worked on the myoelectric hand at the Medical Research Council's powered limb Research Unit near London, is taking the same principle a stage further. He intends to apply the current-amplifying devices for many other purposes besides the powering of artificial limbs.

The basic philosophy behind Mr Reilly's thinking is that the research could be used to help thousands of people who are completely paralysed below the neck by high-level spinal injuries.

Many patients who have lost control of their arms and legs through a break in the spinal cord still retain control of muscles in their necks and shoulders, because the nerves supplying these run from the top of the spinal cord. Mr Reilly has developed a device called an Electro-myogram-sensor — an Emgor for short — which can be implanted painlessly in such muscles. The Emgor, a cylinder 20 mm long and 3 mm in diameter, picks up the tiny electric currents which pass through the muscles when they contract and amplifies the current many times over.

Originally, Emgors were developed to power artificial hands. But Mr Reilly believes that they can now be used for other purposes. The amplified current from the Emgor can be transmitted over a radio beam to a little antenna placed near the patient it can then be used to control many different things — to turn lights or heaters on or off, or to switch on any required TV channel, or even to move the patient's arms or hands so that he can use a typewriter. Emgors can also be used for different purposes at different times, once the patient has acquired the knack of switching from one use to another.

Emgors have been fitted into the bodies of two experimental goats and signals from them are being used experimentally to operate various devices. The first human implant should take place within a few months.



ELECTRIC BUS

Transport authorities in Koblenz, West Germany, have converted a number of 100 passenger buses to electrical power in attempt to reduce noise and air pollution.

The batteries which are carried on trailers provide sufficient energy for five or six hours operation — 50-60 kms.

IN THE GROOVE

A not altogether serious proposal from England suggests a method for recreating sounds from the past.

The theory is that ambient noise impinging upon sculptor's trowels would amplitude modulate grooves in the work that they were creating at the time.

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Acoustic staggering of the two mid-range speakers results in musical definition rarely heard in medium size speaker systems. String tone and woodwinds are particularly natural and easy to listen to . . . sufficient to satisfy the most fastidious music lover.

Finally, let's look at the superb SP3000, prince of the Sansui range of quality speaker systems. With a massive magnet structure on the 15" woofer, bass is reproduced without color or restraint. Total flux is 187,000 maxwells! At 600 Hz. an electrical crossover introduces a lower mid-range speaker, the upper mid-range being handled by an exponential horn squawker. At 7 kHz. twin 2" cone tweeters take over . . . and then, at 10 kHz. the super tweeter.
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We have illustrated just three of the Sansui speaker systems available at your franchised Simon Gray dealer. These are representative of Sansui's comprehensive range. Listen to them — *listen critically*. Sansui can withstand critical comparison — by the most avid music lover. Then compare Sansui *value!*

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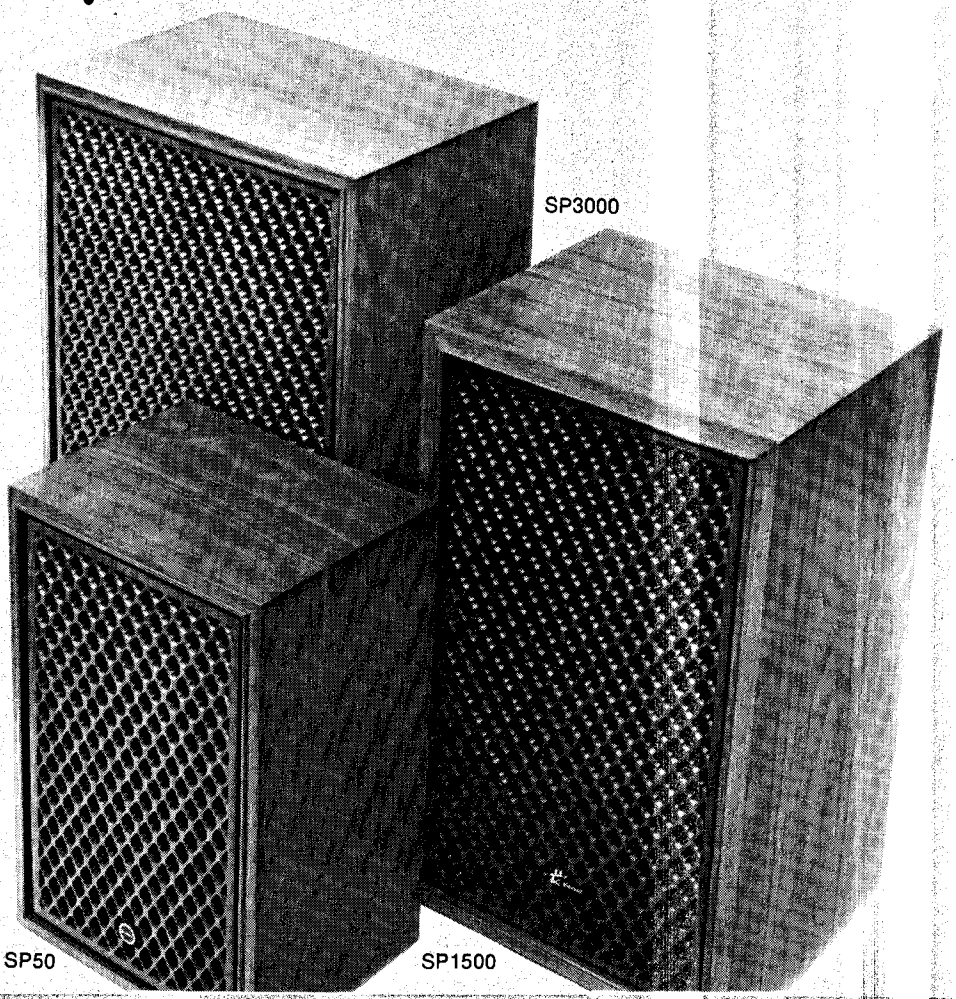

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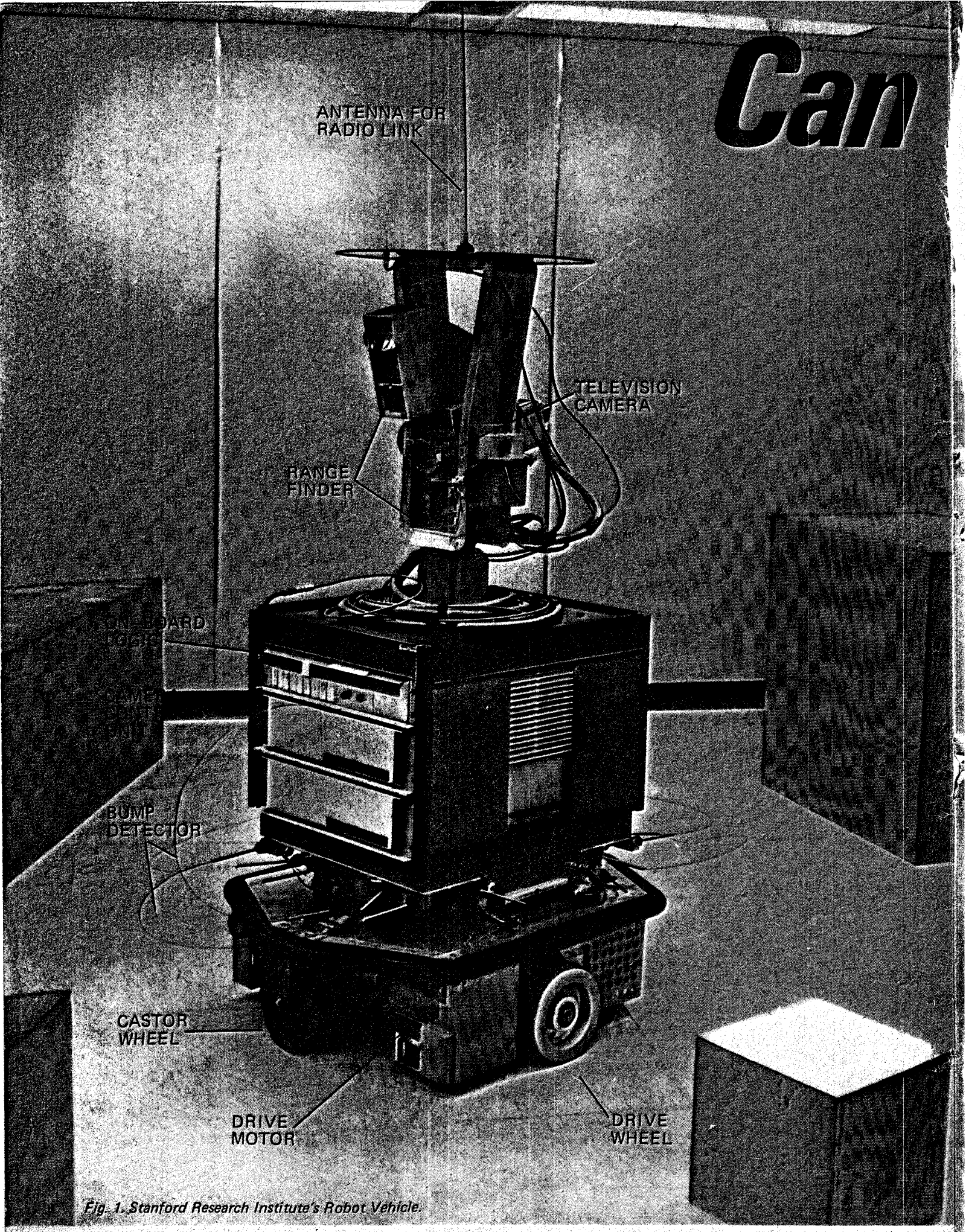


Fig. 1. Stanford Research Institute's Robot Vehicle.

Machines Think?

Is it possible to construct a computer or machine that can think? – This article by Bob Montgomery of Macquarie University outlines current opinion.

Computers are popularly believed to be high-speed number calculators, but this is only partly correct. In fact, digital computers are capable of processing any set of symbols, not just numbers and can perform any well-defined process for the manipulation and transformation of the information represented by those symbols.

General-purpose digital computers have five basic parts. These are:

1. Input devices, which transform information external to the computer into the symbols which the machine understands.
2. Output devices, which transform the computer's symbols back into conventional form; for instance, a computer's print-out.
3. A memory, which stores the symbols before, during, and after processing.
4. An arithmetic unit, which manipulates the symbols according to pre-determined rules (such as mathematical laws – when the symbols are numbers).
5. A control unit, which is the 'executive' of the computer. It is designed to understand and obey a series of instructions. These instructions are usually simple processes, such as "fetch a symbol from a specified place in the memory", or, "shift a symbol a certain number of places".

Some sort of mystical value is often attached to the fact that modern computers are electronic devices and that a parallel may be drawn between their electronic characteristics and the so-called "electrical" functioning of the human nervous system.

But computers are neither a new idea, nor necessarily electronic. Charles Babbage, Lucasian Professor of Mathematics at Cambridge University from 1828 to 1839, produced the plans for an "Analytical Engine", (which however, was never completed). Using a purely mechanical system of wheels and cards, this device would have been faster than a human, although slower than a modern electronic computer.

The major reason for the preference for electrical computers is their inherently greater speed.

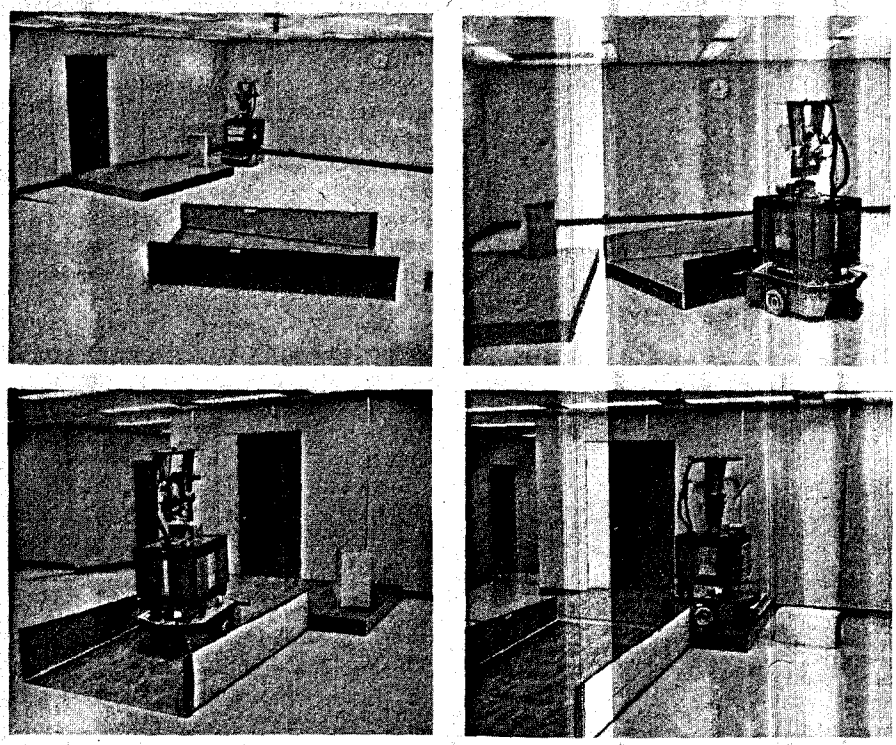
WHAT IS THINKING?

It is not surprising that we have more difficulty in defining what we mean by "thinking", since psychologists still have not been able to find a way to directly observe "thinking" in another human being, much less in a machine.

We usually *infer* that thinking has taken place by observing the person's outward behaviour, or changes in his behaviour after the thinking apparently occurred. However there is an active section of the behavioural sciences which studies the way in which we think (cognitive processes), and how these thinking patterns and skills grow in children (cognitive development).

For our purposes, we will adopt the same two approaches. Firstly, we will say that a machine has been "thinking" if its outward behaviour is such that we would conclude that a human, making the same responses under the same conditions, had been thinking.

The classic example of this approach was the "initiation game" developed by the late A. M. Turing, one of the pioneers in this field. The initiation game is played by three people, a man (A), a woman (B), and an interrogator (C) who could be of either sex. The object of the game is for C to work out which of A and B is the man and which is the woman. The interrogator is in a separate room from A and B, and know them only by the labels X and Y. The interrogator is allowed to put questions to A and B, such as "Will X please tell me the length of his or her hair?" It is A's object in the game to try to make C make the wrong identification, while it is B's object to help the interrogator. So that



The Stanford Research Institute Robot is seen here using a ramp as a tool to enable it to climb up onto a platform and then to push a box off the platform.

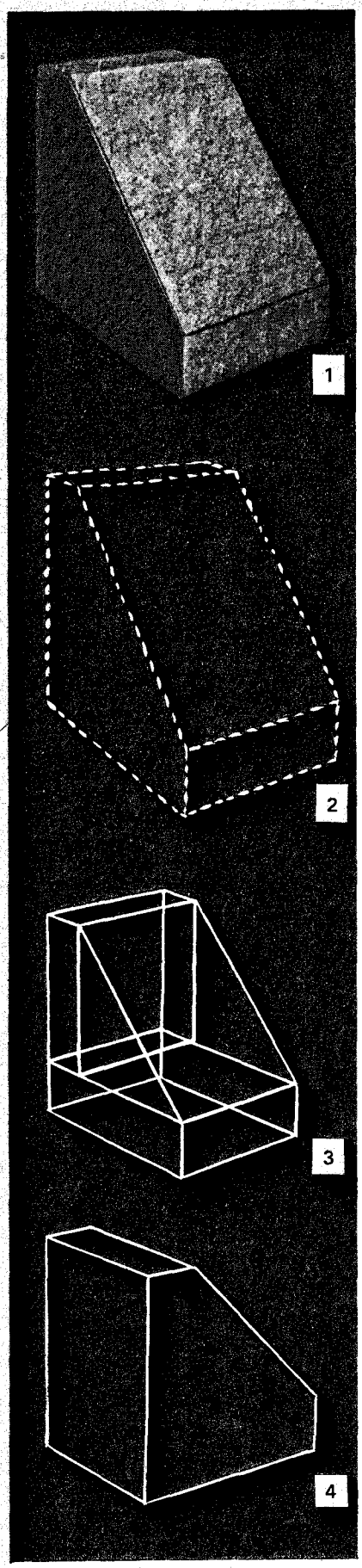


Fig. 2. See text.

the interrogator did not get any clues from the tone of voice, the answers were to be written, or preferably typewritten.

Turing proposed that the question, "Can machines think", could then be answered by asking whether a computer could take the place of the man (A), and be as successful at fooling the interrogator as the man was.

The advantage Turing saw to putting the question this way was that it drew a sharp distinction between man's intellectual and physical characteristics. We are, after all, not concerned with whether a machine *looks* like a human, or can *run* like a human, but only with whether it can *think* like a human.

In 1950, when Turing put forward the imitation game, he could not point at any existing computer which could play the imitation game, although he was confident that it was only a matter of time before the development of new computer programmes and larger storage capacities made it possible.

INTELLIGENT AUTOMATONS

Not all research into artificial intelligence is aimed at developing purely "intellectual" behaviour in machines. Another line of research is aimed at developing machines which move around in, and interact with, their environments.

A simple example of such machines is Peter Vogel's MERV (Mobile Environmental Response Vehicle), which was described in the April issue of ELECTRONICS TODAY.

MERV, "motivated" by a self-preservation "instinct", moves around its environment until it encounters an object. It is then able to identify the object, using several sensory systems, search for memory of previously inflicted pain associated with such an object, and take evasive action if necessary.

More sophisticated is the robot developed by the Artificial Intelligence Group at the Stanford Research Institute in California (Fig. 1). Described as an "intelligent automaton", it is a computer-controller mobile robot, capable of sensing information from its environment and performing tasks normally requiring human supervision.

DESCRIPTION OF THE SYSTEM

The mobile vehicle which is driven by two battery-powered stepping motors, can move forward or backward, and turn to the right or left.

The robot is linked to the computer via a one-way UHF television channel, and a VHF telemetry channel for all other two-way flow of information. Motor-control information from the computer is received over the radio link, and is stored locally (on-board the vehicle) and routed to each of the motors. Optical sensors monitor the number of steps each motor makes, on-board circuitry counts these steps and reports back to the computer over the radio link the completion of each action.

Other controlled electro-mechanical functions include the setting of brakes, and the control of several other stepping motors that provide pan and tilt movements of the head. Sensory equipment includes cat-whisker-actuated bump detectors, an optical range-finder, and a television camera. Picture information sensed by the television camera is sent back by radio link to the computer for processing.

The main function of the sensory equipment mounted on the vehicle is to provide environmental information that is required by the computer to build up models of the environment for subsequent use. A subsidiary function is to provide protection for the robot and other objects. Thus, when the robot bumps into something, the robot's tactile sensors actuate local circuitry to turn off drive motors and apply brakes. The computer is signalled when such a collision occurs and can override the stop order if the plan it generates calls for this action.

The optical range finder, based on the use of optical triangulation principles, has a range from 3 to 30 feet with approximately 10 percent accuracy. On command, the head can be turned in any given direction; a linear, top-to-bottom optical sweep produces a series of distance-measuring signals, which are sent back to the computer to be added to the stored model information. On command, also, a 240 line resolution, 16 gray level television picture can be sent back and temporarily stored in computer memory for subsequent analysis leading to knowledge of important objects and features of the robot's environment.

Crude navigation of the vehicle is accomplished by using the known number of steps that each wheel drive motor makes together with the knowledge of the initial position of the machine.

Overall control is effected by an XDS-940 time-sharing computer fitted with 32K of core and a paging system using a large magnetic drum as swapping storage, thus effectively magnifying the size and number of programmes that can be rapidly brought into operation.

The most outstanding achievement to date of this machine has been to solve a problem requiring it to use a "tool".

For comparison, we know that if an untrained monkey is put into a room in which a bunch of bananas is hanging from the ceiling, just out of reach, and there is a chair in one corner of the room, the monkey will eventually solve his problem by pushing the chair to a point under the bananas, and stand on it to reach them.

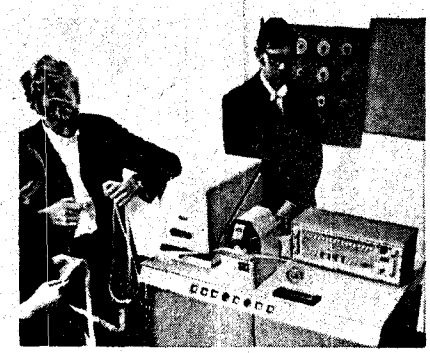
The analogous task for the robot was to get up onto a raised platform and push a box off the platform. In another part of the room was a ramp, and it took the robot about 30 minutes to solve its problem by recognising that it could ascend the platform by using the ramp, pushing the ramp over to the platform, rolling up the ramp, and then pushing the box off the platform.

Both MERV and the Stanford Research Institute robot are striking achievements, and undoubtedly display some aspects of what might be described as intelligent behaviour.

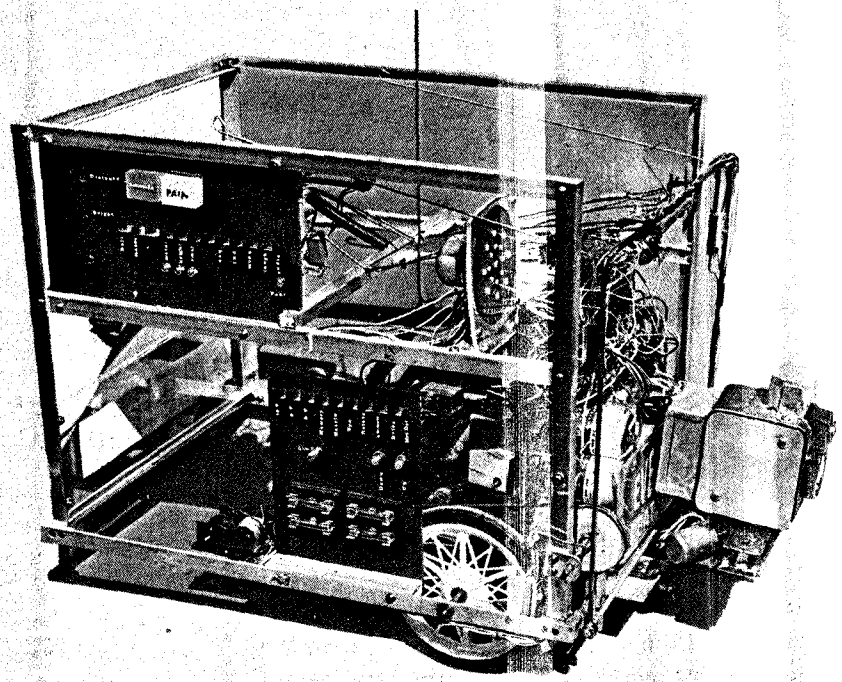
But neither of the machines is capable of a very wide range of responses, and the tasks they can successfully solve are simple. Indeed, we can go well down the phylogenetic scale and find some very primitive animals which have a wider range of behaviours and can solve more complex problems.

Yet few behaviourial scientists would suggest that these animals can "think", in the usual sense of the word.

The point is, of course, that the technical limits on the sensor and effector systems with which the machines are equipped prevent them from competing with even primitive animals in many behaviourial tasks. Thus Turing's point is emphasised again, that is, that we should be interested in the *intellectual* behaviour of the machines. In fact, it is possible to argue that the Stanford experiments are really just another version of the "imitation game", except that we have replaced the man and the woman with a monkey! Now we are asking if the machine can imitate a monkey, at least in problem-solving.



"How extraordinary — it says "Cogito ergo sum".*



Peter Vogel's MERV, built in 1969.

This is made even clearer when we note that the Stanford robot is under remote control by a computer, and it is this computer which does the problem-solving. The robot is really only a mobile device for gathering information (the computer's input), and making responses (the computer's output), and for our purposes we are really more interested in what is going on in the computer.

COMPUTER SIMULATION

This raises the second approach to our question. We have so far defined thinking in a machine as *any* behaviour which, if observed in a human, would be described as thinking. The narrower approach to the question is to ask whether the machine's processes are the *same* as the human's. In other words, to what extent does the computer simulate normal human cognitive processes.

Since early in the history of computers, there have been speculations about the extent to which the machines, themselves are models of the brain.

The short answer, for modern electronic digital computers, is that they are not.

But we can still ask to what extent computer programmes simulate human cognitive processes, although, as we shall see, there have been surprisingly few projects aimed at this.

What behaviour, then, have computers been programmed to perform? Are they such as would lead us to decide that thought-like processes were involved (whether or not those processes are similar to human thought process)?

A number of programmes have been developed which result in what might reasonably be considered intelligent behaviour.

ABSTRACT REASONING

Lawrence G. Roberts, at the Massachusetts Institute of Technology, has developed a programme which is able to complete a three-dimensional figure on the basis of the partial information contained in a two-dimensional diagram. An example of the steps in this abstract reasoning process is shown in Figure 2.

The computer scans a photograph of the object (1), displays its local features (2), and combines line segments to prepare a complete drawing. It accounts for the drawing as a compound of three dimensional shapes and draws in all the interior lines (3). Then it can display the structure from any point of view of request, suppressing lines that would normally be hidden (4).

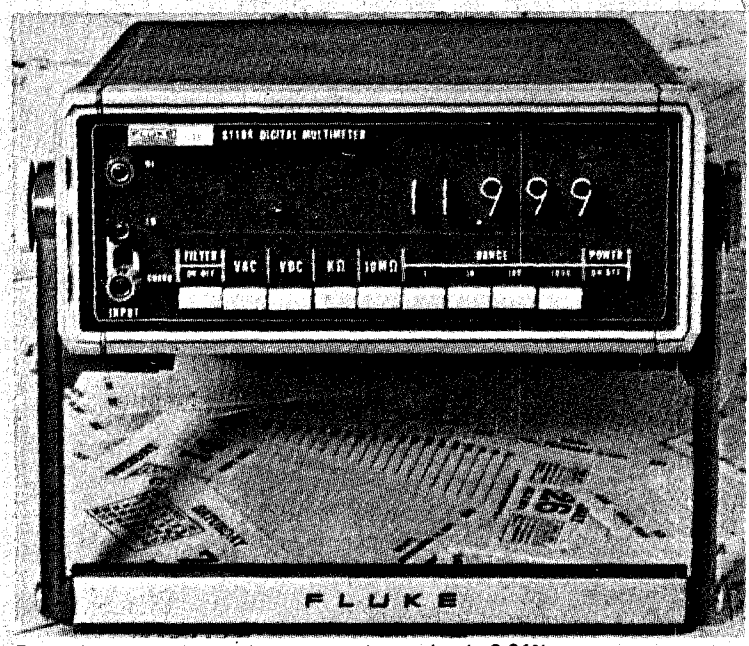
DEDUCTIVE PROBLEM SOLVING

Deduction simply refers to proving a conclusion on the basis of two or more known facts, according to a clear set of rules. Most of us are familiar with

(Continued on Page 99)

THE DIGITAL

Voltmeters were once simple things. They worked well enough providing they were used to measure equally simple voltages — like the anode potential of an 807.
And it probably didn't matter if the meter was 5% out and drew a few milliamps from the source it was measuring.
But in most branches of electronics these days have long since gone, and it is becoming increasingly necessary to measure low voltages, often across high impedances, and to greater accuracies than ever before.
Hence the digital voltmeter — a product of the technology it is used to assist.
In this article, Brian Chapman describes the various types of digital voltmeters and their uses and limitations.



Fluke digital multimeter is guaranteed to maintain 0.01% accuracy (on dc ranges) for at least six months.

An analogue measurement is essentially one that is made continuously. A digital measurement on the other hand is made as a series of discrete steps.

In many instances the same basic quantity can be measured by both digital and analogue methods. A conventional clock has a pair of hands traversing a calibrated dial in a continuous sweep, and there is theoretically an infinite number of intermediate steps between any two points on the clock face. Measurement is continuous and it is therefore an analogue process.

A desk calendar on the other hand is essentially digital. It indicates the date in discrete steps, each of 24 hours.

There is no ambiguity of reading. It either is the 3rd. of June or it isn't. One cannot misread it as June 2¾ or 4½.

This is one of the great advantages of digital readout. There are no reading errors due to parallax or scale resolution, and in the case of electronic digital instruments, no friction or hysterisis to cause mechanical errors.

Even the cheapest of digital voltmeters has better than 1% accuracy whereas an analogue meter with a mechanical movement of 1% accuracy is expensive and still subject to further reading errors caused by parallax and scale resolution.

SPECIFICATIONS

Specifications of digital voltmeters rarely quote accuracy just as such and such a percentage. For if they did it would in effect be a blanket statement implying that at no time due to any combination of factors such as drift, temperature, humidity, linearity, zeroing, etc would the error exceed 1% of the quoted figure.

As digital voltmeters are precision instruments capable of far higher accuracies and resolution than hitherto obtainable, the specifications must include factors which now become of much greater importance.

It is also essential to appreciate that the various types of digital voltmeters have quite individual characteristics and that a meter suitable for one application might be totally useless in another. These different types and characteristics will be described later in this article.

ACCURACY

The figure normally quoted as an instrument's accuracy is really a statement of the percentage error — in fact a digital voltmeter that was 0.01% accurate would have value only as a random number generator. The accuracy should really be stated as 99.99% but as in the case of 'rms' watts, common usage has defeated correct terminology.

There are several different ways of expressing the accuracy of digital voltmeters, and because of this it is necessary to pay particular attention to each manufacturer's specifications and to determine the true implications — especially when comparing instruments that have accuracies specified by different methods.

The most common ways of expressing dvm accuracy are 'constant error', 'proportional error' and 'combinational error'. These are again subdivided as follows:-

VOLTMETER

Constant Error

(1) ± ------ % of full scale
(2) ± ------ digits
(3) ± ------ millivolts
(4) ± ------ % of full scale ± ---- digits

Proportional Error

(5) ± ------ % of reading

Combination Error

(6) ± ------ % of reading ± ---- digits
(7) ± ------ % of reading ± ---- digits (whichever is greater)
(8) ± ------ % of reading and/or digits
(9) ± ------ % of reading ± ---- % of full scale

Of these methods of expressing accuracy the ones in most common use are (4), (5) and (9).

But a constant error statement alone does not sufficiently define the performance of instruments in which the main error is proportional to input voltage.

Hewlett-Packard's 3462A digital voltmeter uses potentiometric-integrating principle.

Nor is the proportional error statement sufficient in itself as it does not allow for the constant error which is present in most digital voltmeters, especially when reading low input voltages.

Hence in 1963 the American Standards Association (in Standard C 39.6) proposed that accuracy should be stated as a percentage of full scale, plus percentage of reading. This method is now used by many manufacturers, but by no means all of them.

The following example illustrates the difference between two accuracy statements for a five digit voltmeter.

(1) ± 0.01% of reading ..... or ± 1 digit
(2) or ± 0.005% of full scale ± 0.005% of reading

If full scale reading on this five digit meter was 99,999 then 0.005% of full scale would represent an uncertainty of five digits in the least significant decade. The total uncertainty of reading would therefore vary from five digits at zero voltage input to 10 digits for full scale reading.

Now consider the second accuracy statement; ± 0.01% of reading or ± 1 digit gives a one digit uncertainty in the least significant decade at readings from 0 to 10,000, the uncertainty then increases linearly until it is 10 digits at the full scale reading of 99,999.

Note that both statements indicate the same error at full scale reading, but *only* at full scale reading. They vary considerably at other points depending on range and reading.

The second statement looks better to the uninitiated purchaser — but implies a higher error on the lower readings. It is nevertheless the most realistic method.

Another very relevant factor is the drift of calibration due to humidity, temperature, and component aging. Top quality dvms usually have included in their specifications, figures for both short and long term accuracy — the latter is generally quoted for a 90 day period within specified temperature and relative humidity limits. In addition a coefficient is often quoted for wider temperature ranges.

SENSITIVITY and RESOLUTION

Sensitivity should not be confused with resolution.

Sensitivity is the value of the least possible change in signal input to which the meter can respond on the most sensitive range. This will generally be the value of the least significant digit on that range. Thus on the one volt range a five digit dvm would have a sensitivity of 10 microvolts.

Resolution, on the other hand, is the value of the smallest change that can be measured on any range and is normally quoted as a percentage of full scale reading. Thus if the full scale reading is 10,000, the resolution is a maximum of one part in 10,000, i.e. 0.01%.

THE DIGITAL VOLTMETER

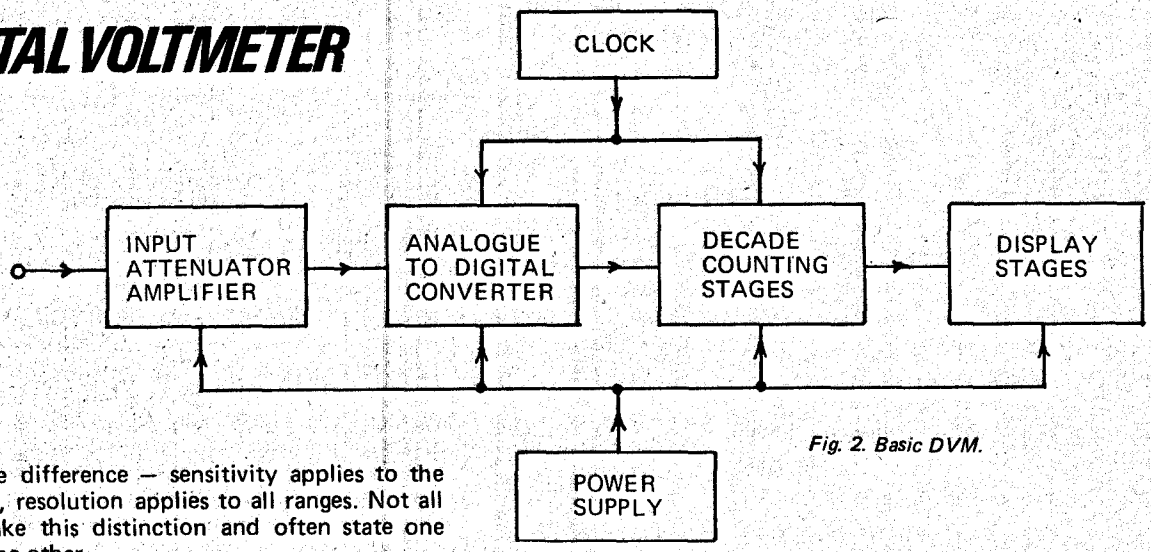


Fig. 2. Basic DVM.

Here then is the difference — sensitivity applies to the lowest range only, resolution applies to all ranges. Not all manufacturers make this distinction and often state one when they mean the other.

The resolution of any dvm must always be equal to or exceed its accuracy, for example an instrument with a conversion accuracy of 0.01% must have a readout of at least five digits, and preferably six, to make use of it.

REJECTION OF SUPERIMPOSED NOISE

The high accuracy and resolution of a dvm cannot necessarily be used unless it can also reject superimposed noise. In many applications this factor may determine the final choice of instrument, as with some types of circuitry the presence of electrical noise may make measurements impossible or inaccurate.

Superimposed noise may be considered to arise from two major sources. These are:-

(1) Common mode noise
(2) Normal mode noise

Common mode noise is only applicable to instruments which have a floating input, or in which the low side of the input terminals can be disconnected from ground.

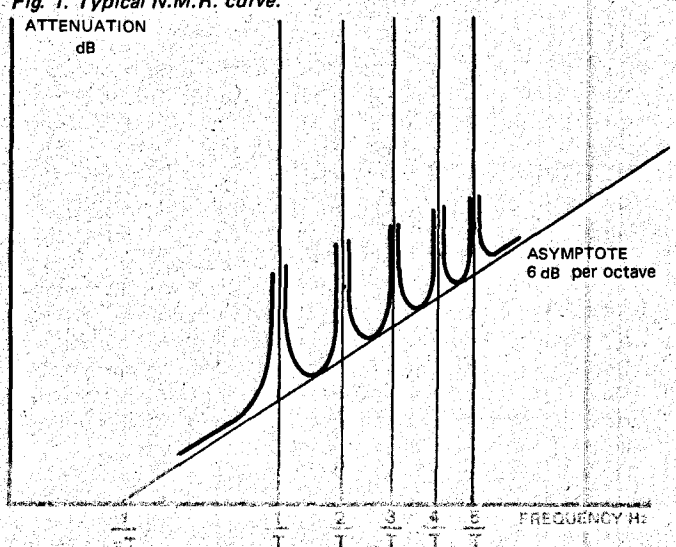
Common mode voltages can have dc as well as ac components and arise due to ground loop currents which produce potential gradients across earthing systems. These voltages can be quite high in the vicinity of heavy power equipment.

Digital voltmeter specifications quote the 'Common Mode Noise' in dB, as 20 log the ratio of the common mode voltage, to the instrument indication due to this voltage.

The ratio is usually measured with a one Kilohm unbalance in either lead.

As an example consider an instrument that when tested with a 100 volt common mode voltage gave a meter reading

Fig. 1. Typical N.M.R. curve.



of 100 microvolts. This is a ratio of 10^6:1 and the common mode rejection is therefore:- 20 log 10^6 = 120 dB. (this is a fairly typical figure for instruments that have floating inputs and use the guard technique).

NORMAL MODE REJECTION

Normal mode rejection is noise in series with the input signal. It is primarily due to induced pick-up and is therefore predominantly of mains frequency.

Normal mode noise rejection (NMR) is specified as 20 log the ratio of the normal mode noise voltage to the instrument indication due to this voltage, and it is expressed in dBs.

In digital voltmeters this figure is mainly determined by the type of analogue to digital conversion.

Instruments of the ramp or successive approximation type are particularly susceptible to noise and may have very low NMRs — typically — 30-60 dB.

Yet for reasons which are explained later in this article, instruments of the integrating type have almost infinite rejection of frequencies which are directly related to the sampling time of the meter.

Non-integrating instruments may be protected against normal mode noise by an input filter, but this lengthens the instrument's response time and hence reduces the conversion rate. For instance a successive approximation converter is theoretically capable of 40,000 readings per second, but when a filter is added the reading rate is reduced to approx. 100 per second.

A typical ramp type meter fitted with a filter would have a NMR of 30 dB at 50 Hz and would take 450 milliseconds to reach a reading of 99.95% of the applied voltage.

By contrast a good quality integrating type dvm could have a common mode rejection of 145 dB, and a theoretically infinite normal mode rejection at multiples of 50 Hz. Common mode rejection and normal mode rejection are often presented in graphical form (as shown in Fig. 1).

INPUT IMPEDANCE

All voltage sources have internal resistance. Any current drawn from the source will thus cause a voltage drop across the source resistance. Hence in any voltage measuring instrument the input impedance must be kept as high as possible to reduce loading on the source and error in the resulting readings.

In a typical (analogue type) voltmeter the input impedance may be 20,000 ohms per volt. Thus on the 100 volt range the input impedance is two megohms. If a

voltage was being measured that had a source resistance of 20,000 ohms — the reading error due to loading would be:-

$\frac{100\ Rs}{Rs+Rin}$ per cent.

Thus when Rs = 20,000, Rin = 2M error = $\frac{100 \times 2 \times 10^4}{(2\times10^6)+(2\times10^4)}$

$= \frac{10^6}{10^6+10^4}$. = loading error approx. 1%

The situation is much worse on the lower ranges, e.g. the one volt range would have an input impedance of only 20,000 ohms and if a voltage measurement were to be taken across the 20,000 ohms source impedance quoted above there would be a loading error of 50%. (How many technicians take this into account?)

All digital voltmeters are superior to their analogue counterparts in this respect. Even moderately priced instruments may have input impedances of 100 Megohms on the lower voltage ranges, and 10 Megohms on the higher ranges. Other dvms have input impedances as high as 10^{10} ohms.

Nevertheless one should always bear in mind that even a 10 Megohm input impedance can cause loading errors which are far greater than the instrument error if the source resistance is high.

OVERRANGING

Overranging is a feature peculiar to digital instruments. The majority of digital instruments have a quoted full scale reading plus an overrange figure of perhaps 25%. The limit of the overrange capability is not always clearly defined and may vary from one range to another.

The manufacturer's overrange specification is merely the reading to which he claims that the percentage full scale accuracy will be maintained. In fact most instruments can be driven beyond this point, but accuracy falls off dramatically.

In many instruments an indicator lamp will show when the display is in the overrange region. However some digital meters are made on which the most significant digit is capable of displaying only a '1' or a '0'. (In other words the highest reading that can be obtained on a five digit instrument of this type is not 99999 but only 09999 plus whatever overrange the manufacturer will permit).

This type of instrument is often referred to as having 4½ or 5½ digits, but in reality it is only really 4 1/8 or so.

STABILITY

Short term stability refers to an instrument's variations over a short period of time (usually 24 hours). It is specified in the same way as accuracy.

Short term stability is mainly a function of random component variations.

Long term stability is quoted over periods of 30 to 180 days. It is primarily a function of aging of components such as oscillator crystals and precision resistors. It is enumerated in the same way as short term stability.

Sometimes a separate figure is quoted for oscillator crystal aging. This is usually specified as 'less than so many parts per million per month'. (A typical specification is <3 parts in 10^7/month.)

THE BASIC DVM

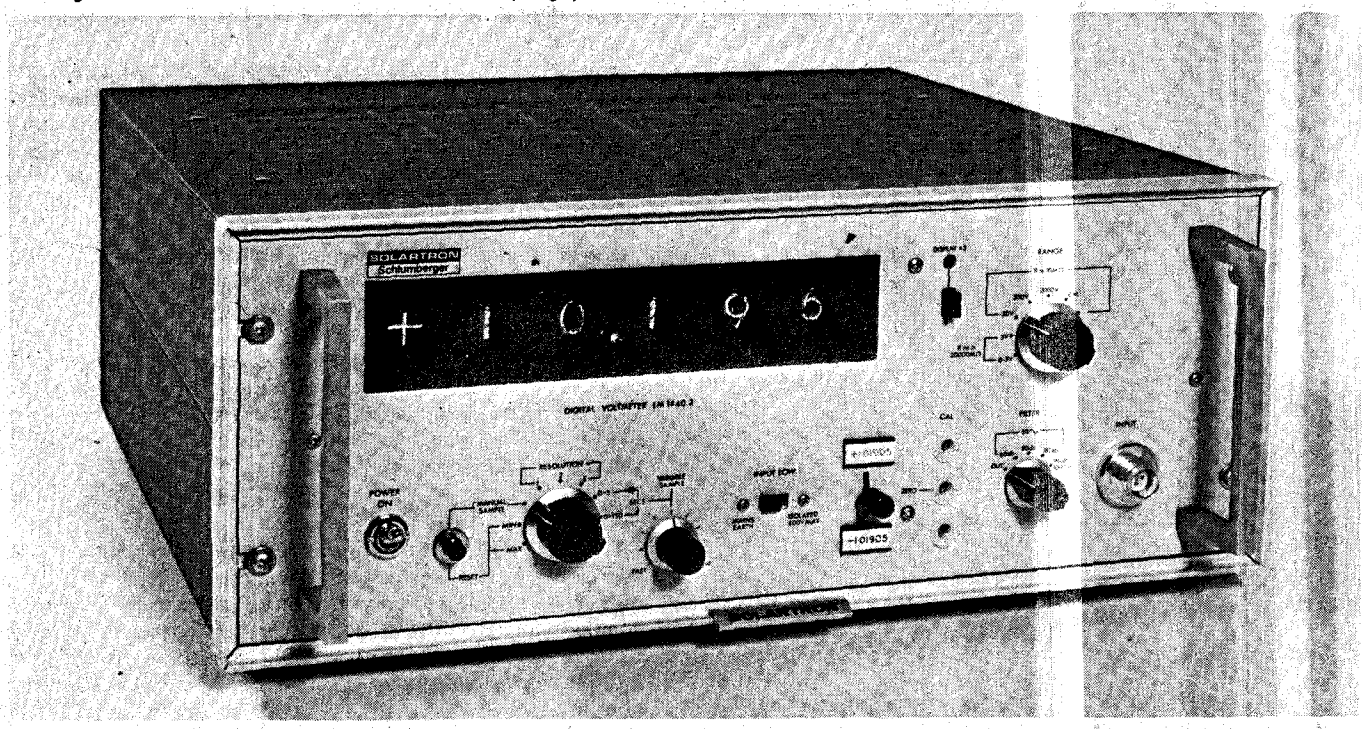
In basic form a dvm consists of an input amplifier/attenuator stage, an analogue to digital converter, a counting and display section, a clock pulse generator and a power supply. (Fig. 2).

The input amplifier/attenuator stage uses conventional electronic techniques, but as the input stage can be one of the main sources of error, the resistive dividers use components having tolerances from 0.01% down to 0.0015% and with temperature coefficients of a few parts per million per degree centigrade.

The input amplifiers (if used) must also be extremely stable, they are usually matched FETs located in an oven and operating as a differential pair.

Drift, short term and long term stability must all be kept to very low levels otherwise it is impossible to maintain calibration.

This digital voltmeter from Solartron has variable sampling speeds.



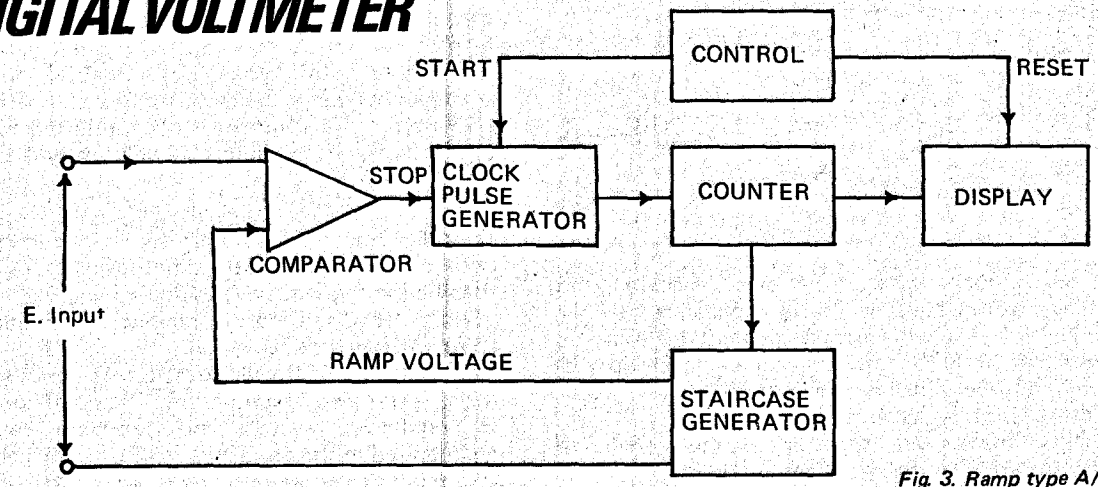


Fig. 3. Ramp type A/D converter.

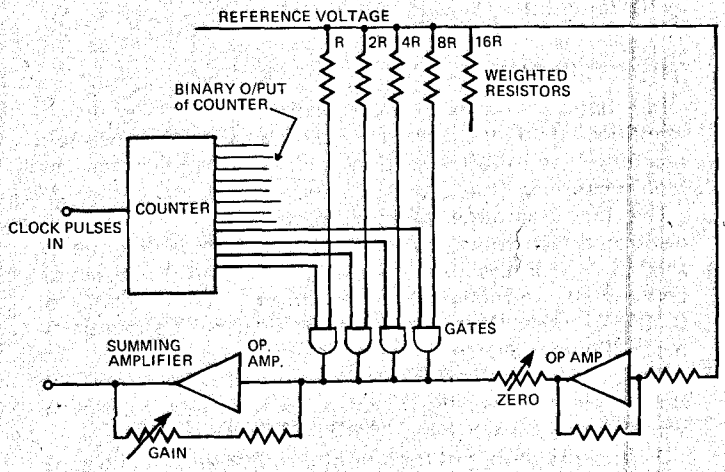


Fig. 3A. Staircase generator.

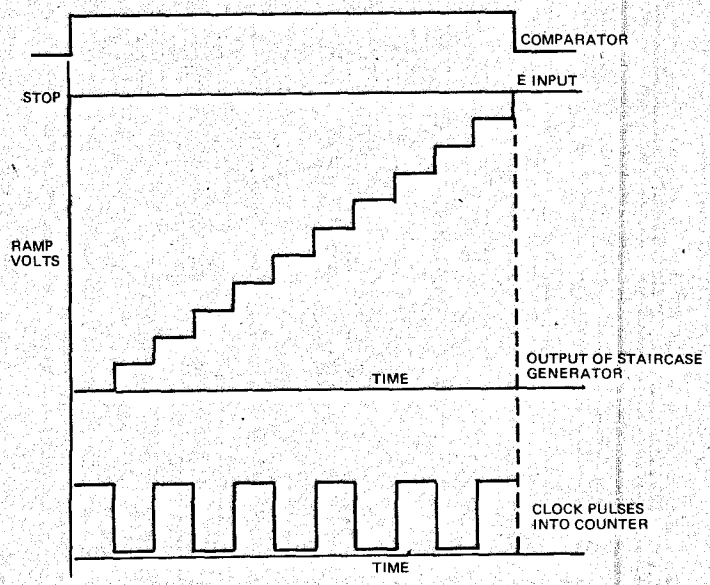


Fig. 3B. Wave forms.

TYPES OF DIGITAL VOLTMETERS

Digital voltmeters are classified according to the type of analogue to digital converter used. The most common types are:-

Staircase Ramp
Voltage to Time Ramp
Continuous Balance
Successive Approximation
Integrating
Potentiometric Integrating
Recirculating Zero
Dual Slope

STAIRCASE RAMP

In the staircase ramp type of converter (Fig. 3), when a voltage step is applied to the input, a clock pulse generator is started which supplies pulses to binary counter stages.

The outputs of the counters are sampled by AND gates which connect weighted resistors to an amplifier, the output of which is proportionate to the sum of the inputs. (This is known as a summing amplifier).

As the resistors are weighted according to the binary values of the counter output lines, the output of the summing amplifier is a voltage ramp which is proportional to the digital input and increases by small equal amounts at each clock pulse.

The so-called staircase ramp voltage is then compared with the input voltage by a comparator amplifier. When the voltages are equal the comparator switches off the clock pulse generator. The counter thus holds a count of clock pulses which is proportionate to input voltage and this count, which is in binary form, is then decoded to decimal and displayed on the readout.

The staircase ramp technique is relatively simple and cheap. Disadvantages are the relatively long time required to take measurements, and the sensitivity to normal mode noise.

In the presence of normal mode noise (Fig. 3C) a series of measurements may result in a number of different readings. Low frequency noise will cause the readout to 'jitter', and high frequency noise may cause the meter to read the peak value of the superimposed noise.

VOLTAGE to TIME RAMP

The basic voltage to time ramp converter is similar to the staircase ramp converter with the exception that the circuit uses an operational amplifier integrator to generate an analogue ramp with an accurately controlled slope. This type of converter is generally cheaper than the staircase method but additional errors can arise due to ramp non-linearity.

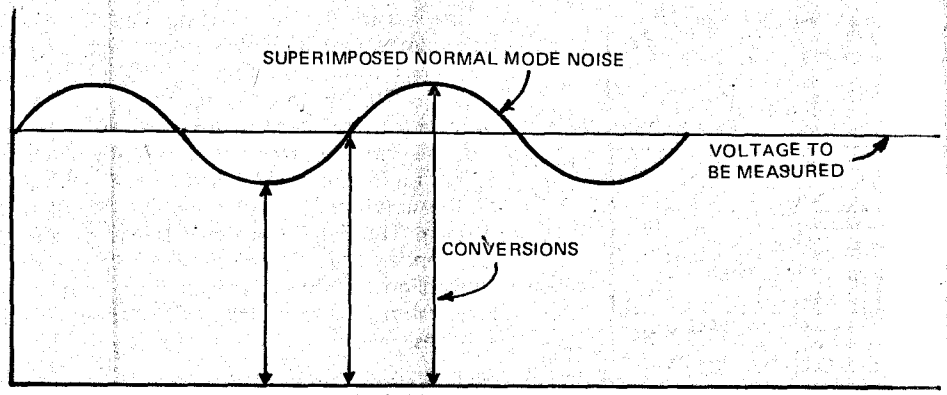


Fig. 3C. Effect of noise on ramp type A/D converter.

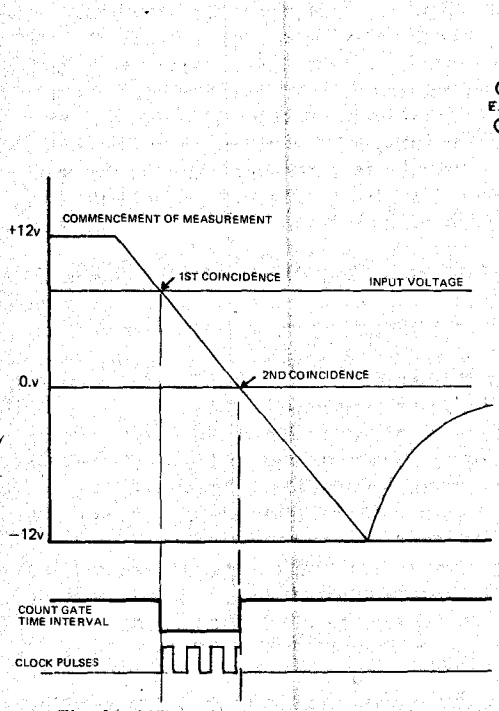


Fig. 4A. Voltage to time conversion cycle.

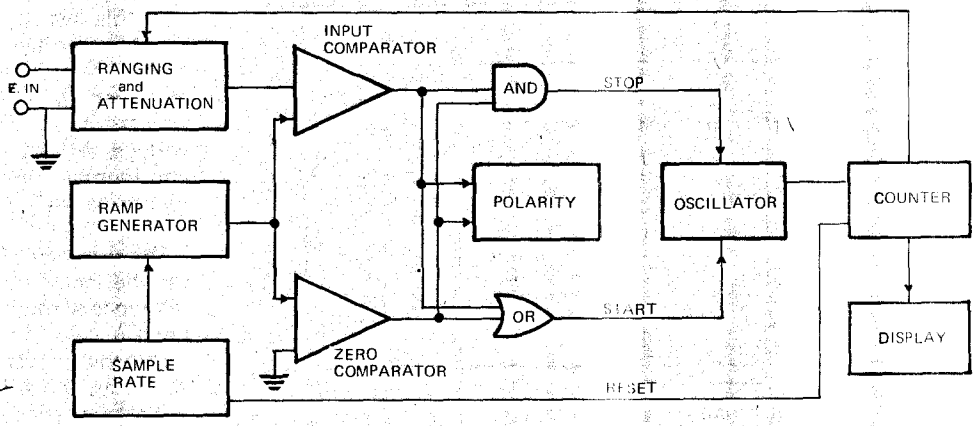


Fig. 4. Voltage to time ramp converter.

A typical voltage to time dvm is shown in Fig 4. This circuit has the added facility of automatic polarity sensing.

The ramp voltage is normally maintained at + 12 volts but can be driven down through zero to – 12 volts. When an input signal is applied, the ramp voltage is driven down until a comparator senses that the ramp voltage equals the voltage of the signal to be measured. At this point a gate is enabled thus allowing clock pulses to be totalled by the counting and display stages.

A second comparator disables the gate when the ramp voltage reaches zero. As the ramp voltage has a controlled constant slope, the time period between the two transitions is proportionate to the applied voltage. The number of clock pulses gated to the counter stage will also be proportionate to this time and, hence, voltage. (Fig. 4A).

Logic circuitry detects the order of the transitions and thus polarity of the input signal, and this is displayed visually on the front panel of the instrument.

CONTINUOUS BALANCE

Another form of staircase ramp is the continuous balance converter. (Fig. 5). This instrument uses the staircase ramp principle for its initial measurement period (which in this case is known as the settling time) but once coincidence has been reached the converter will follow slow input variations at a rate which can be as low as one clock pulse per conversion.

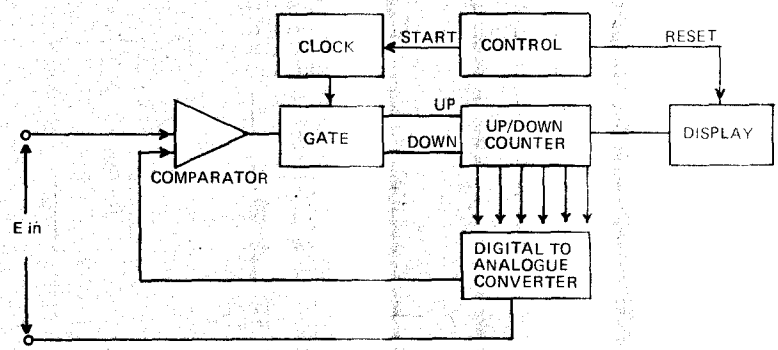


Fig. 5. Continuous balance A/D converter.

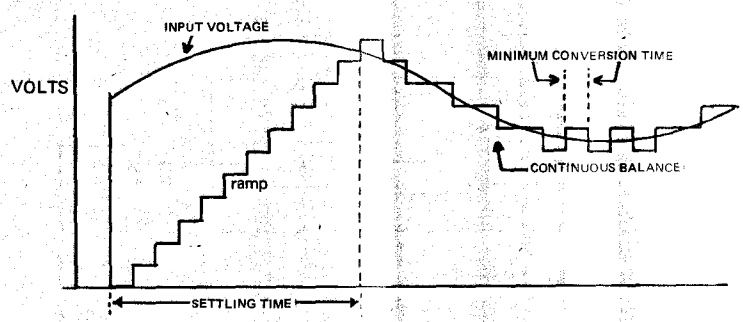


Fig. 5A. Performance of continuous A/D converter.

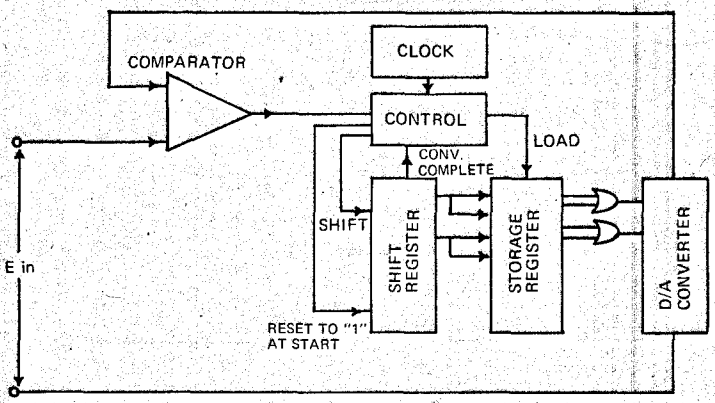


Fig. 6. Successive approximation converter.

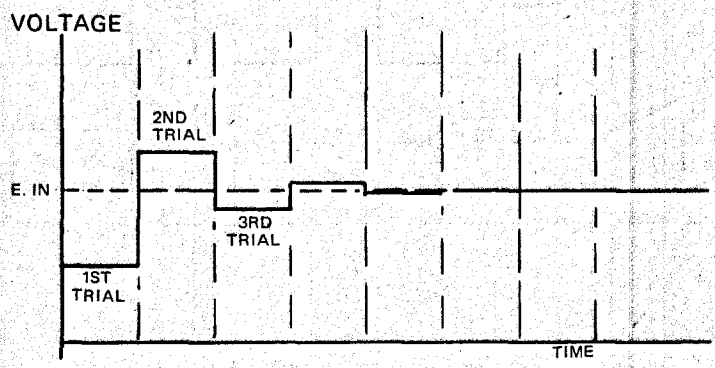


Fig. 6A. Successive approximation conversion.

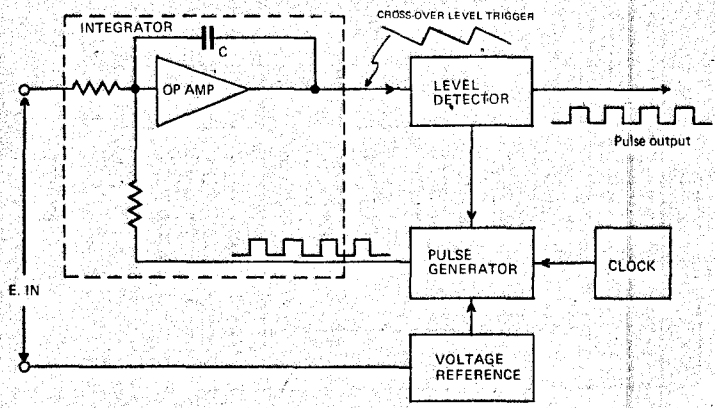


Fig. 7. V/F conversion employing integration.

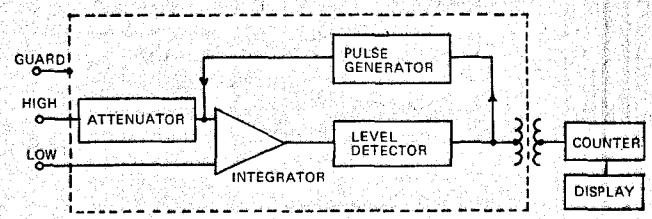


Fig. 8. Guard technique.

This is achieved by replacing the staircase counter with an up/down counter. Comparator logic determines whether the ramp voltage is higher or lower than the input voltage and directs the counter to count up or count down as necessary, to reach coincidence. (Fig. 5A).

If the input voltage varies rapidly due to superimposed noise at a frequency higher than the maximum tracking rate of the converter, the reading will 'hunt' around the mean voltage. Thus at times the presence of superimposed noise can render the instrument virtually useless. However this conversion method is ideal for rapid and continuous conversion of noise-free and slowly varying analogue voltages.

SUCCESSIVE APPROXIMATION

The successive approximation converter (Fig. 6) uses more advanced circuitry than the types previously described.

In this system the decision logic tries successive binary weighted voltages, starting from the highest voltage 'bit', and examines each approximation to see whether the result is higher or lower than the input voltage. If the 'bit' tried results in a comparison voltage lower than the input voltage, this bit is loaded into a storage register. The process continues until all 'bits' have been tried. The result is a binary 'word' which is then decoded and displayed. (Fig. 6a).

The accuracy of this technique is limited by the sensitivity of the comparator, the accuracy and stability of the reference supply, and the total number of 'conversion bits' used.

The advantages of the method include high speed, relative accuracy, and a fixed encoding time.

Digital voltmeters of this type are often used in computer based data logging systems and are capable of conversion rates of 50,000 per second with an accuracy of 0.01%.

The successive approximation method has sensitivity and noise problems. It cannot be used to make measurements in the presence of noise unless filters are used. But a filter slows the response to step input changes and detracts from the advantages offered by the otherwise high conversion rate.

In practice, conversion rates faster than four a second are not required in a dvm unless the instrument is specifically intended for systems use.

INTEGRATING (VOLTAGE to FREQUENCY) CONVERTER

This technique is widely used in good quality instruments because of its excellent noise rejection capability. (Fig. 7).

An integrating converter has the inherent capability to reject sinusoidal noise voltages of frequencies which are multiples of the integrating time of the converter. This is because the integration of integral numbers of sine wave noise pulses is zero.

Thus this method gives infinite rejection of normal mode noise at frequencies which are multiples of the integrating time, and this is usually chosen as a multiple of 20 milliseconds in order to reject 50 Hz mains noise.

In operation the unknown input voltage is applied, via an attenuator/amplifier, to an operational-amplifier integrator, the output of which is a voltage ramp with slope directly proportional to the amplitude of the input voltage.

The output of the integrator is fed to a level sensitive detector which resets the integrator each time a reference level is reached.

As the slope of the integrator ramp is directly proportional to the amplitude of the input voltage, the reset will occur more frequently with higher voltages. The repetition rate of the reset pulses will *therefore* be directly proportional to the input voltage, and these pulses are counted for the sampling time, and displayed.

A further advantage of the integrating technique is that as

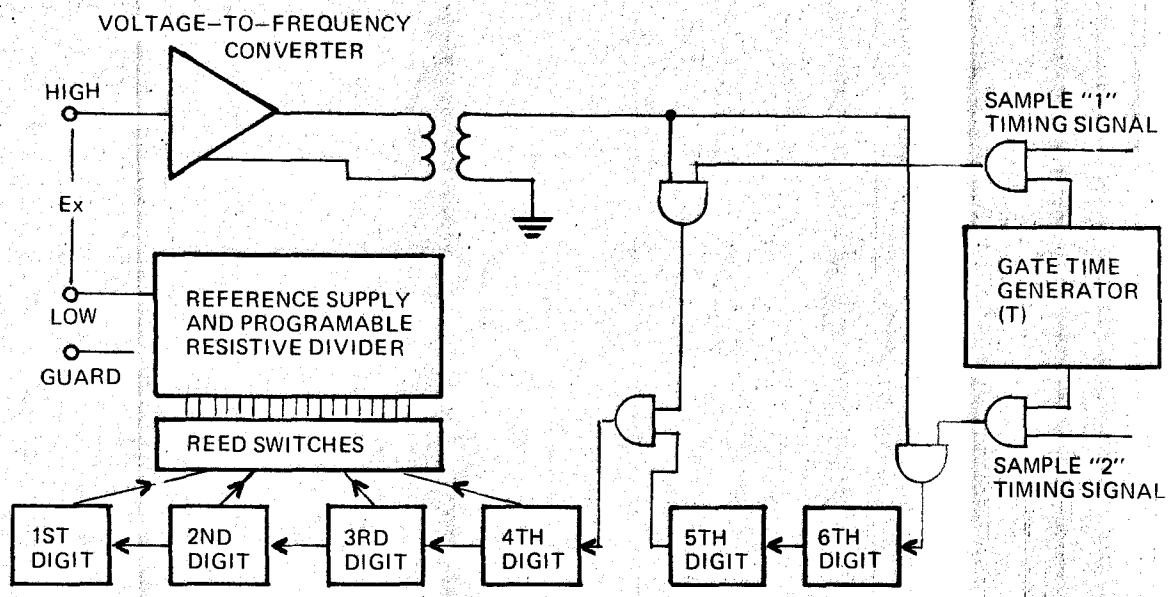


Fig. 9. Potentiometric/integrating digital voltmeter.

the converter produces a pulsed output this may be coupled out by a pulse transformer. Thus the entire converter may be enclosed in a shielded box insulated from earth. This technique which is known as guarding greatly increases the common mode noise rejection. (Fig. 8).

INTEGRATING POTENTIOMETRIC

A normal integrating dvm measures the average of the input voltage over a fixed sampling period; whilst a differential voltmeter compares the input voltage against a highly stable reference voltage.

These two methods are combined in the integrating-potentiometric converter and successfully improve both accuracy and resolution. (Fig. 9).

Instruments of this type consist of an integrating voltage to frequency converter, a counter with storage facility, and a digital to analogue converter which provides a reference voltage to an input comparator.

A reading is taken in two steps. Initially the voltage to frequency converter produces a frequency proportional to the input voltage. This is counted and stored in the first four decades of a six or seven decade counter. This count is then decoded by a highly accurate digital to analogue converter similar to the staircase ramp generator. A comparison is then made between this voltage and the input voltage, and the voltage to frequency converter produces a further frequency proportional to the difference voltage which is counted and added or subtracted to the count already stored. The initial integration is usually accurate to within 0.3% and the potentiometric comparison improves this to about 0.002%.

Following the comparison and subsequent correction, the total count is displayed on the full six or seven decades of the readout.

The advantages of this method include an increase in resolution and accuracy, but sampling speeds are lower than

(Continued on page 117)

Fig. 10. Recirculating remainder DVM.

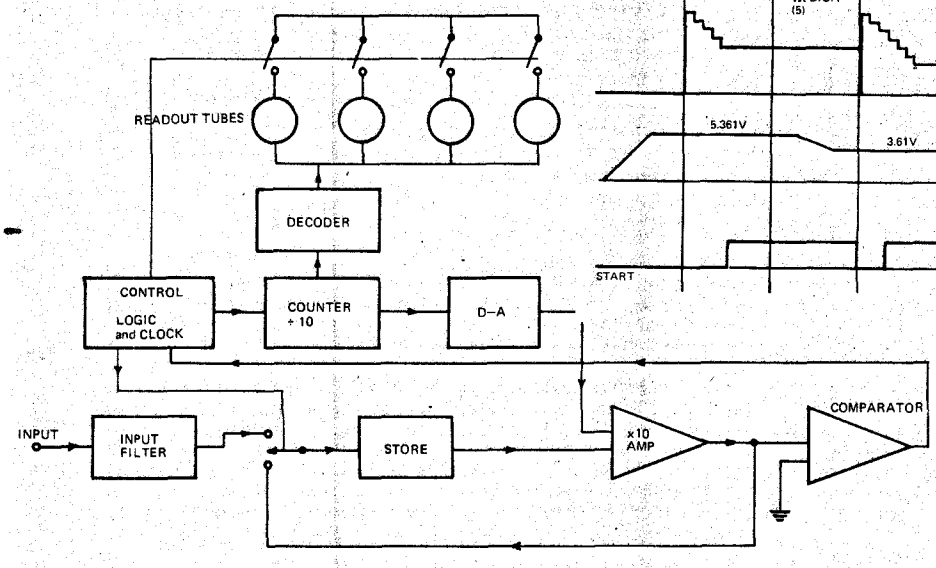
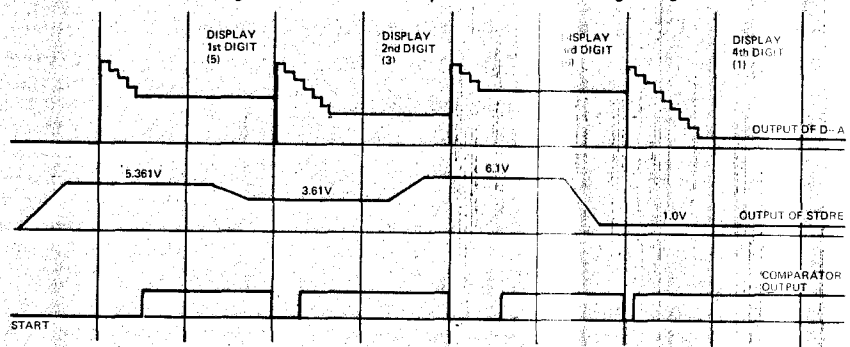


Fig. 9A. Waveforms of potentiometric/integrating DVM.



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LOCAL VOICE MAKES GOOD

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This Australian-made speaker is better than many imported products costing several times the price —

Magnavox (Australia) Pty. Ltd. have produced many well known speakers, possibly the best to date being the 8WR – Mark IV and V which are two of the best wide range eight inch speakers available in Australia in terms of dollars spent. However one problem with the early 8WR's and many other 8" speakers is that their power handling capacity has been below the level of many modern amplifiers.

This problem faces most speaker manufacturers but Magnavox had a requirement where a client asked them to develop an eight inch speaker with a performance comparable to that of the 8WR but with a greater power handling capacity. The research went on for longer than expected and eventually the client decided to solve the problem in another way, but undaunted by the client's change of mind, Magnavox decided to finish their research.

Exhaustive laboratory tests showed that the new speaker could handle 30 watts of average power and so the Magnavox 8-30 was born.

The creation of an 8 inch speaker which will handle 30 watts is not without problems, the most serious being that the ability to handle 30 watts of power conflicts directly with the upper frequency limits of the speaker. The compromise chosen was sensible: the speaker has a good performance up to 7.5kHz and for the frequencies above that figure either two 3UC or two 3TC tweeters can be added with a simple crossover circuit at approximately 5kHz.

Although Magnavox make speakers, not speaker systems, they continued their research to develop a range of designs for small vented enclosures which would develop the full capabilities of these speakers. The enclosures which they developed were a one cubic foot enclosure and a 1.6 cubic foot enclosure. (The latter enclosure is described in detail later in this article).

Before we describe the performance of the system, a detailed description of the 8-30 speaker would be in order.

Firstly the most striking difference between the 8-30 and all the previous Magnavox eight inch speakers is the use of a die-cast aluminium speaker housing instead of the pressed metal housings which have been previously used.

The second most important difference is the use of a large high efficiency barium ferrite magnet which

produces a total magnetic flux of 86,000 maxwells and an air gap flux density of 11,000 gauss.

The third most important difference is that the total available excusion is 0.7" compared with something less than 0.35" for the previous 8 inch speakers which they produced.

To provide for good heat dissipation they have used an aluminium coil former while a curvilinear cone with a viscously damped edge treatment is used to reduce cone break up at mid-frequencies when the speaker is driven at high power.

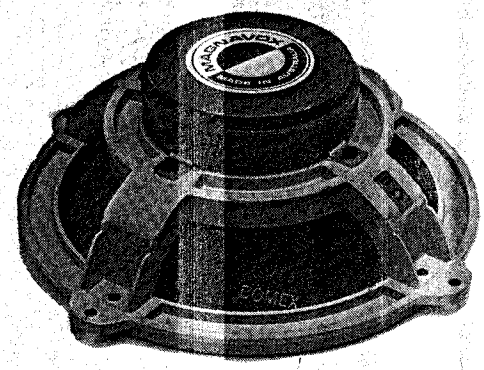
SPEAKER ENCLOSURE

Magnavox manufacture only speakers not systems, and therefore in this review we have been more concerned with evaluating the new 8-30 speaker than the enclosures in which the speakers were provided for test.

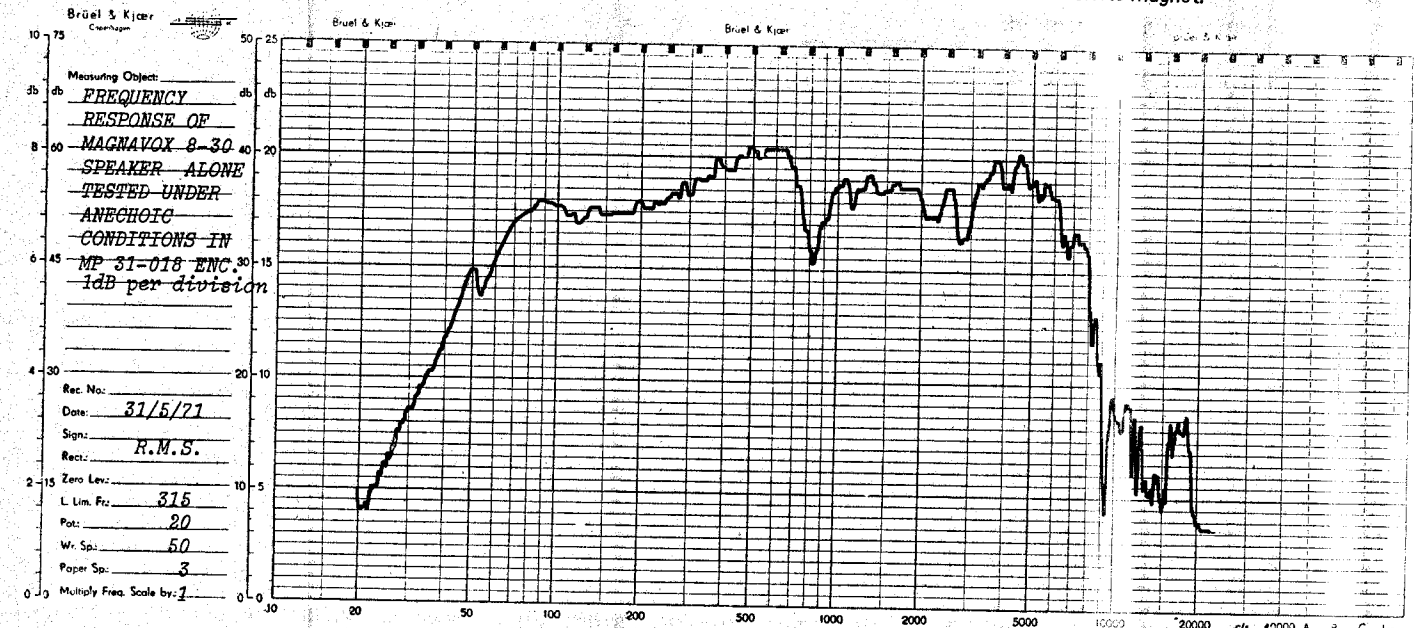
But, unless you are an expert in enclosure design, we doubt that you could design a better enclosure than the Magnavox designed MP31-018. The enclosure can either be built by a handyman, following the plans

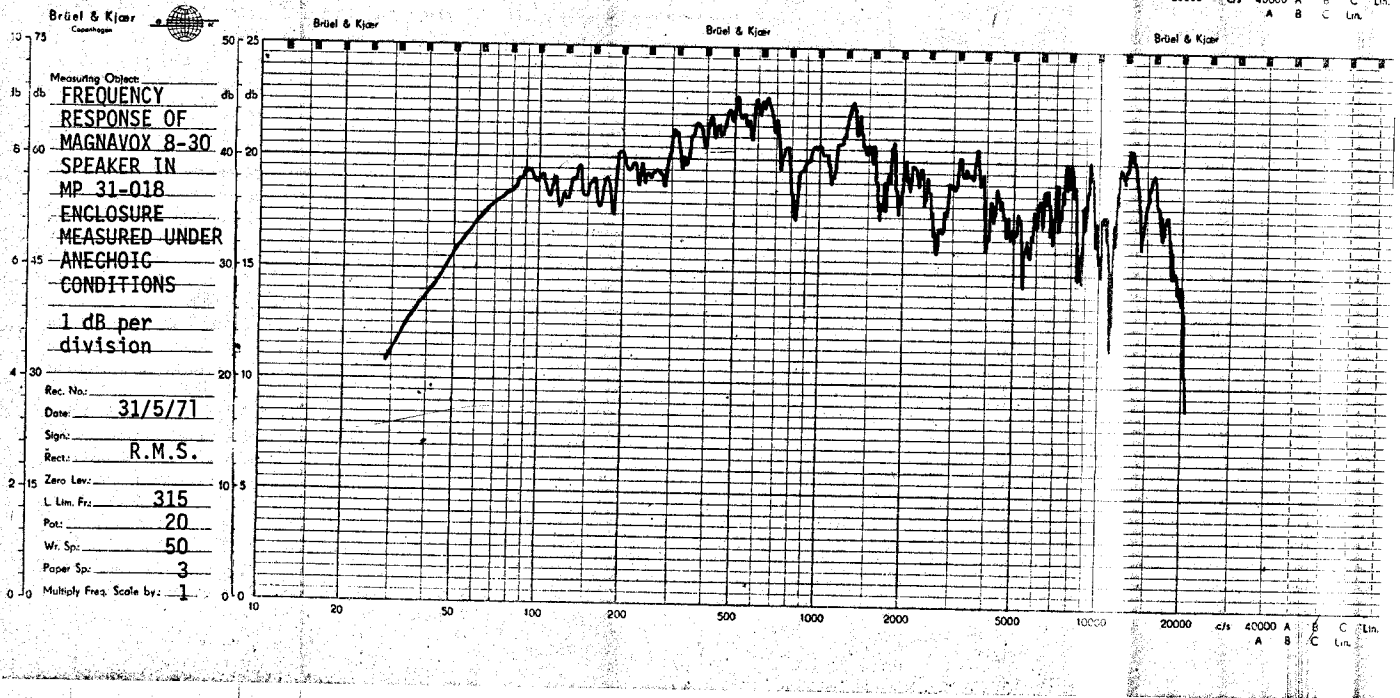
MEASURED PERFORMANCE OF MAGNAVOX 8-30 SPEAKER SPEAKER MOUNTED IN A MAGNAVOX DESIGNATED MP31-018 ENCLOSURE

Frequency response on axis of 8-30 driver (only) measured under anechoic conditions	— 55Hz to 8kHz ± 6dB
Sensitivity: at 1kHz — 1 watt input	— 99dB at 50cm on axis
Speaker weight:	— 4.13lbs
Voice coil diameter:	— 1 1/2"
Overall speaker diameter:	— 9 7/16"
Overall speaker depth:	— 3 3/8"



The Magnavox 8-30 speaker utilises a 3.25 lb. barium ferrite magnet.





LOCAL VOICE MAKES GOOD

following this review, or purchased readymade through many of the hi-fi kitset suppliers.

The MP31-018 enclosure has been designed to give a 24 dB/octave roll-off below the cutoff frequency of 42Hz. The parameters of the speaker and enclosure have been designed to give responses similar to a fourth order Butterworth filter. This design criteria gives the optimum from the system at the low frequency end of the spectrum.

For those interested in the design of enclosures, a theoretical treatment of the subject is given in a paper by A. N. Theile in the Proceedings of the Institute of Radio Engineers (Australia) August 1961. The theory presented in this paper is used by most enclosure manufacturers including Magnavox.

The measurements that we performed on the enclosures showed that the designs of the boxes are excellent and well suited to the 8-30 speaker.

They are in fact better than many of the overseas designs which use far larger speakers than are desirable for the enclosures. (fitted not in the interests of good design, but purely for sales appeal).

PERFORMANCE

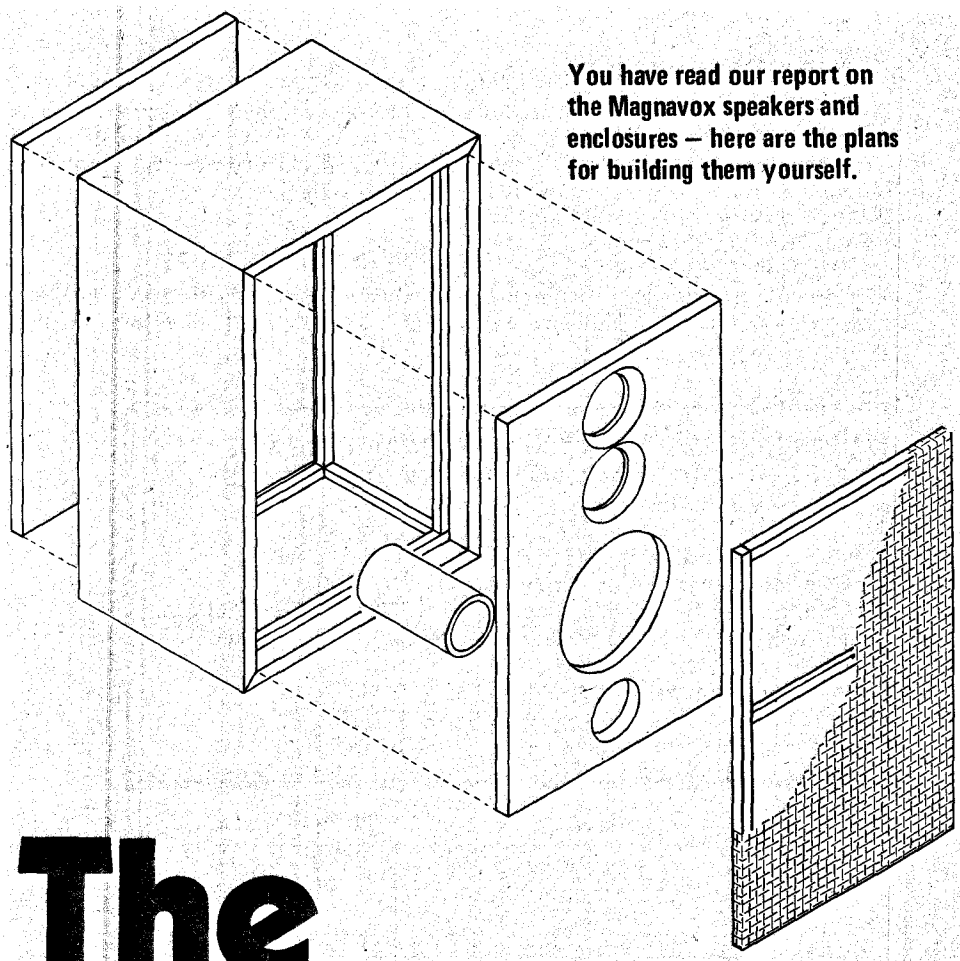
We compared the Magnavox speakers with others costing five to ten times the price. The results were better than expected.

The performance of the 8-30 speaker based on a cost to performance is equal to any 8" low frequency driver currently available in this country.

In fact when combined with the 3UC or 3TC tweeters in the 1.6 cubic foot enclosure, if it were not for the tweeter letting the side down a little above 5kHz, we would most probably have been able to equate them with the best speaker systems costing five to ten times as much.

Notwithstanding, the Magnavox speakers in the 1.6 cubic foot enclosure (MP31-018) are better than any speaker system that we have tested costing twice as much, and comparable to all imported units costing three times the price.

The Magnavox 8-30 speaker is the first of a new line of low cost high performance speakers to be produced by Magnavox and they have made a very impressive start.



You have read our report on the Magnavox speakers and enclosures – here are the plans for building them yourself.

The MP 31-018 Enclosure

The majority of speaker projects published in electronic and hi-fi magazines are intended to provide reasonable performance at minimum cost.

Up to a point they are successful, but few can be seriously compared with professional units costing many times their price.

The unit described in this project is an exception. Our test on page 30-32 of this issue proves it. As our testing consultant says, "they are better than any speaker system that we have tested costing twice as much, and comparable to all the imported units costing three times the price."

Yet these speakers can be home-constructed for less than $40 each!

The enclosure designed in this article has been designed by Magnavox specifically for their type 8 - 30 main speaker and their type 3TC tweeters. The enclosure may not be satisfactory with other types of speaker.

Construction should present no problems to the average home carpenter providing he sticks rigidly to the dimensions given and ensures that the finished enclosure is airtight.

The enclosure must be constructed from particle board having a minimum thickness of ¾". Thicker material can certainly be used, but if it is, the external dimensions must be increased accordingly.

All dimensions given are internal dimensions. Contrary to general belief this does matter, and quite small changes in dimensions will degrade the performance quite considerably.

The back panel must be a good fit and should be held in position by a

minimum of twelve screws. A rubber gasket should be used if there is any doubt about the airtightness of the gap. All other joints should be glued and screwed to ensure rigidity.

Electrical connections through the rear panel must be made airtight — even the slightest gap will seriously affect performance.

All inner surfaces, except the front panel, must be lined with 1" bonded acetate fibre (such as Innerbond).

The tweeters should be Magnavox type 3TC Mk II. This tweeter is a 3½" diameter unit with a curvilinear cone. The rear of this tweeter is enclosed by the manufacturers to prevent air pressure modulation of the tweeter by movements of the main cone.

Two tweeters are used in parallel thus allowing the full 30 Watt rating of the main speaker to be extended to the complete system.

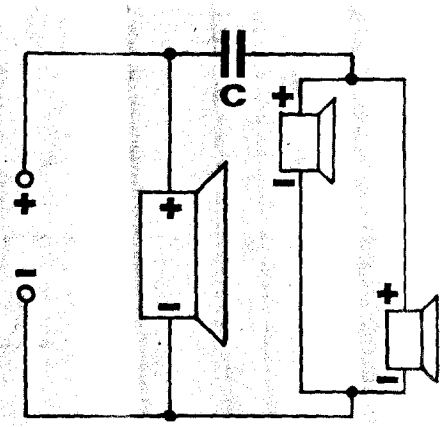
As with the main 8-30 speaker the tweeters are available in different impedances. The most satisfactory arrangement is to use an 8 ohm 8030 unit and two 15 ohm tweeters.

The capacitor, shown as C in Fig. 1, must be a 4 uf. 50 volt working paper, polyester, or lacquered film type. Electrolytic capacitors are not suitable for this application. The capacitor should be mounted within the enclosure by a suitable bracket.

Connections within the speaker enclosures, and from the enclosures to the amplifier, should be made using twin flex of not less than 14/0076 rating.

Magnavox speakers can be obtained from the majority of kit-parts suppliers — many of whom can also supply kits of parts for the enclosures.

Our experience is that the price of these speakers varies from retailer to retailer, but as a general guide the Magnavox recommended retail price is $25-50 including tax for the 8-30 main unit, and $5-11 including tax for each tweeter.

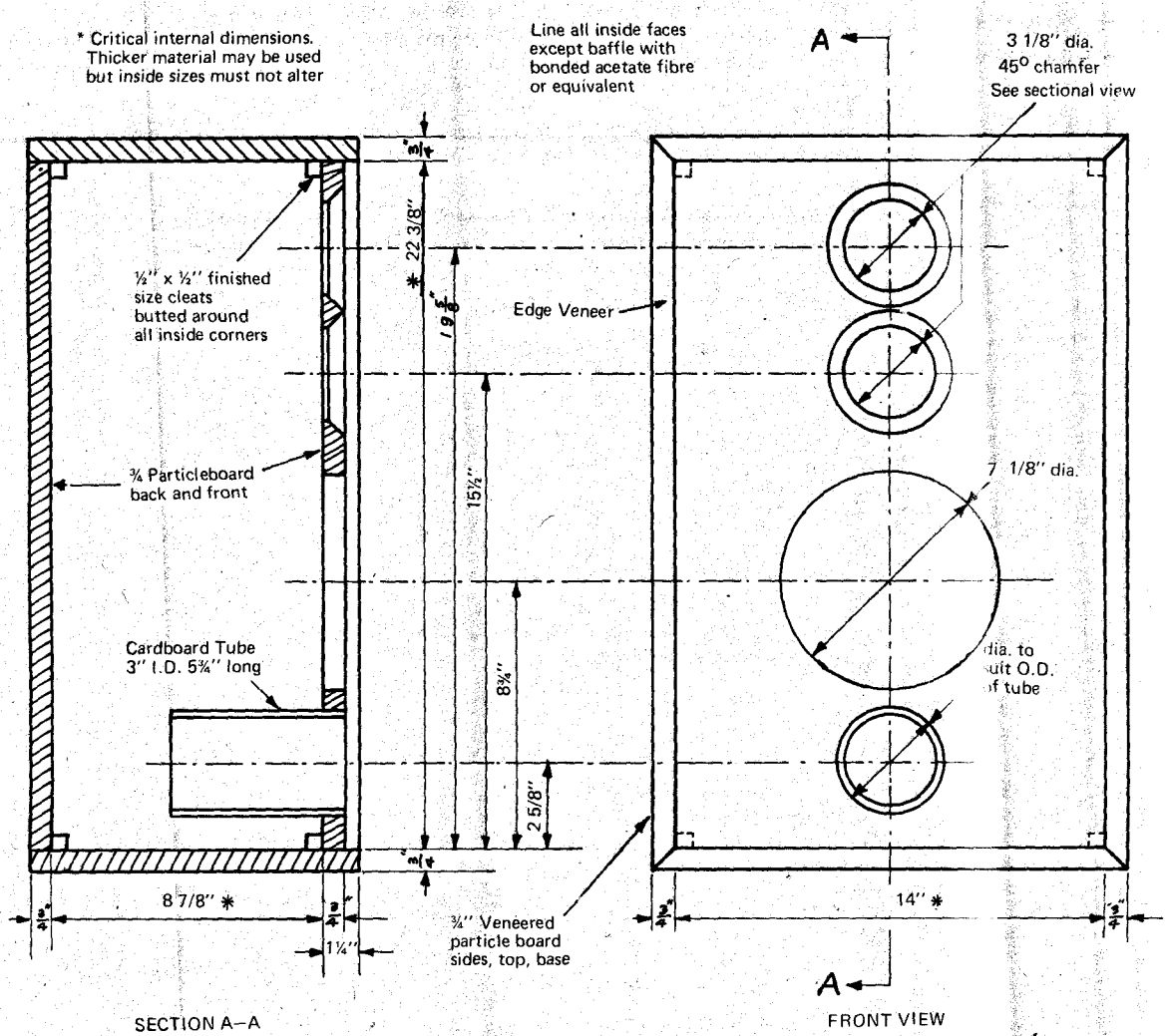


Connect speakers as shown in this drawing — observe polarity as indicated.

Remember that you will need two tweeters and one main unit for each enclosure.

Build these speakers carefully and you can be confident that the result will be at least as good as our prototype unit, a full (and quite independent) report of which is published on the preceding pages of this issue of ELECTRONICS TODAY.

ET PROJECT



TEAC A-2300 TAPE DECK

electronics TODAY product test

Rugged tape recorder from (Japan) combines excellent performance with ease and flexibility of operation.

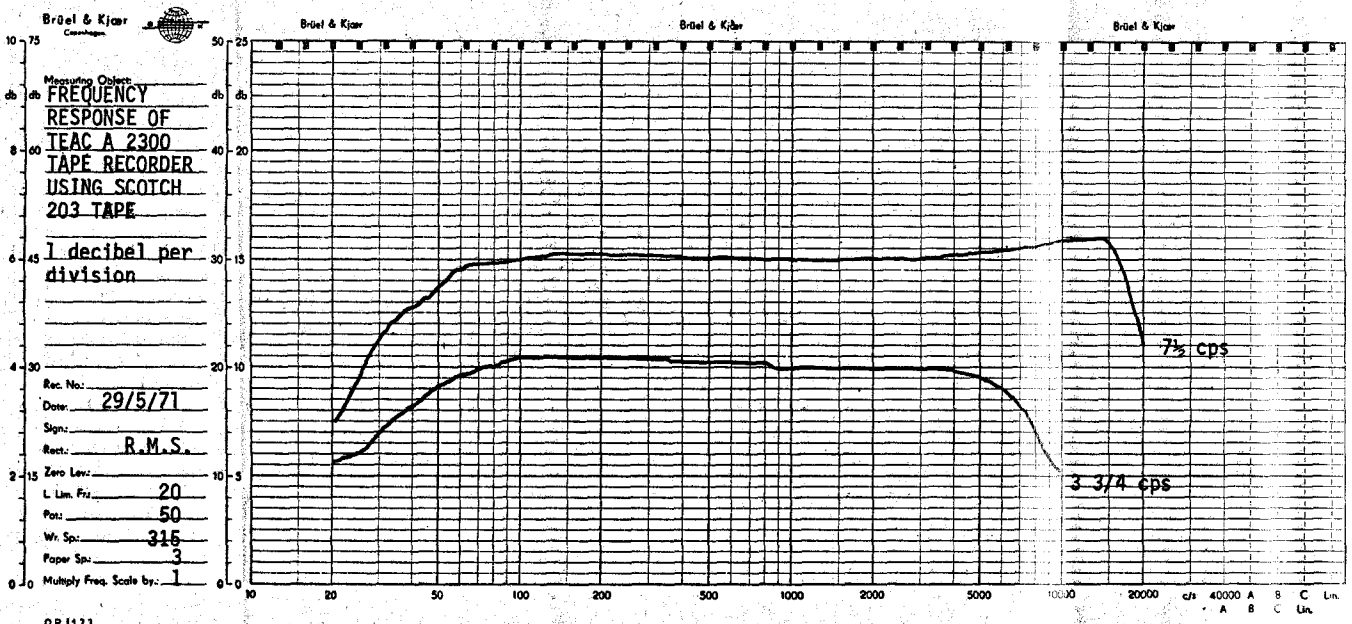
The appearance of the A-2300 tape deck is more impressive than most other tape recorders that we have seen. The two sides are finished in teak oiled timber, and the deck itself is bright satin aluminium, whilst the amplifier panel and the head cover are matt black. There is a four digit counter at the top centre of the deck, and a speed control on the left hand side of the deck.

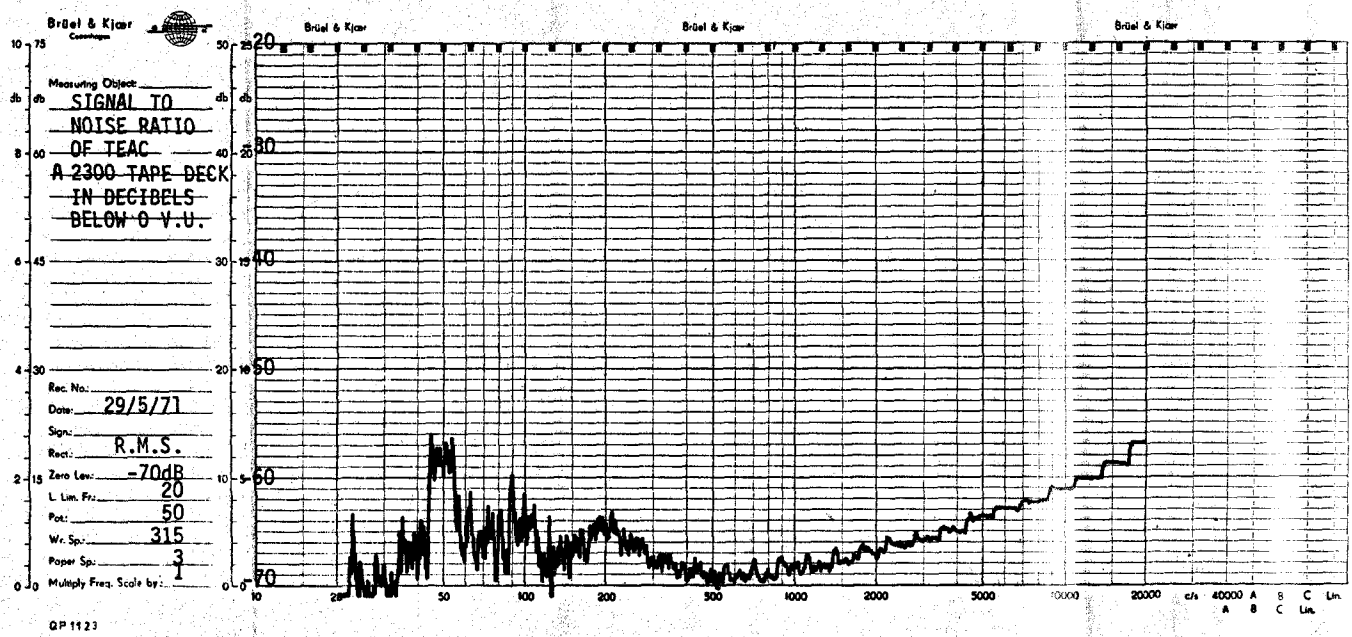
The dual concentric controls provided are comprehensive. The microphone, line and output controls are on the left of two large VU meters, and the transport controls are on the right. These readily allow mixing; dubbing and over-recording.

The transport controls are unusual and consist of push buttons for reverse, stop and forward; together with a toggle lever for fast, pause and replay. These controls are obviously designed for a bi-directional tape deck of the "reversometic" type such as the next deck in the Teac line up, (the A-2500).

These controls are feasible with relay controlled deck system and are a delight to use. We tried to beat the system by pushing buttons and levers at random but discovered that unless something breaks the system is foolproof.

The secondary controls are provided below the main controls in a neat line.





Each is clearly labelled. These are from left to right, two microphone inputs (10kΩ input impedance), a toggle switch for selecting tape or source monitoring with the two VU meters, two toggle switches for selecting either or both of the channels for recording, a recording bias control, a record push button interlock and finally a mains switch.

The inclusion of the bias level switch is both sensible and yet unusual as this facilitates the use of the high performance tapes such as Scotch 203, BASF LP 35LH, AGFA PE 36, as well as the standard tapes, without suffering significant degradation in frequency linearity.

The deck offers two other not so obvious features which a few other manufacturers would do well to copy.

The first these is the inclusion of a viscously damped tension arm which in conjunction with the associated guide post provides a practical and effective reduction of wow and flutter on start up, and creates a constant tension on the tape during high speed spooling. This is an essential feature for a three motor machine as we have seen other similar machines rendered almost useless by the exclusion of such a device. This feature provides the best compromise between head wear, and wow and flutter reduction that we have yet seen.

The second device is an external shut off arm which electrically shuts off the tape transport drive in the event of a tape breakage or more important in the event of one of those spooling accidents which happen on occasions with most other machines.

The drive system uses three motors; one for each reel and a separate one for the capstan. The reel motors are normal shaded pole induction motors whilst the capstan motor is a synchronous hysterisis motor. The use of three motors has many advantages over the more usual one or two motor systems. The principle advantage is the purely electrical control of the drive system rather than through the operation of mechanical clutches and cams. The use of synchronous motors is usually only possible when a separate drive system is used for the reeling spools, because hysterisis synchronous motors are usually larger than induction motors of the same rating.

The use of a synchronous hysterisis motor for the capstan drive provides a very high level of speed accuracy. In the case of the TEAC-2300 this was found to be better than ±0.3% under all conditions of spool diameter and mains frequency. The main factors affecting the tape speed (apart from the mains frequency) are tape slip in the drive system and tape tension. The use of two independant induction motors on the supply and take up spools produces a low level of wow

KEITHLEY
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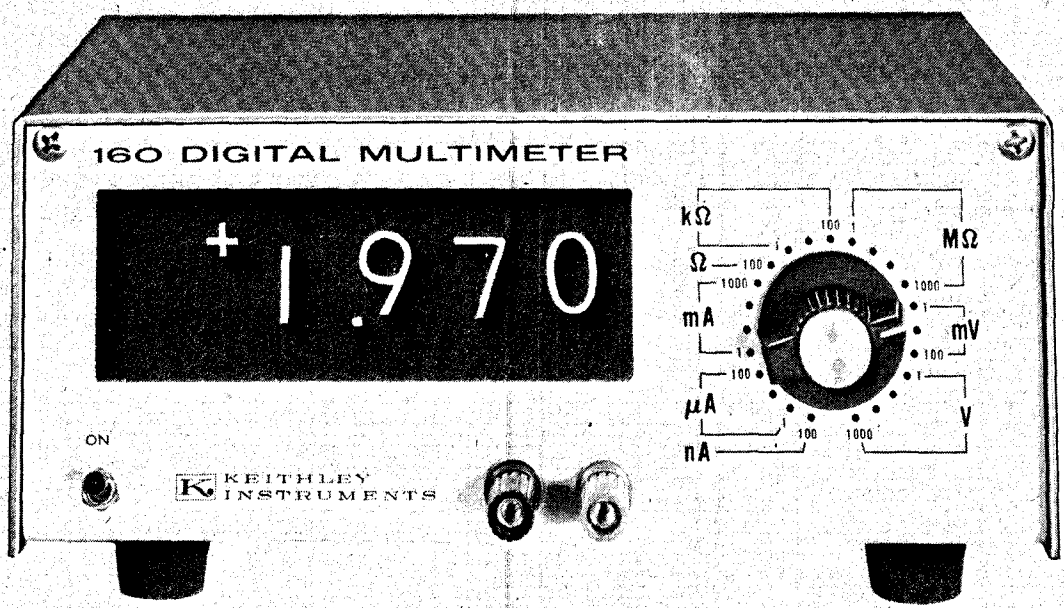

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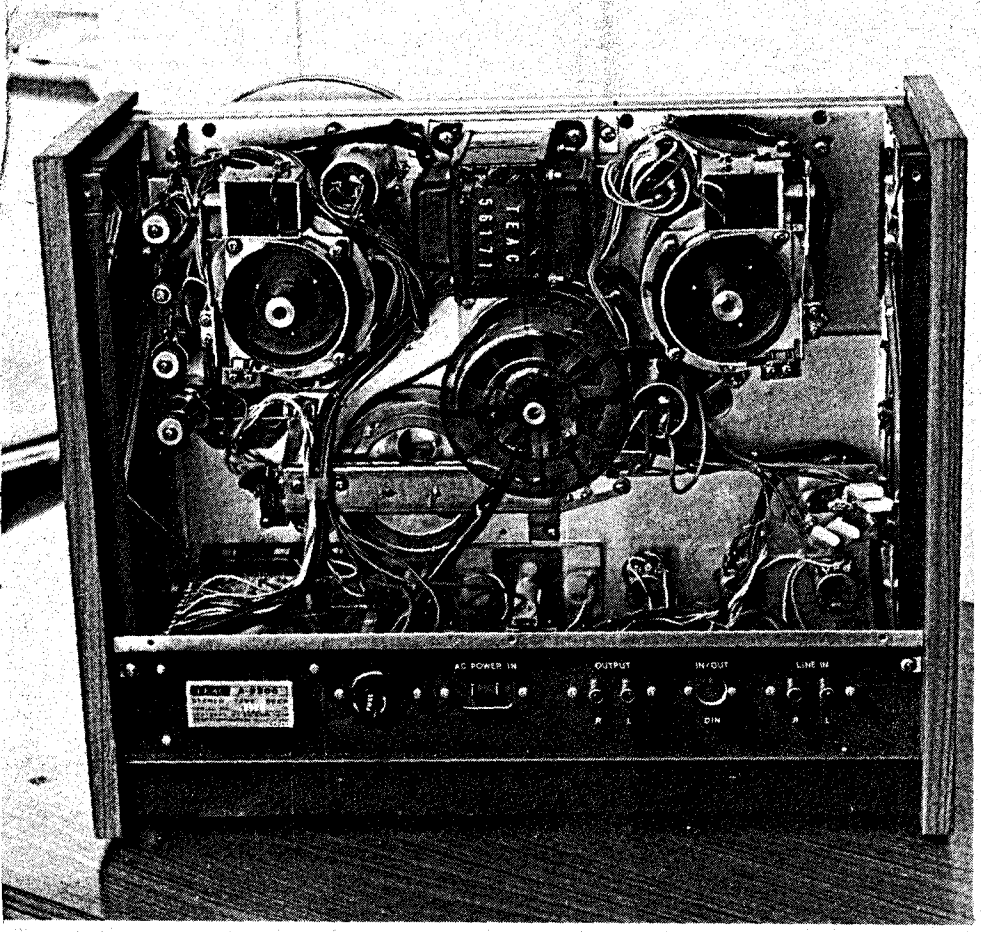
TEAC A-2300 TAPE DECK



Sturdy die-cast chassis rigidly locates main components, all easily accessible for service.

and flutter. In combination with the mechanical tension arm this does not exceed 0.1% RMS at 7½" per second and 0.15% at 3¾" per second.

The other advantage of these two spooling motors is the ability to perform very rapid winding or rewinding. The typical time required for a 1200 ft. tape is 90 seconds but the uniformity of spooling is better than on most other three motor machines because of the tension arm.

The two sets of deck controls (push buttons and levers) are easy to use, but they are not immediately easy if accurate cueing is required because of the need to use both hands. Whilst this may possibly be overcome, we consider that some of the other available systems offer equal or better performance.

The electronic parts of the deck are well laid out both mechanically and electrically. The printed circuits are all neatly mounted on the solid die-cast main frame and include separate record and play-back amplifiers each on its own board.

Other components including the power supply motors, and solenoids are located by anti-vibration mounting so that the unit is quiet and vibration free.

The provision of separate record, replay and erase heads, together with separate amplifiers results in a very flexible system in that the signal being recorded can be simultaneously monitored directly from the tape.

The replay amplifier whilst not providing a high enough power output to drive a speaker does incorporate a transformer suitable for driving a pair of 8Ω headphones at milliwatt levels.

The frequency response of the recorder is very good being 45 Hz to 18 kHz ± 2/3 dB at 7½"/sec. and 45 Hz to 7 kHz ± 1/3 dB at 3¾"/sec.

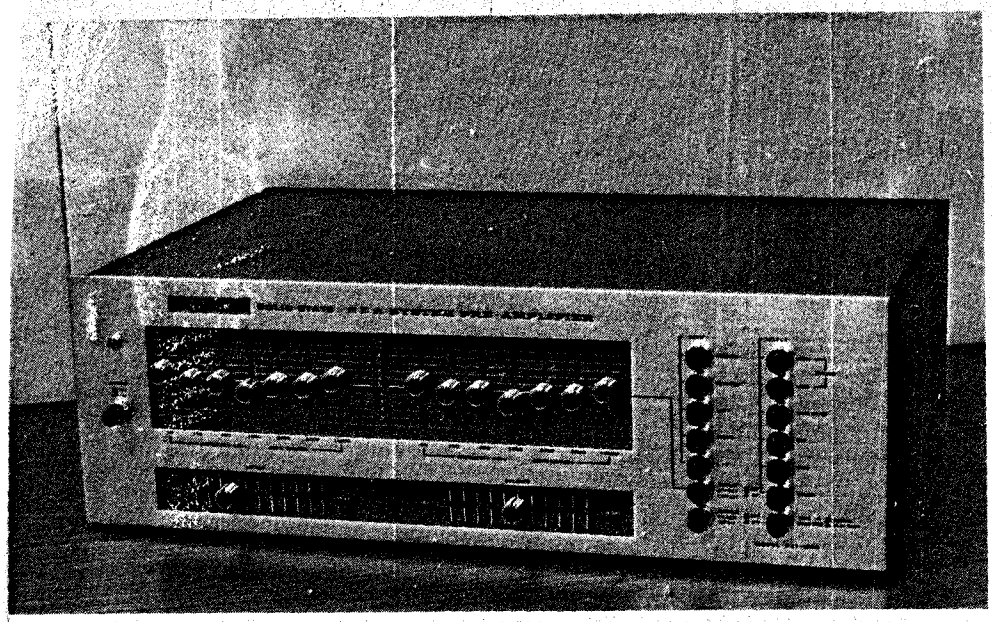
The instruction manual includes a circuit diagram and 18 pages of comprehensive data.

In summing up, this deck provides excellent performance and unusual flexibility for dubbing and the production of special tapes. It is very robust and will undoubtedly provide good service in language laboratories in which it has an obvious use.

These features combined with its appearance will mean that it will also have an appeal to the domestic hi-fi market.

MEASURED PERFORMANCE FOR TEAC A-2300 TAPE DECK SERIAL NO: 8858

Record to Replay Frequency Response	
7½"/second:	45 Hz to 18 kHz ± 2/3
3¾"/second:	45 to 7 kHz ± 1/3
Harmonic Distortion Record to Replay:	
@ 1 kHz & 0 VU:	1.0% at 7½"/second
	1.0% at 3¾"/second
Intermodulation Distortion:	0.3%
Unweighted Signal-to-Noise Ratio	
@ 0 VU & 1 kHz:	55 dB
Erase Ratio for a 1 kHz signal prerecorded	
@ 0 VU:	68 dB
Wow and Flutter at 7½"/second:	0.1%
3¾"/sec:	0.15%
Interchannel Cross talk at 1 kHz:	52 dB
Interchannel Cross talk at 100 Hz:	40 dB
Input Sensitivity for 0 VU	
Microphone	0.3 mV
Line	100 mV
Output Sensitivity for 0 VU	360 mV
Weight:	37 lbs
Dimensions:	14" high x 17¼" wide x 8:: deep



FOURTEEN ON THE FLOOR

We test Nivico's type PST 1000/E pre-amplifier

Some years ago the Americans produced the concept of the graphic controller for professional use, and it didn't take long for the domestic market to follow suit, but so far only to the extent of treble and bass and until recently a mid range control as well.

This, one would think, is enough variability of control to suit most users, but the trend appears to be to produce more and more gimmicks, either with or without justification.

The Nivico PST 1000/E 5011 preamplifier or preamplifier with S.E.A. is an unusual unit. Rather than a graphic controller for bass and treble tone controls, this unit has seven tone controls per channel. Each tone control consists of a 1 1/3rd octave band pass filter that can be adjusted through a ± 10 decibel range in 2 decibel steps. This ability enables frequency response contours to be set up to suit individual requirements.

CONSTRUCTION OF THE UNIT

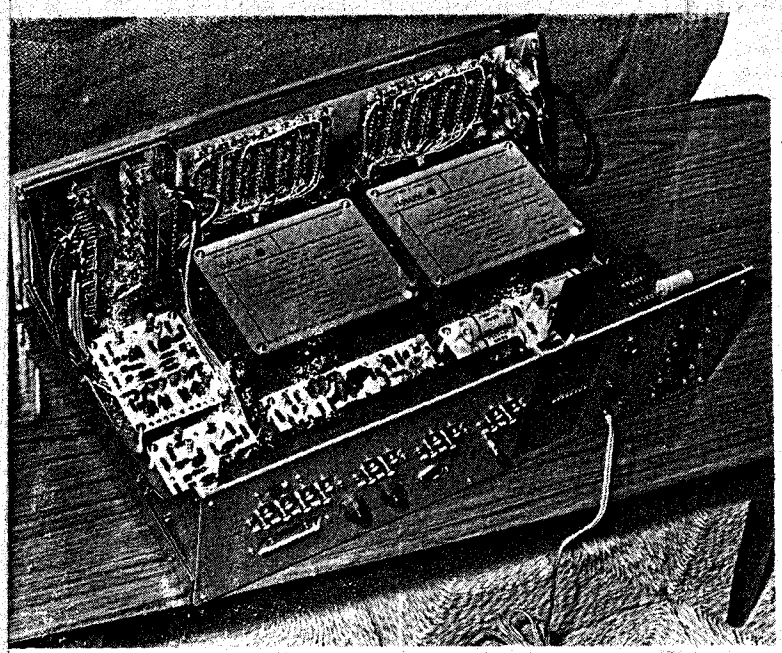
The actual construction of the unit is very plain with a matt anodised aluminium front panel and grey cabinet. This has presumably been designed to highlight the graphic controls consisting of the 14 tone controls, volume control and balance control. These controls are slider potentiometers with bright aluminium knobs with a black insert in the centre of each.

The 14 tone controls operate in a vertical direction while the volume and balance controls are horizontal.

Each control is on a dark grey background which in the case of the tone controls is graduated in 2 decibel steps. The volume and balance controls have arbitrary steps (they are not calibrated).

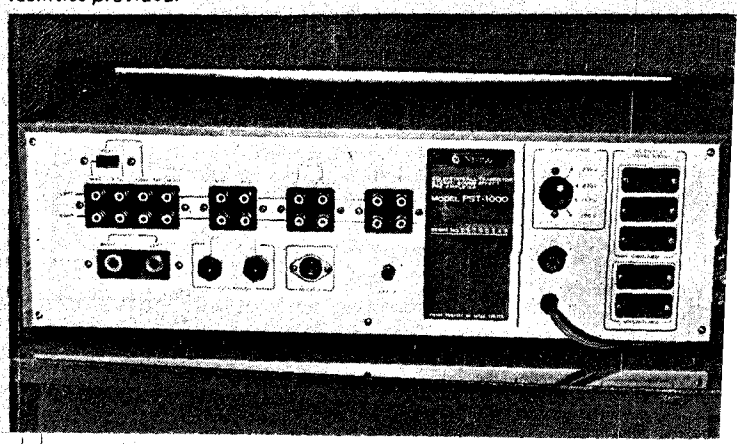
The circuit of the amplifier uses 32 transistors which, whilst a large number by conventional standards, was not unexpected in a preamplifier of such complexity.

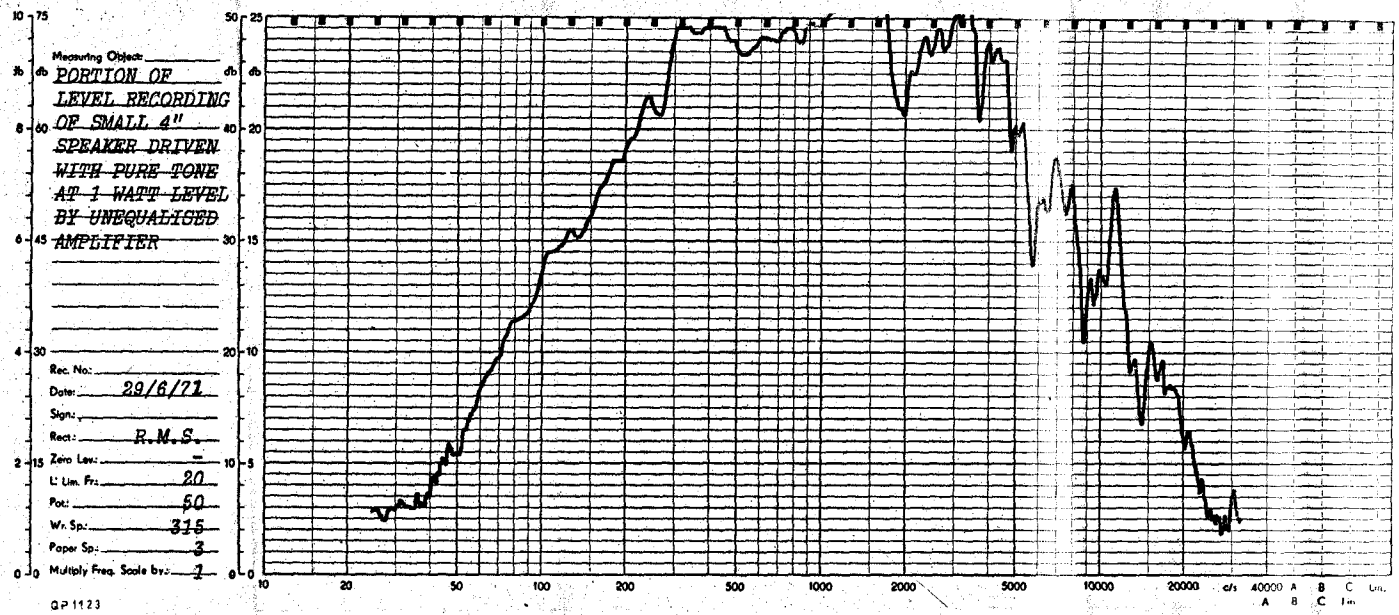
The internal construction is neat and truly professional. Each Sound Effect Amplifier is housed in a separate 6¼" x 5" x 2" metal box with full

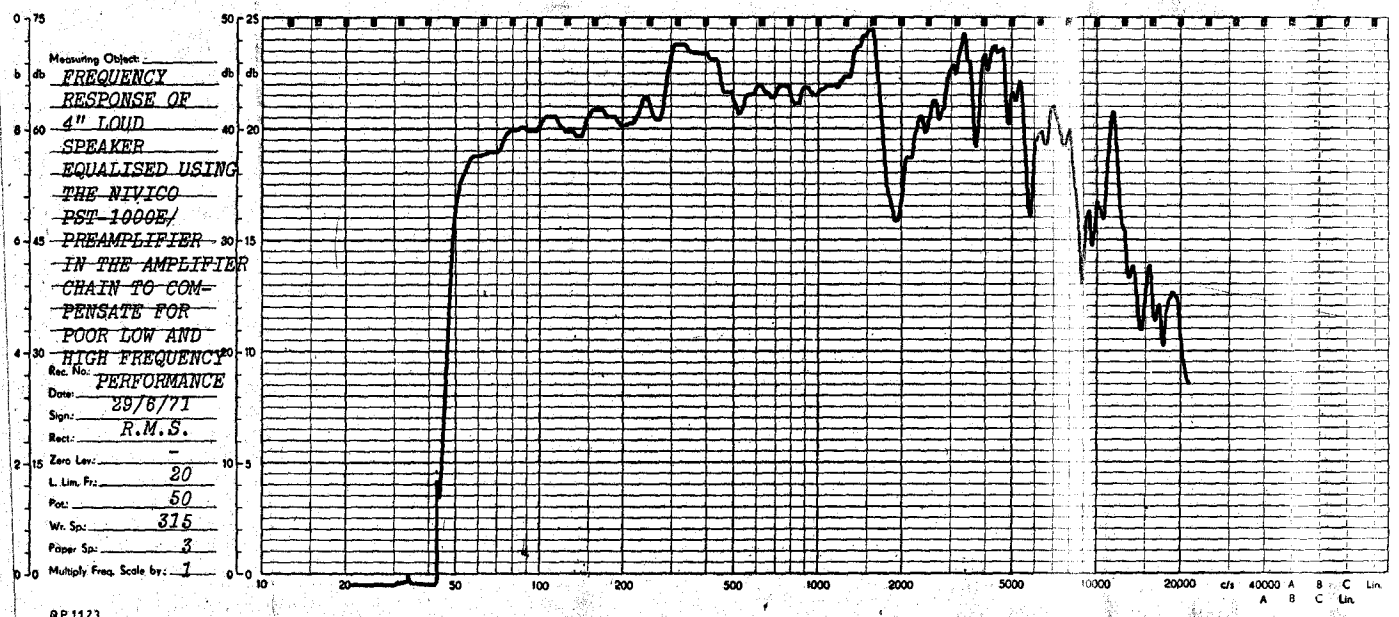


This interior picture shows the clean layout and professional engineering of the Nivico unit.

Rear of unit – note extensive facilities provided.







specification attached to the lid. All other circuitry is mounted on four separate fibreglass-based printed circuit boards.

All the semi-conductors are silicon transistors or diodes and the circuitry is arranged with dual channels on each board.

Our interest was centred on the rear of the filter control slider switches. These incorporate neat banks of resistors to provide the filter performance.

The resistors used are *single ended* ¼ watt composition resistors (i.e. the pigtails both come out at the same end). Such components are unusual and we wonder whether they were developed for this application or for small transistor radios.

The wiring between the sliding controls and all the other sections is impeccable and the impression that we gained was of first class design, workmanship and materials.

Unlike most of the equipment we review, we decided to test this preamplifier before using it in listening tests. The reason for this was that the manufacturer gave no real indication of what the unit is intended to do. We hoped that by testing it we would be able to find out for ourselves.

electronics TODAY product test

We found that the preamplifier had a particularly good frequency response, this being 20Hz to 20kHz ±0.1dB.

It has a wide range of inputs which allow its use with two pickups, either magnetic or crystal, a tuner, a tape head and two microphones. In addition, it has the normal tape monitor facilities.

The equalisation, provided on the tape head and pickup input, is particularly accurate.

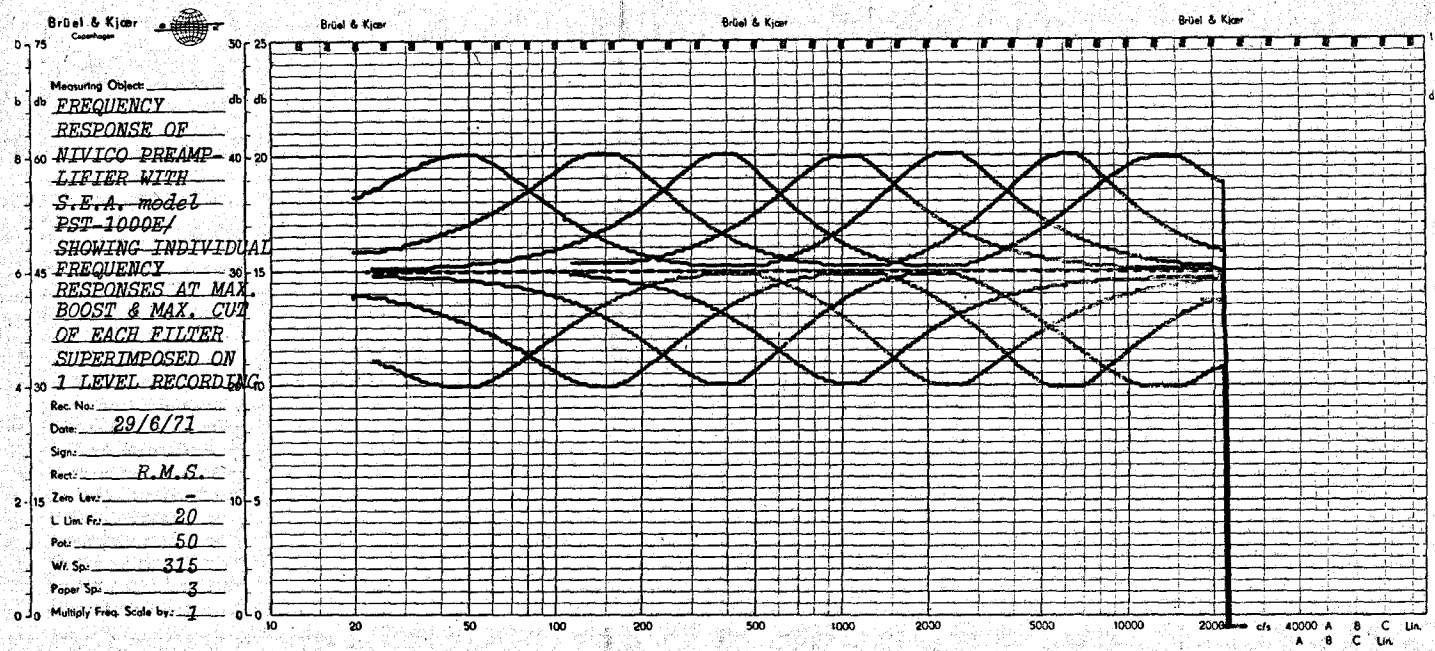
Each of the inputs is selected by individual push buttons. The total number of push buttons in the input selection bank is seven. In addition to these there are five push buttons for stereo, reverse A & B, one for a rumble filter and one for the S.E.A. (Sound Effect Amplifier).

SOUND EFFECT AMPLIFIER

This is the puzzling section of this preamplifier, although electronically it is easy to describe. Each channel consists of seven filters, each 1 1/3rd octaves wide. The levels of these filters can be adjusted over a range of ±10 decibels in 2dB steps. The filters have centre frequencies of 60Hz, 150Hz, 400Hz, 1kHz, 2.4kHz, 6kHz and 15kHz. They appear to be two pole filters although no details are provided about them. The accuracy of the filters, both in level and centre frequency is particularly good with the exception of the '60H' filter, which we found has a centre frequency of 50Hz.

We found that we could use these filters to generate a large variety of curves to quite a high degree of precision.

In the course of our investigation, we produced a curve which most nearly corresponded to the inverse of a cheap 4" loudspeaker mounted in a simple baffle. When used in conjunction with



such a speaker the results of the test were dramatic, the frequency response of the compensated speaker was comparable to an expensive system, although the level at which the speaker could be used without overload was of course very low.

While it proves a point, we do not recommend the purchase of this type of preamplifier to enable very cheap speakers to be used.

We also performed several other tests to see how well the various weighting characteristics which we commonly use could be generated, and were delighted with the results.

Having finished the electronic investigation, we connected the preamplifier through our normal audio equipment.

We found that as far as listening tests were concerned no real advantage appeared to be evident over normal tone controls, and the more complex system was cumbersome to use. the coloration which was obtainable using the controls was not particularly desirable once the room defects and speaker deficiencies had been allowed for.

To use this system in the same fashion as normal tone controls was difficult, time consuming and not particularly satisfactory.

It would appear that the concept of this system is not as well thought out as it should be.

The main usage for this system would seem to be to correct any deficiencies in reproduction equipment (either domestic or professional) and the Sound Effect Amplifier should be used in conjunction with a conventional system. It would then enable the purist to compensate for the deficiencies in his system and presumably leave the controls permanently set in this position. He would then use the conventional tone controls for the addition of slight coloration to suit his individual tastes.

But the ability to accentuate a single band 1 1/3rd octaves wide by a range of ±10dB would appear to be of dubious value.

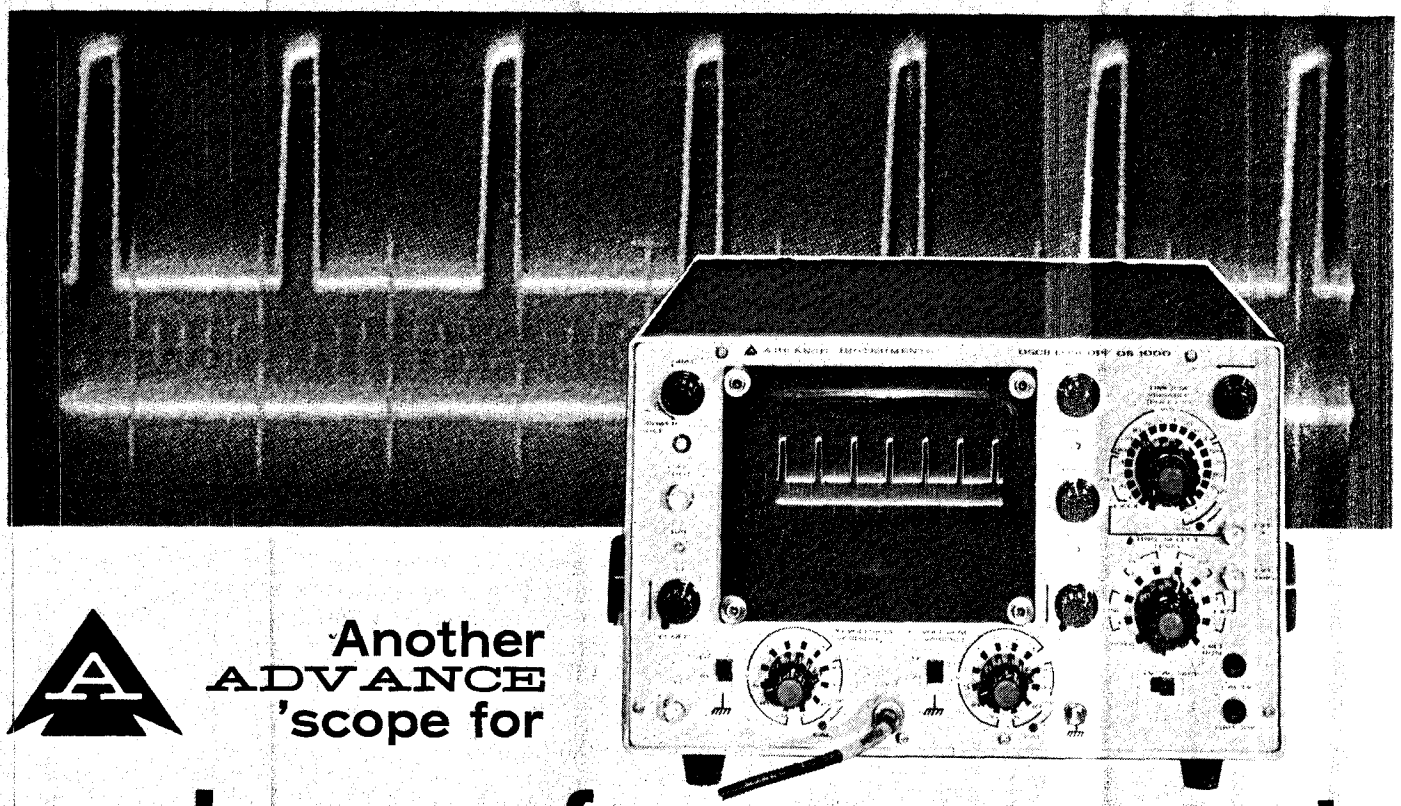
While we are critical of the value of certain features offered in this unit to the domestic Hi-Fi equipment purchaser, there is no doubt about the quality of design and manufacture.

The tolerances on the specifications are particularly good and consistent with most professional equipment. The major exception to this is the handbook supplied with the unit. The only information it *contains is the* correct usage of the controls and connections in the worst 'Japanese English'.

We would rate this unit as a very well constructed device in search of a use.

MEASURED PERFORMANCE OF NIVICO PST-1000E/5011, S/N 6300249

INPUT SENSITIVITIES AND IMPEDANCES FOR 3 VOLT OUTPUT:	AUX. 170mV at 100kΩ impedance adjustable to 250kΩ by means of trimmer.
CRYSTAL INPUT:	120mV at 330kΩ impedance
MAGNETIC PHONO–HIGH:	3mV at 50kΩ "
MAGNETIC PHONO–LOW:	1mV at 50kΩ "
TAPE HEAD:	1.1mV at 350kΩ "
MICROPHONE:	2mV at 350kΩ "
TOTAL DISTORTION AT 3 VOLT OUTPUT:	Less than 0.05% 20Hz to 20kHz
FREQUENCY RESPONSES:	
Auxiliary Input:	20Hz – 20kHz ± 0.1dB
Phono-low and high:	Equalised to within ± 0.5dB of RIAA equalisation
Tape Head:	Equalised to within $^{+0.5dB}_{-1.0dB}$ of NAB equalisation
Microphone:	20Hz – 20kHz $^{+1dB}_{-2dB}$
SIGNAL TO NOISE RATIO:	Better than 80dB in the flat weighted position.
CENTRE FREQUENCIES OF S.E.A. FILTERS:	60Hz, 150Hz, 400Hz, 1kHz, 2.4kHz, 6kHz, 15kHz.
FILTER BAND WIDTH:	1.333 octaves wide
RUMBLE FILTER:	30dB per octave with a 30Hz cutoff frequency
CROSS TALK:	-56dB at 1kHz between each channel
DIMENSIONS OF UNIT:	19" x 13½" x 5-1/8" high 2-channel preamplifier each containing Sound Effect Amplifier Section.



Another ADVANCE 'scope for

precise waveform measurements

OS1000 oscilloscope
15MHz, 7" high

Here is a small size, lightweight 5mV/cm dual trace oscilloscope offering wide time base ranges and comprehensive trigger control combined with broad bandwidth and calibrated deflection factor. Solid state circuitry makes the OS1000 ideal for servicing or laboratory use.

DISPLAY:
10cm x 6cm rectangular tube with 4Kv overall E.H.T.P.31 (standard) or P7 (long persistence) phosphors available. With dark grey filter as standard. Brilliance, Focus and Graticule illumination by normal controls.

EXTERNAL Z MOD:
AC coupled rear panel socket. 1vpk.pk for visible modulation, 60V for blanking. Input impedance 1MΩ.

DISPLAY MODES:
SINGLE TRACE: Y1 or Y2.
DUAL TRACE: Alternate sweep or chopped mode (250KHz) automatically selected by time base setting:
Alternate sweep—0.5μS/cm to 0.5mS/cm, chopped mode—1mS/cm to 1 sec/cm.
X-Y mode—via Y1 and Y2 inputs—selected on time base range switch.
Bandwidth DC to 1MHz.

Y DEFLECTION:
Dual channels—
Sensitivity—5mV/cm to 20V/cm ± 3%.
BANDWIDTH: DC to 15MHz.
INPUT Z: 1MΩ/30pf.
INPUT COUPLING: AC/DC/Ground.

X DEFLECTION:
TIME BASE: Ranges 1 sec/cm to 0.5μS/cm with X10 Expansion ± 5%.
TRIGGER MODES: (i) Internal Y1 + or − (ii) Internal Y2 + or −. (iii) External + or −. (iv) Line + or −.
LEVEL CONTROL: (i) Manual or (ii) Auto with automatic free run in absence of signal.
EXT. TRIG.: Input Z. 100kΩ 15pf.
EXTERNAL X: Via external X input, sensitivity 1V/cm. Input resistance 100kΩ, bandwidth DC to 2MHz.

GENERAL INFORMATION

CALIBRATORS:
(i) CAL.: Line frequency square wave 1V pk.pk ± 2% rise time approx. 20μS.
(ii) PROBE TEST: Time base gate waveform + 10V.

SUPPLIES:
95-111/103-121/111-130.
190-222/206-242/222-260.
Selected by rear panel switch.
45-440Hz. Approx. 35VA.

OPERATING TEMPERATURE RANGE:
0 to + 40° C.

WEIGHT:
20 lb.

SIZE:
7" x 11¼" x 17".
(H) (W) (L)

Probe Kit

An accessory probe kit is available for use with the entire range of Advance oscilloscopes. This provides for a standard compensated test lead which may be terminated at one end with BNC or UHF type connectors and at the probe end may be fitted with probe bodies of x1 and x10 ratio. Spring-loaded hook, needle, 4mm plug and alligator tips may be fitted to the probe, which also has provision for a grounding lead connection adjacent to the probe tip. All the parts are supplied in a plastic wallet suitably compartmented.

Further information available from:

JACOBY MITCHELL

SYDNEY	26 2651	BRISBANE	2 6467
MELBOURNE	30 2491	PERTH	28 8102
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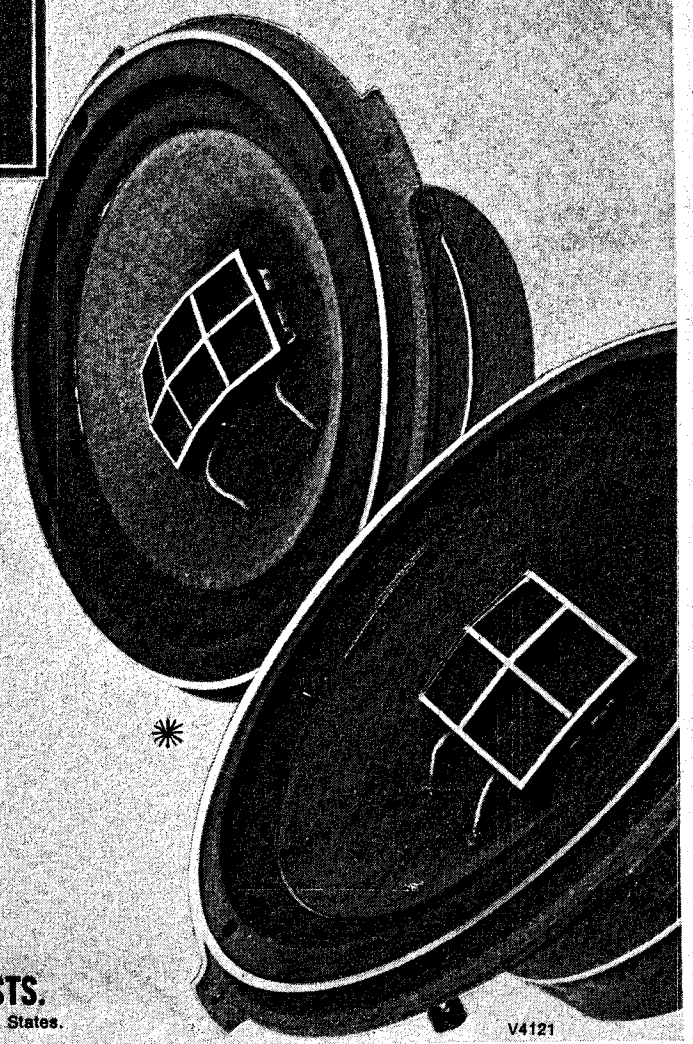

CS 63DX 4-Way 6-Speaker System, gives you a massive 15" Woofer, *two* special mid-range units and three horn tweeters. 80 watts maximum power.

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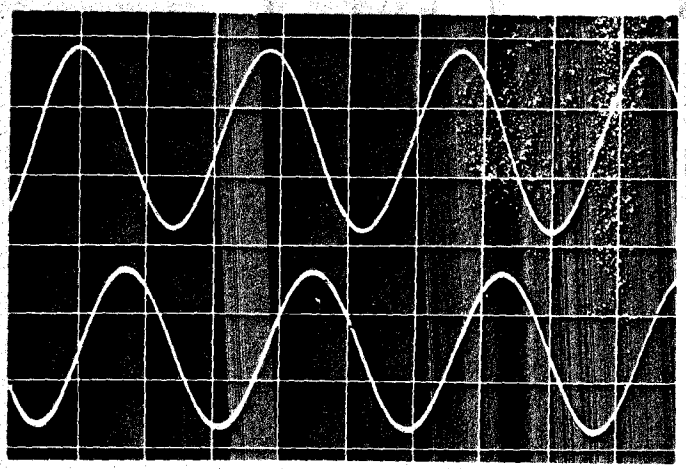
V4121

Tape Recorder Revolution

an Electronics Today exclusive report

A new digital method of recording speech and music may revolutionize the magnetic sound recording industry. Our preliminary report tells how.



System response for 20 kHz sine-wave, (top) input, (bottom) output.

A technique that may well be the most significant advancement in the art of sound recording since the introduction of magnetic tape recorder has been announced by Samuels Engineering, Inc., of the U.S.A. Using a highly advanced analogue to digital conversion process, the new development provides a quantum jump in magnetic sound recording quality.

The new recording process, called ADAmag, virtually eliminates the magnetic tape as a cause of noise and distortion in the reproduced sound, and greatly improves all other vital parameters in professional magnetic sound recording. Signal-to-noise ratio is claimed to be improved by 18 dB to achieve the previously unattainable figure of over 80 dB (referenced to one-half percent third harmonic distortion).

Useable dynamic range is theoretically greater than 85 dB while still maintaining harmonic distortion below one-half percent at peak recording level. Interchannel crosstalk in any mode of operation is improved by more than 45 dB over the entire frequency spectrum from 20 Hz to 20 kHz.

Print through effects are completely eliminated in the reproduced sound without use of any suppressors. Losses in signal level and added distortions found in conventional tape copying are also eliminated by the new process.

This development in sound recording also ensures magnetic recordings which are immune from degradations of sound quality due to tape storage. Since all signal information is digitally recorded on the magnetic tape at saturation level in a similar manner to computer techniques, normal demagnetization losses do not affect the reproduced sounds, and the recording can be considered permanent.

With this advancement in quality of the master tapes, the record industry will have an archival recording which is much closer to the original sound than previously obtainable. The final consumer's records and tapes can then be improved in quality as well, and can be more readily tailored to meet the exact needs of the market.

Other problems of conventional magnetic sound recording such as signal biasing and record/play equalization are bypassed, since the ADAmag process requires no equalization, nor is any signal bias needed. With this innovation, the tape recording electronics adjustments are greatly simplified, and standardization in reproduced signal levels and quality can be more reliably assured. With the new process, ordinary blank sound recording tapes can be used with optimum results, and no adjustment of the system is necessary when changing from one type of tape to another.

This unique recording process converts the incoming analogue sound signals into digitally coded pulses which are recorded on the magnetic tape at saturation level. In playback, the digital pulses are decoded and converted back to analogue sound signals, which are then reproduced through standard sound systems.

While analogue to digital conversion techniques have been widely used in computer and instrumentation recorders for many years, none of these systems has previously achieved the bandwidth and wide dynamic range needed to encompass the full range of musical sound.

The first product to be introduced by Samuels is a professional magnetic sound recording system for the record industry, but the conversion process is readily adaptable to many other uses in the fields of communications, medical instrumentation, and scientific analysis.

The Samuels digital sound recording process is also adaptable to motion picture film sound tracks to render sound quality essentially the same as on ADA recorded tapes. The optical/digital process, if adopted, could save the film industry up to 30% of the cost of each film print release, since magnetic stripping could be eliminated, and the film print processed in one operation.

For the near future, Samuels' marketing director, Bill Cara, believes that the sound quality of LP records and pre-recorded tapes will be considerably improved by use of the system during the original studio recording session and on subsequent processes in the studio. Within five to ten years, the home consumer could be able to buy music tapes recorded with the ADA system which would have quality equal in every parameter to the original master tape. This high quality for the home consumer can be made possible by the digital "saturation" recording process which enables contact printing techniques to be employed for wide-band sound reproduction for the first time.

Samuels Engineering had for the past six years served as a sub-contractor to aerospace and commercial industries. In 1970 Carl Samuels, President, began the search for proprietary commercially oriented products and in January 1971 he launched the ADAmag engineering project. The key members of the Samuels staff include four former engineering/management men from Gauss Electrophysics, a subsidiary of MCA Inc.

Samuels has already received order commitments for several systems to be delivered late this year. By early 1972, they will offer a complete professional master tape system, as well as kits to update older professional tape transports. Prices for the new recording process are about twenty percent higher than conventional top quality studio recorders. ●

THE 'E' CELL DEVICE
a new circuit component

Based on a fundamental electro-chemical principle, this new component can be used as a timer, integrator, or pulse counter.

One of the most interesting and versatile circuit components to be introduced for some time is the 'E' Cell electro-chemical timer manufactured in the U.S. by Plessey subsidiary Bissett-Berman Corp.

Apart from its ability to provide time delays from a few seconds to several months, the device can be used to monitor, record and integrate data and events, it can also add and subtract pulses, events, objects, etc.

As a timing device it can be used for starting, stopping, or delaying machinery; it can be used as a fuse in explosives applications, and for monitoring, overhaul and calibration scheduling, or rental time accounting in all types of electrically operated equipment.

OPERATING PRINCIPLE

The 'E' Cell is in effect, a reversible micro-coulometer, designed in accordance with Faraday's law of electro-plating.

It operates by means of the physical transfer of atoms of metallic silver across an electrolyte.

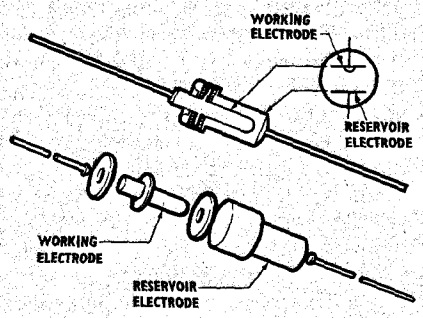


Fig. 1. Cross-sectional and exploded view of the 'E' Cell device, together with its electrical symbol.

The device has a central gold electrode which also serves as the outer case (Fig. 1). When current flows in one direction the positive silver ions in the electrolyte are deposited on the gold electrode and the 'E' Cell has a low resistance — of the order of a few ohms, c.

When current is applied in the opposite direction, the device still exhibits a low resistance as long as there is silver remaining on the working electrode. As soon as the silver has been depleted from this gold electrode, the 'E' Cell changes to a high resistance, usually of the order of several megohms. (Fig. 2).

Since the flow of current is

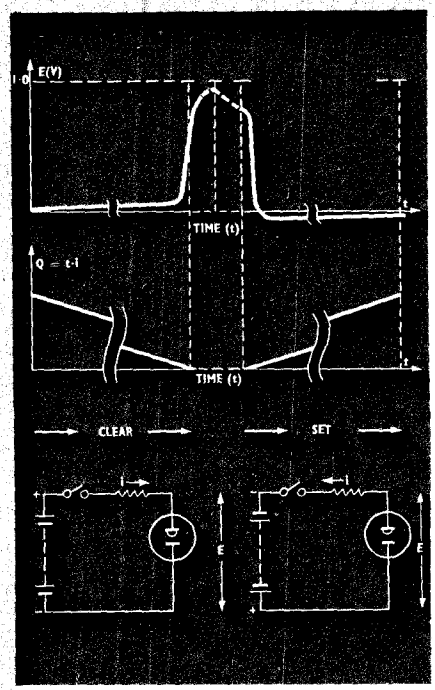


Fig. 2. The 'E' Cell operating curve at constant dc. The curve starts with silver plated on the working electrode (pre-set). The quantity of silver is Q_o (initial charge) = $I_o t_o$.

accompanied by a transfer of silver from one electrode to the other, the device is a true integrator of the current input. At any time, the quantity of silver accumulated on the working electrode represents the true value of the integral of the current that has passed through the device.

The 'E' Cell does not provide any direct indication of the stored integral. However, its end point switching mechanism serves as a fixed reference point, by means of which a read-out of the integral can be achieved.

WHAT AN 'E' CELL DOES

For timing applications a constant current is applied to a previously charged unit.

Since the charge is expressed in microamperehours of silver deposited on the working electrode, the selected time delay is determined by a combination of the charge and the specific constant current being used. The available range of timing is from seconds to months.

The output voltage step change that occurs when the silver mass has been completely transferred is normally used as a bias transition signal for semiconductor devices used to amplify the 'time-out' signal.

For integration applications, a previously cleared unit will accept dc, periodic, or random inputs of any waveshape and store these as a silver mass equivalent to the current-time integral. Readout is obtained by simply measuring the time to clear the 'E' Cell at a known current; the measured time required to reach the point where the device exhibits an abrupt voltage change, multiplied by the readout current is the accumulated charge integral. This could correspond to the total count of a series of events represented by input pulses of constant charge.

To set an 'E' Cell, silver is plated on to the working electrode by injecting a constant current I_s during a known time t_s; the charge set (Q_s) is then $Q_s = I_s t_s$.

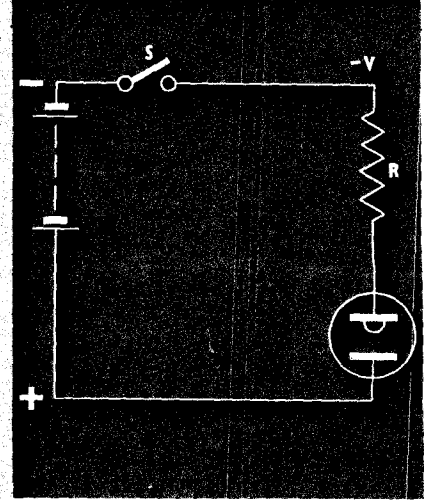


Fig. 3. Setting an 'E' Cell device. The switch S is closed for a time t_s. The charge on the electrode is $Q_s = It$ (V/R)t The voltage V must be regulated and the resistor, R, stable and accurate.

One basic circuit used to signal when a unit has reached stop condition is shown in Fig. 4. When all the silver on the working electrode has been depleted, the voltage across the 'E' Cell rises from a few millivolts to over 800 millivolts causing the transistor to be biased on.

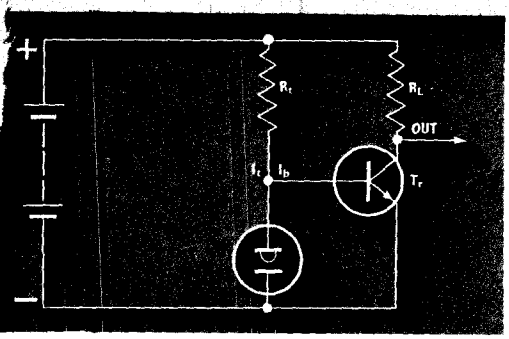


Fig. 4. The basic 'E' Cell device with a semiconductor interface. This circuit can be used as a basic timer and readout circuit.

THE 'E' CELL AS A TIMING ELEMENT

When an 'E' Cell is cleared at constant current, stop condition (i.e. a derived electrical signal) is reached after a definite time t, this time is the amount of charge (silver on the working electrode) Q_s divided by the clearing current I_t. $t = Q_s/It$

For example a unit set at 500 uAH cleared with a constant current of 5uA would time out after 100 hours. 'E' Cell timers can provide time ranges from seconds to months, and the timer can be re-cycled practically indefinitely.

The circuit of Fig. 4 is an example of the simplicity of an 'E' Cell timing circuit. The clearing current in this example would be $I_t = E/R_t$.

THE 'E' CELL AS AN INTEGRATOR

Because the amount of silver plated on the working electrode is strictly proportional to the current-time product, the device is a perfect integrator. This means that it sums accurately any electrical signal, and can be used to integrate or totalize signals from all types of sensors. (Fig. 5).

The amount of silver plated on the working electrode, i.e. the value of the current integral, can then be read out.

An ingenious example of this is the Sentry 7 oil monitor described in detail in ELECTRONICS TODAY, June 1971 issue.

READ-OUT FROM THE 'E' CELL

The process of measuring the amount of silver deposited on the working electrode of an 'E' Cell is similar to the

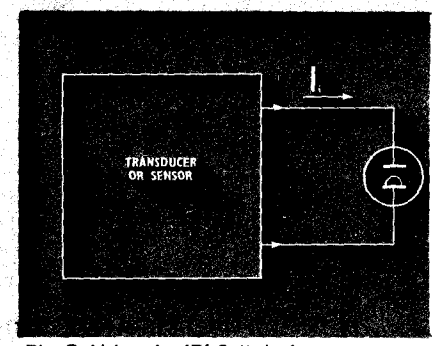


Fig. 5. Using the 'E' Cell device as an integrator.

use of the device as a timer. The unit is cleared with a constant and known current (I_c). The time (t) required to reach stop condition multiplied by the clearing current is the value of the charge (Q). - $Q = I_c t$.

THE 'E' CELL AS A PULSE COUNTER

As the 'E' Cell sums the charges it receives, it can be used as a pulse counter. Pulses of constant charge will each deposit (or take off) the same amount of silver on (or from) the working electrode.

The principle of setting the 'E' Cell with pulses is shown in Fig. 6. If the polarity is reversed, the device is cleared with pulses, and the number of setting and clearing pulses will be equal.

The 'E' Cell device can thus be used to count, add or subtract pulses.

'E' CELL PROTECTION

When in the stop condition the voltage across an 'E' Cell should be limited to less than one volt.

The best and simplest way to do this is to connect a silicon diode in parallel with it. This limits the voltage across the Cell to approximately 0.6 volt. (Fig. 7).

A current generating unit should not be used to test an 'E' Cell as this would either plate silver on the working electrode or deplete it.

Full information about 'E' Cells and their applications can be obtained from the Professional Components Division of Plessey Ducon at Villawood, N.S.W.

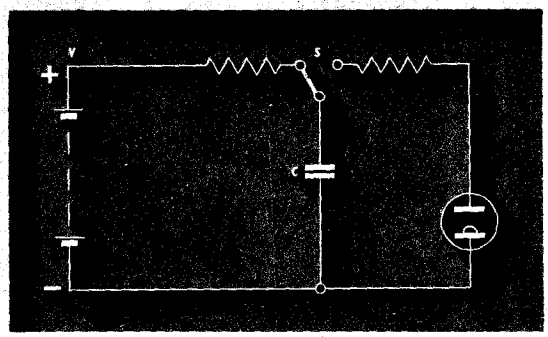


Fig. 6. Counting pulses with the 'E' Cell, Each time switch S is actuated, a charge $Q=C_1V$ is set in the 'E' Cell.

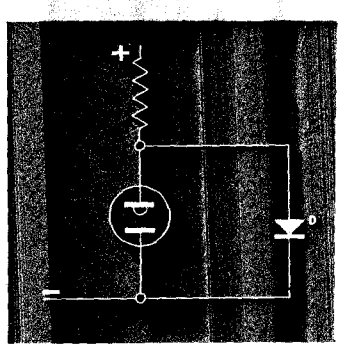


Fig. 7. Protecting the 'E' Cell when in stop condition. The silicon diode D prevents the voltage across the device from exceeding 0.6 volts.

Electrical characteristics of E-cell devices

E-CELL DEVICE TYPE	400-0001 460-0001			400-0002 450-0002 460-0002		
	Minimum	Typical	Maximum	Minimum	Typical	Maximum
Set (charge) (μA/hour)	—	—	200	—	—	1000
Operating temperature (°C)	−55[1]	—	+70[1]	−55[1]	—	+70[1]
Current × time product variation (accuracy) (%)	—	±4%	—	—	±4%	—
Maximum number of recycles	Unlimited within rated limits.			Unlimited within rated limits.		
Forward current, I_F: at +70°C(mA)	[2]0·5 × 10^{-3}	—	1[3]	[2]1 × 10^{-3}	—	2[3]
at −55°C(mA)	[2]0·5 × 10^{-3}	—	See fig. A1	1 × 10^{-3}	—	See fig. A1
Forward voltage, V_F: 0·1 mA, at 25 °C (mV)	—	4	—	—	4	—
1·0 mA, at 25 °C (mV) (See Figure A2).	—	15	—	—	15	—
Stop voltage V_S: 1μA at +70 °C (mV)	500	700	Must not exceed 1V	500	700	Must not exceed 1V
1μA at +25 °C (mV)	600	850		600	850	
1μA at −55 °C (mV) (See Figure A3).	750	950		750	950	
Forward capacitance C_F (μF)	—	40[4]	—	—	80	—
Forward resistance: R_F for I_F = 5μA at 25°C (ohms)	—	~150	—	—	~150	—
R_F for I_F = 0·5 at 25°C (ohms)	—	~20	—	—	~20	—
Stop resistance R_S	Up to several megohms			Up to several megohms		

NOTES

(1) Extreme temperature operation guaranteed only for MIL-SPECS. types.
(2) With d c current; with current pulses, lower mean current values can be used.
(3) Mean current, d c, or pulsed.
(4) As C_F is strongly dependent on the working electrode surface conditions, it can show large variations from one device to the other.

Getting the most from your tape cassettes

by MATTHEW MANDL

Cassette recorders are tricky machines. How you select, use and handle the tape cartridges that go with them can make a big difference in how they sound. Try the easy-to-use tips presented here.

Reprinted by permission from Radio-Electronics, July 1971.

UNDOUBTEDLY the fastest-growing area in home entertainment is the cassette tape player and recorder. The popularity of this tape-recording method includes the inexpensive cassette monaural portable player-recorder units. The stereo decks you can add to your present hi-fi system, plus the higher-priced changers which run through a stack of cassettes as easily as a record changer goes through its motions.

The enthusiastic acceptance of the cassette system stems from the advantages cassettes have over the reel-to-reel processes. Since we still are involved with the electronic problems of recording on tape, however, some precautions are necessary to obtain the best results possible. In addition, if you want to improve performance or upgrade your system, you must become familiar with the basic aspects of cassettes and the avenues open for getting the most out of your system.

Instead of open take-up and feed reels, the tape is totally enclosed in the cassette. Internally, only hubs are used for mounting the tape, with the container sides replacing the reels as tape holders. Thus the cassette makes a neat compact package measuring ½" x 2½" x 4", that requires no tape threading or handling.

Cassettes can be wound fast forward or reverse just like open-reel tapes. They can be interrupted easily and stored conveniently since no rethreading is required to get the tape on one reel as with open-reel tapes.

Another feature is compatibility between monaural and stereo recordings — a condition not present for the open-reel recorders. Thus, you can play your stereo cassettes on a portable monaural machine, or play mono tapes on a stereo deck. There are several differences between the recording process for the cassette and the open-reel type. First, in the cassette, left- and right-channel tracks for a given direction are side by side, thus permitting playing such a recording on a mono machine. For the open-reel process, however, the tracks are interlaced, preventing their being played on mono machines. Cassette tapes are available with playing times of 30 minutes (15 minutes each side), 90 minutes (45 minutes per side), and 120 minutes (one hour each side). A big feature is erasing, a problem which often plagued open-reel machines. The erase protection has been standardized for virtually all cassette recorders. As shown in Fig. 1, a breakout tab for

each recording direction is in the rear of the cassette. Once you break these out with the end of a penknife blade, the record button on the machine is inoperative, preventing accidental erasure of recorded material.

You can, however, erase (or record) on cassettes which have missing tabs by pasting a piece of plastic tape over the tab opening while recording. (Make sure you remove the tape after recording to restore accidental erase protection.)

RECORDING QUALITY

Your cassette tape is about 1/7" wide (0.146") compared to open-reel tape which is about ¼" wide (0.246"). The cassette tape speed is only 1-7/8" ips while open-reel tape recorders have a variety of speeds. The higher the speed, the better the frequency response and the lower the noise.

Since cassette tape is so narrow, squeezing four stereo tracks in, reduces each track to 0.024", with 0.012" separation between left and right channels of a particular pair, and 0.026" separation between stereo pairs. Such narrow tracks, together with the slow tape speed, limit the amplitude and frequency response of the signals that can be placed on the tape. Since the amplitude is low, additional stages of audio must be provided to raise the gain, and background noise rises. Frequency response is between 60 Hz and 100 Hz at the low end and around 10 kHz at the high end. (Many cassette-player manufacturers claim that their units have a frequency response from 30 Hz to 12 kHz — so they have, at an input level of about 5 dB above noise! —Ed.)

In open-reel tapes, the least costly is *acetate* which is suitable for most general purposes and is widely used in the bargain-priced 1.5- and 1.0-mil tapes. Polyester tape is considered to have the best quality base material since it is many times stronger than the acetate and does not break too readily under stress. (The Dupont polyester is called *Mylar*.) The polyester base material is used for the 0.5-mil (triple play) open-reel tapes, thus assuring the required strength for this very thin tape. It is also used in the cassette tape units, and is a must for the extended play C-90 (90 minute tapes) and C-120 (two-hour tapes).

NOISE REDUCTION

In any signal-amplifying system, the signal-to-noise ratio is an important factor. The more you can raise the signal above the noise level, the less noise interference you will hear at the output. If, however, the noise level is fairly high, it becomes difficult to raise the signal above it for complete noise elemination. Thus, for the critical noise factors in cassettes, it is important to use high-quality magnetic materials on the tapes and employ top-performing heads and amplifiers.

It is easy to check tape sensitivity differences. Record the same selection from a record on several of your blank tapes, using the same control settings. Now listen to the differences on playback. You'll find that the more expensive cassette tapes with better quality magnetic materials are much louder on playback. Thus, by reducing the output level of such tapes to an acceptable listening level, we reduce the noise factor compared to cheaper tapes. If your playback machine has level meters showing playback amplitudes the differences are even more noticeable.

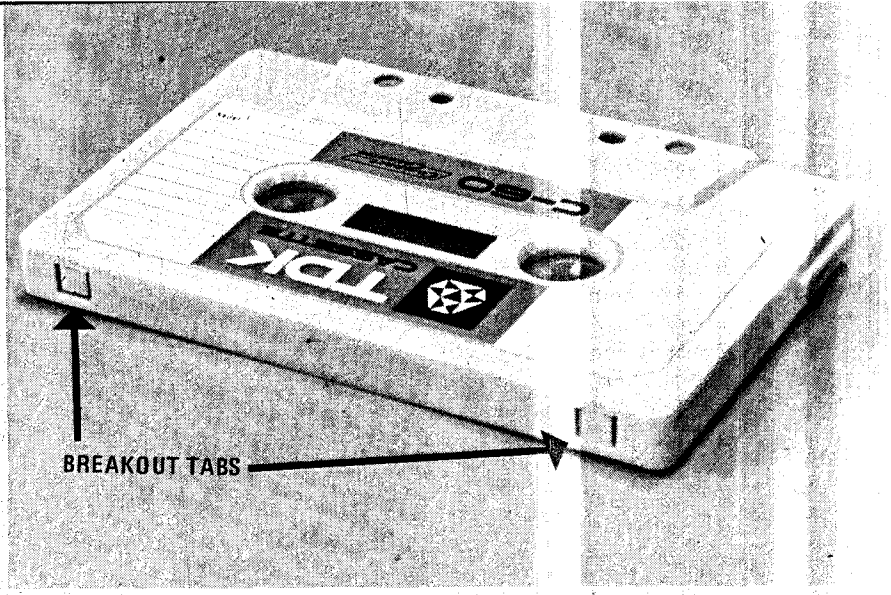


Fig. 1 — Breakout tabs help prevent accidental erasure of tape cassettes. Once the tab is removed, machine cannot record.

BUYING A CASSETTE RECORDER

If you are in the market for a new cassette unit, read the specifications carefully and select one which provides the most for your money. Frequency response alone is not the total answer to good quality — harmonic distortion, even tape movement, low noise, and a crisp response, are all factors. With good tape and a high-quality recorder-playback machine, the reproduction is surprisingly close to what you'd expect from a good system for hi-fi disc playback.

For the ultimate in noise reduction, you will soon be able to buy a machine with the Dolby noise-reduction system built in. High-frequency noise and hiss are

Fig. 2 — A drop of light oil at the hubs of the tape cassette can prevent tape slowdown. Don't let any oil get onto the tape itself.

reduced substantially by the Dolby process. Functionally, it boosts signals which fall below a predetermined level and reverses the process during playback. The boost is about 10 dB, determined by the specific frequency involved, and during playback the decrease is the same amount. Because the boost lifted the weak signals above the constant-level noise, the signal-to-noise ratio is improved dramatically.

Tapes made with the Dolby system can be played on an ordinary machine, but you'll have to turn down the treble to make them sound right. Since the Dolby system *when* built in, increases the total cost by about $50 to $75, you will have to decide whether the increased quality is worthwhile to you.

IMPROVING THE MONO UNIT

Portable mono cassette machines are limited in quality primarily by the small internal speaker and housing. Surprisingly, their solid-state circuitry can provide much superior sound. If you use a good tape you can improve the quality a little on the portables. When, however, you use the mono machine in a fixed location, you can get much higher quality by using an external speaker.

If you have a fairly good speaker on hand (8" or larger) you can attach a plug to the terminals and plug it into the recorder's phone output jack. Most of the portable machines omit the series resistor for phones, used in higher audio-power units. So they deliver full volume to an external speaker. While you won't get much louder results, you will get better low-frequency response and a definite improvement in output sound quality.

Keep your machine in good operation by regularly cleaning the heads. Many cleaner fluids are now available at your hi-fi centre, as are special cassettes of head-cleaner tapes. In particular keep the capstan roller clean and the bearing oiled at all times. This moving part must grip the tape tightly and move it along without slipping or binding.

When tapes are not in use keep them in their container with the flanges holding the tape rollers. These flanges keep the tape from unwinding and reduce the possibility of tape wrap-around at the capstan post and roller. It is a good idea to check the cassette to make sure the tape is not slack.

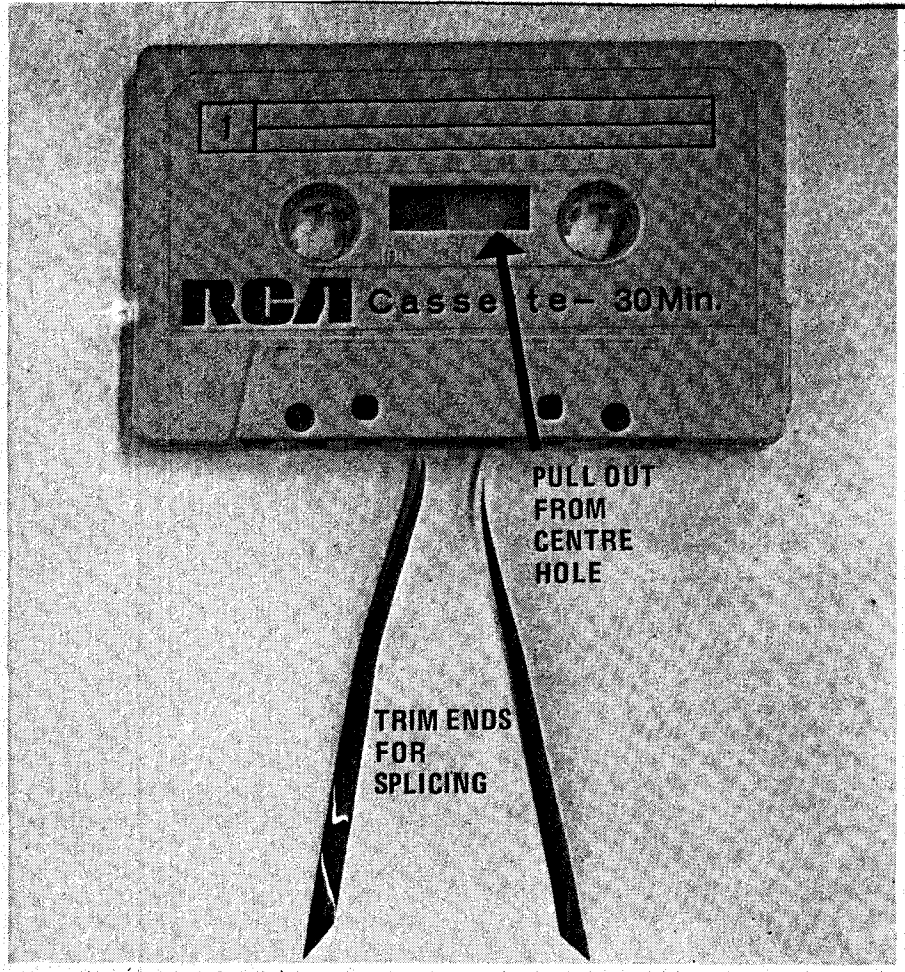


FIG. 3 – TO TRANSFER TAPE from jammed cassette to new cassette, start by pulling out tape leader end. See text for full description.

TAPE REPAIRS AND SPLICING

The lower-priced cassette tapes have the cassette cases press-moulded together. These cases sometimes warp and prevent free movement of tape inside the cassette. When tape binds, it may wrap around the pinch roller or capstan post. The higher-priced cassettes are put together with screws and provide much better alignment.

If you suspect trouble in tape movement, try the cassette on fast forward and reverse. There should be no slow up of tape speed on forward or rewind. Sometimes a drop of oil at the hubs may help, as shown in Fig. 2. Be careful not to over-oil here, however, or the oil will run into the tape windings.

If trouble persists, repairs can be attempted, particularly if the cassette is held together with screws. After removing the screws, pry the two halves of the cassette apart carefully while resting the unit on a table top. The tape is not in reels, but is wound around two hubs. The sides of the cassette housing hold the tape in spool fashion.

With the top off, inspect the inside and note whether the tape has slipped off a post or is being pinched by uneven plastic glides. A small pen-knife blade, an awl, and small tweezers are handy for making corrections.

If glide posts or other internal sections are broken or warped and are beyond repair, you can still salvage the tape if you want to save some valuable programme material or recordings you've made. This is done by using an inexpensive blank tape cassette.

As shown in Fig. 3, the tape is pulled out from the center hole and cut for splicing. One end of the tape from the damaged reel is spliced to one end of the new cassette, and the hub turned with a sharp-pointed tool, such as an awl, to wind the salvaged tape onto the new cassette. When all the tape has been wound up, cut the end of the salvaged tape loose and splice it to the other end extending from the new cassette.

The work is delicate and greater care has to be taken than for ¼" open-reel tape. Commercially available splicers are recommended, since static electricity interferes with precise handling of the narrow and thin cassette tape.

Press-moulded cassettes are virtually impossible to open without damaging the casing. If the tape binds, but can still be pulled out, the best procedure is to rewind the tape on new cassette instead of trying to make repairs. ●

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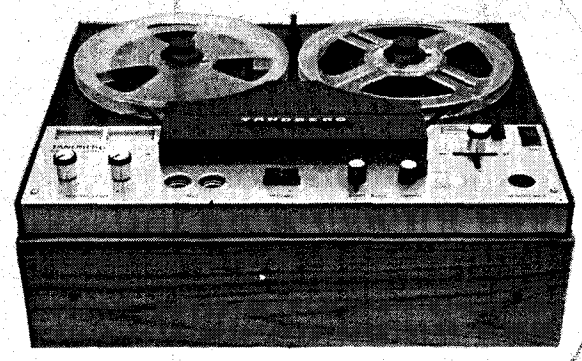
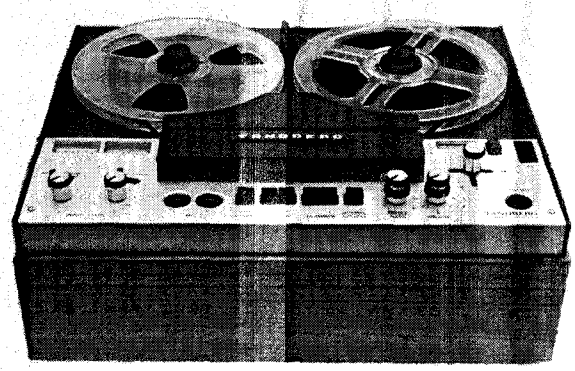


TANDBERG MODEL 3000X.



TANDBERG MODEL 4000X.

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TANDBERG MODEL 3000X.
Stereo tape deck.
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TANDBERG MODEL 4000X.
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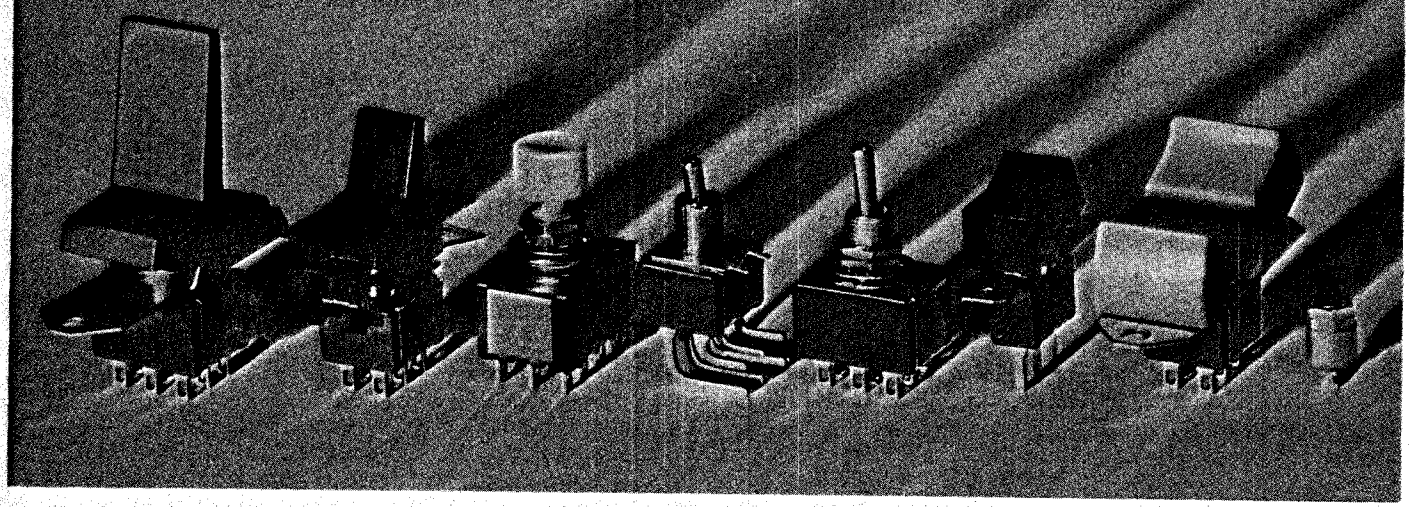


PRACTICAL GUIDE TO TRIACS

PART 3
Zero-voltage switching

Our final article in this three part series explains how Triacs are used in zero-voltage switching circuits – and includes circuits for the control of large heating loads.

Zero voltage switching is a method of varying the power applied to a load by switching line voltage on and off only at the zero crossing points of the sinusoidal waveform.

The technique virtually eliminates the problems of rfi associated with phase control of large resistive loads.

The difference between phase control and zero voltage switching is illustrated in Fig. 27, where the upper waveform shows phase control, whilst the lower waveform shows zero voltage switching.

Zero voltage switching can only be used for applications in which the controlled load is capable of averaging bursts of complete half-cycles. Thus the response time of the load must be long compared with the period of the switching cycle, for it is quite possible that at low power settings, short bursts of say, twenty to thirty half-cycles may be applied at ten second intervals. Thus the method is acceptable for the control of loads such as heating elements, but out of the question for light dimming.

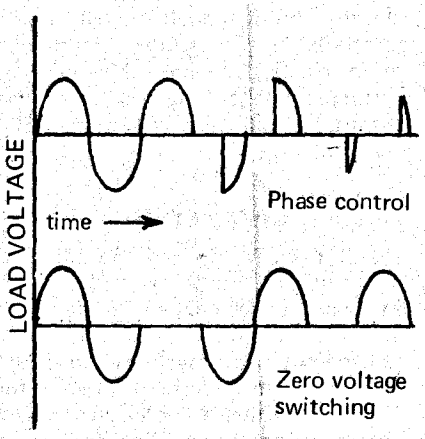


Fig. 27

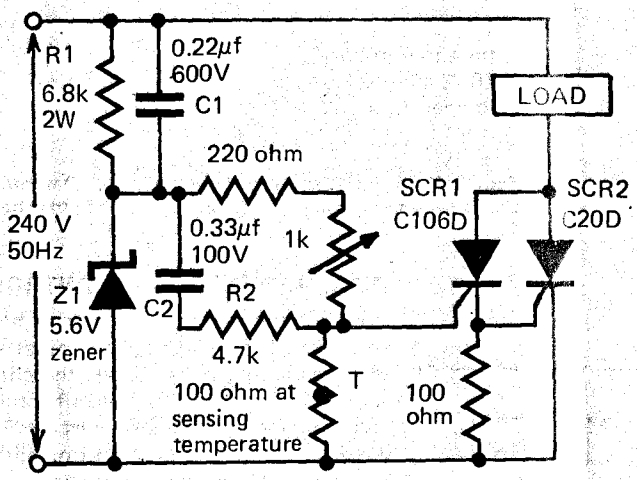


Fig. 28

Fig. 28. Simple half-wave zero-voltage switching circuit, maximum load is determined by choice of SCR2.

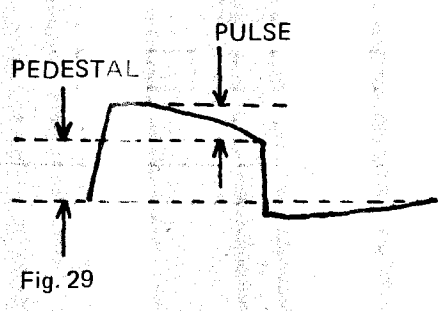


Fig. 29

Fig. 29. Basic waveform associated with circuit of Fig. 28.

HALF-WAVE CONTROL

A very simple yet effective zero voltage switching is shown in Fig.28. This circuit provides half-wave control only, but is very satisfactory for commercial applications where the heating elements can be designed to suit.

The circuit is extremely stable and unaffected by quite large variations in line voltage and ambient temperature. The response time depends upon the characteristics of the thermistor which is used – times of one to two seconds are typical. The sensing differential is around ¼°F at normal ambient temperature.

The Zener diode Z1 forms a voltage pedestal of 5.6 volts nominal amplitude by clipping the incoming positive half-cycle of mains voltage. This pedestal is differentiated by R2, C2 and associated resistors to form a pedestal of reduced amplitude with a pulse superimposed on top of the pedestal (Fig.29). This waveform is applied to the gate of SCR1. The capacitor C1, which is connected in parallel with R1, provides a leading phase shift to the pedestal so that SCR1 is triggered into conduction by the peak of the positive decaying pulse which is superimposed on the pedestal. It does this at the beginning of the positive going half-cycle of line voltage appearing at the anodes of both SCRs.

The thermistor controls the amplitude of the pedestal and thus provides a semi-proportional control with a small temperature differential.

The lock-in configuration of SCR1 and SCR2 reduces the effects of ambient temperature variations. The cost of this circuit is very low compared to a phase control circuit of the same power handling capacity as no rfi components are required.

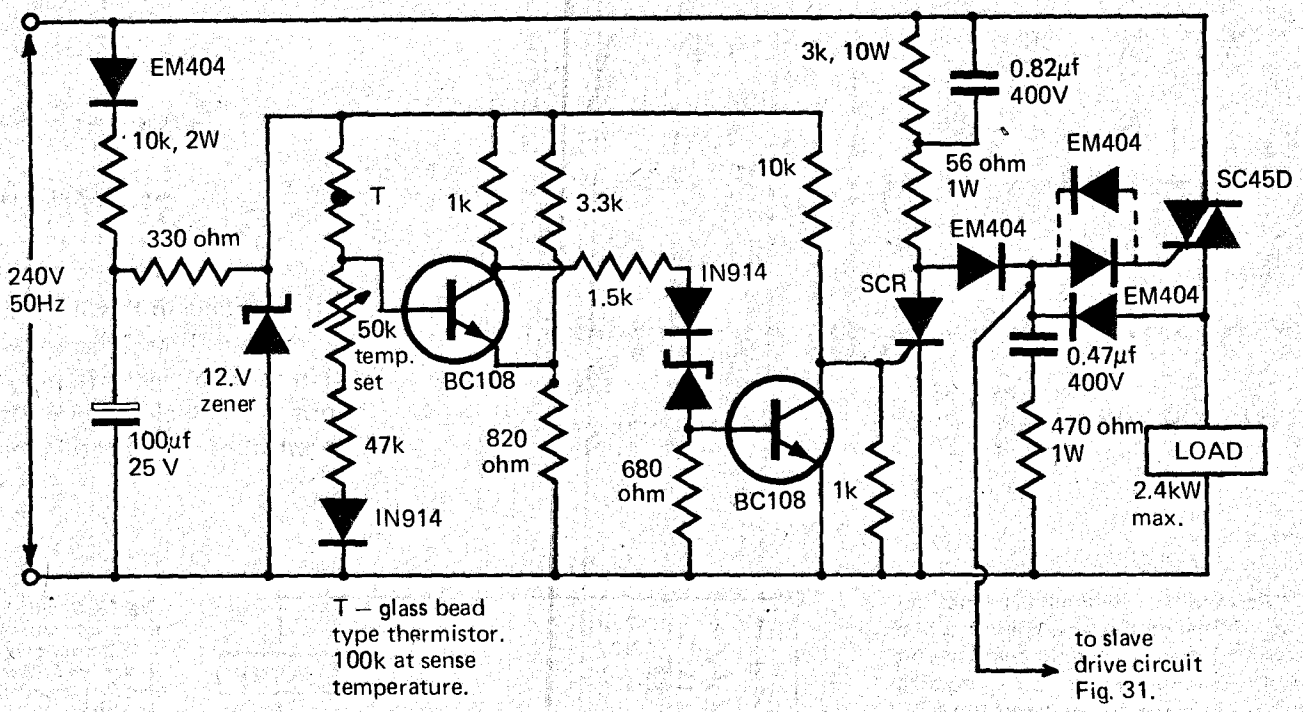


Fig. 30. This circuit can control loads of a size determined only by the rating of the Triac. The slave circuit shown in Fig. 31. can be driven by the output of this circuit if required.

PRACTICAL GUIDE TO TRIACS

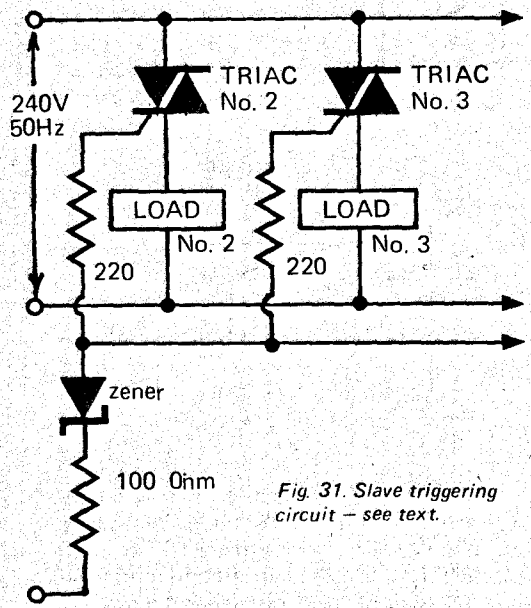


Fig. 31. Slave triggering circuit – see text.

FULL-WAVE CONTROL

The circuit shown in Fig.30 will provide full-wave control of heating loads of almost any size. The triggering circuit will drive Triacs of any size from 1 amp up to 125 amps. In addition almost any number of additional Triacs can be slave driven by the main triggering circuit. (The slave triggering circuit is shown in Fig. 31).

The differential of this circuit is approximately ± 1/6°C. This circuit has a semi-proportional action, and is suitable for applications where large amounts of power have to be controlled accurately and at low cost.

INTEGRATED CIRCUIT CONTROL

A number of companies have produced integrated circuits specifically for zero voltage switching applications. These ICs permit circuit and operational techniques which would otherwise require an unrealistic quantity of discrete components.

The two zero voltage switching ICs most readily available in Australia are the PA 424 from Australian General Electric, and the µ742 TRIGAC unit from Fairchild Semiconductor.

Although outwardly similar, the two ICs are not interchangable – however to some limited extent their functions are the same.

When used with only a few passive components, plus a thermistor, the ICs, (a), develop their own dc power supply, (b), differentially detect sensor unbalance, (c), detect zero voltage crossing point and (d), produce the required Triac triggering pulse.

A simplified version of the PA 424 device is shown in Fig.32. The input section is a differential amplifier consisting of transistor Q1 and Q2. A balanced pair of resistors R1 and R2 form the internal arm of a resistance bridge.

The external arm of this bridge consists of the temperature sensing thermistor and the 'set temperature' potentiometer.

BASIC CONNECTIONS

When the PA 424 is used in the basic Triac triggering connection shown in Fig. 33, the external resistor Rs provides power to drive the circuit and also supplies line voltage zero crossing information.

During the negative half-cycle, diode D1 (Fig. 32) conducts, and external capacitor Cs is charged. This capacitor provides power to drive the circuit during the remainder of the cycle.

As the line voltage goes through zero, the current through Rs also goes through zero, and if required by the sensing circuit the zero crossing detector puts out a triggering pulse. This pulse has sufficient energy to fire practically any suitable Triac.

In essence the Triac is triggered when the resistance of the sensing element Ra falls below the resistance of the 'set temperature' potentiometer Rb. For optimum sensitivity the resistance of the sensing element should be around 5k at 'set' temperature.

The circuit's operation is not limited to temperature control – the input sensor could equally well be a photo-diode, pressure transducer, strain gauge, or any other type of sensing element that has a resistive output in the required range (500 ohms to 50k).

FAIL-SAFE OPERATION

Both the PA 424 and the TRIGAC ICs can be used in sophisticated applications. One example of this is fail-safe' operation of heating loads.

In many control systems the failure (short or open circuit) of a thermistor or resistance thermometer can cause a dangerous condition. For instance a heating control with a normal negative temperature coefficient thermistor would interpret shorted thermistor leads as a very high sensed temperature and would react by *cutting off* the power.

However if the thermistor were to go open circuit (and this is not uncommon) the control system would see this as a low temperature and full power would be applied continuously to the load. In this case an 'open circuit' thermistor detector is required to protect the system against this condition.

A circuit which will achieve this is shown in Fig.34. It is also possible to protect circuits against 'short circuit' failure of positive temperature coefficient thermistors.

Zero voltage switching can be used in conjunction with proportional control circuits for both single and three phase loads. However the circuitry required is fairly complex and outside the scope of an article of this type. Full details of such circuits can be obtained from both General Electric and Fairchild.

TRIACS – FAULT FINDING

As far as the practical electrician is concerned, Triacs are relatively simple minded devices. They either work or they don't – there is rarely a half-way stage.

By far the greatest cause of failure is overloading. It cannot be stressed too strongly that a Triac, like most semi-conductor devices, is destroyed instantaneously by a short circuit placed across its output.

An almost infallible indication of an overloaded Triac is that gate control will have been lost, and the Triac is 'on' all the time. Checking this is quite simple, just unsolder any lead connected to the Triac's gate, and, if the Triac is still switched 'on' then the unit has lost gate control.

Before replacing the Triac, check with an ohmeter to make sure that the load is not shorted out. When the circuit is again in operation, monitor the line current for a time to check that it is within the Triac's designed rating. In particular remember that large incandescent globes have a very heavy inrush current and this may exceed the Triac's short term overload capability. (This is generally five to ten times full rated load for one half-cycle of the input waveform).

The other extreme of failure is when a Triac circuit will not trigger at all. This is generally a failure of the triggering circuit rather than the Triac.

The first obvious check is to establish that there is in fact mains voltage across the Triac. Assuming that voltage is there, a very simple check is to connect a resistor (150 ohms to 1k) between the case and the gate. This should trigger the Triac into full conduction.

If the Triac is triggered into conduction, then the fault lies in the triggering circuits; if the Triac does not trigger, then the Triac is faulty.

Finally, don't test Triacs with a Megger.

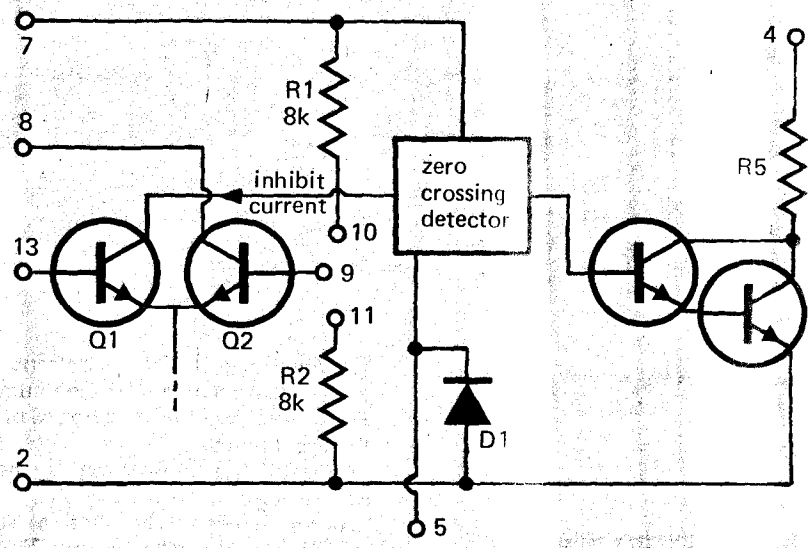


Fig. 32. Simplified schematic of PA 424 integrated circuit.

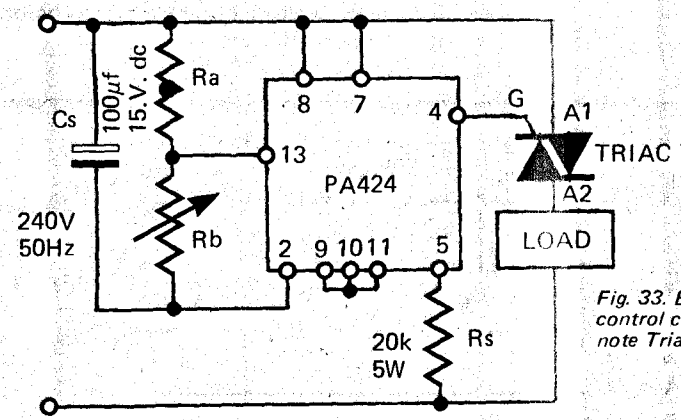
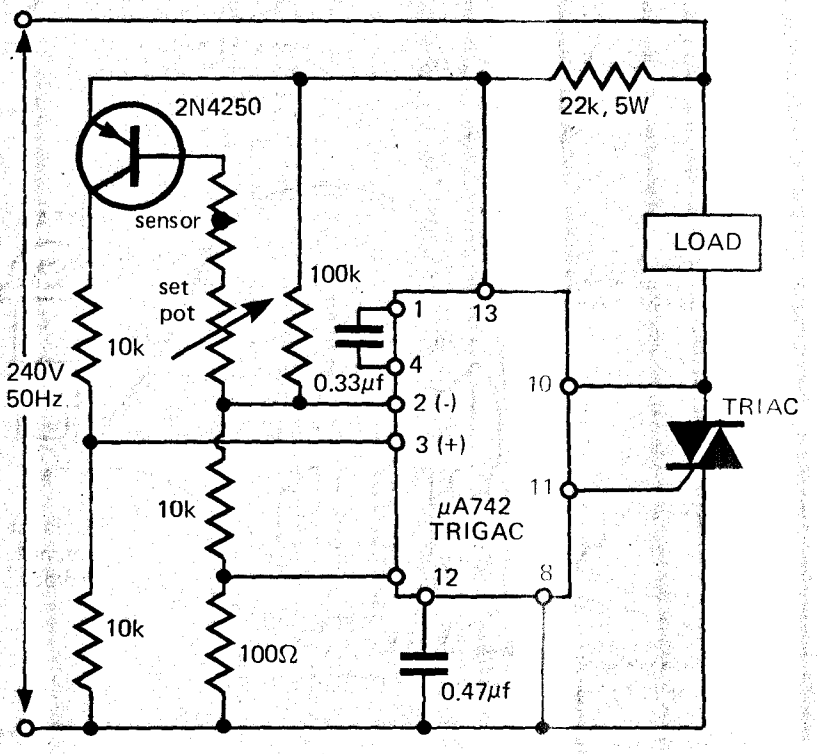


Fig. 33. Basic temperature control circuit uses PA 424 note Triac connections.

Fig. 34. This circuit using a Fairchild TRIGAC IC senses and protects heating loads against open circuit thermistors.



Elapsed Time Indicator

ET PROJECT

This simple indicator tells when your hi-fi stylus needs replacing.

How long has your present hi-fi stylus been in use? One hundred hours, five hundred hours, or one thousand hours?

Is it still the same shape as when it was installed? Or is it worn out?

Audio experts say that a stylus should be changed every 250-750 hours of playing time, although we suspect that most are physically damaged long before they are worn out. And many are replaced before it is necessary.

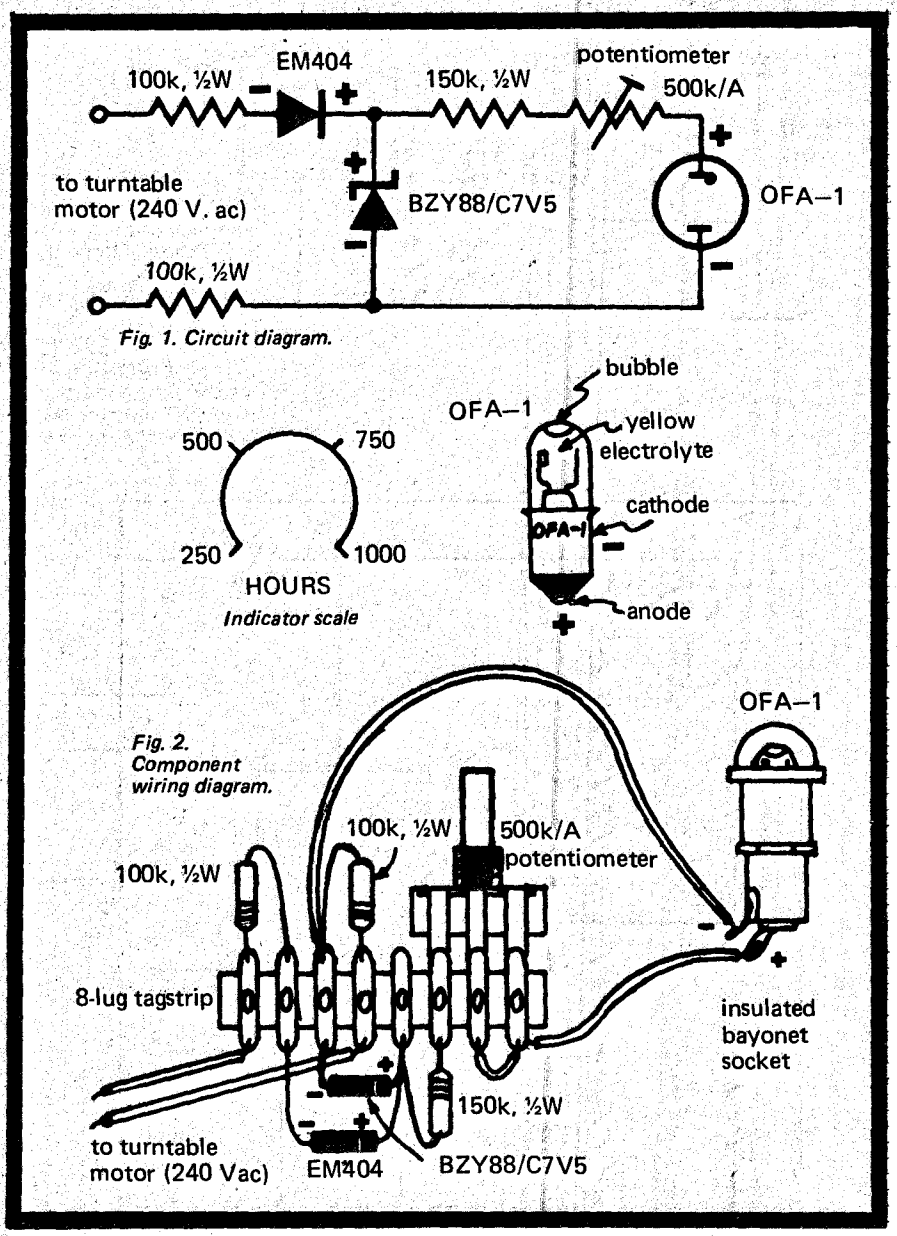


Fig. 1. Circuit diagram.

Fig. 2. Component wiring diagram.

Indicator scale

This simple project provides a visual indication that a preset total of stylus playing hours has been reached.

The circuit described in this project can also be used to indicate when a preset number of hours has been reached in many similar applications.

The basis of the project is the electrolytic elapsed time indicator just released by the Professional Components Division of Plessey Ducon. (The unit should not be confused with their 'E' Cell described elsewhere in this issue.)

The type OFA-1 elapsed time indicator is the same size and shape as an ordinary torch bulb, but it is filled with a liquid which changes colour after a preset time, determined by the amount of current passed through it. The electrolyte is normally yellow but turns green at the end of the predetermined time. The process is not reversible and a new indicator must be used each time, however the OFA-1 unit is sufficiently inexpensive for this to be a practical proposition.

HOW IT WORKS

The circuit of the elapsed time indicator is shown in Fig.1. The unit is connected directly across the turntable motor to ensure that the necessary 240 volt ac power will only be applied to the unit whilst the turntable is in use..

With the exception of the OFA-1 all components may be mounted on an eight-lug tag strip which is soldered to the potentiometer terminals. The complete assembly should then be mounted underneath the turntable in an out-of-the-way position. The potentiometer only needs initial setting, and can then be forgotten.

A pictorial wiring diagram of the complete assembly is shown in Fig.2.

The OFA-1 indicator should be mounted in a position in which it is easily visible, and in such a fashion that neither of the two internal electrodes are exposed to the bubble. Ensure that the bulb holder used for the OFA-1 is insulated for 240 volt operation.

Using the resistor values given in the parts list the unit can be set for a minimum time of 250 hours and a maximum time of 1000 hours. The scale reproduced on this page will provide sufficiently accurate calibration.

Consult your supplier or the manufacturer of the stylus to establish replacement periods. (If unsuccessful, 350 hours is a good average figure). Set the potentiometer accordingly and keep an eye on the little yellow indicator. Green means *go — and* get a new stylus! ●

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Introducing the most effective compact speaker system ever . . .

THE NEW 3 WAY WHARFEDALE TRITON

There's no doubt — with three scientifically matched speakers the new Wharfedale Triton outclasses most other speakers *twice the size* and many *twice the price.* In the Triton an 8″ bass unit is complemented by a 5″ mid-range speaker and a 1″ tweeter; these specially designed and matched speakers offer *restraint-free bass response, smooth middle frequencies* with outstanding "*presence*" and *high frequency performance* which adds the final touch to a very satisfying compact speaker system. Examine the specifications of the Wharfedale Triton closely. See how much more the Triton offers in terms of *musical promise.* Then pay a visit to your nearest Simon Gray dealer and *listen.* You'll be agreeably surprised; furthermore, as you listen, you will become more and more aware of Triton's *fatigue free sound.* This is quality you can listen to hour after hour — quality that's almost impossible to find in compact speaker systems. *Wharfedale . . . truly sound for all seasons!*

SPECIFICATIONS: Size: 21¼″ x 9¾″ x 9″. Frequency response: 55-20,000 Hz. Speaker complement: 8″ bass unit, 5″ mid-range reproducer, 1″ tweeter. Crossover: 7 elements, 3 way. Impedance: 4-8 ohms. Power handling capacity — 18 watts R.M.S. Finishes: Oiled teak or polished walnut. Recommended list price: $159.

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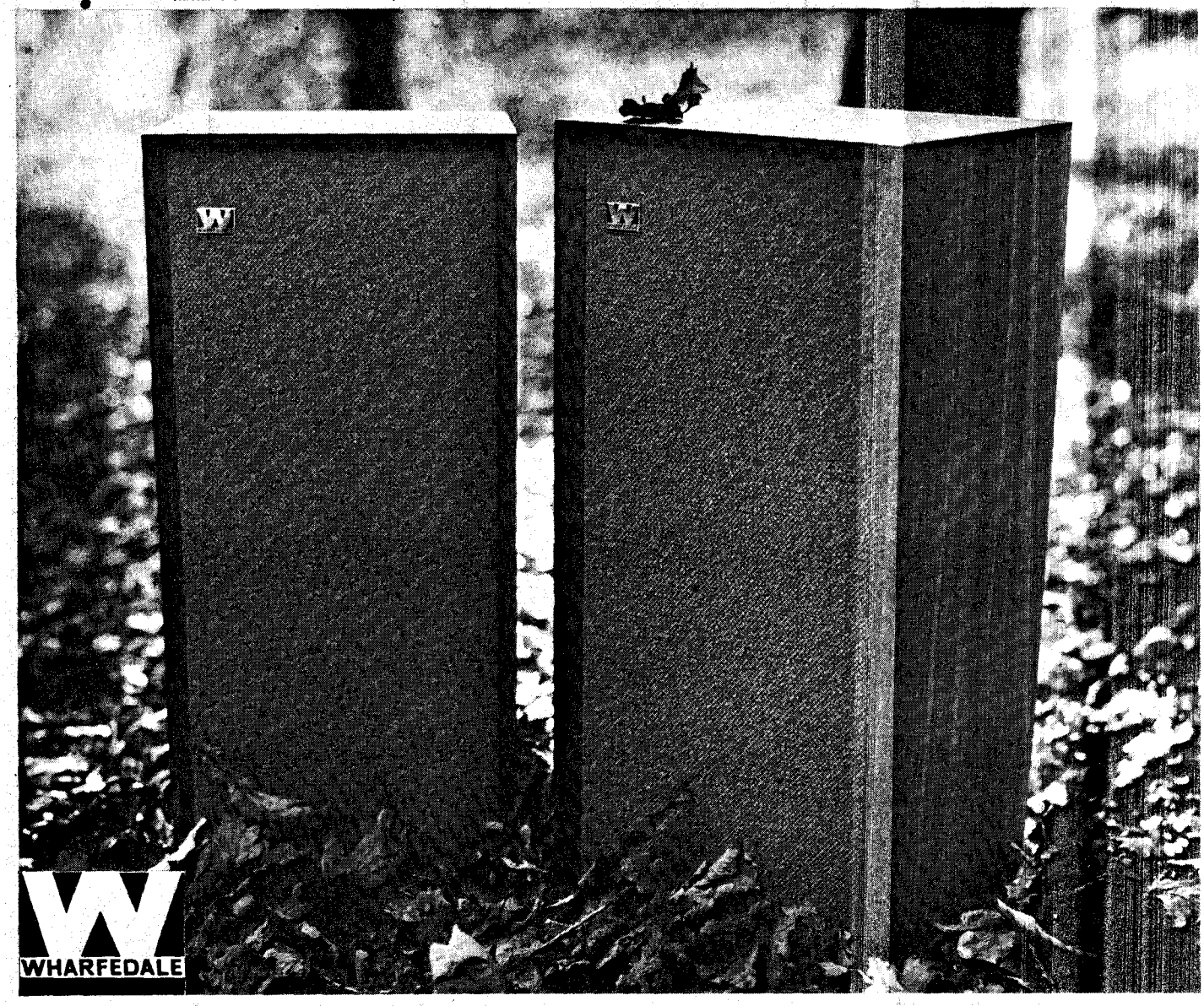


FOUR-CHANNEL SOUND

A SIMPLER WAY

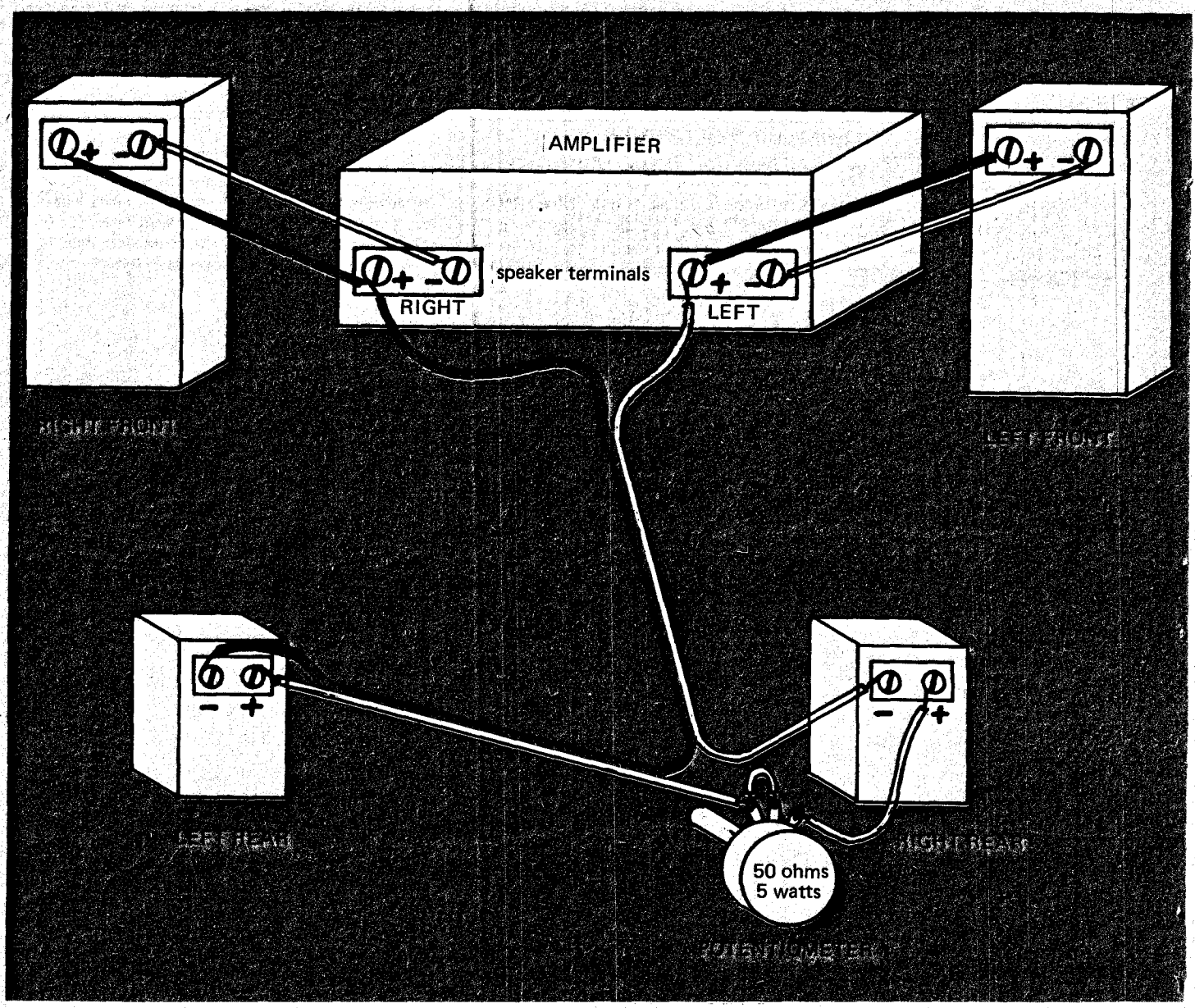


Fig. 1. How the connections are made. Note that all the speakers and the amplifier are shown as seen from the rear. Just connect them exactly as shown in this drawing and then position the speakers as shown in Fig. 2.

Some amplifiers may have the terminals arranged vertically but if in doubt be guided by the 'L' and 'R' markings that will appear somewhere near the terminals.

Terminal markings may also vary. The terminals that we have indicated as '+' may be marked 'hot' or 'high', or just with a red dot. Some may be unmarked but a red wire will be connected to the equivalent terminal that we have marked '+'

Again, the terminals that we have marked with a '–' may be labelled 'common', 'ground', 'earth' or 'low'.

ET PROJECT

This project was originally published in our first issue. The response was overwhelming — and many readers asked if the advice could be republished in a still simpler form. So here it is — reduced to basics.

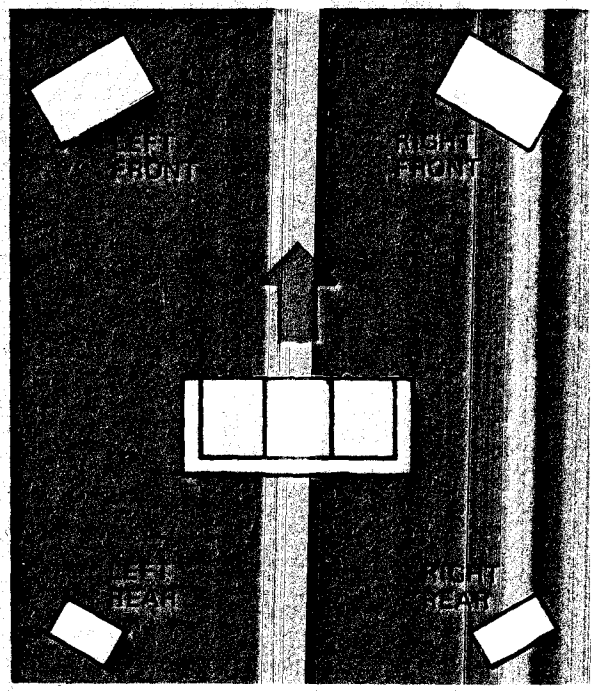


Fig. 2. How the speakers are positioned.

At least a dozen audio equipment manufacturers are actively promoting four-channel versions of their products despite the almost total lack of any suitable recorded material.

It seems like inventing the motor car before the wheel.

A very limited amount of material is available for demonstration purposes. But it's too gimmicky to prove anything. It reminds one of the early days of stereo, only now the trains come at you from all *four* corners.

Ironically, the most impressive four-channel sound that we have heard so far is that synthesized from normal two-channel stereo recordings.

This can be done very efficiently and effectively by units such as the Sansui QS1 Quadphonic Synthesizer or very cheaply, but with considerably less versatility, by connecting extra speakers differentially across the existing amplifier.

The effect of these systems is to add a certain 'depth' to the reproduced sound.

Of course true four-channel sound can reproduce distinctly separated sounds from each of the four associated speakers, but there does not seem to be very much point in this except for reproducing pop music and the music of certain classical composers such as Stockhausen.

RECREATING ORIGINAL ACOUSTICS

The claim most commonly made for true four-channel sound is that it recreates the ambience or reverberant characteristics of the hall in which the original sound was recorded.

This claim is absurd.

There is no way in the world in which you can reproduce the ambience of a concert hall in a domestic sized room without first removing the ambience that you already have.

Lining the room with acoustic tiles is one solution, but this will make the room acoustically impossible for anything other than four-channel sound.

The only way to recreate the characteristics of the Albert Hall at home is to put all four speakers outside on the lawn.

Nevertheless what four-channel sound (both true and simulated varieties) can do, is to introduce a very pleasant 'richness' of sound. It also reduces the effect of apparently listening to the sound through a window in the wall of the recording hall.

And for hi-fi enthusiasts this may well be sufficient to justify the considerable expense involved.

SIMULATED FOUR-CHANNEL SOUND

In its simplest form, simulated four-channel sound is surprisingly easy to achieve. All that is required is a couple of speakers, a few yards of wire and a 50 ohm potentiometer.

The two rear channel speakers and the potentiometer should be connected as shown in Fig. 1. Use 'figure-of-eight' flex with one lead colour coded, alternatively use two different coloured wires.

Connect the leads marked A and B to the two speaker terminals on your amplifier that are marked with a +. The two existing front speakers remain connected in the normal manner.

The choice of speakers and enclosures is not critical. Expensive speakers produce good results but are by no means essential. We obtained surprisingly effective results from $3 speakers mounted on hardboard baffles.

If speakers are obtained specifically for this project, they should have a frequency response that is reasonably flat from 100 Hz to 5 kHz. Above this the response should preferably decrease as there is little ambience signal above 4 to 5 kHz and this system is prone to increase the level of high frequency noise.

A pair of bookshelf speakers without tweeters will be very effective. The Rola type C 60 speakers are excellent for this purpose.

Use eight ohm speakers if possible, regardless of the impedance of the existing main speakers. The potentiometer will enable you to compensate for any 'mismatching' that may occur.

The extra load placed on the amplifier by the two extra speakers is negligible, it rarely exceeds two or three percent.

The potentiometer may be housed in a small case and located close to the main amplifier controls, or housed within one of the additional speaker enclosures. Actual sound level settings are not very critical, and once the level has been set, it is unlikely that it will need to be altered.

THE RESULTS

Place the speakers in the two rear corners of the room (observing the relationships shown in Fig. 2) and play a well-balanced classical record, preferably a symphony or concerto. Adjust the potentiometer so that the rear speakers contribute to the overall sound but cannot be identified as actual sound sources from more than a few feet away.

The results that you will hear largely depend on the recording.

The system is at its most effective when reproducing classical music from well-balanced recordings, and we emphasise the well-balanced bit, for a number of companies produce records and tapes with grossly exaggerated stereo spacing — and with these and 'reprocessed' mono the system has little value.

If, subsequently, you upgrade the system to true four-channel sound, all you have wasted is a 50 ohm pot!

Monarch Amplification

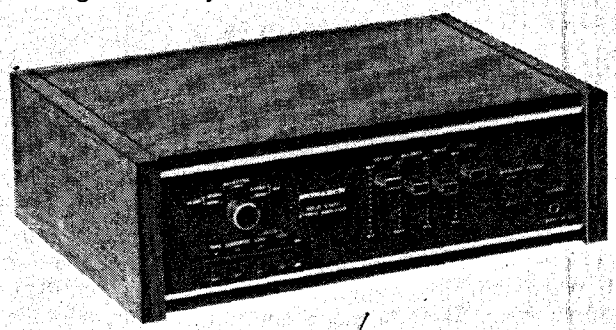
You've probably saved enough money already.

Just when you thought you were still saving up for it, you find out that **Monarch** Amplification can be yours from as little as $107 (or up to $100 less than other amplifiers with similar performance).

Even so, the saving is just beginning—because when you get a really great amplifier at this price, you can spend more on those better speakers you've had your ear on.

Compare one of these **second generation** Monarchs with other, more expensive amplifiers. Check the power, frequency response and the distortion. Have a look at the features listed below, from slide controls and filters, to the satin walnut veneer cabinet.

How much? You've probably saved enough already.



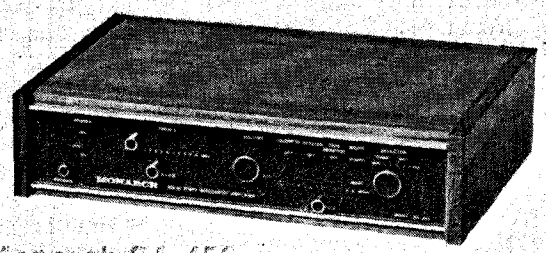
Monarch SA-600

The professional amplifier for perfectionists with a limited budget.

22 Watts per channel of clean, undistorted power, enough power for any speaker system. All silicon transistor circuitry means low noise. Harmonic distortion of 0.8% for transparent sound. Four slide controls for bass, treble, balance and volume. Main and remote speaker connections. High and low filter.

The most flexible, comprehensive amplifier on the market, for the price.

Recommended Retail Price $167.



Monarch SA-450

For your dollar, the most flexible, comprehensive amplifier on the market.

A feature-packed amplifier of very low cost to introduce the beginner to hi-fi performance.

Magnetic and crystal (for your old turntable) inputs. Tape monitor. Loudness and high filter control. Electronic fusing protects transistors. 8 watts per channel RMS. 3 slide controls. A "best buy" for the beginner.

Recommended Retail Price $107.

Australian Distributors

W. C. Wedderspoon Pty. Ltd.

Showroom: 193 Clarence Street, Sydney. 29-6681

A.C.T. Homecrafts, Petrie St., Canberra, 2600.
VIC. Douglas Trading, 191 Bourke St., Melb., 3000.
QLD. Tel-Air Electronics, 187 George Street, BRISBANE. 4000.
W.A. Leslie Leonard, London Court, Perth, 6000.
TAS. P & M Distributors, 87 Brisbane St., Launceston, 7250.
S.A. Sound Spectrum, 33 Regents Arcade, Adelaide

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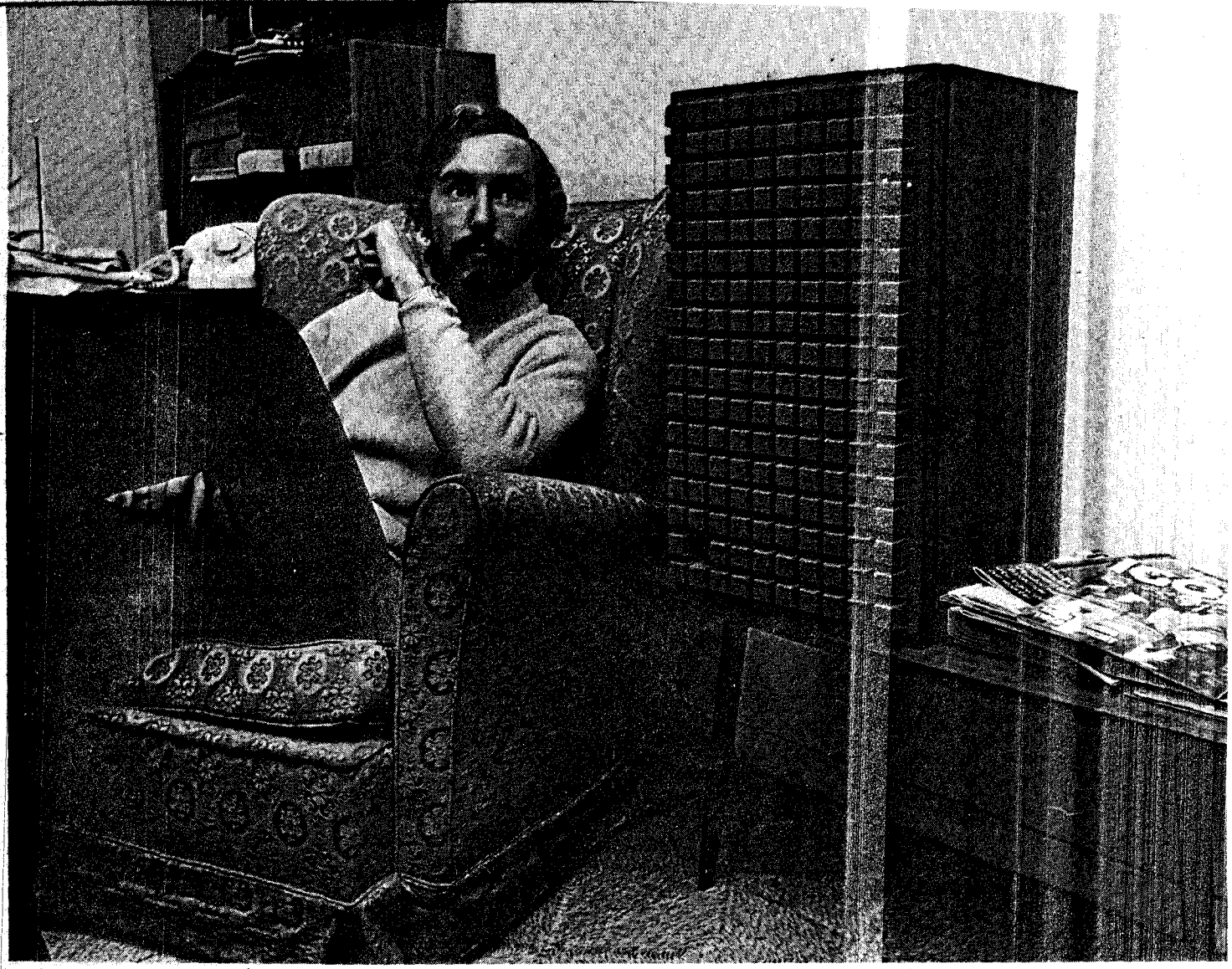


SCULPTURED SOUND

We **test the 'civilian' version of the JBL 4310 control room monitor** speakers.

electronics TODAY product test

James B. Lansing have made their reputation by producing some of the finest studio monitoring systems yet developed.

Their audio monitors and control monitors have been consistently tested and specified for critical applications in sound recording studios in every part of the world.

. But whilst these monitors are quite at home in a broadcast or sound recording studio they don't look quite right in the average home.

Apparently after repeated requests from professional users, James B. Lansing decided to release a consumer version of their small control monitor speaker enclosure styled in a more

SCULPTURED SOUND

The 'sculptured' front grille is easily removable to provide access to 'presence' and 'brilliance' controls.

attractive fashion than the normal grey painted series of control room monitors.

What they did was to put a "sculptured" grooved plastic foam front, (in a wooden frame,) on the face of the enclosure and provided three colours of blue, orange and brown from which the intending purchaser could choose.

Like some of the other speakers that James B. Lansing manufacture, it is apparent that the colours were selected in the interests of producing a striking appearance rather than matching any existing decor. In our opinion the sculptured foam fronts are only suitable for a "modern" to "way-out" environment and may not be as suitable for a conservative environment as are the oiled walnut versions of the control room monitor which have now become available.

VENTED PORT DESIGN

The L100 Century enclosure is almost identical to the type 4310 Control Room monitor (tested — ELECTRONICS TODAY, p. 77, June 1971) except for the porting of the vented enclosure, the mounting positions of the speakers and the mounting of the attenuators used for controlling the output level of the mid-range and high frequency speakers. Whilst the 4310 uses an 8" long by 3" diameter vented port, the L100 Century uses a 1" long by 2" diameter port in the front face of the enclosure. This change does not seem to have resulted in any significant difference in the low frequency response between the two speaker systems.

We tested the L100 speaker with and without the sculptured front face treatment and found no discernible difference in either the rated power or the frequency response even though we had expected to find at least a small difference in the high frequency efficiency. The amount of open area of the foam, together with its woven net backing, does not appear to provide any restriction to the radiation of the sound energy.

The speakers used in the enclosure are a 12" low frequency radiator with a 3" diameter edge wound copper ribbon voice coil and a 27Hz free air resonance, a 4" mid-range speaker with a 7/8ths of an inch diameter edge wound copper ribbon voice coil and a one and three-quarter inch diameter tweeter.

The 12" speaker provides an exceptionally smooth output from 40Hz to 1500Hz, the 4" mid-range speaker provides a somewhat less smooth performance from 1500Hz to 7kHz whilst the tweeter provides a smooth response again from 7kHz to 13kHz.

The appearance of these speakers is unusual and the low frequency radiator in particular has its cone face treated with a material which effectively stiffens the diaphragm and reduces cone breakup. The edge treatment of the low frequency radiator consists of a viscous dampening edge suspension which facilitates a large dynamic motion with a minimum of *non-linear* resistance. All of the speakers including the low frequency radiator, have been mounted on the outside front face of the enclosure which is a 1" thick impregnated particle board. The cabinet, which is lined internally with a 1" fibreglass blanket, is solid and particularly heavy. The finish is professional and right up to the standard of the control monitor, on which it is based.

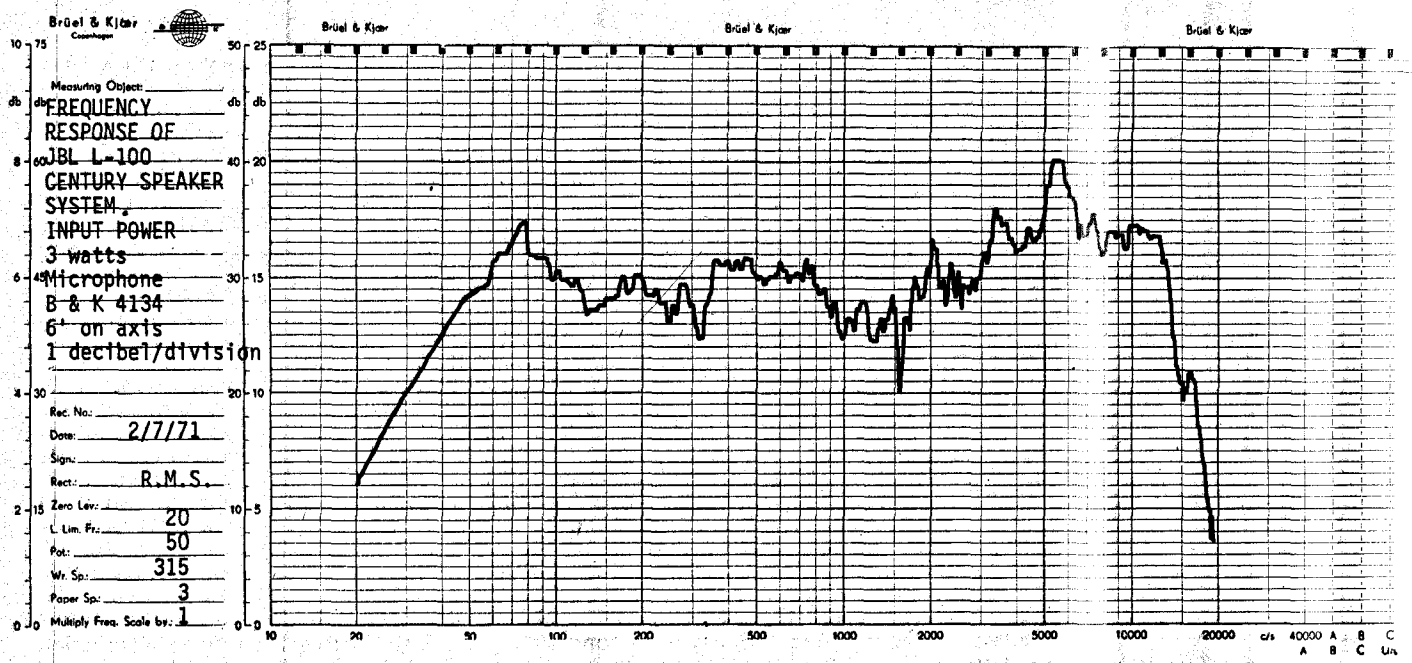
The attenuators for the mid-range and tweeter speakers are located behind the easily removable front panel. These attenuators provide settings of 0, —3, —6 and —9 dBs.

HOW THEY PERFORM

Our first tests on this speaker were to measure its frequency response under anechoic conditions. The results showed that this speaker is equally as good as the JBL 4310 control room monitors. The main difference

MEASURED PERFORMANCE OF JBL L100 CENTURY SPEAKER SYSTEM S/N 11114

Frequency Response:	30Hz to 15kHz ±10dB (see level recording)
Power Rating:	
50Hz to 1kHz	50 Watts average power
1kHz to 15kHz	>10 Watts average power
Sensitivity:	1 watt power produces 100.5 dBs at 50cm on axis
Electrical Connections:	2 spring loaded terminals on rear
Dimensions:	24" x 14" x 13" deep
Weight:	44 lbs.
Finish:	Oiled walnut veneer with removable "sculptured foam plastic face.
Price:	$474 each.



between the L100 Century and the 4310 is that the Century shows a slightly accentuated presence in the region between 3kHz and 6kHz which we found subjectively pleasant, particularly on modern music. We listened to many of our favourite records and a number of test tapes and found that the speakers seemed to have no vices even at power levels above 50W (average power rating).

The low frequency radiator appears to have no difficulty in handling 50W continuous sine wave power at frequencies between 50Hz and 1000Hz and stroboscopic examination showed virtually no signs of cone breakup. The distortion characteristics are very low and this can possibly be attributed to the amount of design work which went into the development of the original control monitor.

The low frequency performance of these speakers is good and clear but they are in no way comparable with JBL systems such as the Sovereign S8R system which we have previously tested (see ELECTRONICS TODAY April 1971). However, we tried some of the same records which we used during the tests of the JBL Sovereigns and they still sound good, particularly the "Bridge over Troubled Waters" (Simon & Garfunkel CBS SBP 233794). It was apparent that the lift in the mid-range response selectively favours certain instruments in that record and certainly the voice.

We listened to a number of other records and were impressed. These speaker systems are smooth and provide tremendous presence. The coloration of the presence whilst not in agreement with the manufacturer's data was not displeasing particularly with modern music. With classical music the effect was not as pleasant but could not be classed as being unpleasant.

Like the other speakers in the JBL range these speakers are expensive but we consider that for the audiophile who wants something different, or something better, these are worth looking at and listening to.

HI-FI FURNITURE

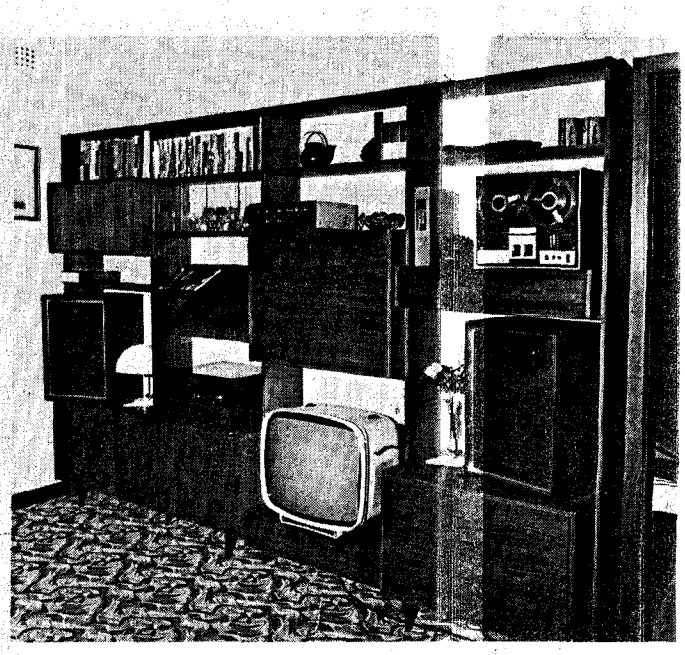
Modular wall units are an excellent way to house hi-fi equipment. But they tend to be expensive.

Now a new range of Dutch-built wall units are available in 'do-it-yourself' component form.

Sixteen basic units are available, all finished in Siamese teak veneer and sanded ready for polishing. With them one can assemble a practically unlimited number of combinations, from simple equipment cabinets to a complete wall unit.

The only tools required for assembly are a hammer and a screwdriver. The importers claim that no experience in woodwork is required.

Full details of the complete Simpla-Lux range can be obtained from Gwen Tinney, P.O. Box 9, Roselands, NSW. Tel. 759-5052.



By ROBIN S. LANIER

DISTORTION: What Hi-Fi Equipment Should Not Do

A primer on sonic nastiness, with some guidelines for the serious listener

DISTORTION, in its broadest meaning, refers to anything that hi-fi equipment should not do. Thus, a major measure of how high the "hi" really is would be how little it distorts. Which brings us to some interesting numbers and their meaning. Just how much distortion is too much? Can the numbers tell us at what level each important kind of distortion will cause a noticeable deterioration in the quality of the sound?

WAVEFORM DISTORTION: HARMONIC AND IM

Present to some degree in every sound-reproducing unit and system, waveform distortion (in either of its forms – harmonic or intermodulation) reflects a lack of proportionality between input and output. This is to say, the output should differ from the input only in size, as the enlargement of a photograph differs from the original. The distortion adds spurious tones that were not in the original, and when they are strong enough they interfere with the sound. The aural *result of waveform* distortion can range from a slight loss of definition or clarity to an intolerable scratchiness and muddiness. The measurement of waveform distortion is the ratio of spurious tones in the output to the total output. For instance, five percent waveform distortion means that five percent of the sound you hear is false sound.

Of the two kinds of waveform distortion, "harmonic" refers to a series of spurious tones added to a single note in the programme. It consists of false tones at twice, three times, etc. the original tone. "Intermodulation" refers to spurious tones that result from the interaction or beating of two original tones that occur simultaneously. Intermodulation (abbreviated IM) has been considered the more objectionable because its spurious tones are not harmonically related to the genuine tones.

Some of the classic investigations into how much waveform distortion can be heard were made by Braunmuhl and Weber in Germany, by Olson in this country and by Moir in England. These scientists conducted tests in which listeners compared distorted with less-distorted sound. The results show a rule of thumb for something between 0.5 percent and one percent as the borderline between inaudible and audible distortion in the middles and highs. However, in the low bass the distortion rose to 20 or 25 percent before it was detectable by most listeners. The latter data, incidentally, could explain why many loudspeakers that distort in the bass still can sound quite good.

Rule of thumb is very important here because in specific cases audibility will vary over a wide range, depending on whether it is harmonic or intermodulation distortion, on which of the series of spurious tones is emphasized, and also on the listener's experience in hearing high-quality sound. It also depends on the character of the music. In any event, the *amount* of distortion usually depends on volume, going up rapidly as you get near the full capacity of your system. Thus, distortion will usually be most evident in heavy bursts of music; the full-orchestra sforzando is one of the best tests of a system's distortion level.

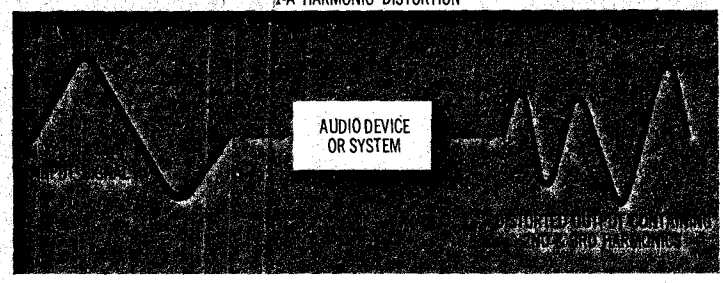
For this reason distortion specs must always refer to a power level to have real meaning. If, for instance, the specification says "0.5% distortion" without saying "at 40 watts output" or the equivalent, you have no idea what the distortion level really is.

Two factors need some elaboration to help us understand the notion of inaudible waveform distortion. The lower figures (under one percent) at which distortion was heard came in the more recent experiments; in these sessions whatever distortion was present came from the equipment on which the music was played, and was considerably lower than in the earlier experiments which perforce used less sophisticated playback equipment. Of course, some minute amount of distortion can be assumed to be present in the programme material in any experiment, so that what the experiments actually tested was how much distortion made a perceptible change in music when *added* to some low amount of distortion already there. Thus, it appears that as the background, or residual, distortion goes down, our ability to hear *added* distortion gets sharper.

The second factor is the effect of our experience in hearing better and better reproduction. The most startling and amusing evidence for this "learning factor" is the success of live-vs.-recorded demonstrations, going right back to the days of Edison's early cylinder machines. At every period of phonograph history there have been many listeners who swore they could hear no difference between the live and the recorded performance. The first electrical phonograph, the Brunswick Panatrope, competed in the 1920's with a symphony orchestra on vaudeville stages around the country, and delighted the music critics. Any listener today would find the Panatrope outrageously low-fi.

We must put these facts together with another one to get a good picture of the waveform distortion picture today. In current systems, only the best amplifiers are consistently within

1-A HARMONIC DISTORTION



How closely does the output resemble the input? Waveform patterns are used in analyzing audio response. With no distortion, output looks like input.

the apparent limits for freedom from such distortion, with full-output distortion figures well under one percent. On the other hand, even the best phone pickups, tape players, loudspeakers, records, and tapes typically carry waveform distortion ranging through one percent and more.

And yet to our ears the very best systems sound extraordinarily "true", without a trace of audible distortion. The apparent contradiction seems to spring from the experience factor and probably from *masking effects,* the ability of one set of tones to make another inaudible. Either the music itself, or one form of distortion, cuts our ability to hear another distortion.

Thus, we can probably expect that as distortion is lowered in the transducers (the pickups and loudspeakers), and we get the experience of hearing cleaner sound than we ever have before, we will begin to feel the need for total system distortion at lower levels than we do now. And we can certainly expect that the distortion will be lowered in the transducers. To mention just one direction of improvement that is in the cards; the transfer of information from record groove to stylus tip suffers from "tracing" and tracking" distortion, and many studies have shown that terrifyingly high amounts of these distortions are likely to be encountered under many common conditions. A number of attacks on these distortions are under way. There seems every reason to believe they will be sharply reduced before long.

But we shouldn't follow the drop of distortion point by point, nor compare one amplifier with another on the basis of tenths-of-a-percent differences. What is important is the over-all, broad trend. We can be just about certain that, for example, 0.1 percent and 0.25 percent total harmonic distortion (THD) in a single unit are both comfortably below audibility (and much lower than the distortion in any complete system today). As for figures like 0.015 percent and 0.023 percent, their only real meaning for the listener is that the distortion is totally and forever inaudible — the actual numbers carry no specific information.

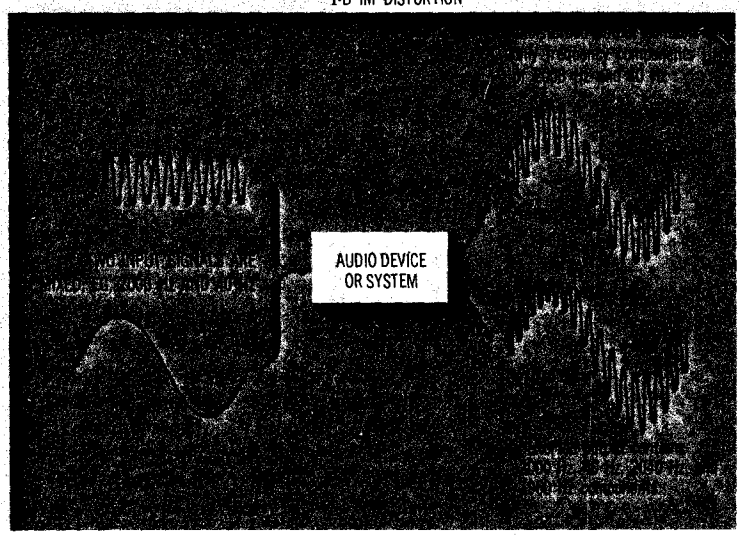
FREQUENCY UNBALANCE AND PEAKS

The second great source of distortion is any error in frequency response, which can be of two kinds: frequency unbalance and "peaks". By frequency unbalance I mean that a whole broad range of the spectrum is reproduced higher, or lower, than the rest, or that the extremes of the range are missing. The effects of frequency unbalance are easily heard: weakness in the bass or a missing low bass range makes the music sound thin and weak, without a sense of "foundation"; too much bass, and the music becomes too heavy, rumbly, or boomy. Weak or missing treble makes the music sound muffled, indistinct, "soft" and lacking in true bite; too much treble and the music sounds hard, harsh, or overbright. Weakness in the midrange gives the music an empty or remote quality with perhaps obvious bass and treble but with no natural resonance or "body."

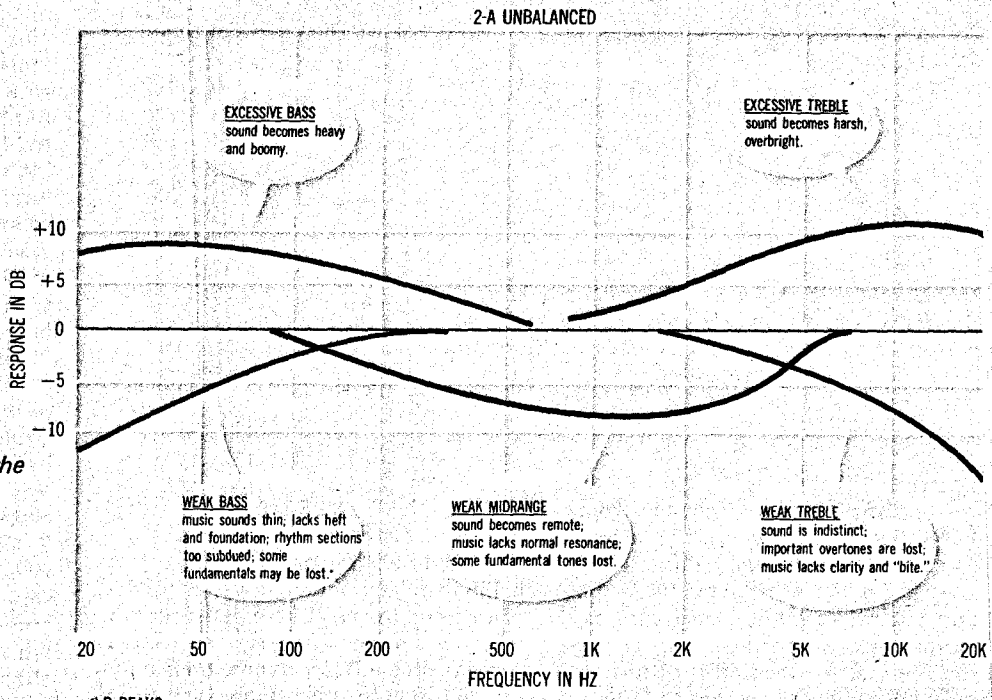
Another kind of frequency error, peaks in response, produces very strong overemphases that send the response up sharply in a narrow range. For example, if the output of a unit or system rises 10 dB from 1,000 to 2,000 Hz and falls again to the original level at 3,000 Hz, we would have a very serious peak at 2,000 Hz — and a strong "honk" that colours the music. Honk is that characteristic through-a-tube, barrel-sounding quality produced by peaks in the mid-frequencies. To hear some honk, make a steady "shussing" sound, first with your hands cupped around your mouth, then with your hands away. Your cupped hands make an acoustic cavity with a resonance that honks; with your hands away the sound has the "open" quality of smooth response.

Peaks in the bass create boom or thud; peaks in the upper treble make a harsh, too-bright sound, or a scratchy quality — cymbals are a good test for

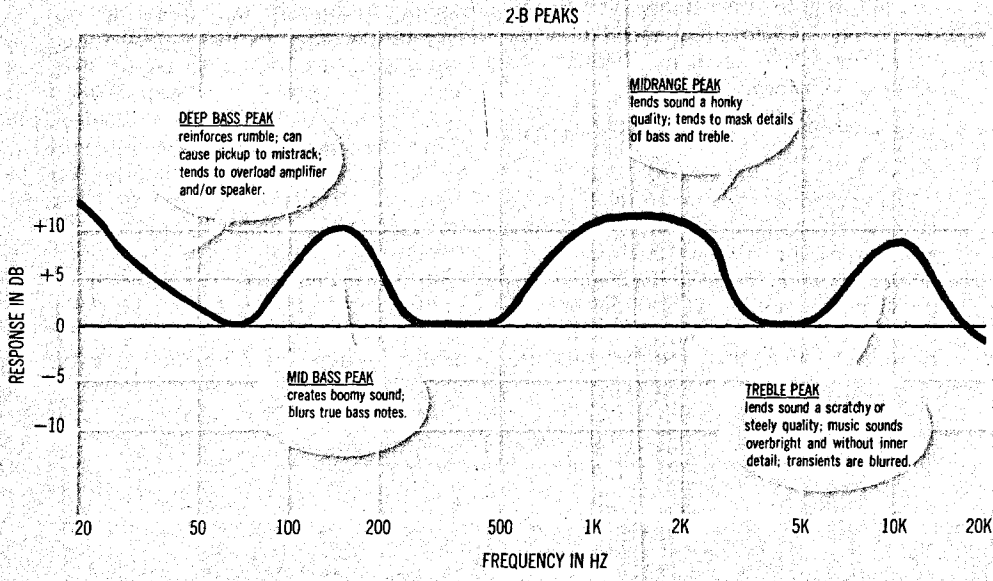
1-B IM DISTORTION



Example in 1-A shows harmonic distortion. This pattern illustrates what happens to a pair of input signals when subjected to intermodulation distortion.



Importance of wide-range, linear response is shown by this graph of frequency response plotted against signal level in decibels. For accurate music reproduction, the entire 20-Hz to 20,000-Hz range should not vary by more than a decibel or two above or below the zero reference line.



A peak in response is an imbalance concentrated in a relatively narrow band of tones and rising in level to considerably more than the few decibels allowed as variations across the full audio band. Peaks such as these may occur in any audio system or component.

this scratchiness. Cymbals should have their natural ultraclear, ringing quality; if they sound like paper being crushed or hissy, you have some peak trouble.

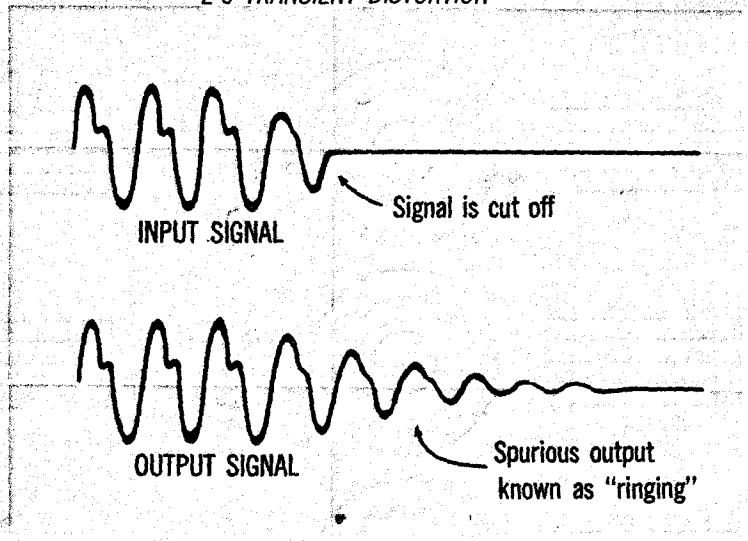
Sharp peaks are also associated with poor transient response, the blurring of the very sharp "impacty" sounds at the beginnings of piano notes, drum beats, and the like. Unless transients are well reproduced, much of the music will lack its natural sharpness and force, its crispness of attack.

What numbers can we use to define freedom from frequency unbalance, and from troublesome peaks? Again only a rule of thumb will do because the exact borderline in dB values between audible and inaudible response effects varies widely with the section of the spectrum involved, the broadness of the up or down in response, and other factors. Also in the equation is the ear's own far-from-flat frequency response curve. The famous Fletcher-Munson hearing curves show that as volume goes down, we lose the bass much faster than we do the middle frequencies; it is to offset this peculiarity of our hearing that we have "loudness controls" with their built-in bass-boost at low volumes. If the bass drops a few dB, it can go out of the hearing range entirely. And in the 2,000- to 4,000-Hz range, where the ear's maximum sensitivity to sound lies, we can detect a small change in level quite readily; here, a dB or two may change the character of the sound noticeably.

Peaks are most serious through the mid-bass to the mid-highs (up to 6,000 or 8,000 Hz), where a single peak of 3 or 4 dB may be obtrusive. A peak at the very bottom or top may simply extend the frequency range a bit.

To sum up, it is close to ideal if the frequency response of a unit or system is "flat" within 1 or 2 dB over the whole range. Somewhat more serious a deviation may or may not produce audible distortion, depending on the

2-C TRANSIENT DISTORTION



An audio device's ability to cease responding when a given signal ends gives rise to transient distortion, heard as a fuzziness or — in severe cases — as a blurred or ringing effect. It is most apparent on sudden percussive sounds. Some experts insist that all of music is a series of transients strung together and that consequently this form of distortion is indeed as important as any other. Complex waves test for it.

factors we talked about and others too. If a whole range is 6 to 10 dB up or down from the average, or if a sharp peak not too far from the middle reaches 4 to 5 dB or more, we almost certainly will hear the effect as an exaggerated tone.

That probably sounds reasonably definite. The problem is that published frequency specs are the most abused of all the hi-fi numbers. I know from personal experience that most hi-fi-component manufacturers try hard for valid frequency specifications. But the fringe operators don't let reality limit their imaginations, thus putting heavy pressure on the honest advertiser and an extra burden of credibility on the unwary shopper. This is an old story; it has been discussed in and out of print for decades, but it is still very much with us.

Very recently, I checked two models of stereo headphones made by a renowned (foreign) manufacturer. The more expensive was billed as having a 20- to 20,000-Hz frequency range — no limits on variations in dB stated. The phones were quite good, smooth and free of serious distortion, but they certainly did not extend to 20 Hz, and the highs generally were down a bit too. The other model, selling for about half as much, carried a 30- to 20,000-Hz spec. It was atrocious, with no bass (that I could hear) below about 200 Hz, a big honk in the upper middle, no top highs — overall, a tinny quality that put it perilously close to the ancient phonograph.

Obviously, when no variation limits in dB are stated, anything goes. Even with the limits, frequency specifications are only a general guide to quality and not a way to compare one piece of equipment exactly with another. As with distortion, the knowledgeable buyer will supplement published information with careful listening. And also, as with other forms of distortion, learning to judge frequency character is a matter of experience, of hearing many outfits of various grades, particularly in A/B comparisons.

MOTION DISTORTION

The third kind of distortion, rampant in low-fi equipment and always a threat to fidelity, is a wavering in the motion of the medium, whether tape or disc. More specifically, the motion suffers a rapidly repeated shift in speed. What this does to the sound is called "flutter" when the change in speed is repeated at rates above about two or three per second, and "wow" for slower repeats. Flutter makes music watery or wavery in pitch; wow gives the musical pitch a roller-coaster ride, and objectionable and unnatural rise and fall.

Flutter and wow figures indicate the amount by which the speed changes. For example, if the normal speed is 7½ ips, 10 percent flutter would mean that the actual speed was shifting rapidly back and forth between 8.75 and 6.75 ips. And that would be a horrendous amount of flutter, making the music an unlistenable hash.

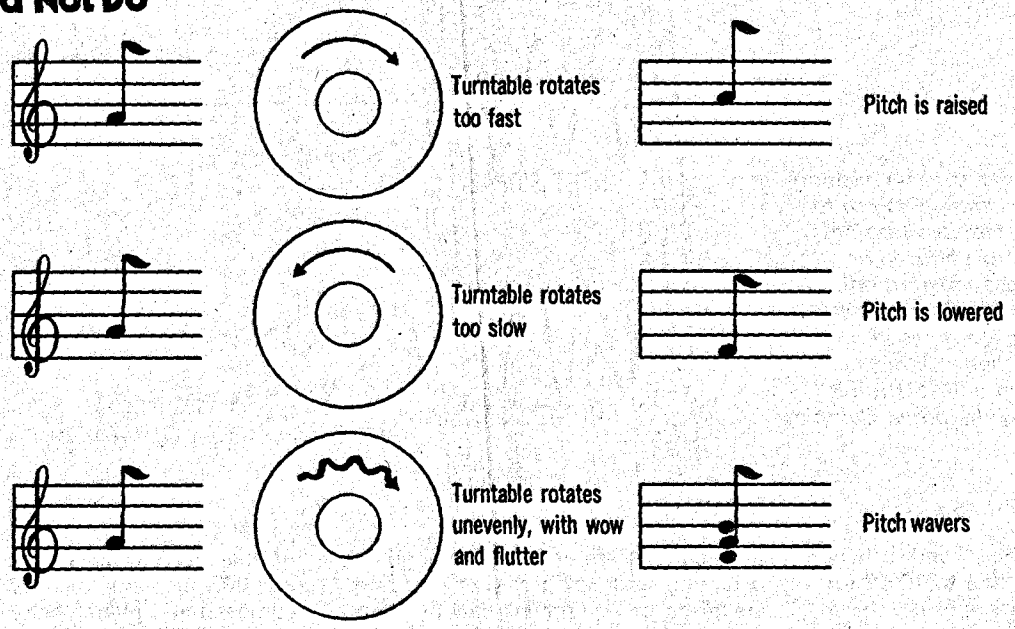
As for the actual borderline level of flutter, again we have a rule-of-thumb figure. The ear is far more sensitive to flutter that is repeated two or three times a second than at lower or higher rates. In controlled tests, listeners with normal hearing have detected as little as .003 percent of 3-Hz flutter in comparisons made between a pure tone and the same tone with flutter!

Luckily, when listening to music the ear does not have the same remarkable acuity. The average figures for music are about 0.1 percent for the musically inexperienced listener, about 0.05 percent for the critical listener. Much medium-to-high-quality equipment makes the 0.1 percent level, and the best units have flutter as low as 0.05 percent. Again, use the published specifications only as a general guide, because there are too many variables. Has the ear's differential sensitivity been taken into account (are the figures "weighted" to match the ear)? What is the flutter rate, or rates? What kind of music will be listened to? The last question is relevant because, in general, flutter is much less obvious in fast music than it is in slow music, and with instruments like the piano and organ far more than with most other instruments. Actually, the quickest test for flutter is careful listening to single, slow notes on the piano.

Another kind of motion distortion occurs when the average speed (of turntable or tape deck) is too high or too low. This sort of error displaces the pitch and the tempo by a proportionate amount in the direction of the speed shift. If the speed is six percent fast, the pitch is about a semitone high. Beethoven's *Eroica* would be played in E, or four sharps, rather than in E flat, or three flats, and that would probably be objectionable to any musically literate listener. The concomitant slight increase in tempo might also prove objectionable.

DISTORTION: What Hi-Fi Equipment Should Not Do

3 MOTIONAL DISTORTION



Music can be distorted if the medium playing it does not run at true speed. Examples shown here for turntables apply also to tape decks. Musical notation has been slightly exaggerated for clarity. See article for detailed explanations.

With a standard pitch for comparison, though, even most musically trained listeners find it hard to detect a speed shift of less than two or three percent, and most high-grade turntables have less speed error than that. On the other hand, many inexpensive changers run unacceptably fast – apparently their makers believe that "brighter" music is especially attractive.

To find out if the speed of a turntable satisfies you, simply listen to a very familiar recording. You will then be conducting what engineers call a "long-term pitch comparison," which is useful in a general sense. To make this test more useful, listen to the same record on a system you know to be on the nose, and then quickly put it on the one you are considering.

For two classes of listeners, speed accuracy – with less than one percent error – is very important. One is the highly trained musician whose pitch discrimination approaches, or actually reaches, "absolute pitch"; such an individual can identify the pitch of a tone without any help from a standard. The other is any musician, down to the merest beginner, who wants to play along with the phonograph or tape machine.

Many of the current manual and automatic turntables are equipped with fine-speed controls, which solve the pitch-speed problem for these two very demanding kinds of listener.

NOISE

This ancient enemy of pleasurable listening is more than just an annoyance: noise actually is a very important variety of distortion. A "noise" can include all or nearly all the frequencies in the spectrum; it can be concentrated in a band of frequencies that is high, low, or in the middle; it can occur at several bands, or at one or more discrete frequencies, like 50-Hz and 100-Hz hum. There are three principal sources of noise: that in the programme source (disc, tape, or broadcast) itself; that added by the playback system; and that in the room, from outside sources, often called "ambient noise."

Whatever its source, the effects of noise are pretty much the same. Noise can mask out the low bass, or the high treble, or both, cutting your 40- to 15,000-Hz system down to a 200- to 6,000-Hz cheapie. (Room noise is the usual perpetrator of this crime.) If the noise is very strong at certain frequencies, it can "punch holes" in the response at those frequencies – some notes will be missing, say, when a cello runs up the scale.

Hum is, of course, a very common single-frequency noise, and the noise that comes from many domestic appliances and machines used in the street is particularly strong at certain frequencies. A low-frequency noise is generally worse than a high-frequency noise of similar power: a low-frequency sound easily masks higher tones (particularly the harmonics of the noise frequency), but a high tone is much less able to mask lower ones.

The restriction of the dynamic range is perhaps the worst crime that noise commits against fidelity. The softest sounds in the programme should be at least several dB louder than the noise. The top is set by the overload point. Throughout the history of recording (and radio, too) this "squeeze" between noise and overload has forced the engineer to compress programme material. The ridiculous 20- or 30-dB dynamic range that used to be standard on recordings (a "live" orchestra hits 75 dB and up!) is found today only on low-fi material. But most recordings, even the best, are still compressed in some degree for a variety of reasons.

Taking it all together, a rule-of-thumb figure for the noise level that will just about let us cross over the border and into high fidelity is 50 dB *below* the loudest signal. This

translates to what engineers call "a signal-to-noise ratio of 50 dB." You could have more noise of some kinds and not have trouble – for example, turntable rumble at *very* low frequencies has much less ability to annoy than a noise in the middle of the spectrum, because of the ear's relatively low sensitivity to low-level, very-low-frequency sound. To put the definition on a fairly exact basis we would have to analyze each noise for its frequency content and then "weight" the measurement to take into account the ear's differential sensitivity. Sophisticated noise meters do this automatically.

However, most over-all system noise figures that the audiophile will deal with cover "unweighted" noise over a broad frequency range, and the 50-dB figure will be roughly applicable. The rule breaks down in some specialized cases – turntable rumble is an outstanding example – and weighting is needed to get a more meaningful figure.

Do different noises add to the total noise? Yes, but not in any simple way. When there is more than one source of noise, as there often is, a single noise will set the overall level if it is much louder than the others. For example, if tape hiss is only 30 dB down and hiss from the amplifier is 60 dB down, the overall noise is not significantly higher than 30 dB. However, if the two noises are of approximately equal level, their total noise effect will be about 3 dB higher (which can be significant) than with either noise alone.

Every dB of noise reduction below the 50-dB level is a gain for fidelity. That's why the recently introduced Dolby system is so important: it already has brought about sizable reductions in the noise on discs and in open-reel tapes, and it is beginning to find its way into new cassette recorders. There are other sources of noise that need attention, such as the very tape used in recording; manufacturers here and abroad have been working to improve tape quality, and better tape is on the way.

Internal noise in top-grade playback systems is already well under control. The best stereo receivers, for example, offer from 65 to 70 dB of signal-to-noise ratio in their disc playback channels. That just about ties it up, unless and until we get radically better discs: the best discs today are, when brand new, in the 60 dB area. The best prerecorded tapes are a little poorer on noise, but not much. Cassettes and cartridges often have been poorer-sounding, but the best ones show that the problem can be solved.

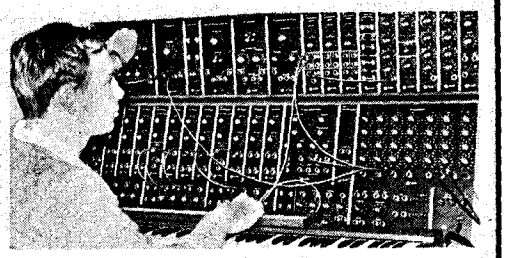
Room noise remains, especially for many city dwellers, the toughest barrier to high-fidelity sound. Solutions run the gamut from buying a house in the country to encasing the walls in sound-resistant materials, mostly involving a lot of money. A very inexpensive solution that has appealed to many listeners lately is buying a good pair of stereo headphones. (See also article on noise reduction – ELECTRONICS TODAY, May 1971).

A few years ago, the U.S. Federal Trade Commission asked the phonograph industry to agree on a definition of "high fidelity." The recommendation of the Electronic Industries Association, the trade group representing mainly manufacturers of inexpensive console and portable phonograph units, included two specs. One concerned harmonic distortion: with both channels in a stereo machine producing a total of 5 watts, THD should be no greater than 5 percent. The other dealt with frequency range: it should be at least 100 Hz to 7,000 Hz, *plus or minus* 5 dB! Nothing about flutter, nothing about noise.

Obviously, the makers of the cheapies had no intention of giving up their right to the "hi-fi" label; moreover, if their proposed "standard" had been accepted by the FTC, they would have been able, with "government approval," to offer their non-hi-fi wares as if they really were hi-fi. It didn't take long for the idea of defining high fidelity in ludicrously low-fi terms to get hooted out of existence.

Nevertheless, the serious listener and the hi-fi components industry do agree generally on a set of numbers that, used in a broad sense and always supplemented by careful listening, *can* lead us to genuine high fidelity. Next year or in the next decade we probably will have revised those numbers extensively, but that is the strength and the appeal of the pursuit we call high fidelity. ●

ELECTRONIC MUSIC SEMINAR



A seminar on the state of the art of electronic music in Australia will be held at the Faculty of Music, University of Melbourne.

This, Australia's first national presentation of electronic music will be held over five days, from August 9 to 13 1971. Besides a daily programme of lectures, concerts and demonstrations to be held throughout the week will offer a comprehensive exposition of electronic music in its present day context.

The seminar is being supported by the Australian Council for the Arts.

Papers will be contributed by musicians in the electronic field from all over Australia, and, in addition, two composers from overseas will participate in the seminar. They are Milton Babbitt, Professor of Music from Princeton University in the USA, and Cornelius Cardew from London.

Sessions will cover five main areas:–

(1) Electronic music and its applications in education.
(2) Electronic music and its applications at University level.
(3) Commercial applications.
(4) Requirements for building a studio.
(5) Electronic music presentation.

Professor Milton Babbitt will give two public lectures in the evenings, and special concerts will be given on three evenings. The concerts will include performances of real time electronic music by Milton Babbitt, and related composers, and a concert will also be presented by Cornelius Cardew.

During each morning and afternoon there will be continuous demonstrations of electronic music from all over the world; virtually every electronic studio in the world has been asked to send examples of the most recent work produced.

It is hoped to provide the broadest possible perspective in which to set the seminar.

The programme has been arranged by Keith Humble, Senior Lecturer in composition in the Faculty of Music. Further details can be obtained from the Secretary, Mrs. Helen Dore, 4 Hansen Street, Kew, Victoria.

ELECTRONIC MUSIC SYNTHESIZER

A full scale music synthesizer has been developed by Electronics Today. The unit will be produced in modular form.

Constructional details will commence shortly.

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429 Pitt Street, Sydney. Ph. 211-2826

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MISCELLANEOUS

New, unmarked PNP transistors Asst. BC177 and BC178.
PKTS. 10 for ONLY **$1.50**. Post 15c.
New, top quality German-made resistors, ¼w 5% 30 diff. values.
PKTS. 100 for ONLY **$1.50**. Post 15c.
New, unmarked (type AX1270) PNP silicon planar transistors.
PKTS. 10 for ONLY **$1.50**
New, mica and ceramic capacitors, many values.
PKTS. 100 asst. for ONLY **$2.00**
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New, top quality German-made electros from famous manufacturer.
FIRST COME—FIRST SERVED. LIMITED QUANTITY.

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2500	mfd	6V	35c	250	mfd	15V	19c
5000	mfd	6V	40c	400	mfd	15V	20c
10000	mfd	6V	65c	500	mfd	15V	22c
1000	mfd	15V	35c	5, 10 or 25	mfd	25V	11c
2500	mfd	15V	40c	50	mfd	25V	16c
5000	mfd	15V	65c	100	mfd	25V	18c
500	mfd	25V	28c	250	mfd	25V	23c
1000	mfd	25V	40c	1, 2 or 5	mfd	35V	13c
2500	mfd	25V	65c	10	mfd	35V	14c
5, 10, 25	mfd	6V	10c	25 or 50	mfd	35V	16c
50, 100	mfd	6V	11c	100	mfd	35V	19c
250	mfd	6V	13c	200	mfd	35V	22c
500	mfd	6V	18c	250	mfd	35V	25c
2, 5, 10	mfd	15V	10c	25	mfd	15V	11c
50	mfd	15V	12c	POSTAGE 20c ANY QTY.			

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We pass the benefit of our shrewd bulk purchasing on to our customers . . . Away with fancy and inflated prices . . . The proof of the pudding is in the eating, so come along to our new but temporary surplus disposal shop and find out for yourself. If our prices are not below any of our competitors, don't be afraid to tell us and we will reduce immediately . . . We have thousands of bargains in electronics, electro mechanics, and we know that you will be satisfied with our prices. We can promise you a continued money-saving policy, vastly changing component selection, and happy people who are happy to serve you . . . All we ask is for you to give us a try . . . we know that after the first call from you we have not made a customer for life but also a friend for life.

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240v fractional horse-power motors, 1/15 h.p., 1500 r.p.m. 3 phase. Ideal for fans, miniature drills, etc. ONLY **$4.00** each. Post $1.00. 240v ¼ h.p. motors, 1425 r.p.m. ONLY **$6.00** each. Post $2.00. 240v ½ h.p. motors, 1425 r.p.m. ONLY **$8.00** each. Post $2.00.

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Ex-Army carbon microphones, all in good condition. **25c** each.

BELL WIRE

Reels of twin single—cord bell—wire, 440 yd. reels ONLY **$10.00** reel. Post $2.00.

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Fibreglass and phenolic, size 10" x 5", **30c** or 10 pcs. for **$2.00.** Post 40c.

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Tables of many different "CLEARANCE" items, take your pick, 5c each for personal shoppers only. Don't delay, hurry over!

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Cash immediately available for redundant and surplus stocks of Radio, Television, and Electronic Equipment, or in component form such as meters, plugs and sockets, valves, transistors, semi-conductors, capacitors, resistors, speakers, etc., etc. The larger the quantity the better we like it.

PLEASE NOTE

For the convenience of our customers, we will remain open until 8 p.m. every THURSDAY.

SELENIUM RECTIFIERS — BRAND NEW

80v	12A	**$6.00.**	Post $1.00
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TEMPERATURE INDICATORS

Were $1.00 each, now only **40c**, post 10c. Two colour dial—hot and cold.

UNISELECTOR SWITCHES

4 bank 25-way full wipers. 1000 ohm coil, 48V. D.C. operation. Various switching and computing selections. **$3.50**, 60c postage.

HIGH-SPEED MAGNETIC COUNTERS

(4" x 1" x 1") 4 digit 12/24V, 500 ohm. For batch counting or lap timing. **95c** each. Plus 15c postage.

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Breakmake impulse ratio 2:1 and speed 10 i.p.s. Trigger type. Dozens of uses for the experimenter. **$1.25.** Postage 20c.

COMPUTER PANELS — HONEYWELL

Approximately 90-100 components, diodes, capacitors, resistors, pots, transistors. Qty. 1-4 **$2.50**, postage 50c. Qty. 5-9 **$2.00**, postage $1.00. Qty. 10-24, **$1.80**, postage $2.00.

2 COMPUTER TURRET UNITS 2 x 2D21, 2 x 12AU7

Consisting of 4 useful valves, 18-way connectors, resistors and capacitors. **$1.00** pair. Post free.

RELAYS

Post Office type 3000. 25, 100, 250, 500, 1000, 1250, 2000, 3000, 10,000 ohms. Various contact make-ups. Other values available. **$1.00** each. 10c postage.

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I.C.L. 4-pole change-over. 12/24V. **75c** each.

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2-pole single change-over. 1000 omega coil. 24V. operation. 75c each.

TELEPHONE SETS

Brand new and packed "Siedle" push-button telephone sets—all master stations. Ideal for inter-office, home or factory use. All units in attractive 2-tone grey and white modern styling. 15-way desk phone C/W junction box, extension lead and 10 lamp signal indicator. Were selling at $58.50, our price **$25.00.** 11-button wall phone, as above. These were $42.00, our price **$16.00.** 6-button wall phone complete as above but with 5 lamp signal indicator, now reduced from $34.00 to only **$13.00** set. 240v. power supplies to suit above units were selling at $36.75, our price **$15.00.**

DEAD MEN SPEAKING?

A review of "Breakthrough" by Dr. Konstantin Raudive, published by Colin Smythe Ltd. (England). Reviewer: Brian Chapman.

Dr. Konstantin Raudive and a number of very distinguished scientists and theologians are either perpetrating an elaborate hoax — or they have made what is perhaps the most remarkable discovery of modern civilization.

For they claim to be able to record the voices of the dead.

We have heard recordings of these voices and are convinced that — whatever their true origin — they are not, as has been suggested, just random noise.

On the other hand, we are by no means convinced that they are authentic recordings of voices of the dead.

Linguists included in our party of listeners pointed out that at least three of the 'speakers' made elementary mistakes in either pronunciation or usage of what was supposedly their own language (once each in Spanish, French and Russian). Example:

A dead Spaniard identifies himself as the philosopher Ortega, and proceeds to mispronounce the first word of his 'message'. The word (as spelt on the record jacket) is "entrojas" and he pronounces it with an English 'j' (entrodjas). A Spaniard would have said "entrohas" — the letter 'j' in Spanish has an 'h' sound.

Hard to explain, even if one accepts the theory that the dead were using Latvian-born Dr. Raudive as their communication link.

Nevertheless, the recordings are certainly intriguing — as is the eerie, staccato sound of the voices.

The book, which will be available in Australia later this year, gives full details of the recording techniques required for such experiments.

Editor

"Perhaps no one can fully understand the true value of life, his own or others', until he experiences the terror of facing complete annihilation. To innumerable thinkers throughout the ages, life has appeared as more than a puppet show; they have rejected the idea of dissolution in a limitless void as a denigration of human intelligence and dignity, and have looked for a deeper meaning behind man's existence."

Thus speaks Konstantin Raudive PhD. in his book entitled "Breakthrough", recently published by Colin Smythe in Great Britain.

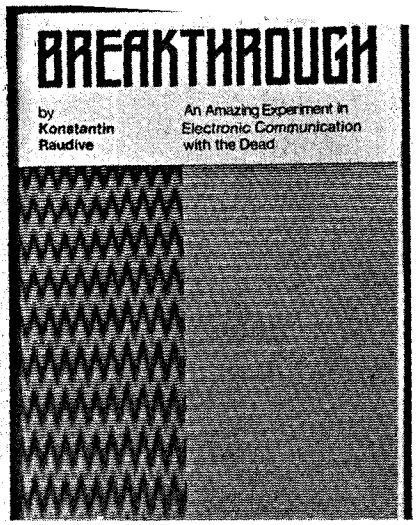
Smythe was handed a copy of the German text while attending the 1969 Frankfurt book fair and told: "Here is a book you might like to publish. You had better take it and look at it."

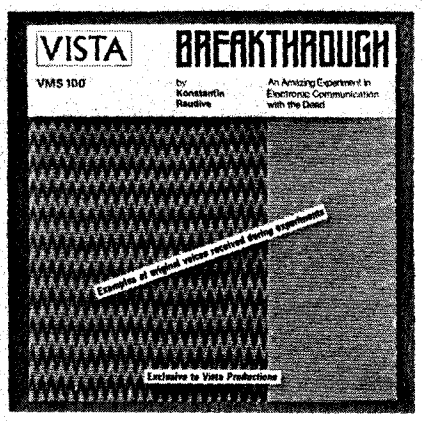
On reading the text, he discovered that Raudive maintained that life after death is a reality which can be scientifically proven. He would not have taken the book seriously, had it not been for the section containing letters and comments by scientists of known integrity. Among these were Professor Gebhard Frei (Catholic priest and philosopher), Professor Alex Schnieder (physicist), Professor Dr. Hans Bender of Freiburg (psychologist) and many others.

Dr. Raudive for many years has been conducting experiments with tape recorders based on the discovery by Swedish author Friedric Jurgenson of voices which appeared on recording tapes, apparently without human intevention. Raudive says his research had shown that these voices did not appear to be random but responded to invitation to manifest themselves. Even more astounding was his claim that the voices gave logical answers to questions and were apparently voices of dead people.

Before committing his publishing house to something as apparently dubious as this Colin Smythe's editor, Peter Bander, contacted Dr. Raudive and put the matter to the test himself.

Dr. Raudive subsequently came to England and demonstrated the phenomenon, and his recording methods, before a select audience. Meanwhile Peter Bander, using methods described to him by Dr. Raudive, conducted his own private



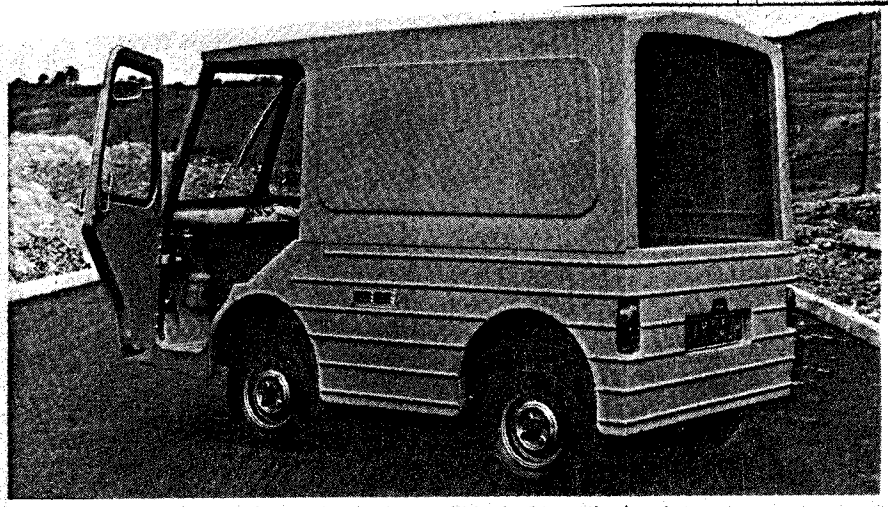


experiment and was disturbed, when replaying the tape, to find a voice which — although it spoke in a fast and strange rnythm — was unmistakably that of his mother, who had died some time previously.

At Dr. Raudive's demonstration an electrical engineer, David Stanley, thoroughly examined a brand-new tape recorder, a batch of new sealed tapes and the little diode attachment used by Dr. Raudive, and gave it as his opinion that everything had been done to make absolutely sure that nothing used for this experiment had been tampered with in any way.

The some twenty people at this session had been carefully selected for their impartiality and had not been told beforehand of the purpose of the gathering. Dr. Raudive gave the audience a brief talk on the purpose of the experiment and his methods of making the recording before proceeding. Initially the experiments were a complete failure, much to the embarrassment of Dr. Raudive and the secret amusement of the sceptical audience. However, towards the end of the evening, while re-running a tape, suddenly there it was — a rhythmic voice, at twice the speed of human speach, said: "Raudive there". To all present it was clear and understandable: here was a voice which called on the name of the person most involved with it all.

(Continued on page 122)



This British Leyland electrically powered van will be in Australia shortly.

British Leyland's ELECTRICAR

the latest on British Leyland's electric vehicles — Harold Dvoretsky reports from London.

AS WE tipped a few months ago BLMC are being more serious about electric cars than they care to admit.

What holds them back is simply development of a suitable battery.

Basically we are still in the age of the far-too-heavy lead-acid type of battery. The promises of a year or so back — even months ago — that zinc-air, even the fuel-cell, would be perfected by now or next year, have failed to materialise.

There have been problems that not even the mighty NASA space programme has been able to foresee or overcome — particularly so far as cost is concerned. But the breakthrough, is now dawning. First the throwaway zinc-air cell for torches and small medical equipment. Later the bigger throwaway cell, and in the not too distant future, the rechargeable cell which is what is needed for the electric car.

It all boils down to a proper power to weight ratio — but when the fuel (or battery source) weighs far more than the motors, it doesn't get past the first power point.

But this isn't worrying BLMC. British Leyland are getting over the doldrums, looking ahead and planning ahead.

The Michelotti-designed "Electricar" is an excellent step in the right direction for a pollution-free city car.

BLMC's two prototypes for city car and city delivery van or pickup are based on 'Mini' suspension and running gear components. All three weigh in the vicinity of 17 to 18 cwt with the 24 cell 48 volt lead-acid battery pack installed — under 12 cwt without them.

The two motors are series wound, 3.9 hp, one hour rated to BSS 1727, units, with forced ventilation by two external blower fans controlled by an isolating key switch.

Controls are carbon stack for smooth gearless acceleration with an economical half-speed position.

Crompton-Leyland who make the vehicle would no doubt like to use the Crompton Parkinson electronic "Powermiser" controller which is an SCR chopper-type system.

But the "Powermiser" in its present form, as used on a lot of Britain's 50,000 electric (72 volt) vehicles, costs around 170 pounds stirling — not too much for a worthwhile "extra" on a 1500 pound sterling delivery vehicle but a lot on a vehicle aimed at costing half that amount.

The "Powermiser" gives infinitely variable, smooth and stepless speed control at all times.

It works automatically no matter how the pedal is depressed, and it has a form of controlled overload protection so that drivers can't damage either battery or the vehicles. There aren't any contactors, so maintenance is eliminated.

Charging would be normally carried out overnight, the range could be increased considerably if the batteries were charged during standing time. As all the vehicles are fitted with their own charger and 25 feet of cable for use in a normal household 13 amp 240 volt plug, this shouldn't prove too much of a difficulty. ●

Electrically powered truck from Russia's All-Union Research Institute at Kaliningrad. The Institute have also developed a similar electrically powered car. Both vehicles have a range of 65 miles at a cruising speed of 38 mph.

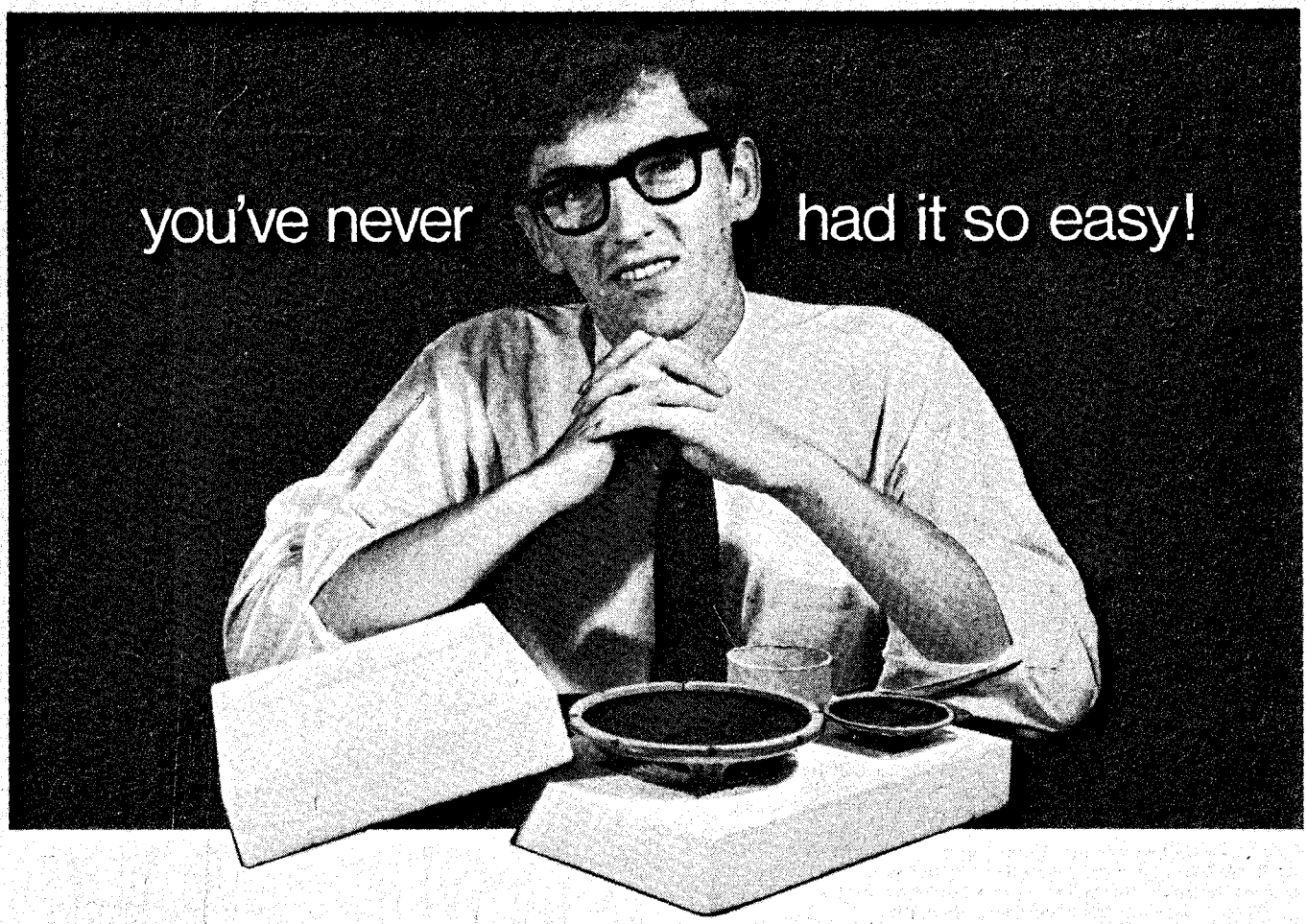
ELECTRIC VEHICLE IN AUSTRALIA

Hawker Siddeley Brush Pty. Ltd. are to import a BLMC Morrison electric vehicle for evaluation and demonstration purposes in Australia.

The vehicle will be the pickup van which has basically the same technical specification as the BLMC Electricar, which we reported exclusively last month.

Hawker Siddeley Brush Pty. Ltd. is a subsidiary of Hawker Siddeley UK who are 50% shareholders with British Leyland in Crompton-Leyland Electricars Ltd., where the cars are being developed. The evaluation van — one of several now being delivered all over the world, to the U.S., New Zealand, Australia and elsewhere — should arrive in Australia on or about August 19th.

Crompton-Leyland are also to send out four big electric vehicle chassis which will have special bodies built on them in Australia to evaluate their use in the hotter climate of Australian cities.



here is a completely new Rola speaker system in kit form!

Now you can easily make up your own high efficiency, wide range speaker system at low cost! Plessey Rola has released a new kit containing two newly developed loudspeakers, all necessary electrical componentry and details to construct the small 17" x 10½" x 8¾" overall enclosure. You get: A Plessey Rola C60 woofer and C3GX tweeter, a special tunnel port, hook-up wire, cross-over condenser, 50 ohm potentiometer, control knob, component mounting board, external terminals and construction details — all securely packed in polystyrene. **The completed 0.625 cu. ft. system has a frequency response from 50 Hz to 19 kHz and will handle 10 watts RMS.**

C60 Woofer

A new highly compliant, high efficiency bass speaker offering optimum performance in small enclosures. Response is from 35 Hz to 7,500 Hz±6dB. The specially treated heavy mass cone achieves sharp cut-off at the 5,000 Hz cross-over point. The 1 lb. 11 oz. magnet assembly with air gap flux density of 12,000 *gauss minimises* transient distortion.

C3GX Tweeter

A new curvilinear cone tweeter with flat response from 1,500 Hz to 19 kHz±6dB. The cone is designed to achieve a sharp, low frequency cut-off. With suitable cross-over this speaker can be used in a 10 watts RMS system.

kit components

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AR31

SWIMMING POOL

CONTEST CONDITIONS

Contest winners will be decided by a panel of judges professionally engaged in the electronics industry. Advice will also be obtained from technical experts involved in domestic swimming pool construction.

The judges' decision will be final and no correspondence will be entered into concerning the outcome of the contest.

Judging will take into account:

(a) SENSITIVITY AND IMMUNITY FROM FALSE ALARMS. The unit must respond to an object — roughly spherical in shape, not exceeding 14 lb in weight and having a specific gravity of not less than 1.00 — falling through a height of not more than 12 inches. Under these standard conditions, an alarm must be given when this object is dropped into a pool (not less than 25ft. long by 15ft. wide) at any point around the perimeter. Ideally the alarm unit will have a sensitivity adjustment which will also cater for various size pools.

The unit must not be affected by changes in water level due to rain or seepage, and arrangements must be made to prevent false triggering by wind-induced ripples, thunder, lightning, aircraft, or heavy-vehicle noise.

(b) RELIABILITY. All components must operate within manufacturer's specifications. The unit must be shown to be protected against accidental damage and corrosion. There should preferably (but not essentially) be some remotely operable method of checking operation.

(c) VERSATILITY AND EASE OF INSTALLATION' The unit must be simple to install in any size, shape or type of domestic swimming pool.

(d) MANUFACTURING FEASIBILITY AND COST. Units should have a realistic manufacturing cost and should preferably not incorporate any components requiring special manufacturing methods or techniques.

Entries are acceptable from all readers — amateur or professional — except employees, or families of employees, of Modern Magazines (Holdings) Ltd., Simon Gray Pty. Ltd., and their respective agents, distributors, dealers or associated companies.

Considerable publicity will be given to winning entries. Contestants who foresee a commercial future for their entries should consider provisional patent protection.

In the first instance, entrants should submit full mechanical and electrical details of their entries, together with detailed description of operation. Photographs may be included if required. Every care will be taken to safeguard the entrants' plans, but no responsibility can be accepted in this respect. DO NOT SEND ACTUAL UNITS.

Initial selection will be based on the entrant's description and plans.

Finalists will be asked to submit working prototypes for physical and electrical evaluation.

These prototypes must be soundly constructed, but no marks will be awarded for or against quality of finish.

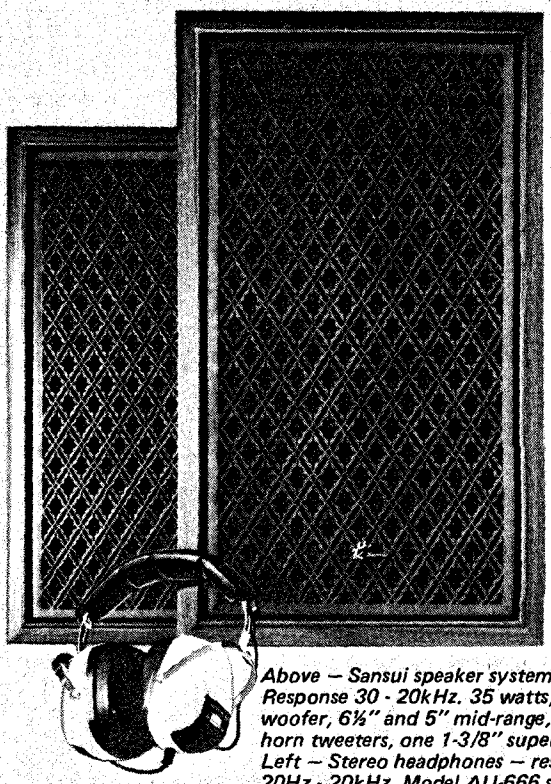
ELECTRONICS TODAY reserves the right to publish details of any entries, whether winners or otherwise.

There is no entry fee and entrants may submit more than one design if they wish — but each entry must be accompanied by a coupon from ELECTRONICS TODAY.

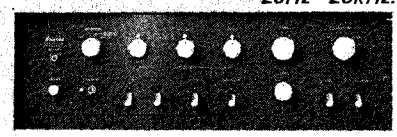
Final closing date is November 23, and the results will be announced shortly after.

Entries should be addressed to: Design Competition, Electronics Today, 21-23 Bathurst St., Sydney, N.S.W. 2000.

Make sure your name and address is on each and every enclosure. And please do NOT send actual units unless otherwise advised.



Above — Sansui speaker system. Response 30 - 20kHz. 35 watts, 12" woofer, 6½" and 5" mid-range, two 2" horn tweeters, one 1-3/8" super tweeter. Left — Stereo headphones — response, 20Hz - 20kHz. Model AU-666 stereo amplifier — 10Hz — 40 kHz — 35 watts per channel rms.



Sansui turntable — two speeds, four pole synchronous motor. Magnetic cartridge with 0.5 mil. diamond stylus.

EXAMPLES OF HI–FI EQUIPMENT AVAILABLE FOR THE WINNER'S CHOICE AS PART OF $1000 FIRST PRIZE PRESENTED BY SIMON GRAY PTY. LTD.

SAFETY CONTEST

Can you design an effective and reliable system which will provide audible warning if a child falls into a swimming pool?

If so, you could help reduce the increasingly large number of young children drowned every year in unattended swimming pools.

EVERY YEAR toddlers and small children drown in unattended swimming pools – tragedies that strike swiftly and almost silently, for the splash of a two-year-old is not loud and will rarely be heard more than a few feet away.

This is a serious hazard – becoming more so every year as the number of domestic pools increases – and about which questions are now being asked in State Parliaments.

And so far there is no really satisfactory solution – no alarm system that can be relied upon to operate under all conditions.

That is why we have chosen this problem as the object of our first design competition.

What we are seeking is a system that will provide audible warning if a small child falls into (or is about to fall into) a domestic-size swimming pool.

There are many different approaches to solving this problem, the most common of which is to sense the transient change in water level.

But it must be remembered that the water level in a pool may rise or fall several inches due to rain or leakage, and any system that utilises wave action to initiate the alarm must not be affected by slow changes in water level.

Other factors to consider include:

(a) Wind-induced ripples.
(b) Effect of thunderstorms.
(c) Avoidance of false triggering by birds, leaves, etc.
(d) Effect of constant immersion on components.

It is strongly recommended that the system should be battery-operated and that, if it is, battery drain should not exceed 1½ mA from a 6 or 12 Volt battery. Provision should be made to check battery condition.

Systems in which electrodes detect wave action are not acceptable as entries, unless the electrodes automatically adjust for slow change in water level of at least six inches.

POSSIBLE OPERATING METHODS INCLUDE:

* *Pressure sensing transducers.*
* *Ripple sensing electrodes.*
* *Doppler shift of audio or ultrasonic energy.*
* *Light beams (but remember curved pools). pools).*
* *Detection of high-frequency component of 'splash'.*

FIRST PRIZE

$1000

WORTH OF HI-FI EQUIPMENT FROM

SIMON GRAY

Pty. Ltd.

RUNNER–UP PRIZES TO BE ANNOUNCED LATER

This is the first of a series of design competitions to be run by ELECTRONICS TODAY.

The purpose of the competition is to indicate known problems and to provide publicity, plus material incentive, for successful solutions.

ENTRY COUPON

ELECTRONICS TODAY DESIGN COMPETITION
21, Bathurst Street, Sydney 2000

Herewith my entry in your swimming pool alarm design competition. I have read the contest conditions and agree to abide by the judge's decision.

SIGNED.....DATE.....

NAME (block letters).....

ADDRESS.....

.....

A separate coupon must accompany each entry.
Closing date for this contest is November 23rd, 1971.

HI-POWER

ET PROJECT

Build this high-power strobe for parties, light shows and discotheques.

This high-power strobe light is ideal for use at parties, light shows and discotheques.

It provides a short intense pulse of light adjustable in frequency between one flash per second and twenty flashes per second.

The circuit is unusual in that several strobe lights may be driven from the one basic triggering unit.

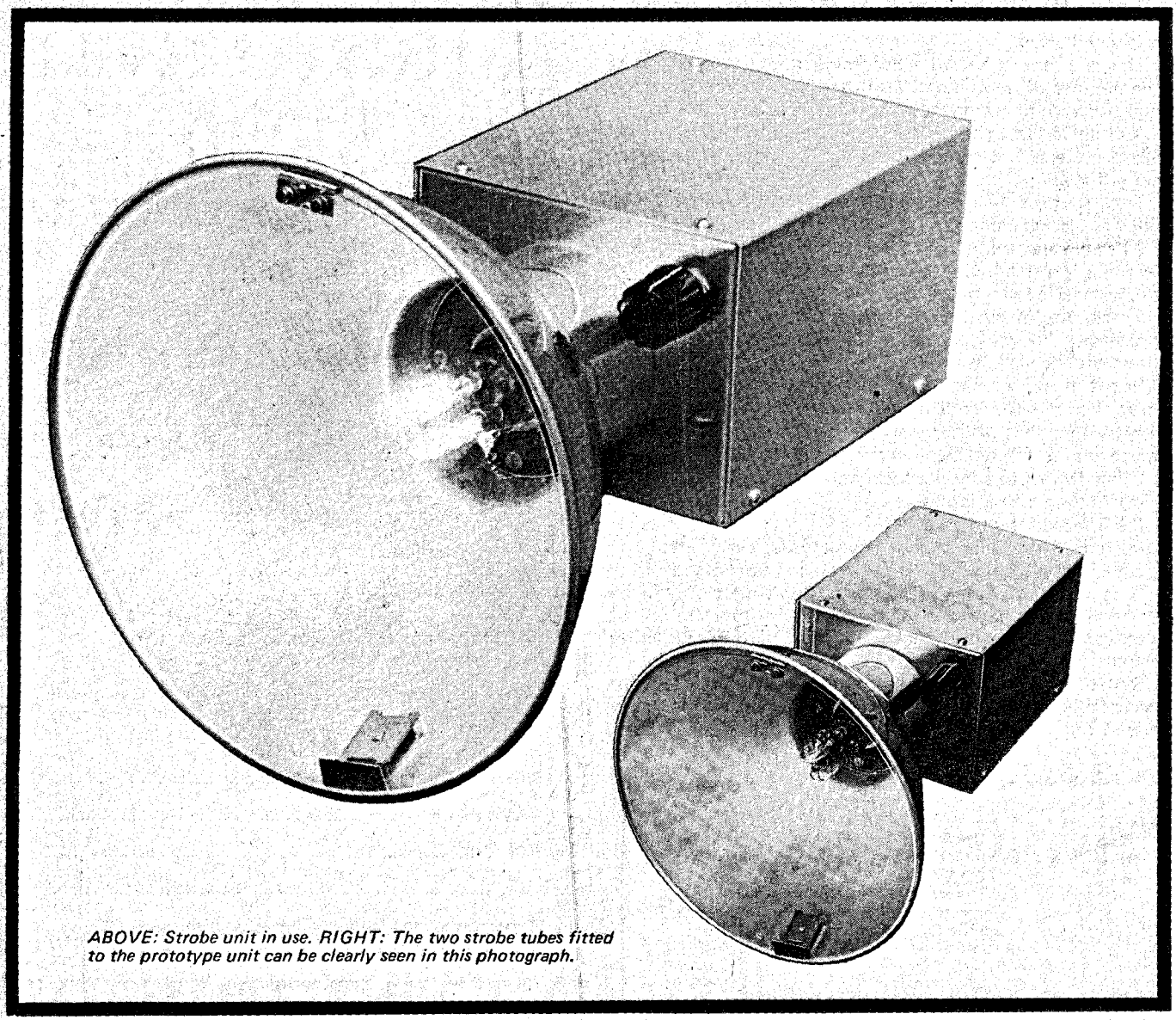
CIRCUIT DESCRIPTION

The circuit of the complete strobe unit is shown in Fig.1.

Diodes D1 to D4 produce positive voltages, at the points marked 'A' and 'B', on alternate half-cycles.

The voltage appearing at point 'A' charges the capacitors C2 and C3, these two capacitors supply the energy for the strobe tube.

Strobe operating frequency is determined by the timing circuit of SCR1, RV1, R2, C1 and LP1/2. Timing capacitor C1 is charged via RV1 and R2 by the positive voltage appearing at point 'B' on alternate half-cycles. When the charge on C1



ABOVE: Strobe unit in use. RIGHT: The two strobe tubes fitted to the prototype unit can be clearly seen in this photograph.

STROBE

exceeds the break-over voltage of the neons LP1 and LP2, these conduct triggering SCR1.

When SCR1 conducts, the timing capacitor C1 discharges through the primary winding of the pulse transformer (T1) and SCR1.

This causes a high voltage spike to be generated in the secondary winding of the pulse transformer, and it is this spike that triggers the strobe tube into conduction.

Capacitors C2 and C3 discharge practically instantaneously through the strobe tube resulting in a brilliant flash of light. Peak current may exceed 60 amps during this short period.

Since both the timing circuit and the storage capacitors are charged by an unsmoothed half-wave supply, neither can conduct for longer than one half-cycle of supply voltage.

The amount of light produced by the strobe tube during each flash is a function of the capacity of C2 and C3. Increasing the size of these capacitors will increase the amount of light but only at the expense of tube operating life. The capacitors specified will provide several hundred hours operation at a light level adequate for most purposes.

A far more satisfactory way to increasing light output is to fire two or more strobe tubes from the main triggering circuit. This is done by connecting the second and further tubes, additional 220 ohms resistors, and 6.5uf storage capacitors, as indicated by the dotted lines in Fig.1.

No modifications are required to the main timing circuit.

If desired the additional strobe tubes may be mounted within the existing single reflector.

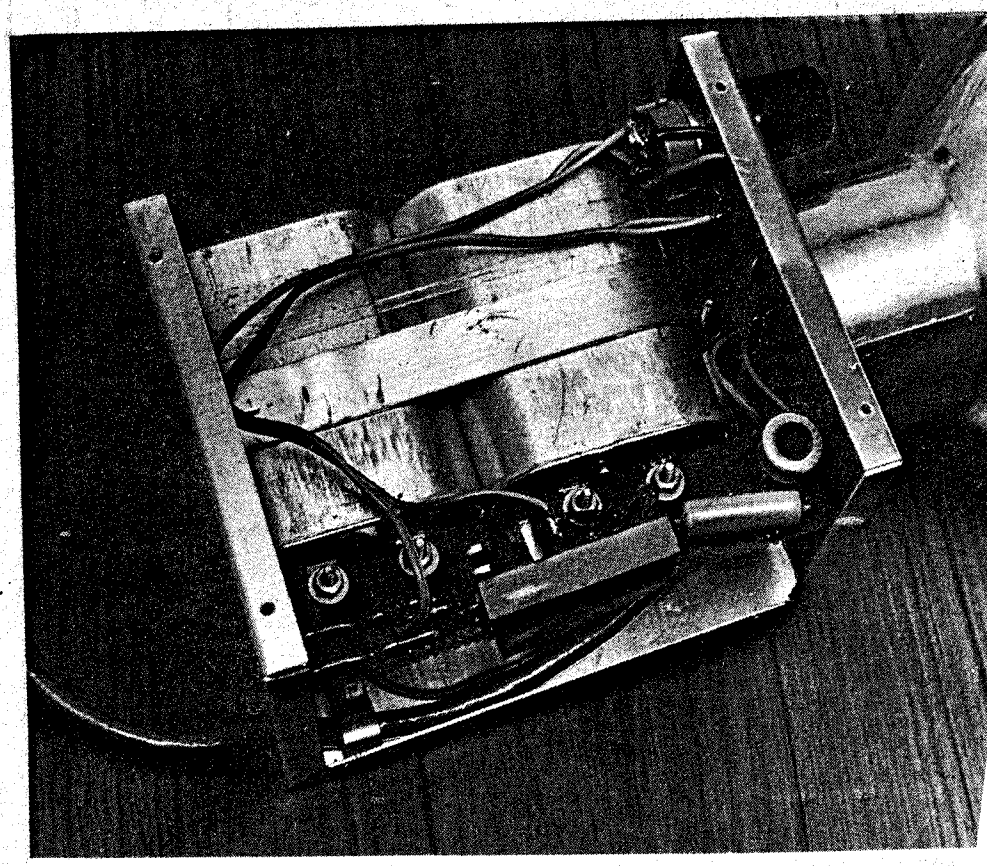


Fig. 5. Construction of the unit — this particular unit has been constructed to drive two flash-tubes. The additional capacitors and 220 ohm, 10 watt resistor referred to in the text can be clearly seen. The pulse transformer is on the extreme light of the matrix board which in turn is bolted securely to the energy storage capacitors.

CONSTRUCTION

Our prototype unit was constructed from an aluminium case 5¾" x 4½" x 3½" onto which was mounted a 7" diameter photographic type reflector.

The reflector should be fitted with a perspex cover to protect the tube. A suggested method of locating this cover is shown in Fig.2.

The strobe tube or tubes should be soldered into an octal plug. A corresponding octal socket is housed in the *base of* the reflector (as shown in Fig.2.) This enables the tube/s to be easily removed for replacement.

Since this unit is connected directly to the 240 volt mains, great care must be taken to earth all external metal parts. Unless you are thoroughly conversant with electrical wiring, have the finished unit checked by a licenced electrician.

Component layout is simple and non-critical. Apart from the capacitors and strobe tubes, all components may be mounted on a matrix board or on tag strips.

The storage capacitors are 6.5uf, 250 volt working, paper insulated units of the type used for power factor correction with fluorescent lights. These have been selected for this purpose because they have high discharge current ratings and are readily obtainable at a cost less than $2 each. This type of capacitor is larger than the electrolytic variety.

If space is critical, electrolytics of the same capacity, but having a 450 volt dc voltage rating, may be used in their place. They will however require replacement at frequent intervals.

If the recommended type of capacitor is used, the matrix board carrying the remaining components can be bolted to these capacitors' terminals, and the capacitors securely located within the metal case.

LOCATE COMPONENTS SECURELY

All components must be fixed rigidly in position so that there is no possibility of their contacting the metal case. If there is the slightest doubt, insulate the component with tape, and line the interior of the metal case with an insulating board.

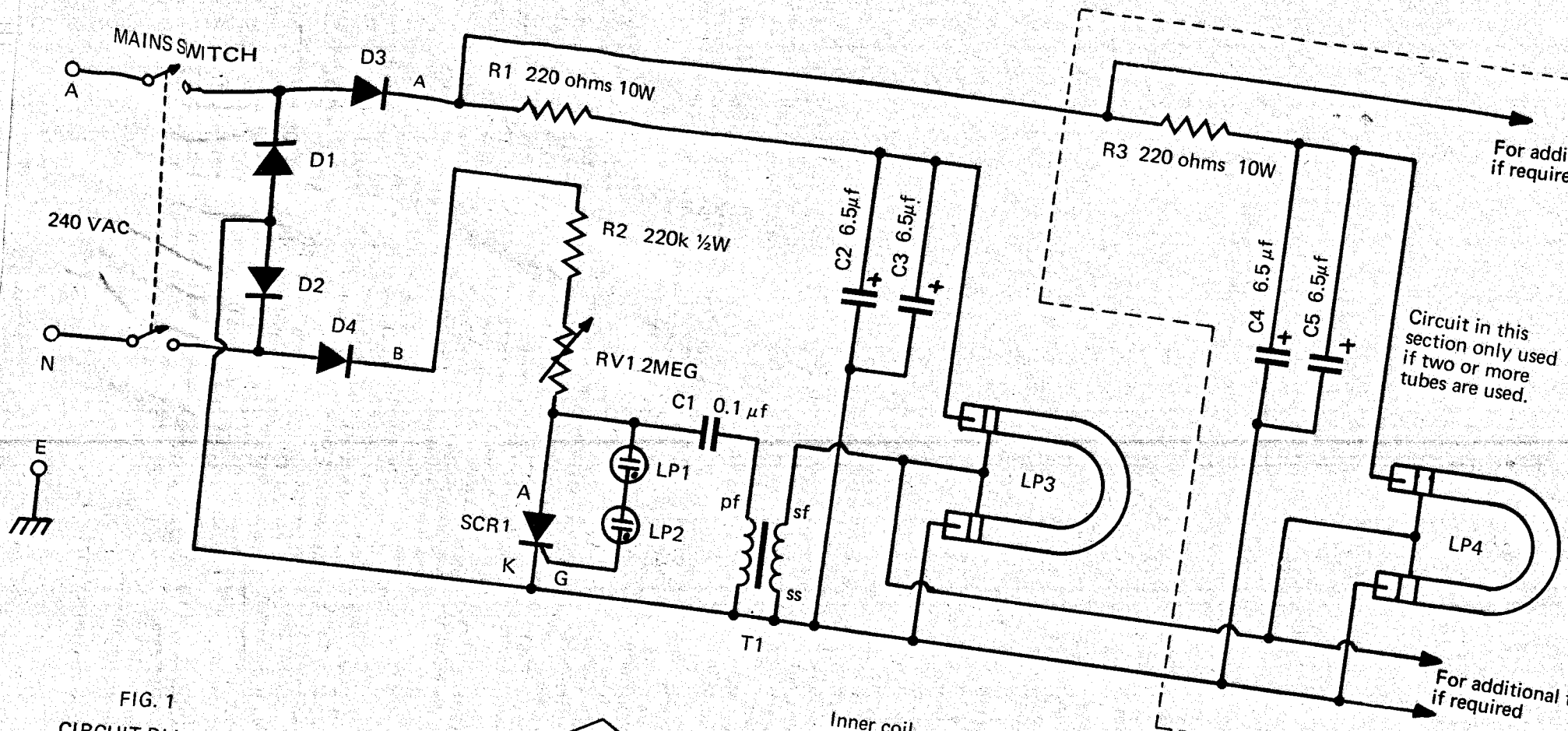
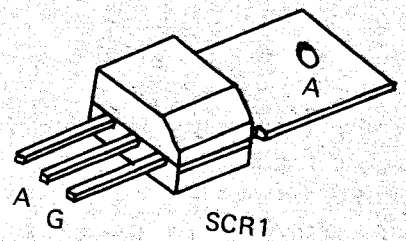
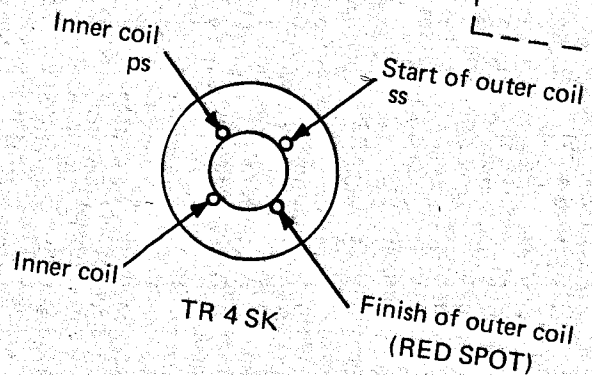


FIG. 1
CIRCUIT DIAGRAM





HI-POWER STROBE

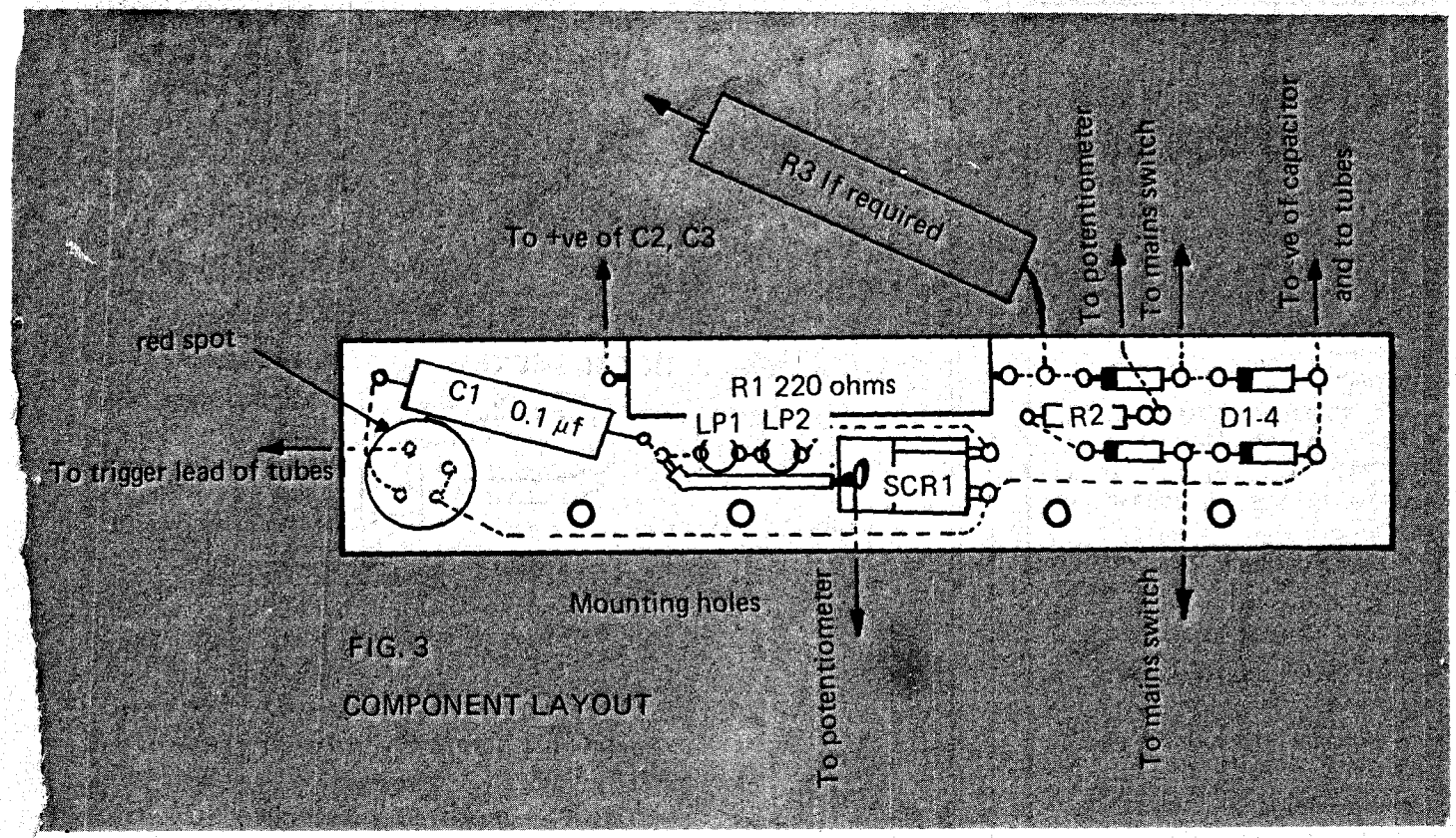


FIG. 3

COMPONENT LAYOUT

Connect components using 23/0076 240 volt insulated wire. A two-pole mains switch must be used, this may consist of a separately mounted unit, or it can be combined with the main speed-setting potentiometer (a combined switch-potentiometer is specified in the parts list).

The mains cable must be protected by a grommett at the point where it enters the case, it must also be securely attached to the case by a suitable clamp.

Two types of strobe tubes have been found to operate satisfactorily with this project. These are the Philips type 126048 and the Circuit Components type MFT 1210.

A length of tinned copper wire must be wound around the Circuit Components strobe-tube to act as a triggering lead (Fig.4).

This lead is inbuilt in the Philips strobe-tube, but we have found that an additional winding may be required (in this application) to eliminate erratic triggering.

WARNING

Repetitive pulses of light — especially those occurring at frequencies around nine flashes a second — may cause epileptics to have convulsive seizures.

Those prone to grand mal, petit mal, or psychomotor attacks should avoid areas where strobe lights are used.

In the event of such an attack whilst a strobe is being used, the strobe light must be turned off immediately. — JV.

(Turn to page 78)

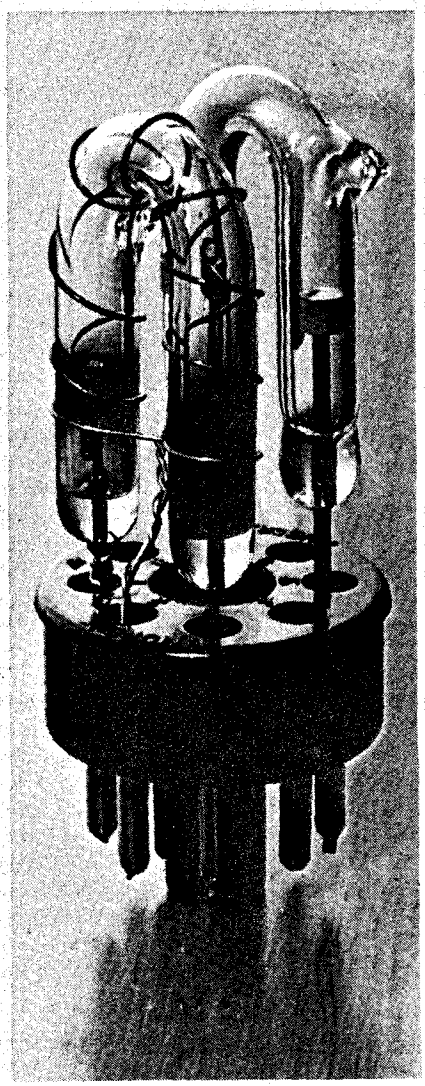
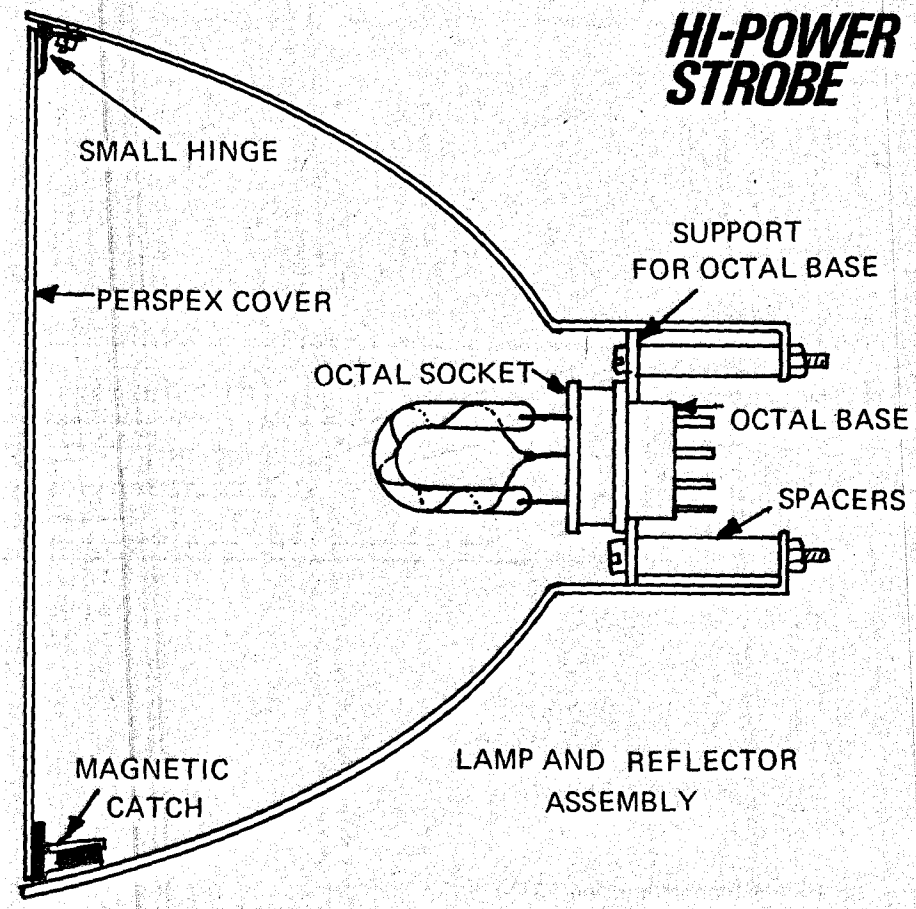


Fig. 4. Two strobe-tubes are mounted in one octal holder. The Circuit Components tube is on the left, and the Philips tube is on the right. Note that a triggering lead must be attached to the Circuit Components unit. The wire is simply wrapped around the tube as shown.

HI-POWER STROBE



PARTS LIST

D1,D2,D3,D4.	—		silicon diode EM 404 (or equivalent)
R1	—	—	resistor 220 ohm, 10 Watt, 10%
R2	—	—	resistor 220k, ½ Watt, 10%
R3 *	—	—	resistor 220 Ohm, 10 Watt, 10%
RV1	—	—	potentiometer, 2 Megohm, linear scale, with double pole switch.
C1	—	—	capacitor, 0.1uf, 400V.
C2, C3 **		—	capacitor 6.5uf, 250 volt ac.
C4, C5 *		—	as above
LP1, LP2		—	neon indicator tube – GE-NE2
LP3		—	strobe tube, Philips type 126048 or Circuit Components type MFT 1210.
LP4 *	—	—	strobe tube – as above
T1	—	—	pulse transformer – Elevam type TR4SK or equivalent
SCR1	—	—	silicon controlled rectifier, C106D, BT100A, 500R or equivalent.
Octal plug		—	McMurdo type L8USP1
Octal socket		—	McMurdo type RT8
Sundries		—	reflector, metal box, spacers, perspex cover, hinge, magnetic catch, hook-up wire, three-core flex, nuts, bolts, washers, etc.

** Components marked with one asterisk – only required if two or more strobe tubes are to be used.*

*** If unobtainable from your kit parts supplier, these capacitors can usually be obtained from main electrical dealers handling fluorescent lighting equipment.*

Beethoven surely would have chosen BRAND 7

. . . top recording tape in the U.S.A. —now fully imported for connoisseurs in Australia

Brand 7 is professional quality tape with increased output and reduced distortion. Better frequency response and improved uniformity for lower modulation noise.

Brand 7 tape is calendered to achieve a smoother oxide surface with dry synthetic lubricant to eliminate squeal, gumming of heads and reduce head wear.

BRAND 7 GIVES SHARPER BRIGHTER RECORDINGS.

Each reel has colour coded leader tape and aluminium foil sensing and cueing strips prespliced to the beginning and end. Green leader indicates the beginning—red leader indicates the end. Aluminium foil sensing material for use with automatic stop and reverse control recorders and auto sensing devices.

Brand 7 is available in 5" x 600' reels at $2.50 to 7" x 3600' reels at $13.25.

Trade Enquiries: Green Corporation Ltd., 2a Waverly St., BONDI JUNCTION. 389-8733

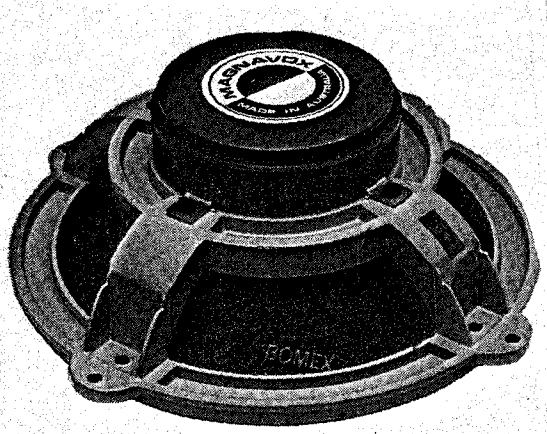
Available at all good tape recorder and sound specialists throughout Australia.

INSTROL

SPEAKER SYSTEMS

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

NEW MAGNAVOX 8-30 SYSTEM



Featured in "Electronics Today", it handles 30 watts RMS, features a new high performance 8" speaker, two 3" tweeters, and is available in cabinet 20¾" x 12¾" x 8¾" (1 cu. ft.) or 23¾" x 15½" x 10⅝" (1.6 cu. ft.). Available in teak or maple veneer.

COMPLETE SYSTEM

Kit of Parts ..... **$49.00** (1 cu ft), **$59.00** (1.6 cu ft)
Built and tested ..... **$61.00** (1 cu ft), **$74.00** (1.6 cu ft)

SEPARATE COMPONENTS

Enclosure kit (1 cu ft) ..... **$16.50** (maple), **$19.00** (teak)
Enclosure kit (1.6 cu ft) ..... **$28.50** (maple), **$31.50** (teak)
Built Enclosure (1 cu ft) **$28.00** (walnut), **$32.00** (teak)
Built Enclosure (1.6 cu ft) **$43.50** (walnut), **$48.50** (teak)

WHARFEDALE SPEAKER SYSTEM KITS

The Wharfedale Super Linton, Melton and Dovedale III are now available as build-yourself kits, featuring INSTROL quality cabinet kits in choice of maple or teak veneer.

The Super Linton kit employs an 8" and 3" speaker, frequency response 40-17,000Hz, cabinet 21" x 11½" x 9½". 15 watts RMS.

The Melton kit employs a 12" bass and a tweeter, cabinet 22¾" x 13" x 10", 25 watts RMS.

The Dovedale III kit employs a 12" bass, 5" mid-range and 1" tweeter. Cabinet 28" x 15½" x 10". 35 watts RMS.

COMPLETE SYSTEM

Super Linton kit (Unit 3) **$49.50**
Melton kit (Unit 4) **$90.00**
Dovedale III kit (Unit 5) **$128.00**

SEPARATE COMPONENTS

Unit 3 encl. kit ..... **$16.00** (maple), **$19.00** (teak)
Unit 4 encl. kit ..... **$23.00** (maple), **$26.00** (teak)
Unit 5 encl. kit ..... **$29.00** (maple), **$32.00** (teak)

MULLARD MINI SPEAKER SYSTEM

Employs a Magnavox 6WR and a 3TC tweeter, has no crossover network; is ideal for low wattage. Cabinet is 14½" x 8⅛" x 8¼".

COMPLETE SYSTEM

Kit of Parts **$28.00**
Built and Tested **$34.00**

SEPARATE COMPONENTS

Enclosure Kit ..... **$9.00** (maple), **$10.50** (teak)
Built Enclosure ..... **$14.50** (walnut), **$16.50** (teak)

ECONOMY BASS REFLEX SYSTEM

Special 1970 design consists of a Rola C8MX speaker in cabinet 20" x 11" x 9". Ideal for low wattage.

COMPLETE SYSTEM

Kit of Parts (teak or maple) **$24.00**
Built and Tested (teak or walnut) **$36.00**

SEPARATE COMPONENTS

C8MX speaker only **$8.26**
Enclosure kit ..... **$15.00** (maple), **$16.50** (teak)
Built Enclosure ..... **$26.50** (maple), **$29.00** (teak)

ROLA ONE POINT THREE SYSTEM

This popular system employs a Rola C8MX speaker with 3DX tweeter. Power handling capacity of 10 watts RMS. Cabinet 22" x 13" x 10¾".

COMPLETE SYSTEM

Kit of Parts **$36.00**
Built and Tested **$49.00**

SEPARATE COMPONENTS

Enclosure Kit ..... **$19.50** (maple), **$21.50** (teak)
Built Enclosure ..... **$31.00** (walnut), **$34.00** (teak)

INSTROL
HI-FI & ELECTRONICS CENTRE

Please send me the following speaker systems and/or speaker enclosures. These will be sent by road transport or passenger rail, freight payable on receipt of goods.

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

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

NAME.....

ADDRESS.....

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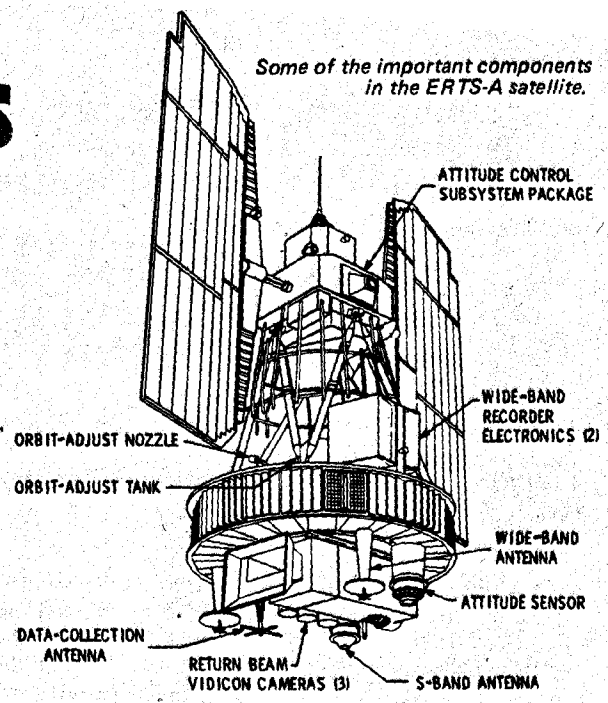
T18

Earth Resources Technology Satellite

electronics in Space

Satellite to be orbited next year will survey the earth's resources.



Some of the important components in the ERTS-A satellite.

Rising from the launch pad at California's Western Test Range, in March 1972, will be a 1788 lb satellite called ERTS-A.

The new satellite will be launched by a Delta rocket into a special sun-synchronous near-polar orbit, 565 miles above the earth's surface.

From this vantage point, the first Earth Resources Technology Satellite will probe the surface of the earth beneath.

Television images and data will be transmitted to ground stations in Alaska, Texas and Maryland from the satellite's special multi-spectral cameras and scanners.

The ERTS-A satellite is powered by banks of solar cells, which collectively generate nearly one kilowatt of electrical energy.

4200 LINE TV

Each of the three TV cameras carried by the satellite has 4200 scanning line resolution. This enables them to delineate objects as small as 250 ft across on the earth's surface.

Each camera will view the same 100 square mile area, but will use different portions of the light spectrum.

As all objects reflect, radiate or absorb heat or light in a characteristic spectrum — any change in their normal pattern may be easily seen.

To achieve this, one camera will view the green portion of the spectrum (0.47 to 0.57 microns), the second camera the red portion (0.58 to 0.68 microns), and the third camera the near infra-red portion of the spectrum (0.69 to 0.83 microns).

Also included in the ERTS-A satellite is a multi-spectral optical/mechanical scanner that produces a strip image by continuously sweeping a 100 mile wide path.

This multi/spectral scanner rapidly samples three portions of the visible light spectrum plus a fourth spectral band in the infra-red region.

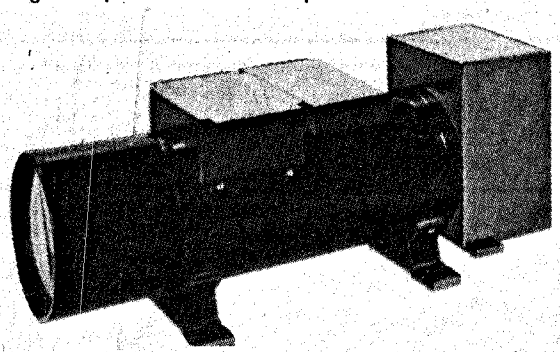
The output from this scanner can either be stored on a wideband recorder or transmitted directly to earth. Interpretation of this, and other data transmitted by the satellite, will be carried out by computer techniques.

A primary use of the ERTS-A satellite will be cartography. One of the advantages of the satellite's special orbit is that the TV cameras will always view the earth's surface below, at the same sun angle. Therefore lighting of the viewed area will be uniform. This reduces errors in interpretation.

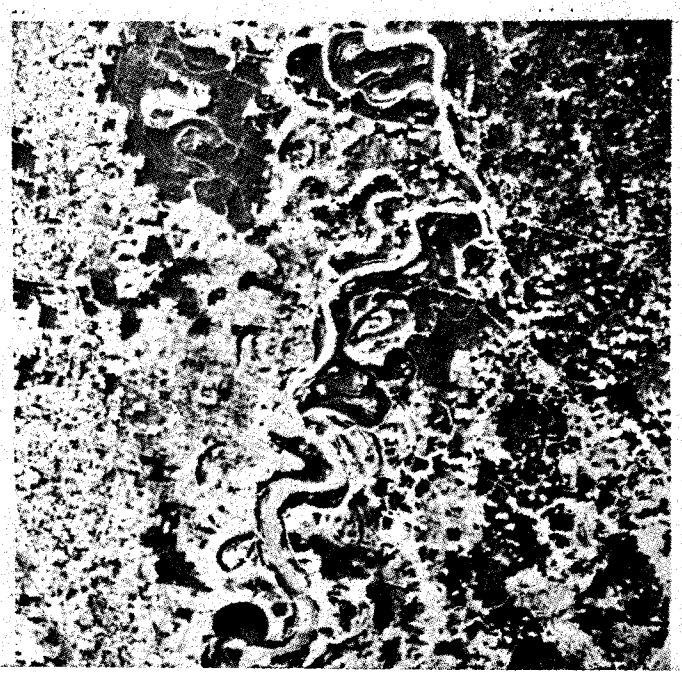
As the satellite's cameras photograph from positions 565 miles above the earth's surface, data in the subsequent pictures is essentially orthographic. Thus objects in the 100 square mile viewed area will maintain the correct relationships, and the distortion that normally occur in aerial photography will be virtually eliminated.

The satellite will cover the earth every 18 days, and it is predicted that sufficient data to create a detailed map of the whole globe will be available within a year of launching.

Other uses for the multi-spectral systems of the ERTS-A satellite include oil and mineral exploration, correlating ground features with existing deposits, detecting and pin-pointing pollution sources, measuring colour, temperature, depth and tides of the sea, surveying water resources, and providing information of value to all forms of agriculture. ●



A model of the vidicon TV camera, three of which will be carried aboard each satellite. Using 4200 horizontal scanning lines, this will be the highest resolution TV system ever flown in space.



An infrared photo of the Mississippi River and the surrounding area taken from Apollo 9 spacecraft. Scientists can analyze such pictures for land use, water distribution, and vegetation.

Submarine Simulator

The Royal Australian Navy's new submarine simulator will cost over $2.2 million. Here's what it does.

A submarine command team trainer costing over $2,200,000 has been ordered by the Royal Australian Navy.

The equipment which is designed to train a submarine command team and crew in tactics and operations is currently being manufactured in England by the Electronic and Display Equipment Division of Ferranti Ltd.

When finally completed, the trainer will be installed in a Royal Australian Navy establishment in Sydney, by E.M.I. Electronics (Aust) Pty. Ltd.

Unlike tactical trainers, in which training cubicles can represent any sort of vessel, the Royal Australian Navy's simulator is built as a replica of the complete control and operation areas of the R.A.N.'s latest Ovens Class submarines.

As in aircraft flight simulators, a true copy of the working environment is made. Sonar gear, plotting tables, and fire control systems are all correctly positioned as they would be in the actual submarine.

Normal visual and audio indications are given of echoes, sea noise, vessel generated noise, sandbanks, wakes, knuckles, fish, etc.

The sonar picture is therefore a realistic one, that corresponds to all of the conditions existing around the ship as well as to the setting of sonar controls, beam positions, etc.

Target data is, of course, correlated to all sensors. For instance, a target seen in the periscope will have a radar echo area of the correct size, and will give the correct sonar 'signature' for that particular type of vessel.

Weapon release and fire-control systems are also simulated, thus enabling the full sequence of maritime operations – attack, reconnaissance, screening, etc. – to be carried out as at sea.

For integrated training, the various sensor outputs are communicated to the operations rooms and weapons systems, thus completing the normal information chain.

The selection and firing of appropriate weapons, and the computation of miss distances, complete the overall loops in integrated exercises.

In tactical training, with the sensor stations unmanned, target relative bearings and positions can be routed directly from the computer to the plotting tables.

The greatest advances in the design of the R.A.N. simulator has been in the field of sonar generation. It was decided in the very early stages of development that tape-recorded data would not suffice, as the chances were slight of an exactly similar situation being reached, or of the correct echo being generated from a mixture of recorded sequence.

Instead the sonar data is generated as a dynamic function by the computer, which continually controls special sonar effects circuitry, taking full accounts of existing transmission losses, propagation anomalies due to thermal layer effects, and sonar polar diagrams.

T.V. PERISCOPE

In the Royal Australian Navy's simulator sensor displays include an optical presentation for the attack periscope.

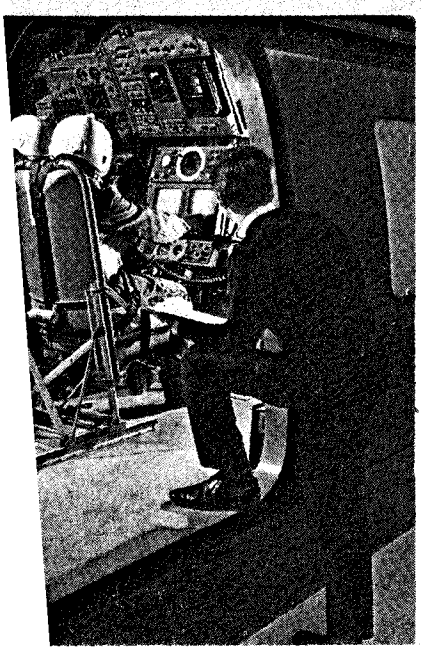
Great realism is provided by using television techniques and small models of the target ships which appear correctly positioned in the periscope's field of view in relation to bearing, waterline elevation, angle-on-the-bow, range and speed.

This display can be computer controlled or varied manually by the Controller from his programming console.

The setting up of exercises, including calling up of 'external' aircraft, ships and submarine tracks within the simulator's control computer (Ferranti Argus 500 digital computer with disc file) is facilitated by graphical cathode ray display systems. These systems are also used to monitor selected parameters during the exercise, and to enable the training exercises to be replayed in part or fully as required.

The R.A.N. simulator, when installed, will enable the full range of submarine command, operating and tactical proceedures to be practiced in realistic conditions.

Not only can weapons be fired at the 'enemy' but the latter can fire back resulting in a representative reaction on the simulator sensor systems. ●



The simulator is built as a total replica of one part of the working environment. In the picture at left trainees learn submarine detection procedures in a helicopter weapons simulator.

When completed the R.A.N.'s simulator will be virtually identical to an existing unit currently installed at HMS Dolphin in Scotland. The simulator's main programming console is shown at right. From this console the controller can present an exact TV replica of what the periscope can see if it were raised during an exercise.

WHAT'S ENCEL GOT THAT OTHERS HAVEN'T?

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Encel's qualified technical advisers help to make your audio purchases a satisfying experience. They are all audio enthusiasts and are happy to help you select the equipment that suits your particular requirements best.

THE BEST AFTER-SALES SERVICE . . .

Encel backs every purchase with real service. A large workshop, staffed by skilled electronics technicians, using the latest laboratory test instruments, ensures that your equipment will always perform to your satisfaction.

THE MOST-EXPERIENCED MAIL ORDER SERVICE . . .

Encel, now the biggest hi-fi specialists in Australia, has for many years successfully fulfilled mail orders for audio equipment from clients throughout Australia and S.E. Asian countries.
All equipment is carefully packed and is insured while in transit.

THE MOST HELPFUL, FREE AUDIO ADVISORY SERVICE . . .

If you can't get to one of the Encel showrooms, use the Encel mail enquiry service to solve your problems on audio equipment, etc.
Just mail your queries on stereo or components indicating price range; what facilities are needed, your personal preferences in sound, etc., and any other specific details of what is required and Encel experts will assist.

AND MORE FAMOUS BRANDS TO SELECT FROM!

Encel's range includes these and many other leading makes:

CELESTION speaker systems, outstanding for quality in sound and construction.

SEAS speakers, for fine, realistic sound at modest cost.

LUX amplifiers, famous for performance and technical quality.

ROTEL amplifiers, outstanding performers in the medium price range.

MARLUX tapedecks, and Dobby cassette units, advanced, high-quality units for the discerning enthusiast.

MICRO turntables and cartridges, precision made for top-quality performance.

CAMBRIDGE amplifiers, finest quality from England.

CONNOISSEUR turntables, tonearms and cartridges built to high standards for excellent performance at low cost.

STAX electrostatic headphones, the world's finest.

LUSTRE tonearms and lifts, high in quality and low in price.

GRACE tonearms and cartridges, highest quality.

P.M.L. condenser microphones and headphones, fine performance at economic cost.

INTERDYN X50 amplifiers, Australian-built units offering excellent performance.

EE143B

ENCEL ELECTRONICS PTY. LTD.

■ **AUSTRALIA'S GREATEST HI-FI CENTRES**

MELBOURNE: 431 BRIDGE ROAD, RICHMOND, VICTORIA. 3121. TEL: 42 3762.

SYDNEY: 257 CLARENCE STREET, SYDNEY, N.S.W. 2000. TEL: 29 4563, 29 4564.

■ **TRADE-INS ACCEPTED** ■ **TERMS AVAILABLE**
■ **MAIL ORDERS THROUGHOUT AUSTRALIA**

Capitol Cassettes

in beautiful boxes

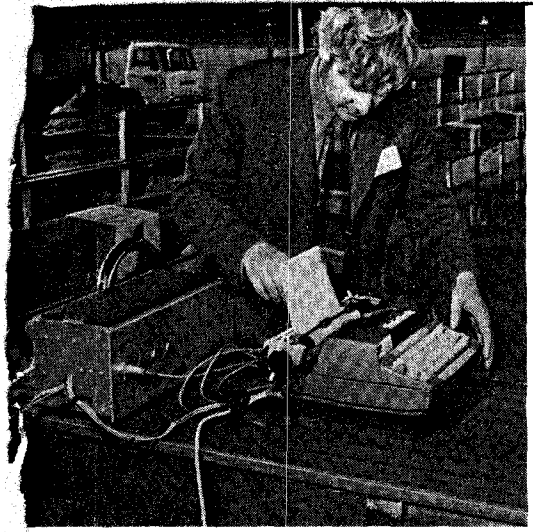
Unrecorded cassettes have never looked so attractive — now that Capitol have introduced the beautiful boxes. Just remove the protective wrap and you have a really eye-catching box for your unrecorded cassettes. Capitol cassettes in the beautiful boxes come in 30, 60, 90, and 120 minute playing times.

So now you get the unrecorded cassette you want — plus a beautiful box.

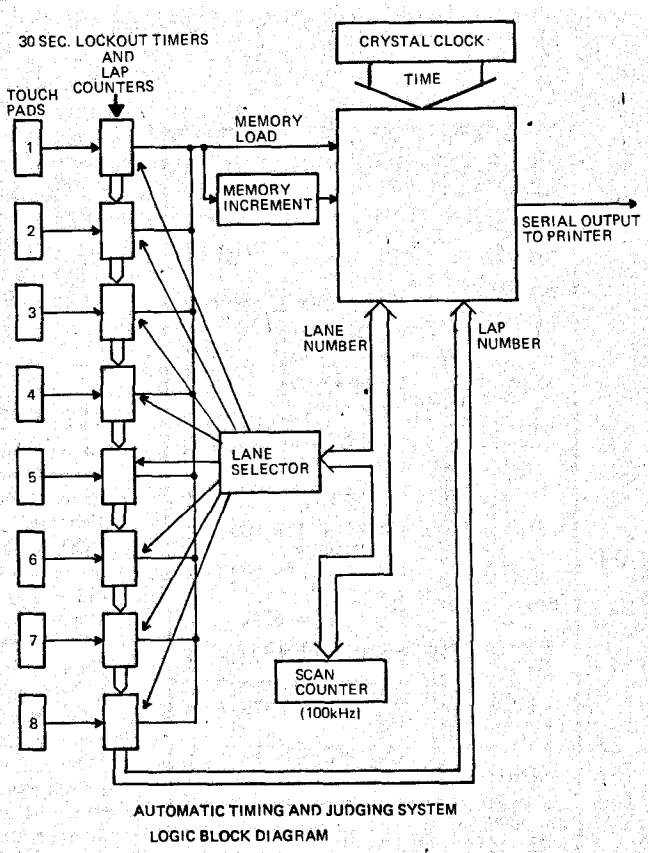
Strange no-one thought of it before!

Capitol

Distributed by E.M.I. (Australia) Limited. Branches in all States.



electronics in Sport



AUTOMATIC TIMING AND JUDGING SYSTEM
LOGIC BLOCK DIAGRAM

Electronic Swimming Timer

New electronic timer records and prints out results.

Melbourne-based D.D. Webster Electronic Pty. Ltd. has achieved an Australian first with its recent installation of an automatic timing and judging system in the Melbourne Olympic Pool.

While similar systems have become the standard form of judging at the Olympic Games and with many overseas athletic and swimming associations, Australia has lagged behind the rest of the world in this field.

A high landed cost prohibits the import of the overseas systems into the country, and until now there has been no local industry aimed with swimming and athletics in mind.

The Victorian Amateur Swimming Association which owns the device becomes the first amateur sporting body in Australia to adopt an electronic judging system.

Mr. David Webster, 29, designer of the new machine, expects it will put an end to the controversial decisions which have plagued Australian swimming competitions in the past.

HOW IT IS USED

The swimmers are started by a sharp report from a set of high pitched horns placed evenly amongst them, overcoming the unfair advantage of competitors nearest a starting pistol.

Pneumatic-electric touch pads are suspended in the water at the end of each of the pool's eight lanes.

The pads are large — 7' 6" x 3' — so there is little chance of a swimmer failing to register.

As each swimmer touches his pad at the completion of a lap, his lane number, lap number and time in minutes, seconds and hundredths, are committed to a short term buffer memory. This information is then printed out serially to give a permanent record free from all human error.

Competitors with identical times (to within one/hundredth of a second) will still be printed out in correct finishing order as a result of occupying successive locations in the buffer memory.

The unlikely event of two swimmers being so close as to be unresolvable by the machine logic has been avoided by employing a scanning system of finish sensing which checks each lane individually in sequence, at a rate of 100 kHz.

By this means, swimmers finishing within less than one ten/thousandth of a second are assigned an arbitrary finishing order.

DESCRIPTION OF LOGIC BLOCK DIAGRAM

Each of the eight inputs has its own associated lap counter, lockout timer and gating circuitry. The inputs are related by the scanning system which examines each of the eight lanes in sequence of 100 kHz.

When the swimmer in any lane finishes, a memory load signal is generated upon the next pass of the lane selector. At this instant, the respective lane number, lap number and elapsed time are loaded into one of eight possible locations in the buffer memory. When the loading cycle is complete, the memory is incremented one step in preparation for the next lane to touch. In this way eight lanes of information can be used allowing time for the slower print-out to catch up.

The printer is an electric typewriter modified for automatic printing of numerics but leaving the typewriter free for normal use.

The control and memory console has a regulated power supply, and logic circuitry which consists of 126 TTL/MSI integrated circuits distributed between thirteen plug-in circuit boards.

Front panel controls are kept to an absolute minimum having only a power switch, start and re-set push buttons. All other functions are fully automatic.

Development is currently in progress to enable the basic unit to be used for other similar purposes. ●

Electronics in Education

ELECTRONIC PIANO TUTOR

A new audio-visual method of tuition is claimed to enable beginners to play simple piano music at sight from standard musical notation.

The method devised by Teaching Developments Ltd., in Britain, is complete and self-contained in 32 concise lessons on filmstrip or slides, and soundtape.

Three editions of the system are available. The Class edition, designed with economy as a first consideration, is used with any manually-controlled filmstrip or slide projector and any standard tape recorder.

The Automated Class edition is used with a remote-controlled filmstrip or slide projector and any standard tape recorder, with a suitable synchronizing device to read the pulses on the tape and operate the projector. With this method the 'lesson' need only be switched on; thereafter the operation is automatic, leaving the teacher free to supervise the class. This edition is particularly suitable for senior or adult students where the full-time services of a teacher cannot be spared.

The Automatic edition is used with a fully automatic sound-film strip projector. Requirements of these projectors differ widely and specifications of the equipment must be supplied.

Details of the method known as the Robinson Audio-Visual system can be obtained from the publisher, Keith Prowse Music Publishing Co. Ltd., 21 Denmark Street, London, WC2.

A NEW VISUAL AID

A 'Touch Tutor' which has no knobs or buttons but operates at a touch on the screen, has been produced by a British firm to aid the teaching of backward or sub-normal children.

The equipment can also be used to enable normal children to learn to read and write at an earlier age.

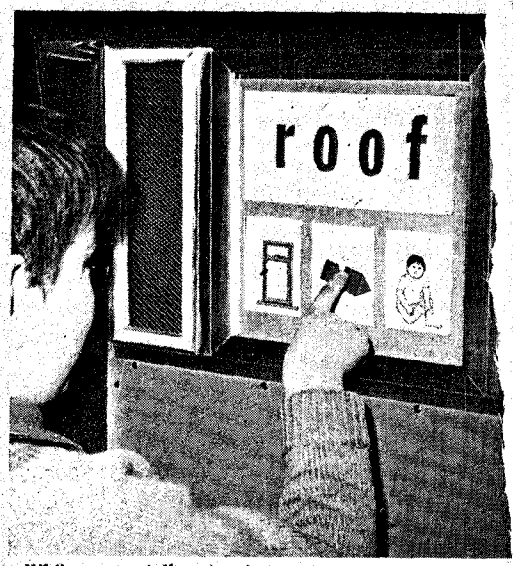
The screen shows a word or sentence in the upper half and three drawings in the lower half, one of which corresponds to the word above.

The pupil touches the panel of his choice — and if his answer is correct, the machine "says" the word and changes the display.

If the child touches the wrong panel, the display is changed, giving no second 'guess'.

In this way the child learns to associate the series of letters with the picture and the spoken word, in so simple a manner that it is possible to teach a normal child of three-and-a-half to read.

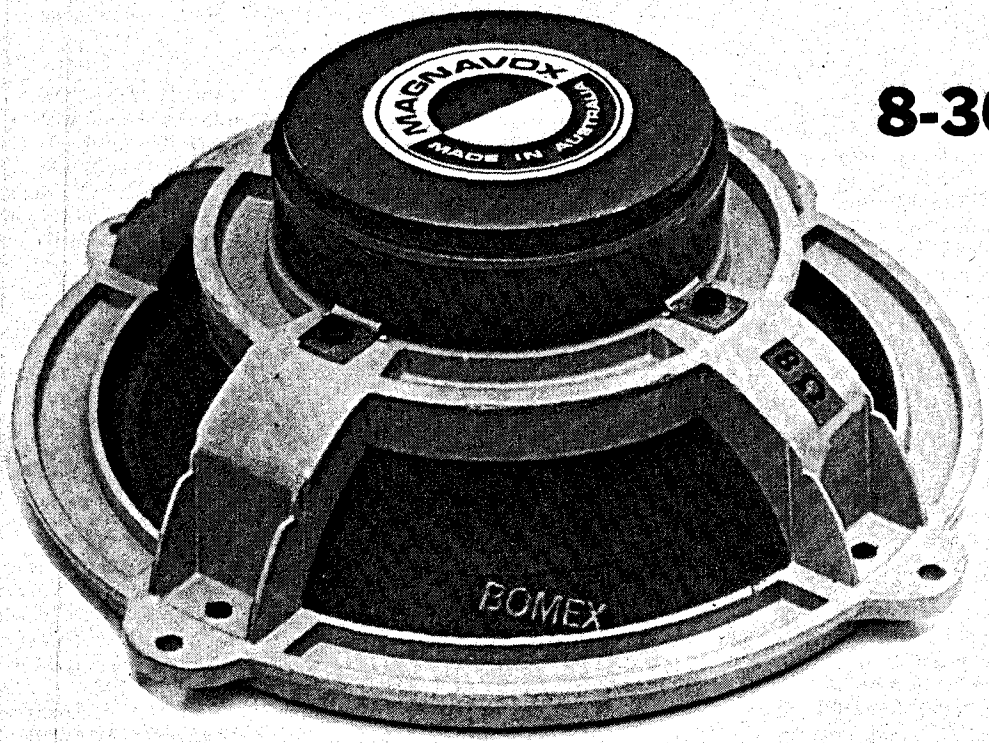
A range of programmes of some 100 frames is available for use with the machine which is fitted with an automatic counter to total correct answers. When the child reaches a predetermined level of competance with a particular programme, a light shows on the machine, indicating that the programme should be changed.



While essentially simple to operate, the Touch Tutor is practically cheat-proof and its rapid change of display and 'speech' can hold the interest of the student for considerable periods.

The 'Touch Tutor' is made by Behavioural Research and Development, Ltd., West View, Newcastle-upon-Tyne, England.

MAGNAVOX



8-30

The result of three year's research. A new concept of Hi-Power, Hi-Fidelity 8 in. loud speaker.

MODEL 8-30

Featuring . . .

- FREQUENCY RESPONSE 35Hz – 18KHz (WITH 3TC TWEETERS).
- POWER HANDLING – 30 WATT RMS.
- RUGGED DIECAST ALUMINIUM, EPOXY COATED HOUSING.
- MASSIVE FERRITE MAGNET ASSEMBLY.
- 1½" VOICE COIL – ALUMINIUM FORMER.
- WHEN USED 1.6 CU.FT. ENCLOSURE DESIGN FREQ., RESPONSE IS 35 – 18 KHz.
- IN 1.0 CU.FT. ENCLOSURE DESIGN FREQ., RESPONSE IS 50 Hz – 18 KHz.

For enclosure and kitset suppliers, detailed information on loudspeaker and design of recommended enclosures, contact Magnavox distributors; or Magnavox.

MAGNAVOX (AUSTRALIA) PTY. LTD.

6-12 O'RIORDAN ST., ALEXANDRIA, N.S.W. 2015. 69 4506.

AUDIO NEWS

SANSUI HI-FI PROMOTION

Australian sales of Sansui hi-fi equipment should increase substantially during the coming months due to the customer-orientated Sansui sales promotion launched by Simon Gray Pty. Ltd. – with the assistance of Atkins Carlyle in W.A.

The promotion has three main features. Firstly, to introduce hi-fi equipment to diverse groups of people, Sansui dealers, assisted by Simon Grey representatives will arrange audio demonstration evenings to interested clubs and organisations.

Secondly, recognising the wide range of customer preferences and budgets, Sansui have issued all their salesmen with specialised aids to help optimize combinations of turntables, amplifiers, speakers, etc., from the extensive Sansui range.

Thirdly, every customer purchasing a complete Sansui system during the four month promotional period will receive a free gift pack containing a Dust Bug, a Parostatic Disc Preener, a 50 page booklet entitled 'A Guide to Better Care of Long Playing Records', and a 12" check and play record, thus helping him to obtain optimum service from his equipment and records.

Nor has the salesman been overlooked, for prizes will be awarded to Sansui salesmen scoring the highest number of sales points during the period.

DOLY FOR FM RADIO

The Dolby company have announced that their noise reduction system will soon be available for use with FM broadcasting transmitters and receivers.

The company claim that the system greatly improves the signal-to-noise ratio from distant FM stations, and of course allows the transmission of a greater dynamic range.

Whilst the system is more effective with receivers that are equipped with the appropriate Dolby circuitry even those without are said to have improved reception.

For those who would be quite happy to have even un-Dolbyised FM, rumour has it that we shall see FM just as soon as the economy can withstand increased government spending.

COLOURFUL CASSETTES

EMI (Australia) Limited announces the release of a new range of budget priced, unrecorded, hi-fi, low-noise cassettes, available in 30, 60, 90 and 120 minute playing times.

Capitol Mod Cassettes are packed in cardboard boxes with a difference. Each box is attractively decorated with varying colourful floral designs.

A feature of this packaging is that once the outer transparent trade-marked wrapping has been removed, the complete colourful floral design is exposed, leaving no trace of any marking.

AUSTRALIAN HI-FI AUDIO SHOW 1971

The 1971 Australian Hi-Fi Audio Show will be held at the Koala Motor Inn, Sydney, from Thursday, 19th August to Sunday, 22nd August inclusive.

The following companies will be exhibiting:–

Simon Gray Pty. Ltd.
Haco Distributing Agencies Pty. Ltd.
W. C. Wedderspoon Pty. Ltd.
H. J. Leak (Aust.) Pty. Ltd.
Auriema (Australasia) Pty. Ltd.
Maurice Chapman & Co. Pty. Ltd.
Atram Pty. Ltd.
Astronics Australasia Pty. Ltd.
Hagemeyer (Australasia) N.V.
Audiosound Electronic Services Pty. Ltd.
Philips Electrical Pty. Ltd.
Audio Engineers Pty. Ltd.
Fred A. Falk (Sales) Pty. Ltd.
H. Rowe & Co. Pty. Ltd.
Convoy International Pty. Ltd.
Australian Musical Industries Pty. Ltd.
Instrol Hi-Fi Centre
Jacoby, Mitchell Limited.

The Koala Motor Inn is close to the city centre, and has ample parking facilities in the area.

The exhibition area has its own street entrance adjacent to the main hotel entrance. Admission is free and by ticket only – available from all audio showrooms throughout New South Wales.

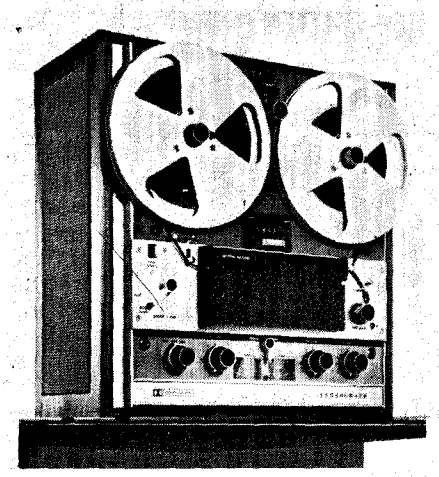
Apart from the ground floor exhibition area where all displays will be static, exhibitors will be using suites on the 13th floor of the Koala Motor Inn for demonstration purposes; the advantages of this being twofold, firstly there will be virtually no noise interference between the various demonstrations, and secondly, room acoustics in each of the suites are very similar to normal home environments, i.e. carpeted floor, drapes at the windows, normal furniture, etc.

One of the attractions will be the opportunity for anybody to try his or her skill at being a "disc jockey" – a special booth complete with microphone and turntable will be available for visitors to record their own voice introducing a record. All aspiring "deejays" will be recorded and the best of them will broadcast live on air in one of the regular radio programmes.

The Audio Show will be open from 10.00 a.m. to 10.00 p.m. from Thursday, 19th August to Sunday, 22nd August, inclusive.

AUDIO NEWS

FERROGRAPH RECORDERS WITH DOLBY



Ferrograph Series 7 stereo recorder, with Dolby 'B' noise reduction.

Most Ferrograph tape recorders, are now available with the Dolby 'B' noise reduction system, following a licensing agreement reached between the Ferrograph Co. Ltd., and Dolby Laboratories Inc.

These are the only high-fidelity domestic-use tape recorders available with this system in the world, according to Ferrograph.

This type 'B' system is based upon and works on the same principles as the Dolby 'A' type professional noise reduction system.

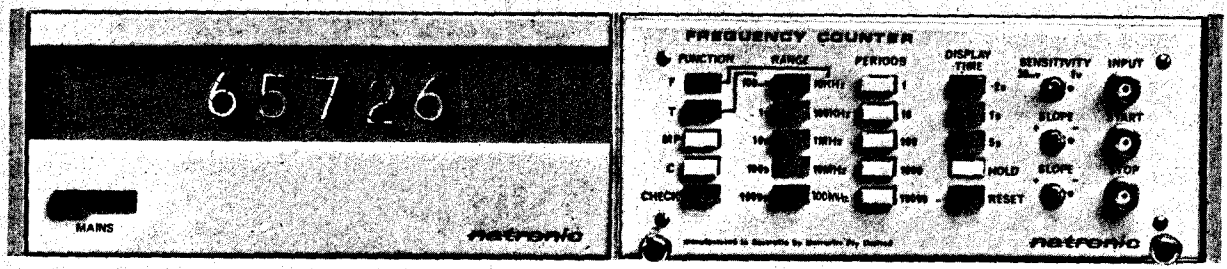
The 'B' system eliminates the background noise once considered inevitable in recording wide-frequency-range sounds at the low speeds generally associated with domestic tape recorders.

Explained simply, the 'B' system – based on patented electronic circuit designs – monitors music as it passes through the system and immediately before recording takes place. In the quieter passages of music, where noise is most easily discernible, the system automatically increases the circuit gain. These quiet passages are recorded therefore at slightly higher levels.

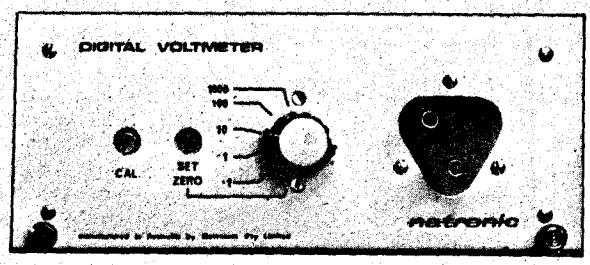
When this recorded material is played back through a tape recorder fitted with a Dolby system, the added brightness of low-level material is automatically reduced to its original level, simultaneously reducing the noise levels by 10 dB, while maintaining the integrity of the programme material.

Compatibility is good. Non-Dolby recordings can be played back on a Ferrograph machine with the 'B' system, by simply switching out this function. When a Dolby recording is to be played on a recorder without the system, some adjustment of the tone controls will be necessary to reduce the high-frequency response.

TWO FOR THE PRICE OF ONE



Frequency counter plug-in module type 5040 and basic main frame type 501



DVM plug-in module type 50410

Modular construction enables the Natronic 500 series of digital instruments to be used for accurate and repeatable measurement of a large number of variables. The instruments are constructed as a basic main frame with interchangeable plug-in modules.

Frequency counter plug-in module type 5040 and basic main frame type 501 combine to form a 100MHz frequency counter with facilities for period timing and event counting.

DVM plug-in module type 50410 and basic main frame type 501 combine to form a highly accurate integrating digital voltmeter. Principal features of the instrument include excellent zero stability, 0.02% accuracy maintained over a wide temperature range and good rejection of common and series mode interference.

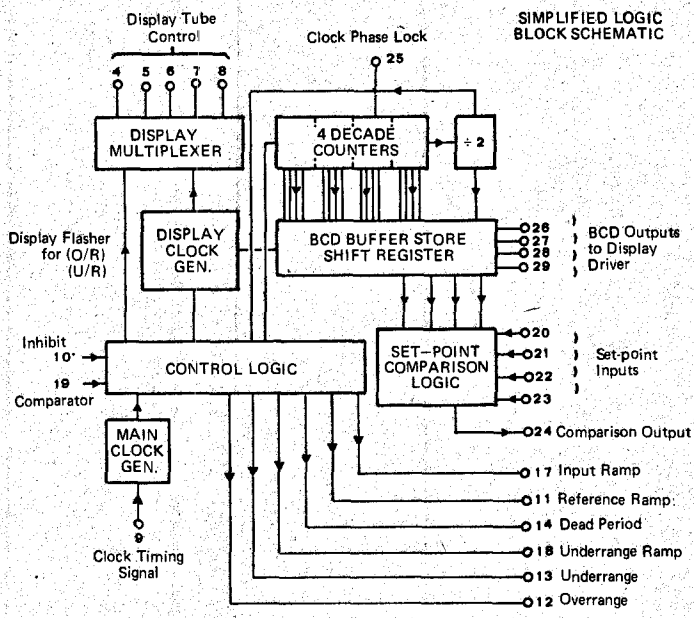
A main frame with both plug-ins available for what you would normally pay for one instrument.

NATRONICS PTY. LIMITED
THE CRESCENT, KINGSGROVE, N.S.W. • Phone 50-0111
74 RAGLAN STREET, PRESTON, VICTORIA. 3072

IRH THE EQUIPMENT DIVISION OF IRH INDUSTRIES LIMITED

COMPONENT NEWS

DVM LOGIC MODULE



A DVM logic module featuring MOS LSI construction has been released by IPL (U.K.).

Designated the MC902, the device is encapsulated in a special 30-lead epoxy/ceramic hermetic D.I.L. package and incorporates all the logic functions required for a five digit DVM operating on the dual slope principle.

Applications include, sophisticated miniature DVMs, multimeters, panel meters, counters, A-D converters etc. The manufacturers claim that the MC902 can save about 20 TTL packages in instruments employing conventional IC techniques.

Further information is obtainable from Teknis Pty. Ltd., P.O. Box 635, Crows Nest, NSW. 2065.

FOUR-WAY MULTIPLEXER

A four-way series/shunt multiplexer featuring low leakage, low ON resistances, direct drive from RTL, TTL or MOS logic capability and ON before OFF series/shunt switching has been released in Australia.

Designated the IMS 501, the device comes as a 14 lead D.I.L. package.

Applications include input switching to the current integrator in a dual-slope DVM and current amplifier functions in similar instruments.

Details from Teknis Pty. Ltd., P.O. Box 635, Crows Nest, NSW. 2065.

PRECISION VOLTAGE REGULATOR

A new monolithic voltage regulator from SGS (Italy) features single silicon clip construction using the Planar epitaxial process.

Designated the L123, the device consists of a temperature compensated reference amplifier, error amplifier, power series pass transistor and current limit circuitry. Provision is made for adjustable current limiting and remote shutdown. In addition, the device features low standby current drain, low temperature drift and high ripple rejection.

The L123 can be used with positive or negative supplies as a series, shunt, switching or floating regulator.

Applications include laboratory power supplies, isolation regulators for low level data amplifiers, logic card regulators, small instrument power supplies and power supplies for digital and linear circuits.

Further details from Warburton Franki, 372 Eastern Valley Way, Chatswood, NSW. 2067.

VERSATILE ADHESIVE

A versatile, high strength, rapid bonding adhesive, called Permabond, has been released in Australia.

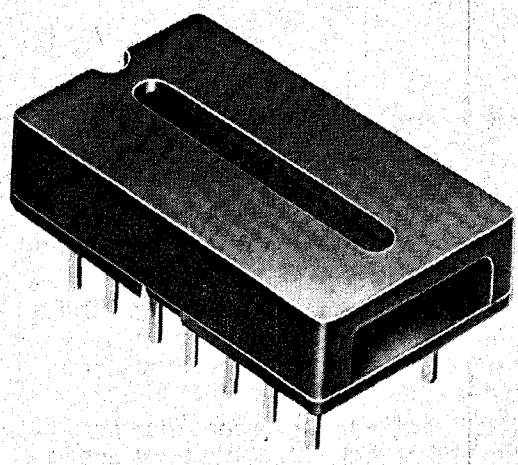
Capable of bonding almost any combination of materials, the adhesive features fast setting times (10 to 45 seconds), high tensile strength when set, low viscosity, it is impervious to most chemicals and produces a colourless, transparent bond.

No heat or pressure is necessary to effect a bond so that delicate parts can be cemented without risk of damage.

The adhesive is useful for bonding rubber, metals, plastics, wood and glass to themselves or each other. Components can be secured to circuit boards, plastic name plates to metal panels and rubber grommets to chassis holes etc.

Further details are available from Industrial & Medical Electronic Co., 6th Floor, 288 Little Collins St., Melbourne.

14-LEAD HEADER/PLUGS

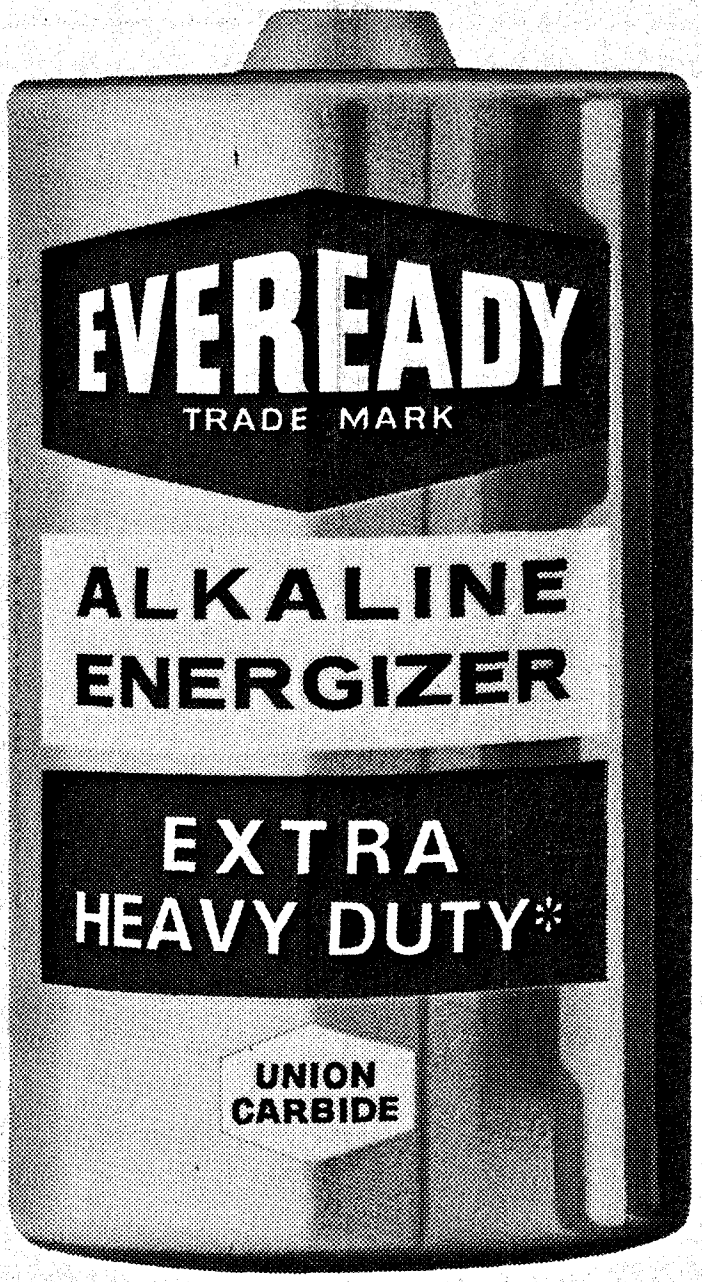


A 14-lead Pin Header/Plug only slightly larger than a 16-lead D.I.L. I.C. package is being distributed in Australia by McMurdo.

Useful as a convenient housing for discrete components or a free cable plug, the unit is 0.79" long by 0.49" wide by 0.20" high.

The gold plated contact pins extend 0.187" from the body and have an insulation resistance (between pins) claimed to be typically 10^4 MΩ at 500 V. d.c.

Further details from McMurdo (Australia) Pty. Ltd., 242 Blaxland Rd., Ryde, NSW. 2112.



THE ALTRUISTIC ALKALINE

Maybe a battery can't be high-minded but the people who made this one are.

Union Carbide set a standard for their Eveready Gold Alkaline Energizer battery that kept a lot of their top engineers awake a lot of nights.

They demanded a battery that would outlast all others with continuous use in high-drain equipment; one that would deliver fresh power instantly — even after months on the shelf or in equipment left idle for long periods.

They insisted on a battery that would operate in any extreme of temperature, remain utterly sealed to protect equipment, deliver absolutely consistent voltage at all times and have an extremely low impedance with a resultant improvement in fidelity when used in sound reproducing equipment.

If you demand a lot from a battery, this one delivers.

The Eveready Gold Alkaline Energizer.

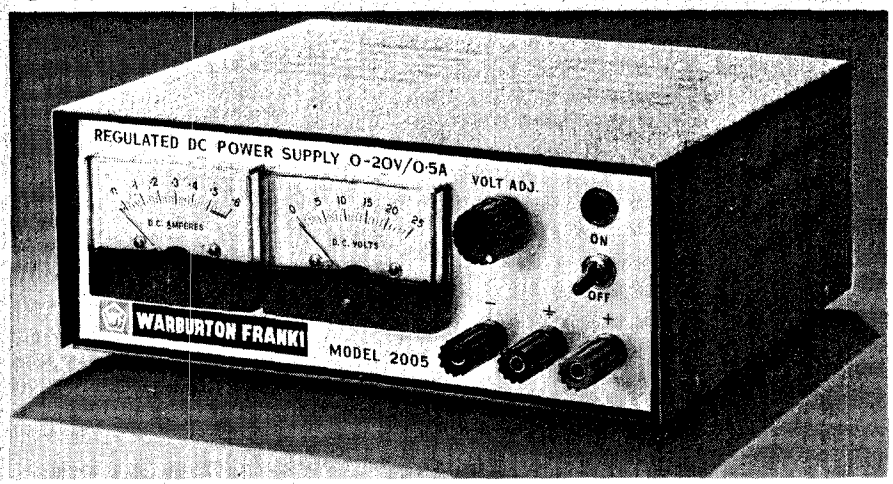
Built on a promise that no longer keeps us awake nights.

EVEREADY BATTERIES Products of UNION CARBIDE 'Eveready' & 'Union Carbide' are registered Trade Marks.

085.P.181

EQUIPMENT NEWS

LOW COST POWER SUPPLY



WARBURTON-FRANKI have recently released a low cost general purpose power supply.

Designated WF2005, manufacturers claim that the unit has 0-20V continuously adjustable output voltage at 0.01% regulation. The 2005 produces no power turn on/turn off overshoot and output ripple is < 1mV peak-to-peak. The unit is small in size and is internally protected so that two or more units may be connected in series to provide different voltage configuration.

The 2005 is especially interesting to educational institutions where simplicity of operation and robust construction are essential. Other uses include typical bench top power supplies and production line applications.

Full details from Warburton Franki, P.O. Box 182, Chatswood, NSW 2067.

SHORT RANGE TELEMETRY

A TELEMETRY SYSTEM (known as type SRT.1) has been designed by EMI (Aust.) Ltd., to meet the requirements of instrumentation in difficult or inaccessible locations.

Basically it consists of a small transmitter with self-contained rechargeable battery. The transmitter battery may be recharged by plugging it into a socket at the rear of the receiver. The receiver battery is recharged by connecting mains (240V 50 cps) to the unit.

The transmitter is frequency modulated with a pulse width modulated sub-carrier. This ensures maximum accuracy for transmitting slowly varying signals or dc levels. The modulating signal band-width is dc to 4 kHz; 25 mV rms will fully modulate the sub-carrier. This sensitivity has been chosen to suit input transducers such as strain gauges, pressure transducers, thermocouples, etc.

The receiver, which may be located several hundred feet away from the transmitter (depending upon intervening materials) has been designed to limit at 2 microvolts input, thus ensuring good signal-to-noise ratio. Its output is 0-1V peak-to-peak into 600 ohms. This is also displayed on a meter.

Details from EMI (Aust.) Limited, Electronics Division, 109 Burwood Rd., Hawthorne, Victoria. 3132.

TRANSDUCERS FEATURE LIGHT SPRING-LOADED ARMATURES

Lightweight spring-loaded armatures are used in a range of low-cost miniature displacement transducers introduced by a British company.

The built-in captive spring return transducers are available in ac and dc versions and meet a developing specialist need. They provide multi-point measurement at minimum cost, with wide applications in industrial research and general technological fields.

A minimum of friction and low mass of moving parts (armatures weigh only 0.9 grm.) make them suitable for such applications as profile, creep and load measurement (with transducer mounted in a load sensitive member) and as position elements in servo systems.

There are four models in both ac and dc series, with strokes of ± 0.025 in. and ± 0.100 in. In both series the spring return armature is completely contained within the main body of the transducer.

The ac units, which are linear variable differential transformer devices, offer exceptionally high linearity of 0.1% of output over rated stroke, and low carrier phase shift, facilitating 100:1 range expansion, when used with the company's solid-state modular carrier amplifier systems.

The dc units (which use a similar operating principle) provide a means of accurate measurement without using an external high frequency ac supply and associated amplifier/demodulator units.

Details from H. B. Selby & Co. Pty. Ltd., 352-368 Ferntree Gully Road, Notting Hill, Vic. 3168.

AUTOMATIC FREQUENCY COUNTER HAS 1.0Hz RESOLUTION

A RANGE of fully automatic frequency counters featuring 1.0Hz resolution and 11 digit display readout have been released by the Instrument Division of Auriema (Australasia) Pty. Ltd.

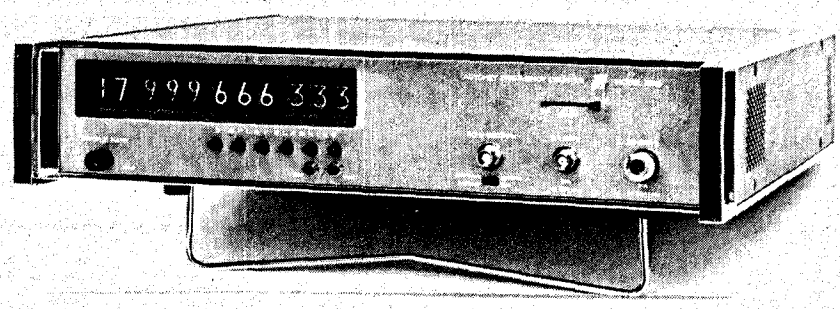
To make a measurement, it is only necessary to connect the signal to the input. If the signal is within the frequency and amplitude range, the counter will measure it, despite FM or noise.

No tuning is required nor any sensitivity adjustments. The frequency can be read directly in GHz, kHz and Hz.

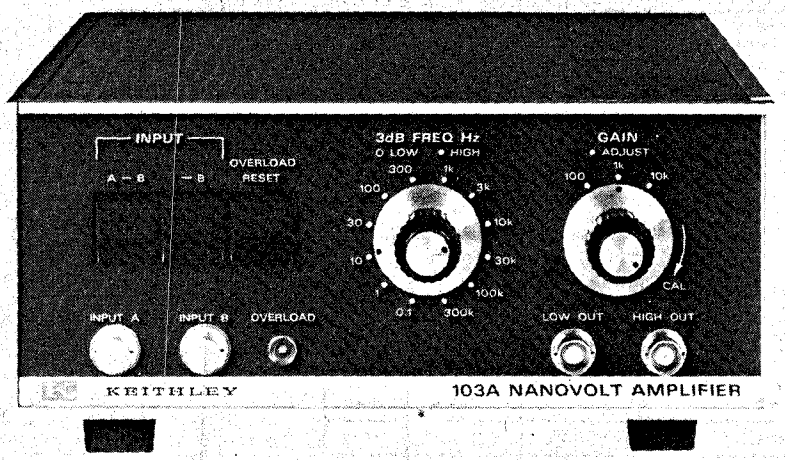
It can be used for the testing of communications equipment and links, and production line testing of communications equipment.

There are three instruments in the range; the EIP 351 covering from 20Hz to 18GHz, the EIP 350B with coverage to 12.4 GHz, and the EIP 360B, a basic counter to 210 MHz, with plug-in capability to extend the frequency coverage to 18 GHz.

Full details from Auriema (Australasia) Pty. Ltd., 63 Inkerman Street, St. Kilda, Victoria, Vic. 3182.



EQUIPMENT NEWS



NANOVOLT AMPLIFIER

KEITHLEY's Model 103A Nanovolt Amplifier features low-noise performance, wide bandwidth (0.1 Hz to 300 kHz), and calibrated gain (up to 60 dB).

The 103A is designed to enable low-level signals to be amplified with ease. The user is provided with a choice of differential or single-ended input configurations to simplify connecting the amplifier to the source. Noise figure contours in both configurations are available on request from the importers. Input impedance is 1000 MΩ shunted by 20 pF in the differential mode.

Bandwidth of the Model 103A can be reduced to limit interfering noise through the use of front-panel selected upper and lower cutoffs.

Common-mode voltages up to 1 volt peak-to-peak can be handled by the 103A and the manufacturers claim that overloads of up to 20 volts will not harm the instrument.

Output from the 103A is 10 volts peak-to-peak and thus sufficient for virtually any readout.

The 103A can be powered from any ±18 volt, 50 mA regulated source. An accessory power supply, the Model 1031A, is also available and powers up to 3 Model 103A Nanovolt Amplifiers.

Full details from Warburton-Franki Ltd., 364 Eastern Valley Way, Chatswood, NSW 2067.

'NON-MAGNETIC' MASS SPECTROMETER

A 'NON-MAGNETIC' quadrupole mass spectrometer has been made in Britain for use in the fields of surface physics, residual gas analysis and analytical applications.

Known as the QMS40, the principal features of the instrument are fast scanning, linear mass scale and high resolving power together with small physical dimensions which enable it to be added to existing systems or large analytical instruments.

Fast scanning of the instruments permits visual display of the spectrum up to mass 200. The addition of a multiplier allows fast scanning at low pressure of 10^{-12} torr which provides essential data in the achievement of low pressures.

Total and partial pressure readings are quickly and easily obtained by direct reading of the meter of the control unit.

Mass identification is made easy by the linearity of the scan provided by this instrument.

Design and construction of the source region allows the injection of ions or electrons into the mass filter thus enabling the QMS40 to be used in electron or ion desorption experiments.

Modular construction of the QMS40 control unit provides interchange facility for operation of the instrument with the variety of detection systems required for specific experimental conditions.

Further details from GEC-Elliott Automation, Electronics Division, 15 Whiting St., Artarmon, NSW 2064.

EIGHT-CHANNEL MULTIPLEXER

TEKTRONIX Australia Pty. Limited has announced the 4701 Eight-Channel Multiplexer. The 4701 multiplexer can be used with most XYZ storage or non-storage CRT displays. It is part of a modular, expandable system answering many of the requirements for multi-information displays for biophysical, biochemical, educational, mechanical, hospital and process control applications.

The 4701 features eight differential input channels, and a calibrated time base. It is

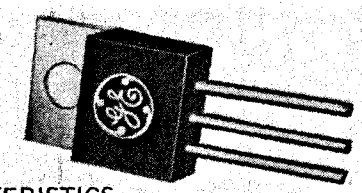
Triac SC146

Bi-Directional Triode Thyristor 10A RMS Up to 400 Volts

MAXIMUM ALLOWABLE RATINGS

RMS On-State Current, Amperes	Repetitive Peak Off-State Voltage, V_{DRM}		Peak One Full Cycle Surge (Non-Rep) On-State Current, I_{TSM} Amperes	Operating Temperature
	B Volts	D Volts		
10 AMPS	200	400	80	−40°C to +100°C

The General Electric Company, originator of the triac, now adds to its broad line of thyristors by offering a molded silicone plastic power pac traics, with these features:
Reliable — Silicon pellet design utilizes proved PNPN structure with glass protection on the pellet — No maximum torque limit on mounting screw
Versitile — Round leads — greatly simplifies customer assembly — Designed for either printed circuit board or chassis mounting — Compatible with JEDEC TO-66 mounting registration



CHARACTERISTICS

Test	Symbol	Max.	Units
Peak Off-State Current	I DRM	2	mA
D.C. Gate Current	I GT	50	mAdc
D.C. Gate Voltage	V GT	2.5	Vdc
Peak On-State Voltage	V TM	1.65	Volts
Holding Current	I H	75	mAdc

Examples of applications for the SC146 are control circuits for major appliances such as washers, refrigerators and electric ranges.
Houseware applications will include electric ovens, hair dryers and portable tools. Industrial applications include electric furnace controls, machine tools, business machines and copying machines plus many others.

AUSTRALIAN GENERAL ELECTRIC LTD.

103 YORK ST; SYDNEY . 2000. Ph. 298711

DISTRIBUTORS: Watkin Wynne Pty. Ltd., 32 Falcon St., Crows Nest. Tel: 43-2107
GEC-Elliott Automation Pty. Ltd., Adelaide, Tel: 23-2700
PB Components, Melbourne, Tel: 53-2766
GEC-Elliott Automation Pty. Ltd., Brisbane, Tel: 32-0441
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NEW PRODUCT
BY
YUNKER ELECTRONICS

TYPE 185U / 50U
UNIVERSAL COUNTER
TYPE 185F / 50F
FREQUENCY COUNTER
TYPE 50F
(50MHz Frequency Counter)

FEATURES:

- Frequency 10Hz to 185MHz.
- High input sensitivity.
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- 7 digit latched display with fast store transfer.
- Excellent serviceability by plug-in circuit boards.
- 6 month guarantee.
- Designed and manufactured in Australia.
- Cheapest counter of its class in Australia.

YUNKER ELECTRONICS
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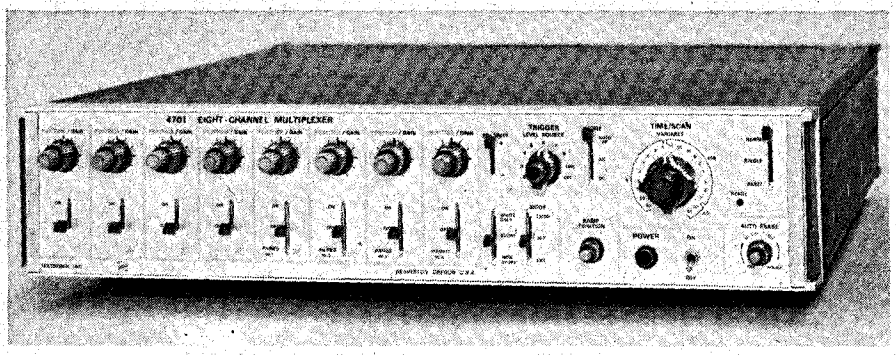
PHONE: 81 2818

EQUIPMENT NEWS



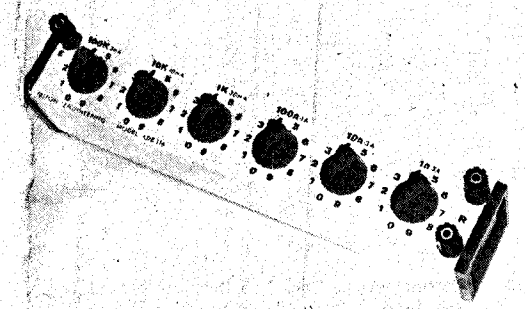
plug-to-plug compatible and provides signal conditioning for Tektronix types 601 and 611 Storage Display Units, non-storage 602 Display Unit and the 4501 Scan Converter. The 4701 permits up to eight Y-T displays, up to four X-Y displays or combination of Y-T and X-Y displays.

Each channel has differential inputs with a MΩ, 20 pF input impedance and CMRR is better than 100:1. The bandwidth is 1 MHz. The channels can be operated in alternate, chopped or external-programmable modes permitting a choice of ways to view signal information. When the EXTERNAL switching mode is selected the ON channels are controlled through three TTL compatible input lines. Binary information applied to these lines by the user permits 1 through 8 individual ON channel selections and sequencing.

The time base supplies linear full screen repetitive or single sweep displays from 10 μs to 50 s in 21 calibrated steps. Nominally 1 volt of X output is supplied for use with display units. Maximum output is ±5 volts at 50 Ω output impedance.

Sweep triggering is simple and versatile. Any of the 8 channels of display information can be selected as a source to initiate the sweep. Also, an external source and a power line source is provided. Automatic peak-to-peak, dc coupled or ac coupled trigger modes permit easy, reliable triggering for virtually all applications.

Full details Tektronix Pty. Ltd., 80 Waterloo Rd., North Ryde, NSW 2113.



NEW LOW-COST DECADE BOX

A NEW low-cost decade box for use in laboratories, schools, industry and by the serious amateur, has been released by DC Electronics Pty. Limited.

Designed and made in Australia by Triton Engineering Co., Sydney, it has six decades from 1 ohm to 1 megohm, and is available for only $29.50 each, in lots of five.

The manufacturers claim that all decades from 10 ohms to 900 kohms are accurate to ±1 percent and that the accuracy from 1 ohm to 9 ohms is ±5 percent.

The permissible continuous loading is 1 watt per step at room temperature.

The switch design incorporates beryllium copper wire contacts which engage a copper track on the printed circuit board. The resistors from 1 ohm to 99 ohms are noninductive bifilar wire wound, and from 100 ohms to 999K ohms are high stability deposited carbon.

Full details from D. C. Electronics Pty. Ltd., 32 Smith St., Collingwood, Victoria, 3066.

NEW VHF FM WALKIE TALKIE

Strato Communications have announced the release of a VHF hand held transceiver which is approved by the PMG. The unit features 1 watt transmitter output, multi-channel operation and all solid state circuitry employing silicon transistors and integrated circuits.

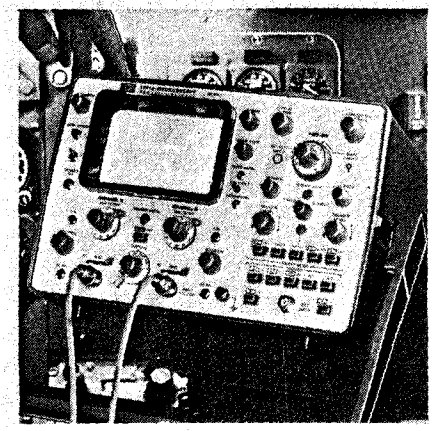
EQUIPMENT NEWS

The unit employs electronic function selection rather than a conventional multi-position press-to-talk switch to overcome problems of dust and corrosion effects encountered with conventional techniques.

Called the Stratocom SH-501, the unit can be powered by Ni-G rechargeable batteries or standard Zn-C cells.

Full details from Strato Communications Pty. Ltd., 25 Wentworth St., Parramatta, NSW, 2510.

PORTABLE OSCILLOSCOPES



Hewlett Packard have introduced a new line of portable oscilloscopes called the 1700 series.

Features include low power consumption, external ac, dc or internal battery operation, dual channel (10mV/div.), 10ns/div. on expanded sweep, 35 mHz bandwidth and stable, sensitive triggering.

Useful in field service or workshop situations, the new oscilloscopes weigh only 24 lb. All units include an adjustable handle that can be detented to function as a stand.

Further details from Hewlett Packard Aust. Pty. Ltd., 22-26 Weir St., Glen Iris, Victoria. 3147.

FREQUENCY SYNTHESIZER SIGNAL GENERATOR

Logi Metrics have produced a frequency synthesizer signal generator called the Signalock 925.

Claimed to be stable to within 10 Hz the instrument features a closed-loop digital locking technique allowing locking at 100 Hz intervals throughout the 50 kHz to 80 MHz range.

A digital readout display and selectable resolution to 10 kHz, 1 kHz or 100 Hz are also included. The generator can be locked to its internal reference, an external reference or be operated in the unlocked mode.

Further details from Elmeasco Instruments Pty. Ltd., P.O. Box 334, Brookvale, NSW 2100.

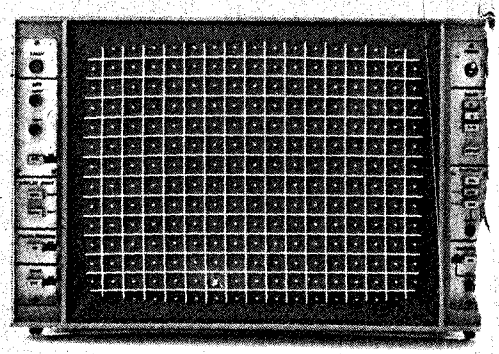
LOGIC PULSE GENERATORS

A robust, low cost logic pulse generator developed by a British firm can be carried in the hand to provide on-the-spot facilities for IC circuit systems. It measures 4¾" x 6¾" x 3½" and weighs 2¼ lb.

Its output pulses, derived from a TTL gate, are fully compatible with DTL and TTL levels. Pulse recurrence frequency is 1 Hz to 10 Hz in two ranges, pulse length 1μ sec to 500μ sec with rise and fall of 20 n sec and pulse delay of 150 n sec.

Full details from Warburton-Franki Ltd., 364 Eastern Valley Way, Chatswood, NSW, 2067.

MONOCHROME MONITOR



Tektronix Aust. Pty. Ltd. has announced its first entry into the picture monitor field with the 630 Monochrome Picture Monitor, which complements the 650 colour picture monitor announced simultaneously.

It features solid state circuitry, a 15" diagonal, (essentially square) picture tube, dc coupled deflection circuits, regulated power supplies, preset brightness and contrast controls for 1.0 V signal (variable controls included), independent push buttons to move the vertical and/or horizontal sync pulses into the picture and an underscan function that reduces the raster scan approximately 20% to enable the display of the entire active picture.

Full details from Tektronix P/L., 80 Waterloo Rd., North Ryde, NSW, 2113.

Can Machines Think?

(Continued from Page 19)

the deductive proofs used in conventional mathematics, particularly in geometrical theorems.

Computer scientists have come to distinguish between two different approaches to deductive problem-solving. The first, which is called algorithmic, basically means solving the problem by trying out all the possible steps in all the possible solutions. While this may at first appear to be certain to turn up the right answer, there is, of course, no guarantee concerning the amount of computing required. There is, for example an algorithm for playing chess, but it is not a practical one. Using exhaustive, algorithmic methods to solve problems has been described as "as sensible as placing typewriters before monkeys and waiting until they produce all the books in the British Museum".

The second approach is called the heuristic method. Heuristic techniques basically involve a capacity to size up the current situation, and choose a plausible (if not always good) next step. Thus heuristic programmes do search for the best solution, like algorithmic programmes, but they try much fewer possibilities. Heuristic programmes may not always produce an answer to a well-defined problem; but when they do, will produce it without an intolerable amount of computing.

Furthermore, it has been suggested that, since humans are known to solve problems for which there is no practical algorithm, but sometimes fail to solve problems for which a simple algorithm exists, they must use heuristic problem-solving methods. Therefore heuristic programmes should be a better approximation of human thought processes.

Arthur L. Samuel, of the I.B.M. Corporation, has developed a heuristic programme which plays drafts (or checkers). This programme explores thousands of board positions, but not the millions of possible combinations, and it makes use of an assessment of the current situation and possible outcomes of selected moves to decide its next play.

COMPUTERS THAT READ

One of the more spectacular developments in this field is the STUDENT programme designed by Daniel Bobrow.

The machine first "reads in" the statement of the problem and tries to rewrite it as a number of simple sentences. Then it tries to convert each simple sentence into an algebraic equation. Finally it tries to solve the set of equations and present the required answer (converted back to a simple English sentence).

But STUDENT also displays a very human-like flexibility in its problem-solving behaviour. For instance (in Figure 3), STUDENT shows it can make "intelligent" guesses, or ask for help, when it lacks sufficient information to solve a given problem.

SIMULATION OF HUMAN BEHAVIOUR

There have been attempts to design programmes which simulate human thought processes, such as the ARGUS programme, which solves word analogy problems, similar to the geometrical analogy problems described above, and EPAM, a verbal-learning programme. Unfortunately, the performances of such programmes either have not been systematically compared with human performance or, when they are, are often found to be poor simulations. This situation need not be permanent. The EPAM programme for example was revised and its augmented successor, EPAM 111, is impressive in its ability to mimic human learning behaviour.

It is also interesting to note that programmes have been designed which are intended to simulate human personality and social processes, although whether you would consider these behaviours as "thinking" is arguable in itself.

In any case, the future of computer simulation of human *behaviour* looks unpromising. Psychologist Earl Hunt, reviewing the field of research in 1968, concluded that generally the programmes proposed as models of

(THE PROBLEM TO BE SOLVED IS)
(THE GAS CONSUMPTION OF MY CAR IS 15 MILES PER GALLON. THE DISTANCE BETWEEN BOSTON AND NEW YORK IS 250 MILES. WHAT IS THE NUMBER OF GALLONS OF GAS USED ON A TRIP BETWEEN NEW YORK AND BOSTON Q.)

(THE EQUATIONS TO BE SOLVED ARE)

(EQUAL G02556 (NUMBER OF GALLONS OF GAS USED ON TRIP BETWEEN NEW YORK AND BOSTON))

(EQUAL (DISTANCE BETWEEN BOSTON AND NEW YORK) (TIMES 250 (MILES)))

(EQUAL (GAS CONSUMPTION OF MY CAR) (QUOTIENT (TIMES 15 (MILES)) (TIMES 1 (GALLONS))))

THE EQUATIONS WERE INSUFFICIENT TO FIND A SOLUTION

(USING THE FOLLOWING KNOWN RELATIONSHIPS)
((EQUAL (DISTANCE) (TIMES (SPEED) (TIME))) (EQUAL (DISTANCE) (TIMES (GAS CONSUMPTION) (NUMBER OF GALLONS OF GAS USED))))

(ASSUMING THAT)
((DISTANCE) IS EQUAL TO (DISTANCE BETWEEN BOSTON AND NEW YORK))

(ASSUMING THAT)
((GAS CONSUMPTION) IS EQUAL TO (GAS CONSUMPTION OF MY CAR))

(ASSUMING THAT)
((NUMBER OF GALLONS OF GAS USED) IS EQUAL TO (NUMBER OF GALLONS OF GAS ON TRIP BETWEEN NEW YORK AND BOSTON)

(THE NUMBER OF GALLONS OF GAS USED ON A TRIP BETWEEN NEW YORK AND BOSTON IS 16.66 GALLONS)

Fig. 3

Computer is momentarily stumped because it has been told that the distance from Boston to New York is 250 miles but has no positive knowledge that the distance from New York to Boston is the same. The computer makes a guess that the two phrases describe the same thing and goes on to solve problem.

(THE PROBLEM TO BE SOLVED IS)
(THE GROSS WEIGHT OF A SHIP IS 20000 TONS. IF ITS NET WEIGHT IS 15000 TONS, WHAT IS THE WEIGHT OF THE SHIPS CARGO Q.)

THE EQUATIONS WERE INSUFFICIENT TO FIND A SOLUTION

TRYING POSSIBLE IDIOMS

(DO YOU KNOW ANY MORE RELATIONSHIPS AMONG THESE VARIABLES)

(GROSS WEIGHT OF SHIP)

(TONS)

(ITS NET WEIGHT)

(WEIGHT OF SHIPS CARGO)

yes
TELL ME

(the weight of a ships cargo is the difference between the gross weight and the net weight)

THE EQUATIONS WERE INSUFFICIENT TO FIND A SOLUTION

(ASSUMING THAT)
((NET WEIGHT) IS EQUAL TO (ITS NET WEIGHT))

(ASSUMING THAT)
((GROSS WEIGHT) IS EQUAL TO (GROSS WEIGHT OF SHIP))

(THE WEIGHT OF THE SHIPS CARGO IS 5000 TONS)

Lacking information with which to solve problem, computer asks for help. The operator, (typing in lower case letters) provides the necessary relations but does not use the same words as the problem used, forcing literal-minded computer to make some assumptions.

TYPICAL OBJECTIONS

Despite the existence of the programmes described above, and many others like them, we still hear objections to the possibility that machines can think. Turing, who gave us the "imitation game" mentioned earlier, foresaw such objections and ably dealt with them. We will briefly review his arguments.

(1) The theological objection states that thinking is a function of man's immortal soul, and therefore machines cannot think. Turing's reply was that, even if you accepted the first part of the argument, you could then argue that creating "thinking" machines was like creating children, "providing mansions for the souls He creates."

(2) The "heads in the sand" objection is rarely expressed openly, but basically comes down to saying that the consequences of machines thinking would be too dreadful, so let's hope they cannot. This is, of course, not a logical refutation of the argument at all and can be dismissed.

(3) The mathematical objection is more complex, but, put simply, it is possible to show by mathematical logic that there are limitations to the powers of "thinking" machines, that there would be some questions that some machines could not answer. Implicit in this objection is the notion that the human intellect is not so limited, and human thinking does not make mistakes. The fallaciousness of this claim is obvious.

(4) The argument from consciousness is essentially that machines cannot think because they do not have conscious feelings. Turing's reply was to point out that we do not really know, in the sense of having directly observed, that *anyone* has conscious feelings, other than ourselves. I know that I have conscious feelings, but I cannot experience your conscious feelings. In practice, of course, we conventionally accept that other people think, and there seems no reason why we should not extend the same courtesy to computers.

At the time he wrote, Turing was prepared to concede that there was still mystery about the nature of consciousness, but felt that this was irrelevant to the question. One leading physiological psychologist has stated that consciousness is the result of the complex interactions of the billions of nerve cells in the brain. If this is correct, there is no reason in principle why it should not be possible to design a computer with similar complexities of function.

(5) Arguments from various disabilities take the form, "I agree you can make machines do the things you say, but you will never be able to make one to be friendly (or fall in love, enjoy strawberries and cream, and so on)." This criticism really amounts to saying that machines cannot have much diversity of behaviour, and this is just another way of saying that computers have limited storage capacity. As Turing went on to point out, if you show the sceptic how a machine could do the required task, this was often disregarded, as the solution offered was too "mechanical". Thus this argument becomes very similar to the argument from consciousness, in that it suggests that there is something "special" and "non-mechanical" about the physico-chemical events in the brain which underlie behaviour. There is, of course, no scientific evidence to support such a notion.

"About this computer of yours that does the work of three men . . ."

(6) Lady Lovelace's objection was to Babbage's Analytical Engine, the mechanical computer described earlier. It had, she wrote, "no pretensions to originate anything." The argument that a machine can never do anything really new has been raised many times since. It is implicit in this argument that man, unlike the machine, does originate material. Thus the answer to the argument is to point out that again no scientific evidence has been offered to show that the creative act, such as writing a novel, is not the outcome of the author's processing a series of inputs (his experiences and education) to produce a new output, the content of which stems directly from the nature of the inputs and of the processor.

(7) The argument from informality of behaviour contrasts the supposed unpredictability of human behaviour with the supposed predictability of machine behaviour. It is generally then concluded that we cannot be machines, therefore machines cannot do what we can do, i.e. think. The simple existence of the behavioural sciences is a refutation of this argument, since it is fundamental to any science that the phenomena it studies are governed by discoverable laws.

Psychologists have by no means uncovered all the laws of human behaviour, but they have certainly made a good start and can make fairly reliable predictions under a variety of conditions.

(8) Argument from continuity in the nervous system, in Turing's paper, compared one aspect of computers with the related aspect of the nervous system. We need not concern ourselves with the details since, as mentioned earlier, computers are not, and are not intended to be, models of the brain or the nervous system. While there are some striking functional similarities and parallels in organisation between nervous systems and electronic circuits, there are also some large differences in both function and structure. The point is that these differences do not, in themselves, preclude the possibility of both kinds of system engaging in the same, or at least very similar, behaviours, just as a paint brush and a spray gun produce very similar results despite their structural and functional differences.

THE FUTURE

It seems reasonable to conclude that computers already exhibit behaviour which can fairly be described as thinking. The most tenable objection to this proposal might be the criticism that our computers are rather narrow-minded specialists, often outshining the human intellect on one kind of activity, but dunces, or completely incompetent, in all others.

As has already been pointed out, this is simply a reflection of currently available computers and programmes.

Minsky has proposed that it is in principle possible to design and programme a computer that can not only improve its own programmes but also its own design. Once this development takes place, we will have set in motion a new evolutionary process, the evolution of the thinking machine.

Then, Minsky feels, it will be inevitable that, for the first time in his existence, man will have to share the earth with intellectually superior beings. ●

* **"I think, therefore I am".**

RECORDINGS... CLASSICAL

REVIEWERS: John Araneta, Christopher Wagstaff, John Clare.

STOCKHAUSEN — Kurzwellen. DGG Stereo 2707 045. Harold Boje, electronium and short-wave radio; Alfred Alings and Rolf Gehlhaar, tam-tam and short-wave radio; Aloys Kontarsky, piano and short-wave radio; Karlheinz Stockhausen, filters and potentiometers. Double album.

'Kurzwellen' is basically an uninterrupted improvisation lasting 53½ minutes. The players react collectively or in solo (this, I take it, predetermined by Stockhausen) to signals and snatches of programme picked up at random on short-wave radios.

In his sleeve notes, Stockhausen says, "These records should not be played mono and, because of their large dynamic range (should be played) at relatively high volume, if possible with four loudspeakers – two for each channel, one speaker in each corner of the room."

I am afraid I fell down on the last requirement, though I imagine that some of the desired effect can be obtained by listening through earphones, which I did. Earphones supply at least a third vividly imagined sound source, giving the impression that one's head at least is inside the music, or perhaps that the music is inside one'e head – in any case, a not-too-difficult imaginative leap gets you somewhere near where Stockhausen would have you in relation to the music.

It should promptly be pointed out that much of this improvisation is quite musical and even harmonious, in the broad sense. It has a musical flow, mostly, and can be experienced as music rather than as a succession of sounds or textures.

It is not always very memorable music. Sometimes it is only curiosity as to what the musicians will do with a particular signal which sustains interest. On Stockhausen's terms this is not a valid criticism, for he has always maintained that music which can be enjoyed intellectually rather than emotionally, or sensually, has its place – and never more so than in this technical age.

One of the first signals, from the BBC, is remarkably similar to the opening of Beethoven's Fifth Symphony. The players repeat and paraphrase this for a few minutes before receiving a more nebulous short-wave sound, which prompts some rather more interesting improvisation. However, they do not always do better with abstract material.

Stockhausen's idea seems to be in part to create a 'strange' environment of sound, some of which is produced electronically, into which familiar cadences and familiar sound 'objects' are allowed briefly to intrude. Sometimes, of course, more strange sounds are brought in from the radio waves: "Does not," says Stockhausen, "a great deal of what we receive on our short-wave radios already sound as if it came from quite different spaces – beyond speech, reportages, music, morse code?" The players then react to the alien or familiar intrusion, almost as if to discuss it among themselves on a musical level.

These reactions are often at once instinctual and highly sophisticated. Familiar sounds may be received as by men adrift in space, or as though by beings who had never heard these sounds before.

On the second side of the first recording, a snatch of some European song in the popular idiom (whether actually popular or not I can't say, never having heard it before) is met with antagonistic deep glowering sounds, which soon give way to a peaceful and quite lovely interlude. This suggested to me a tribe of apes reacting with hostile suspicion to something strange, then deciding that they like it and sitting back in unselfconscious euphoria. The music which expresses this euphoria, however, is beyond the making of apes.

There are some quite exciting passages where everyone takes off on the sometimes syncopated rhythms of short-wave static, and there are moments of magic conjunction where an elongated and garbled voice fits right into what is being played at the time of its being picked up.

The recorded sound is very good. This double album will be an essential buy for anyone more than casually interested in Stockhausen. Whether I would have bought it myself is hard to say. Having had the opportunity to listen extensively, I can only say that I will certainly be listening to it again. – J. C.

J.S. BACH — Toccata & Fugue in D minor (MWV 565); Fantasia & Fugue in G minor (BWV 542); Prelude & Fugue in E minor (BMW 548); Passacaglia & Fugue in C minor (BWV 582). Karl Richter (organ). Decca Ace of Diamonds SDD 258. Stereo.

Here we have oboe sonatas by probably the most familiar composers of the Baroque Era. The Handel sonatas sound very much like Telemann in places – no doubt written before Handel left Germany. The Bach sonata is probably better known for flute and harpsichord. The Vivaldi sounds much like any of his other sonatas. Whereas the harpsichord parts for the Handel and Vivaldi works are built up from figured basses (and in this recording a 'cello reinforces the bass line), the Bach sonata has a separate part written out in full.

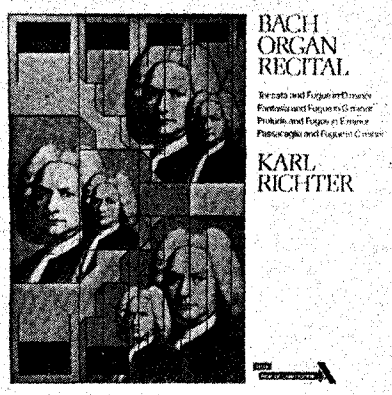
The disc is primarily intended to demonstrate the artistry and skill of the oboist, Heinz Holliger. This it does well. From beginning to end his control over the instrument is strongly evident. Each phrase is beautifully shaped and the music comes to life. An ordinary Vivaldi sonata can sound very beautiful when in the hands of a fine artist.

Quite amazing is the different timbre of sound Holliger obtains for some movements (Handel Op. 1 No. 6, 2nd and 3rd movements). Embellishments (especially those for repeats) are well thought-out and delivered with confidence. Rapid passages are played with good precision, and his triple-tongueing in the last movement of the Vivaldi is notable. There is throughout a sweetness in the upper register which is quite lovely – usually we have to put up with a rather thin and 'scratchy' sound. Some of Holliger's contrasts in dynamics are perhaps slightly overdone (mainly in the Bach sonata).

The only real shortcoming of the record is the sound of the 'cello. Often it is out of tune – and since the bass part is the basis for the Handel and Vivaldi works, this irregularity of pitch is immediately apparent. Somehow the 'cello does not blend well with the cembalo – in fact, it sounds rather plummy. Perhaps this is due to its well pronounced fundamentals, but I did not like it. The lack of planning makes the 'cello sound quite ponderous. It would have probably been much better to omit the 'cello and let the harpsichord play its part (which it probably does anyway) – or, better still, to use a viola de gamba (with its more prominent upper harmonics).

Both Holliger and Picht-Axenfeld play well together, the second movement of the Bach sonata being particularly beautiful, and entries are firm. The oboe, however, is often a little dominating. This is excusable for the Handel and Vivaldi works, where the oboist is probably the main feature, but in the Bach the cembalo has its own importance.

A good showcase for an expressive oboist. – C. W.



CLASSICAL

HANDEL/BACH/VIVALDI — Oboe Sonatas. Heinz Holliger, oboe; Edith Picht-Axenfeld, harpsicord; Marcal Cervera, cello. Philips SAL 3772. Stereo. Handel — Sonata in G Minor, Op.1 No. 6; Sonata in B Flat Major; Sonata in C Minor, (Op.1 No.8. Bach — Sonata in G Minor, BWV 1020. Vivaldi — Sonata in C Minor.

Karl Richter's conducting of Bach's choral works has always been impressive – his performances of the Mass in B Minor and the Christmas Oratorio are the finest I have heard. This performance of Bach organ music is, however, one of the worst I know.

Unless you have very Victorian ideas on how Bach should be performed, this is not a record to have. Mr. Richter loves reed stops for almost all the counterpoint (even including the fugue subjects), with the result that no part is clearly distinguishable – except when fugue subjects are "served out" by playing them on another manual, as in the C Minor Fugue. Climactic moments are disastrous since Richter insists on using full organ each time, achieving merely a large, thunderous noise.

The organ used (Victoria Hall, Geneva) does not help matters with its overblown 16' and 32' open woods and roaring pedal ophicleides – but it *does* have certain stops which, if used in right combinations, can be useful for the performance of Baroque organ music. Richter does use some of these stops in the E Minor Fugue, but only for the episodes – once the subject material appears, we are back to the messy sound of multitudinous 8' flues and reeds.

There are many changes of registration (perhaps too many for the echo effects of the D Minor Fugue), and where there are manual changes for the episodes, the contrast of sound and timbre is somewhat overdone. Richter is content to accumulate stops during a section and, in fact, the Passacaglia sounds like one gigantic build-up from a soft 16' pedal theme to full organ for the last variations.

Phrasing is disappointing throughout. Richter uses staccato freely (even for fugue subjects) but not with any regularity, so that the opening theme might be played staccato but the pedal entry legato (as in the E Minor Fugue). In some instances the use of staccato for some of the fugal episodes is fine – it can provide an effective contrast – but continous use can be very pedantic, as in the G Minor Fugue. There is little feeling of continuity within the fugues themselves – the opening of the D Minor Fugue sounds quite dainty, whereas the end is austere and rather cold.

I find particularly annoying the changes of tempo during a work; not only do we have different registrations for each variation of the Passacaglia, but (Variations XIV, for instance) different tempos. Rubato is freely used, but this becomes distressing when Richter applies it to the endings of variations in the Passacaglia.

On the whole then, a *very* romantic performance. Richter's later recordings of Bach organ music for DGG are better, but still do not approach the magnificence and beauty of those made by Marie-Claire Alain (ERATO) or Lionel Rogg (ORYX, WRC). – C. W.

STRAVINSKY — The Firebird (complete 1910 version). New Philharmonia Orchestra, conducted by Ernest Ansermet. Decca SET 468-468A (Includes bonus record of rehearsal). Stereo.

Ernest Ansermet was the first conductor to record the complete 'Firebird' at a time when the entire score was anything but known to concert and record buyers.

A decade later, another recording was made by Ansermet – this time for stereo – and, as in the first recording, with the Suisse Romande. As this second recording is still available on Decca Ace of Diamonds, with still more than acceptable sound, it seemed needless duplication on the part of Decca to record the same work with Ansermet a third time.

The availability of the composer's own magisterial reading (GBS) and of a fine Dorati (French Philips) also did not make me exactly eager for another recording by Ansermet, both of whose earlier efforts were, it seemed to me, rather anaemic renditions. Certain portions of the score – especially the Infernal Dance and the Finale – appeared simply beyond Ansermet's achieving. His orchestra in these sections sounded as if it would fall apart any moment, and intonation was uncertain, in any case. Strange, I thought, for a man whose performance of other Stravinsky works were in fact very fine – if, at times, a trifle smooth compared to the composer's.

It was brave of Decca to record a third version – but how worthwhile in this case! These records preserve a moving memorial of the Swiss conductor's powers at the end of his life. Every moment here seems to glow with an unusual light. What playing! So much nuance of phrase and tonal colour is captured that it is hard to believe the same man could have conducted those earlier performances. One just cannot pick out a particular instance of fine phrasing over another.

The 1910 score is not gratefully written for the orchestra – but what control is displayed here! One cannot put it down to the definitely finer orchestra: a hearing of the rehearsal record that accompanies this performance reveals some of the aura as Ansermet struggles to resolve the intricate difficulties involved here. Perhaps the finale is not presented with the same majesty and control of wind and brass that only Eugene Ormandy once achieved on (Am.) Columbia ML-4700 in a performance of the Suite. But it is in many ways finer than the composer's own.

All-in-all, this performance is in fact a more subtle display of the colours of the score. The rehearsal record preserves some moving episodes – as when Ansermet, working to achieve the precise coloration from the Triangle, recognizes an old face: "Ah, you are here?" – "Yes (from the Triangle), I am here." "Then," Ansermet pleads, "do it, as in the old time!" At the last, the orchestra breaks into applause for a justly elated Ansermet. – J. A.

LISZT — A Liszt Recital. Sonata in B Minor; Etudes d'execution transcendante No. 4; Mazeppa; Annees de Pelerinage — Premiere Annee: 'Suisse'; No. 6 — Vallee d'Obermann; Liebestraume No. 3. Pascal Roge (piano). Decca SXL-6485. Stereo.

The piano music of Liszt – indeed any music by Liszt – is difficult to put across. Technical obstacles are obvious, but a musician must have more: an affinity for the music, an identification, one is almost tempted to say.

It is easy for any Liszt to sound plain bad, and a lot of it is. But how many times does 'bad' Liszt come to life, become interesting, even noble in the hands of a few performers? – and few there are, despite any so-called Liszt revivals. A popular enough work, like 'Les Preludes' may well be faded rhetoric – but in the hands of Mengelberg and, oddly enough, Fiedler, the same work was an experience.

At age seventeen, Pascal Roge possesses an already remarkable technique. He manages to breathe a little life into that 'Mazeppa'. Some very lovely playing here, particularly in the more reflective episodes. Roge's youthful enthusiasm does not quite succeed in the 'Valley d'Obermann', while the 'Liebestraume' is certainly one of the most tired, bored interpretations of the piece. Roge is too young for 'Vallee' and already old for the 'Liebestraume'.

But the Sonata! A performance or recording of this enigmatic 1853 piece can easily be unbearable. It requires, paradoxically, a youthful flair, with at the same time an elderly aristocratic detachment (how necessary these qualities are for much Liszt – and it is not coincidence that these same qualities might best describe the Weimar Liszt).

It is a pity that Decca has seen fit to give this disc a brittle piano sound. Played at moderate volume, the Sonata sounds quite virtuosic but also brittle. An adjustment of the controls brings across half of a great performance.

Roge displays dazzling finger work, excitement, lacking only a little restraint, or detachment or serenity, particularly for the latter stages of the work. But this is nevertheless one of the finest renditions of the Sonata available. Just about everyone else goes a long way to convince me that this is perfectly unlisteneable music. Perhaps there is something in this performance which will give us a noble Sonata in the future. Meantime, those interested must really hunt around for the Barere or Fleischer recordings (both deleted) – or failing that, comfort themselves with an irritating, mannered, yet remarkable performance by the 1932 Horowitz on Seraphim 60114. – J. A.

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RECORDINGS... JAZZ

REVIEWERS: John Clare, Graeme Bell, Bert Williams.

LOUIS JORDAN — "One Sided Love" Pzazz SLP 321. Stereo. One Sided Love; Bullitt; New Orleans and a Rusty Old Horn; You Gotta Go; I'll Get Along Somehow; Wild Is the Night; Sakatumi; What's on Your Mind? Monkey See, Monkey Do; Watch The World.

The elements of rock-and-roll were present in jazz, blues and boogie – but certain artists, like Louis Jordan and Earl Bostik, put it together in a way remarkably similar to the format which emerged in the fifties and became the addiction of kids all over the world.

Jordan won some repute as a jazzman on a alto with Chick Webb's band in the late 1930s – but with his own band, the Tympany Five, he concentrated more and more on novelty vocals, and, of course, earned himself more bread than he could have hoped to do otherwise.

This is not to say that he completely forsook jazz and the blues. One of his biggest hits was 'I'm Gonna Move to the Outskirts of Town' which was recorded by Ray Charles on a memorable recording, 'Genius Plus Soul Equals Jazz'. I am certain that Charles listened quite a lot to Jordan – as well as to more 'primitive' bluesmen, notably Blind Willie Johnson. Charles in his more restrained, sly and lascivious mood sounds quite similar to Jordan. In 1946 Jordan's recording of 'Choo Choo Ch! Boogie' sold a million copies.

This is a quite recent recording of Jordan, with a big band and chorus. There are a lot of novelty numbers which are pretty funny, not least for their naive quality. There are a few quite expressive 'serious' performances, and there are two bursts of Jordan's raunchy saxophone – on 'One Sided Love' and 'Bullitt'.

The band is alright. The drummer plays a cross between fifties rock and old dance-band style. All the same, it often rocks very happily indeed. Jordan, who must be sixty-odd, has a remarkably young voice, and his saxophone is as powerful as ever.

This is a great party record, and at the same time something of a collector's item. The recorded sound can only be described as second-rate by today's standards, and this seems to be the norm with this import label. On the cover, incidentally, there is a tribute from one great entertainer, Sammy Davis, to another – Louis Jordan. – J.C.

EDDIE LANG AND LONNIE JOHNSON — The Jazz Makers Swaggie S1276 Mono. Two Tone Stomp, Bull Frog Moan, Work Ox Blues, Blue Blood Blues, I'll Never Be the Same, Prelude, There'll Be Some Changes Made, etc.

Featuring two great guitar players, this album spans the entire American popular music spectrum of the late twenties, from concert classic to country blues, from back-room small-band jazz to elegant Broadway and Hollywood popular songs – and the common ingredient is Eddie Lang.

Lang, who was born Salvatore Massaro in Philadelphia in 1903, was trained according to the established European cultural tradition; and Lonnie Johnson, the negro, was raised in the home of jazz – New Orleans – where he was born in 1900. Their respective backgrounds could hardly have been more different, yet they worked together in perfect harmony – which I'm sure could be largely attributed to Lang's amazing adaptability.

All of the tracks were recorded in New York between April 1927 and May 1929 – and 'I'll Never Be the Same' and 'There'll Be Some Changes Made' should be well-known to local jazz lovers, as they were released locally many years ago. On these, and other tracks on Side A, Lang is accompanied by Frank Signorelli – former pianist with the original Dixieland Jazz Band – and one could not wish for better examples of the silver tone for which Lang was noted. They say that he possessed a magnificent guitar, and he always knew how to make a single melody line really sing.

Lang's musical idol was the great Spanish guitarist Andres Segovia, and in 'April Kisses' (Lang's own composition) and Rachmaninoff's Prelude he displays his brilliant technique.

Side A closes with 'Jeanine I Dream of Lilac Time', and the sympathy between pianist and guitarist on these non-jazz tracks only comes about when two great professionals get together in mutual respect.

Side B, however, gets down to the real stuff of which blues and stomps are made of, and this time it is a different Lang, adapting himself to the earthy feeling of a natural self-taught negro – Lonnie Johnson.

Lang grew up in the New York dance-band world of the twenties and early thirties and had never undergone the experiences of Lonnie Johnson, yet here he is playing blues with the authentic rapport of a negro.

The last four tracks from this side are all from the Okeh 'race' repertoire, and on 'Work Ox Blues' and 'The Risin' Sun', we also hear one of the finest blues singers of that time – Alger 'Texas' Alexander. This is raw honest stuff, with no refinement or added flavouring to make the music palatable to the sophisticated white audience of the day.

The April 30, 1929 session, recorded under the name of Blind Willie Dunn's Gin Bottle Four, is certainly a strange one. Lang and Johnson are joined by King Oliver on cornet, J. C. Johnson on piano, and Hoagy Carmichael scat singing and banging on some old cymbal, a drinking glass, and what sounds like Oliver's empty trumpet case and a Latin-American scraper. Later on he finds some temple blocks to fool around with. The titles on this particular session are 'Jet Black Blues' and 'Blue Blood Blues', which were also released in Australia on 78 rpm many years ago.

Eddie Lang died in 1933 and Lonnie Johnson in 1970, the latter's age being variously estimated at 70 and 81 years old. More than 40 years after making these discs, Lonnie Johnson remembers and says of Lang: "He was one of the greatest musicians I ever worked with."

Quality is surprisingly good, particularly on the guitar duet tracks. A very worthwhile buy in any man's language. – G. B.

BIX BEIDERBECKE — Bix and Tram 1928. Swaggie S1269 Mono.

There's some beautiful Bix Beiderbecke cornet on the Swaggie release of 'Bix and Tram 1928', but there are also some laughably schmaltzy vocals, the nature of which can be gauged from the titles of two tracks alone – 'Our Bungalow of Dreams' and 'My Pet'.

Poor Bix! He was a jazz great, but on most of his recordings he was surrounded by pedestrian rhythm sections, saccharine saxophones sections, and most cumbersome paraphernalia of what was called The Jazz Age. No wonder he resorted to the bottle heavily and frequently.

Even 'Bungalow of Dreams' is redeemed by his beautiful introduction, and he shines in the chase chorus with Tram (the nickname of saxophonist Frankie Trumbauer) after that dire vocal on 'Borneo'.

He takes a superb break on the delightfully mellow 'There'll Come a Time', which is strictly instrumental except for the mystifying horse whinny at the very end. Referring to this track in the sleeve notes, the erudite Brian Rust says the composition was "apparently a collaboration between the New Orleans trumpet player Jde 'Wingy' Mannone and the king of New York's hot trombonists – a strange partnership." I mention this only because it is strange that Rust, normally a very thorough fellow, failed to refer to Mannone's own record of the tune under the title of 'San Antonio Shout' (with the so-called New Orleans Rhythm Kings in 1934).

Tram and Bing indulge in some amiable corny patter before Bing sings 'Mississippi Mud', which has more superb Bix.

Tram, and probably Hoagy Carmichael, are responsible for the patter on 'Take Your Tomorrows'. Tram then plays the first half of the first ensemble on C melody

JAZZ

saxophone, and Bix leads the second jammed half in very thrilling fashion. He plays sublime, lazy, floating, over-the-hills-and-far-away cornet behind Tram's vocal chorus.

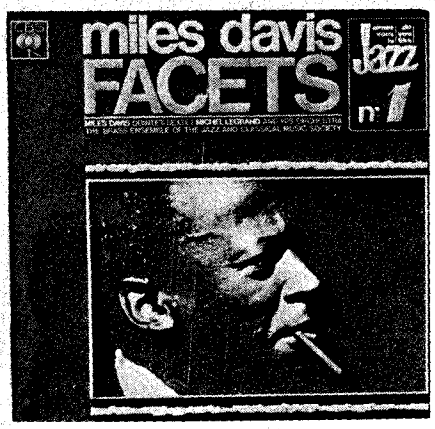
There's little other instrumental work worth noting.

Eddie Lang plays wonderful guitar behind the sickly saxes on 'Lila' and behind Smith Bellew's vocal on 'Love Affair', and there's acceptable clarinet from Izzy Friedman on 'Love Nest'.

That, alas, is about it.

Be advised, though, that those dated vocals by such performers as Scrappy Lambert, Smith Bellew and Martin Hunt often precede scintillating cornet work by Bix, which shines all the more by comparison.

– B. W.



MILES DAVIS — Facets. CBS 62637. Mono. Miles Davis, trumpet; Wayne Shorter, John Coltrane, tenor sax; Phil Woods, alto; Herbie Mann, flute; Frank Rehak, trombone; Red Garland, Bill Evans, pianos; Paul Chambers, Milt Hinton, bass; Jimmie Cobb, Philly Joe Jones, drums. Devil May Care, Budo, Blue Christmas, Sweet Sue, Three Little Feelings, Jitterbug Waltz, Round Midnight, Wild Man Blues, Django, Jazz Suite for Brass.

This is an apparently random collection of Miles Davis, from 'Budo' with Miles' quintet of 1955 to 'Blue Christmas' with a short-lived sextet of 1962. It includes a session arranged by Michael LeGrand and two tracks – 'Jazz Suite for Brass' and 'Three Little Feelings' – with the Brass Ensemble of the Jazz and Classical Music Society.

There is some dull stuff here, some good tracks and two gems. JJ Johnson's 'Jazz Suite' is enjoyable to hear once again for nostalgia, and that's it. He's made the brass ensemble sound like a cross between Stan Kenton and a Navy band. The LeGrand stuff is nice but not great. I don't like the way he has arranged 'Jitterbug Waltz' in two time signatures. Miles, however, plays beautifully.

Herbie Mann's solo and LeGrand's touches of Debussy almost destroy the mood Miles establishes with his stem mute on 'Round Midnight'. Louis Armstrong and Jelly Roll Morton's 'Wild Man Blues', on the other hand, is very good and has a fine Coltrane solo. Miles introduces 'Django' on stem mute with the stem pulled out – a marvellous sound, breathy but almost without overtones on soft notes. He replaces the stem for his in-tempo solo, giving a more edgy sound, and here LeGrand's soft cascades work where they failed on 'Midnight'.

'Devil May Care' has Miles swinging beautifully with the aid of Jimmy Cobb and Paul Chambers, the high-speed shuffle of his blunt-tongued runs generating terrific intensity within a small dynamic range, his brief, savage leap into the upper register gaining thereby in impact. 'Blue Christmas' you can forget. Must be the only time Miles has recorded with a vocalist. 'Budo' is a boppy workout with muted Miles and uncharacteristic Coltrane. 'Sweet Sue' and 'Three Little Feelings' are classics – if you are interested in jazz, I don't think you should be without them.

The first eight bars of 'Sweet Sue' seem pretty abstract to me to begin with – I can't even remember how the middle eight goes – but Miles has used a weird, oblique paraphrase of them as his theme statement.

Miles, Coltrane and Red Garland take four choruses each in which they probe a most peculiar, mysterious area, only indirectly related to melancholy. It remains a strange, indefinable mode of feeling. This was truly experimental jazz in its time, and it retains its fascination. Listen to the weird chords Garland plays in accompaniment and during his own solo. Take note of Coltrane's opening phrase – where is he going? Philly Joe's loosely splashed cymbal, accents. That odd gurgling sound, somewhere between a single note and a trill, with which Miles almost stops the beat. I can only imagine he does it by fluttering his tongue whilst depressing his trumpet's valves halfway. For all that, it's real hot jazz.

'Three Little Feelings' is a simple and very pleasing arrangement for the brass ensemble by John Lewis. The second part has perhaps the most beautiful trumpet solo Miles has ever played. The sound he produces! Fragile, yet full and glowing. The poise and delicacy, and the underlying strength, of his phrasing! There are people who keep inanely repeating the old baseless cliche about Miles being an introverted player. Oh, yes. So was Bix Beiderbecke. So is Bobby Hackett.

Quite a bit has been lost from the originals in the recorded sound, in dynamics rather than detail. – J. C.

ANDRE MAURICE — Acting Trio. Actuel 529314. Stereo. Phillie Mate, tenor sax; Andre Maurice, cello; Jean-Pierre Sabar, piano; Acting No. 4, Acting No. 13, Cello Discordao No. 9.

I'm inclined not to consider this as jazz but as chamber music (though it seems to have been recorded in the open air) using many of the techniques and actual phrases of free jazz, but taking off from there into a range of sounds produced by such relatively haphazard methods as squeeling the ball of a finger along a polished surface of a bass string, plucking the strings inside the piano with a variety of objects, rapping with the bow against the cello, and so on.

All of these have, of course, been used as colouration, and even for short musical passages, in free jazz; but, in the main, even avant-garde jazz men have confined themselves to sounds which can be controlled in terms of pitch and timbre to the degree one would expect from a conventional musical instrument, however raucous or unusual those can be.

The improvisations of the Acting Trio often have as much in common with the music of Cage and Stockhausen as with Archie Shepp or Pharoah Sanders.

Tenor man Phillips Mate seems to have been influenced by both Shepp and Sanders, though he gets a much thinner sound than either and he doesn't try to swing in a jazz sense. In the middle register he gets something near the academic saxophone sound, though a little meatier than that. He stays in the false upper register a lot and his playing is effective in the context, though one gets the impression that one could be as effective oneself, saxophonist or not. This probably not the case, unless you happen to be a good player, because Mate's playing here certainly demands a considerable command of the instrument: that squeeling is all very accurate, when you listen carefully.

Sabar, as we have intimated, spends as much time inside the piano as out, strumming apparently at random at times, playing quite musical phrases at others.

Maurice plays some simple but pleasing conventional passages on cello, and gets a lot of gouging and scraping sounds, some of which seem to be produced by shortening radically a string and bowing savagely at it between the fingers.

The players are at all times interacting with each-other and maintaining a musical flow, but I have difficulty in picking one performance of this kind as being better than another, in any but completely subjective terms. I enjoyed this. It is always interesting, and in a couple of places quite exciting.

The best parts for me are those where Sabar pours out cascade on cascade of atonal notes and chiming dissonant chords while Maurice groans down low and Mate produces a remote, crying song. In these passages the instruments are played more or less conventionally, and I wonder if using sounds produced with limited control is not a bit of dead end. In theory you should find yourself using broad approximations of ideas you might be able to articulate in detail on a specially designed instrument. Here, I think, is where electronics are getting to play an increasing part. – J. C.

THE GENE SIEGEL ORCHESTRA — 'The Gene Siegel Orchestra'. Pzazz SLP 325. Stereo. Olivier Messiaen Influence, Rain Dance, Song for a Lost Weekend, Terra Incognita, Transcendental Theme, Mystery Monolith, Song for Our Brothers, etc.

There are those who after a cursory hearing of this record would dismiss it as a hotchpotch of jazz and clasical elements, and I am dubious of third Stream' music myself – but this jazz band, plus strings and electric instruments, bears repeated listening. As with Stan Kenton, they are open to criticism for incongruous juxtaposition, for following complex sounds, not with simplicity so much as with banality, but they do a lot of things which are good in the ear.

I hope that this has not unduly raised expectations: it is not a record to be taken all that seriously. Each track has passages which would fit comfortably into the soundtrack of a petroleum commercial – but while you are allowing it to go by as a pleasant moving background, odd voicings, contrapuntal passages, strands of modern classical harmony and relatively horny contemporary jazz solos emerge from time to time and grab your attention.

Unfortunately it is not very well recorded. The bass on some tracks is badly defined, and the sound overall lacks the sharp immediacy which could have made it quite exciting in parts. – J. C.

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RECORDINGS... POP TRENDS

REVIEWER:
John Clare.

MODERN CHICAGO BLUESMEN — The Best of the Chicago Blues. Vanguard VSD-1/2. Stereo. Jimmy Cotton, Junior Wells, Buddy Guy, Otis Spann, Homesick James, J.B. Hutto. Double album set.

This must be the bargain, if not the record of the year.

I've heard many of these tracks on imported recordings, but I'm not sure that they've been released in this country before. Either way, I fairly sprang at the chance to grab them for myself.

On here are some of the most powerful blues performances I've ever heard. Buddy Guy's 'I Had a Dream Last Night', Junior Wells' 'Vietcong Blues', and Guy's 'Sweet Little Angel', are the real spine-chillers, but really everything that Guy or Wells touch is charged with emotion and sheer dynamism; there are only one or two dull tracks on the whole double album and they are only dull by comparison.

Much as I respect the way the Beatles and the Rolling Stones developed, it is amazing to think how popular they became even before they had gone past pretty puny imitations of the kind of music you'll hear on these recordings, and really it must be said that few of today's rock groups, though they may pile on more volume, are able to get anything like the rhythmic tension of some of these performances – particularly the medium or slow tracks, which are to my mind the best.

Buddy Guy's voice is high and shivering with emotion and sensuality. Listen to the tender but fiercely burning passion of 'Sweet Little Angel':

I've got a sweet little angel
And I love the way she spreads her wings;
Yers! When she spreads her wings around me,
I get joy, yeah, in everything!

His guitar here echoes the intonations of his voice: high, almost hoarse, incredulous in the face of pleasure. You've got to be in good health to take it. The interplay with Spann's piano, here as elsewhere, is quite astonishing.

On 'I Had a Dream Last Night', Guy's voice and guitar are sharp as a whip. This is everything a blues band should be: they are able to hang it all out until you feel you can hardly take any more, and yet every note counts. In the seventh bar of (I think from memory) the third chorus, Guy's guitar tangles briefly with an impassioned trumpet, and at this point I stood straight up off my chair, pointing, calling soundlessly for someone to come and hear. I was alone in the house; funny feeling, that.

Listen to the dialogue throughout between guitar and Jack Meyer's bass.

Otis Spann plays some great old-time stomping boogie piano – you can almost see the glasses jumping in a row – but his best playing is in accompaniment, or in powerfully economical solos between vocals. On Buddy Guy's 'One-Room Country Shack', his deep chords fairly growl.

These, however, are just the highlights. It's all solid, and every household should have one.

THE ROLLING STONES — The Stone Age. Decca SKLA 5084 Stereo. Look What You've Done, It's All Over Now, Confessin' the Blues, One More Try, As Tears Go By, The Spider and the Fly, My Girl, Paint it Black, If You Need Me, The Last Time, Blue Turns to Grey, Around and Around.

Here we have some of the Stones' earliest stuff on record – and we can see the transition from a pretty ordinary blues band to a massively successful pop group.

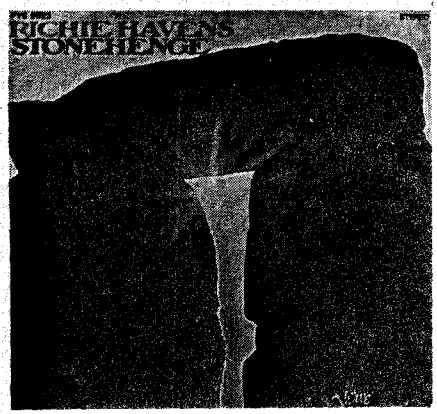
It's obvious that the transition was necessary for their survival. Jagger was laughable as a blues singer, and the band seemed to find it very difficult to get any of the attack or rhythmic tension of a good blues group. They only began to develop these qualities years after they had made their big impact.

Listen to how really bad a drummer was Charlie Watts. Wooden and clumpish, he had no more technique than Ringo, and none of Ringo's undeniable ability to move a band along. The Beatles, incidentally, never attempted the tough, groovy medium tempo blues that the Stones were apt to try. They concentrated more on Chuck Berry style, mechanical, happy bouncing blues, and the Stones seemed able to handle this stuff better as well, as in 'Around and Around'. Not surprising, for they were only boys.

On their really successful things, such as 'Paint it Black' Mick still appears to be the singer who has nothing. What he had, obviously, had little to do with singing. For a start, he was the first Unisex image. At one angle he was positively ugly, projecting lewd and coarse masculinity; a change of angle and expression, and he was pretty as a girl. He was at once pretentious and a roughneck.

Above all, he was vicarious with fulfillment for many an awkward young buck. If young acned Billy Smith sidled up to a girl and said "Hi" she would probably tell him to get lost without blinking or breaking the rhythm of her jaws chewing gum. But Mick could say "Hi, like a spider to the fly, jump right into mah web," as the song goes, and you knew he would be set. Mick was evil, the lucky devil.

This recording is pop music history. The Stones' pop things were, of course, good in their way. They achieved what they set out to do, and they exercise the indefinable fascination of successful pop music – even when you can't really get involved with it. The recorded sound is a bit rough.



RICHIE HAVENS — Stonehenge. Verve Forecast FVS 9523. Stereo. Open Our Eyes, Minstrel, It Could Be the First Day, Ring around the Moon, Baby Blue, There's a hole in the Future, I Started a Joke, Prayer, Tiny Little Blues, Shouldn't All the World Be Dancing?

Nina Simone quite often sounds like a man, so it's quite fascinating to hear some of her style rubbing off on a male singer.

Richie Havens is not in her class, and the influence is not all that marked, but it is there. His voice is rougher and his delivery is straighter. He is not really a blues, a jazz or a soul singer. He is a black folk singer, though that label is losing its meaning day by day; pop has in many parts of the world largely become today's folk music (I only object to those who want me to accept it as today's classical music as well).

Havens is a good example of the way today's folk music differs from folk and pop music of the past. Until very recently the music of the people was concerned with everyday things almost exclusively; specific griefs and pleasures, trivia and tragedy, and there were great masterpieces in which common nostalgia, pleasure or grief was invested with such intensity that it became almost unearthly – almost, one might say, if the term were not so over-used, it transcended itself.

Today's songs, on the other hand, jump straight into the metaphysical, talk often in abstract rather than concrete terms. The pitfalls of yesterday were mawkishness, sentimentality, forced emotionalism. Today's traps are pretention, meaninglessness on the one hand, or monumental platitude on the other.

I'll leave you to make up your own mind about Richie Havens on this count. Here's a

quote from his cover notes: "To all the temples built by man of stone and other transient material: I wish to live to see them all crumble into truth and piles of light."

A lot of Havens' songs have a traditional 'folk' feeling. I mean that rhythmic and harmonic structure common to such diverse things as 'Jezebel' and 'The Stranger Song'. This is enhanced by Havens' chunking acoustic guitar, and made more 'cosmic' in the contemporary connotation by electric instruments and shirling strings. It's all very enjoyable, though there are times when one wishes Havens were indeed Nina Simone.

Simone is the only singer whose interpretations of Dylan songs I prefer to those of their composer. On Dylan's 'Baby Blue' here, Havens delivers the rather loosely connected couplets with increasing agitation. I don't think that this is matched by any accumulation of strength in the lyrics themselves, which, I have the distinct impression, Dylan just rolled off until he couldn't think of any more.

Dylan's monotonous delivery allows one to appreciate each couplet as an isolated image or sentiment (some of them are just theatrical and arty cliches). I won't go into Nina Simone's methods here. Suffice it to say that she is, to my mind, the great interpretive artist of these times.

An interesting, enjoyable, well-produced recording.

ERIC BURDON AND WAR — Black Man's Burden. Liberty SLYL934193. Stereo. Two-record set.

It gives me no pleasure at all to dismiss an expensive production like this one, but the truth is that this is a pretty dull recording on which Eric proves conclusively that he is no blues singer. There is some similarity between Burdon's approach and that of Georgie Fame, but Fame is infinitely more musical.

The back-up group, War, is black, They have that feel, but they are just not getting into anything here. They need someone strong out front. Or perhaps, as a friend assures me, they are a good group on their own.

This is not really bad, but there is nothing to hold one's interest for more than a few minutes.

CLODAGH RODGERS — 'Rodgers and Heart'. RCA SL101931. Stereo. Under Your Spell Again, Like a Humble Bunny, Wind of Change, Jack in the Box, Stand by Your Man, I'm Gonna Make You Love Me, Wolf, Let Me Be the One.

Miss Rodgers is quite a sexy-looking girl in her way, so if sexual fantasies are in your line, this is for you. She doesn't sing too badly either, but then she doesn't sing all that well. The title of the record is a cruel pun on her name and those of songwriters Rogers and Hart; cruel when, as it turns out, the tunes here are in the tradition of thoroughgoing pop garbage, along with 'Puppet on a String', or 'How Much Is that Doggy in the Window?' and on back through the tin-pan alley legacy (and its London imitation).

'Jack in the Box', is in fact a blatant attempt to come up with another 'Puppet on a String', with which to take out the worthless Eurovision Song Contest once more. I'm glad I'm not in England at this point in time. I remember holidaying in Spain and finding myself still plagued by the dreaded 'Puppet on a String'. After hearing it on radios on the beach all day, I walked into a club in the evening in good time to hear the band go into it and to see all the holidaying English patrons leap up, galvanized by national pride, and begin bouncing on the dance floor like jumping beans sychronised by remote control. A disgusting sight.

The best I can say for this disc is that it is probably a good party record. Don't invite me. Production is not particularly good, and surface noise occurs here and there.

TONY WILLIAMS — The Tony Williams Lifetime. Polydor 2425 019. Stereo. Tony Williams, drums; Larry Young, organ; Jack Bruce, bass; John McLaughlin, guitar. To Whom it May Concern, Allah Be Praised, Once I Loved, A Famous Blues, Big Nick, Right On.

When I heard that this recording was to be released in Australia, I got Peter Smetana, who had an imported copy, to review it for us. As it turned out, the local release took a little longer to appear than I had anticipated.

The more I hear this recording, the more accurate I find Peter Smetana's review (Electronics Today, April issue). So I shall just add a bit of general information.

Two of the musicians here, Williams and McLaughlin, are Miles Davis discoveries. Jack Bruce is, of course, Jack Bruce of 'Cream' fame. Tony Williams was about nineteen when he first played with Miles Davis, and he's still pretty young. He has played with many other great jazz musicians — including, most notably, Eric Dolphy. Therefore he brings to what might be classed as a heavy rock album (probably the 'heaviest' rock ever recorded) all the subtlety, finesse and sharp passion of the jazz tradition.

He always reminds me of a kind of Cassius Clay of the drums: precocious, arrogant, flash, phenomenally brilliant. He's got it all — freakish sense of time, a great range of textures and individual rhythmic figures, frightening power and the ability to talk, articulate on the drums; a great feeling, in other words, for the feeling of sticks on skin.

McLaughlin and Young have, above all, individual SOUNDS on their instruments. It is boring to repeat, but true nevertheless, that most rock guitarists and most jazz and rock organists (surprising, to me, how little jazz and rock organ playing differs) sound alike. The practitioners here have instantly recognisable sounds and styles. McLaughlin's rhythmic sense, and his phrasing, are quite unique in rock, drawing as they do from experimental jazz. Jack Bruce is just a very good bass player. He plays several other instruments very well too, but not here.

The music on this record is undoubtedly influenced by Miles Davis, but it's more concentrated, heavier, and perhaps ultimately not quite so interesting. At first listening, however, most people will probably find these shorter bursts of speed and power more successful than Miles' more spaced-out improvisations. This stuff tromps all over you from beginning to end. There's very little daylight to be seen through the music. I prefer what Miles has done, but this is never less than devastating. If you are really musical, you will know that some of the heaviest rock was played not by Led Zeppelin or Uriah Heep, but by the Beatles, right at the beginning of Sgt. Pepper.

Right, now have a listen to this.

We should point out, in case you have been put off, that the review this record received elsewhere bore little relationship to the music itself, though we do not contest that reviewer's right to dislike the music. It is much simpler and more straightforward, more planned and less improvised than he has indicated. I can only imagine that it was the intensity of the music which threw him into confusion.

MICHEL POLNAREFF — 'Polnareff's'. AZ Disc, STEC 81. Stereo. Voyages, Ne dans un Ice-Cream, Petite Petite, Computer's Dream, Hey You Woman, Le Desert N'est Pas en Afrique, etc.

Why not, for a change, tune in to some French pop music and see what is happening there? On the evidence of this recording by Monsieur Polnareff, it is coming into line with pop music everywhere. As a general trend I would say that this is a pity, but in the case of French popular music I don't mind in the slightest. French and Italian pop songs vie for the honour of being the most abysmal of all in my estimation.

M. Polnareff writes most of his own material, and while his songs tend to sound a bit too much like French pop songs, the rock group and orchestral backings are pretty good. They don't set out to be very original, but to be craftsmanlike and easy to listen to — and they are.

There are the usual baroque cliches, some film soundtrack scoring for strings and horns; but there is also a bit of surprisingly swinging jazz piano, some sharp bursts of brass, and overall a spaciousness of sound which is thoroughly enjoyable.

My pressing distorts a little in forte passages, and the stereo possibilities are not exploited as they might be in a recording of this type, but all-in-all it's not bad at all. The bass work, incidentally, gets very good in places; corny in others.

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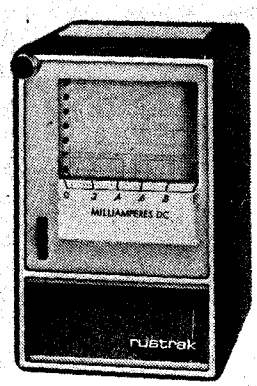

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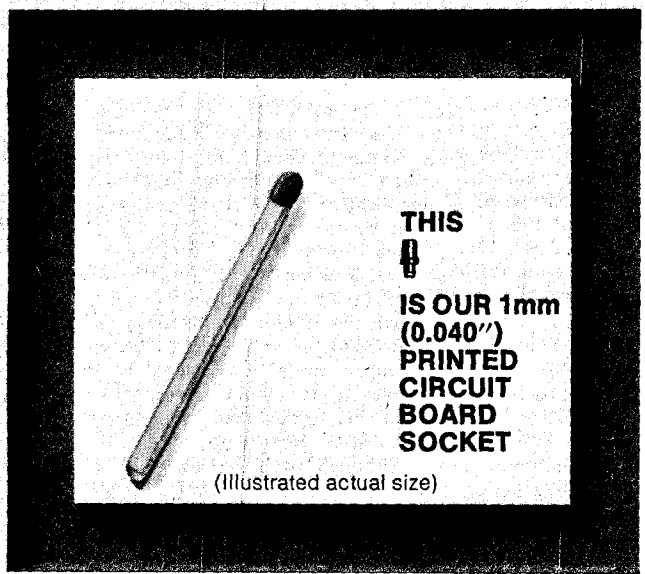

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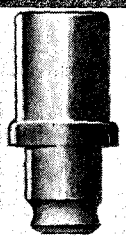

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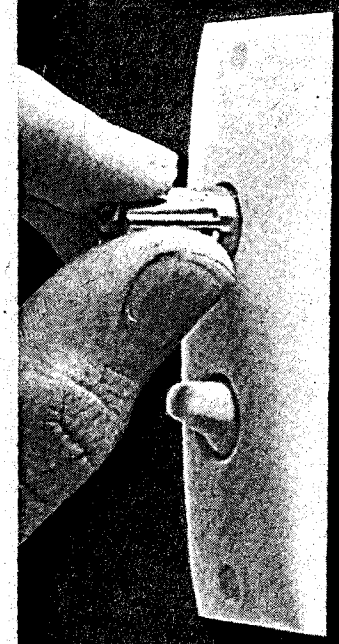

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BOOK REVIEWS

REVIEWER: Brian Chapman

PRACTICAL ELECTRONIC SERVICING TECHNIQUES by Larry Allen. Published by TAB Books December 1970, soft covers 255 pages 8½" x 5½". Price $4.95. Available from Grenville Publishing Co., Sydney.

Many people say that there is no substitute for experience in the servicing of electronic equipment. This is very true but it must also be bourne in mind that mastery of any subject can only be realised when a sound and solid knowledge of basic theory is the foundation.

Larry Allen knows what he is talking about and has done a very creditable job of explaining service techniques in simple, uncomplicated language. His basic theory is sound and there are very few ambiguities in his explanations.

The treatment and coverage is specifically slanted towards the needs of inexperienced people, making their debut as servicemen, who want practical commonsense, rather than detailed mathematical theory. Although the simplified treatment of transistor theory is the early chapters would perhaps make the purists shudder, need of, a detailed mathematical model of a transistor. In fact any effort to include such material at such an need of, a detailed mathematical model of a transistor. In fact effort is to include such material at such an early stage could only lead to reader confusion and loss of confidence. The author has succeeded in avoiding over complication without, as happens in many similar books in this price range, making ambiguous and erroneous statements. approach to servicing in general, and then proceeds to deal with basic transistor theory and transistor approach to servicing in general and then proceeds to deal with basic transistor theory and transistor amplifiers etc., etc. Section two examines methods of isolating faults causing distortion in audio amplifiers and then gives a practical approach to the servicing of record changers and tape decks.

Although the treatment of the subject is quite good the quality of photographic reproduction leaves much to be desired. This is a shame as the author has gone to considerable trouble to supply plenty of photographs to illustrate his points. I personally found myself peering at them in an effort to pick out the specific detail referred to in the text.

Sections three and four describe servicing techniques for transistor radio and television receivers respectively; finally section five deals with the operating principles and circuitry of typical servicing test instruments.

In all a good meaty book for the new serviceman who would find it good value at modest cost.

COMPUTER CIRCUITS AND HOW THEY WORK by Byron Wiels published by TAB Books October 1970, soft covers, 188 pages 8½" x 5½". Price $4.95. Available from Grenville Publishing Co., Sydney.

The title of this book is perhaps a little misleading, one would perhaps expect that the usual gambit of AND/OR, NAND/NOR gates and flip flops would be discussed and the organisation of these to form shift registers, accumulators, arithmetic units would follow.

This is not the case, however, and as the author states in his introduction, the book is not meant for those who do not already have a basic knowledge of electronics.

I would go even further and say that you should also have a basic knowledge of computers. The general description of major computer components, is in fact quite sketchy.

In the main the book describes the application of medium scale integrated devices to typical computer hardware. Indeed the section labelled "Applications" takes up 111 of the 188 pages. Only 40 pages approximately are devoted to the organisation of the computer as a whole.

A good glossary at the end of the book defines most of the common digital and computer jargon but would hardly be of benefit to the readers to whom this book would be of value. The author has not thought well enough about the level of reader to which his book is aimed and to my mind should have eliminated the general sections, and made applications the main and only theme. As it is, it is neither one thing or the other.

If you know nothing about computers at all don't buy this book it is not for you. It does, however, present some interesting material to those who want to expand on an already fairly firmly established general computer knowledge.

PULSE & SWITCHING CIRCUITS by Harry. F. Swearer published by TAB books 1970, 254 pages 8½" x 5½". Price $4.95. Obtainable from Grenville Publishing Co., Sydney.

As the preface to the book states, this is not an engineering thesis; it is a practical examination of pulses, the circuits that shape them and the variety of ways they can be put to work.

The first chapter of the book lays down the firm foundation of basic definitions, pulse characteristics, harmonics, etc. Chapter 2 deals with multivibrators of various types and this is followed by a further chapter on amplifier response to pulse waveforms and the effect of L and C, differentiating and integrating networks.

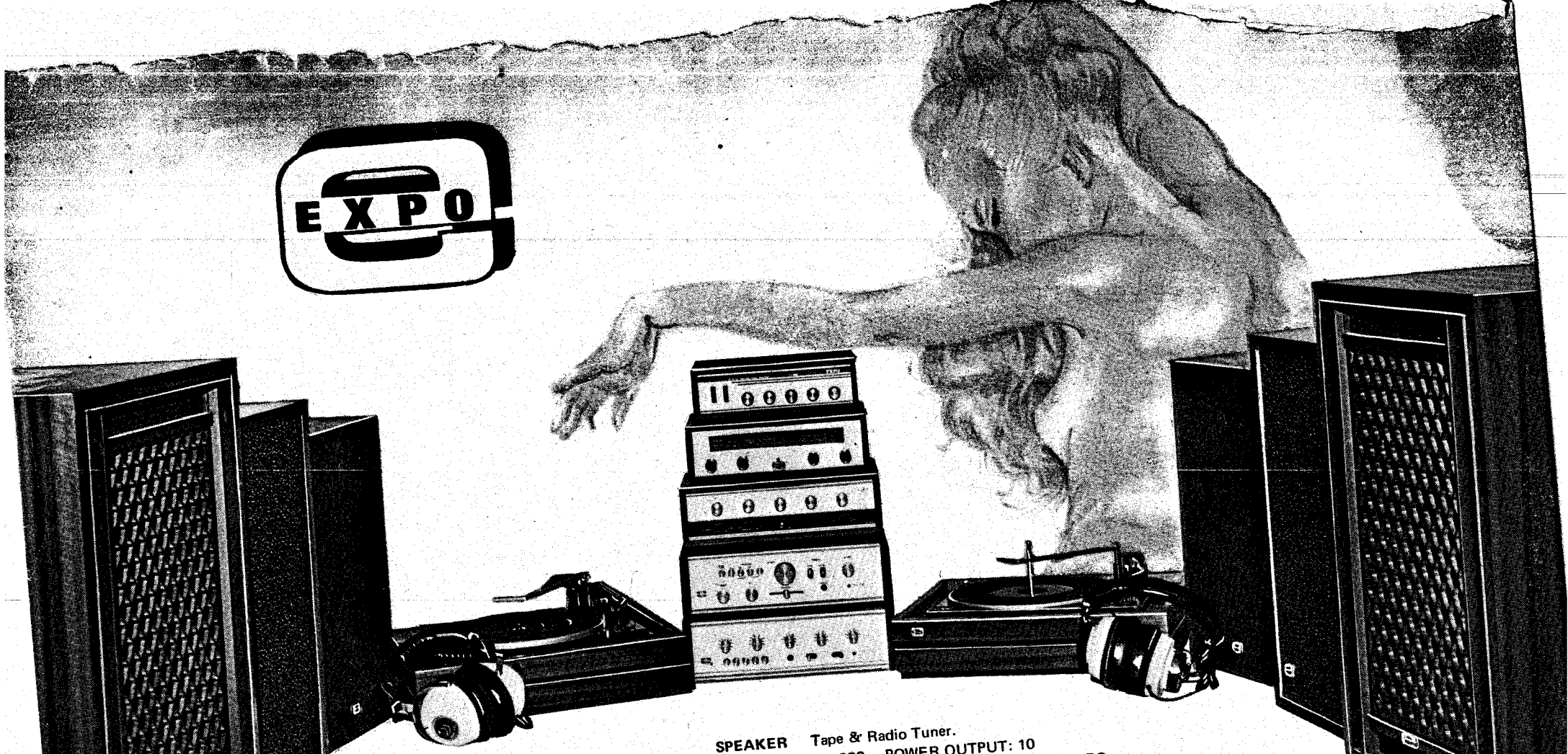
The book then settles down to study the application of pulse circuits in various electronic disciplines. The subjects discussed are:–

Television
Digital computers
Radar
Telemetry
Closed-loop Remote Control
Automation
Probe problems
Miscellaneous switching circuits.

Naturally enough in attempting to cover such an extremely wide range of applications, no particular subject or circuit can be covered in much detail. Indeed, the book takes on the form of a reference manual giving merely sufficient detail to explain the most common circuits used in a particular discipline, together with a brief outline of the operation of these circuits.

Much useful information is given, however, and home experimenters would find this book a reasonably good source of interesting circuits.

Although well written and interesting reading for those technicians who like to know a little about disciplines in which they are not directly involved, the book is by no means a text book. It must be considered to be good value for the modest cost, but not really an essential purchase.



SPEAKER SYSTEMS (left to right) **SS88F** – SPEAKERS: 2 x 8" twin cone, 1 x 4" tweeter. POWER HANDLING: 25 watts. FREQ. RESP.: 30Hz – 22,000Hz. SIZE: W-16", H-24", D-12". **SS83** – SPEAKERS: 1 x 8" – 1 x 4" – 1 x 3" tweeter. POWER HANDLING: 20 watts. FREQ. RESP.: 30Hz – 20,000Hz. SIZE: W-9¾" H-18¾", D-9¾". **SS80** – SPEAKERS: 1 x 8" – 1 x 3" tweeter. POWER HANDLING: 25 watts. FREQ. RESP.: 35Hz – 18,000Hz. SIZE: W-11¼", H-17-7/8", D-8-7/8".

TURNTABLES (left to right) **EXPO 418** Auto/man. rec. player – teak or walnut cabinet, hinged lid. 2 pole motor – ceramic cartridge – stylus (sapphire) 12" turntable. **EXPO 419** Auto/man. rec. player – teak or walnut cabinet, hinged plastic lid. 4 pole motor – magnetic cartridge, diamond stylus, 12" turntable.

AMPLIFIERS (1st, 3rd, 4th & 5th – top to bottom) **E-1000** – POWER OUTPUT: 7 watts x 7 watts RMS. FREQ. RESP.: 30Hz – 20,000Hz. CIRCUITRY: 12 trans, 4 diodes (ITL-OTL) Magnetic or crystal cartridge. Tape & Radio Tuner. **KA-330** – POWER OUTPUT: 10 watts x 10 watts RMS into 8 OHMS. FREQ. RESP.: 20Hz – 40,000Hz. CIRC.: 20 trans, 10 diodes (ITL-OTL). Magnetic or crystal cartridge, tape & radio tuner. **KA-3100** – POWER OUTPUT: 12 watts x 12 watts RMS. FREQ. RESP.: 20Hz – 40,000Hz. CIRC.: 20 trans, 4 diodes (ITL-OTL). *Scratch & Rumble Filters, Magnetic or crystal cartridge, tape & radio tuner. **KA-410** – POWER OUTPUT: 20 watts RMS. FREQ. RESP.: 20Hz – 60,000Hz. CIRC.: 20 trans, 10 diodes (ITL-OTL) *Same as previous description.

TUNER (2nd-on centre equipment). **C-100** -FREQ. Range: 540KHz –1600KHz.Variable gain control. Teak or Walnut cabinet.

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LETTERS FROM OUR READERS

MUSIC SYNTHESIZERS

Could you publish a constructional project on music synthesizers?

E.J. St. Leonards NSW.

• We have been working on this one for quite a long time, however our prototype unit is practically completed and we will commence publication of the project shortly.

Intending builders must understand that this will be an extremely complex and quite expensive project. The Electronics Today synthesizer is a full scale instrument, and is more complex than the average electronic organ.

FREQUENCY RESPONSE

The manufacturers of my cassette recorder claim that it has a frequency response from 40 Hz to 13 kHz, but it does not seem to be anything like this. Is there something wrong?

J.S. Pymble, NSW.

• Yes – but not with the recorder.

TYPOGRAPHICAL ERROR

There is a typographical error on page 77 of your July issue. I cannot understand why you don't spot errors as obvious as this.

A.K. (aged 13) Carlton, Vic.

• Sorry – but none of us is infallible. Not even the youngest!

SPARKS

In your article on electronic engine tuning you state that regardless of the polarity of the main electrical system the secondary side of the ignition system must always have a positive earth. I disagree. I believe that the coil must be installed in the primary circuit according to the way the battery is grounded. If the battery negative terminal is grounded the negative terminal of the coil must be connected to the distributor or vice versa.

I do of course agree that correct polarity affects engine performance – especially cold starting.

R.T. Thornleigh.NSW.

• Our reader is quite correct – providing he limits his argument to coils which are marked + and –. Then, as he says, the coil should be installed in the primary circuit according to the way in which the battery is grounded. This will automatically result in the correct secondary coil polarity.

Unfortunately its not always that simple. For some coil manufacturers still mark their products not with + and – signs, but marked SW. and CB., or + and DIS.

At one time this was no problem because it was taken for granted that cars would have a positive earth system. There were a few exceptions, and for these the same coil would be produced with the primary connections reversed internally. But externally there was no way of telling which was which.

Trouble begins when a coil so marked is fitted to a vehicle with a battery polarity opposite to that for which the coil was intended. Unless the coil connections are deliberately reversed the vehicle will now have reversed polarity.

Further one cannot always be certain that a coil has been correctly connected internally.

We have seen two (European made) coils incorrectly assembled in this manner.

A classic example of reversed coil polarity occurred in the 1930s when a large number of American cars were finally-assembled in Canada.

These vehicles used a coil in which the case formed one primary connection. Somewhere along the line the wrong polarity coils were fitted, and it was several months before it was discovered why several thousand vehicles were down on performance.

SOMEONE BOOBED?

The advertisement on page 7 of your July issue is disgraceful.

D.R. Perth, WA.

• ? ? – Ed.

PEDANTRY

Your use of the word Hertz is just pedantry — what's wrong with cycles.

R.W. Hobart, Tas.

• They're slow and uncomfortable — have you got shares in Avis or something?

TAPE FEATURES

I congratulate you and your organisation on the excellent presentation of your recently launched magazine. May I suggest that you include a section devoted to tape recorders and recording.

NWC. N. Geelong, Vic.

• Thank you for your comments. We certainly won't neglect this aspect of hi-fi. As you will note we published a tape test last month and have two articles on this subject this month.

SOLAR CELLS

Where can I buy solar cells?

E.K.D. Dayboro, Qld.

• These are manufactured by many companies — try those made by International Rectifier, local agents are Warburton Franki, 372 Eastern Valley Way, Chatswood, NSW.

LINEAR VELOCITY

We need a method of measuring the linear velocity of strip material. It is not possible to make contact with the strip in any way.

J.H.R. Pty. Ltd.
Brisbane, Qld.

• This is a very difficult problem. The only satisfactory method that we are aware of involves auto-correlation using a reflected light technique. Probably Hewlett Packard or Solartron could help you.

EX-READER

I cannot think of a single reason why I should ever buy your magazine again.

S.D. Wellington NZ.

• We need the money?

THE DIGITAL VOLTMETER

(continued from page 27)

puld otherwise be possible with a straightforward tegrating technique.

The integrating part of the method ensures a high level of jection for normal and common mode noise, enabling easurements to be made with accuracy in the presence of gh noise voltages.

The method combines the advantages of the two chniques, and the design requirements of the integrator re reduced in comparison to a straight integrating converter.

RECIRCULATING REMAINDER

This is a combination of the staircase ramp and the potentiometric type converters. (Fig. 10).

It is simple in that it has only one decade counter and only one decoder for the display, the readout being multiplexed (or time-shared).

Initially the input voltage is stored within the instrument — in analogue form. The single decade counter — the output of which goes to a staircase type of digital to analogue converter — is set to '9'. The decade counter then clocks down and is stopped when the output of the digital to analogue counter is equal or less than the stored input voltage.

The value now held in the decade counter becomes the integer part of the stored voltage, i.e. if the stored voltage was 5.361 volts the decade counter will stop at 5. This value is then displayed on the 1st digit readout tube.

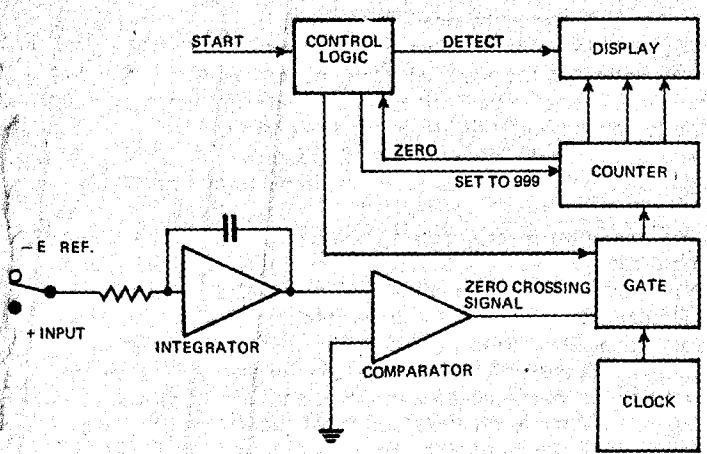


Fig. 11. Dual slope integrator.

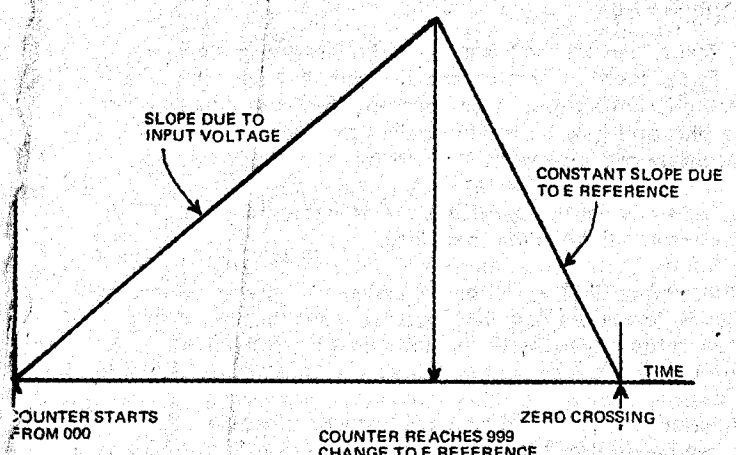
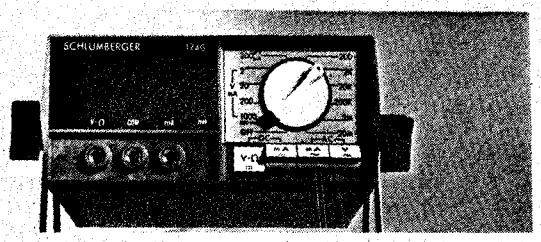


Fig. 11A. Dual slope integrator output.

THE DIGITAL VOLTMETER



The difference between the stored voltage and the digital to analogue converter is the remainder — in our example this would be 0.361 volts. This is amplified by ten and fed back into the store, as 3.61 volts. The decade counter is again set to '9' and the above sequence repeated except that the resultant decade counter value is now displayed on the 2nd digit readout.

The sequence is then repeated for the 3rd and successive digits.

DUAL SLOPE INTEGRATION

This is a fairly recent innovation and is commonly used in panel meters and other medium priced instruments. (Fig. 11).

Assume that a three digit display is used — initially when an unknown voltage is applied to the input a 'start conversion' pulse is generated, and simultaneously all the counters are set to '0'.

The integrator, which may be of simple design, begins to ramp up with a slope which is proportional to the input voltage. At the same time, clock pulses are gated to the counters which commence to count up.

Control logic detects when the count reaches 999, and then gates off the input voltage and gates on a reference voltage. The reference voltage is opposite in polarity to the input voltage and the integrator therefore instantaneously begins to ramp down with a slope proportional to the reference voltage. The process continues until zero voltage is reached.

At this point a zero crossing comparator closes the clock pulse gate, the counter stops and now holds a count which is proportional to input voltage. (Fig. 11A).

Design requirements for integrator and clock accuracies are much less stringent with this method because both input ramp and reference ramp use the same circuit path. Component inaccuracies cancel out, and accuracy becomes dependent mainly on the stability of the reference voltage and, if used, the input amplifier.

As with other integrating instruments the method provides good rejection of normal mode noise.

SUMMARY

These then are the basic types of digital voltmeters.

Each type of instrument has specific advantages and specific limitations. An instrument that is suitable for one application may be totally useless for another; especially if accurate measurements have to be made at high speed or with superimposed noise.

Generally speaking, price is a reasonably good (but by no means infallible) guide to quality.

Some digital voltmeters are better than others — and Electronics Today will be reviewing a number of different types during the next few months — but the dvm market is too competitive for really poor quality instruments to be sold.

Finally remember that accuracy is expensive. Very few measurements need to be made to accuracies closer than 1% — and even the cheapest of digital meters will do this with ease. ●

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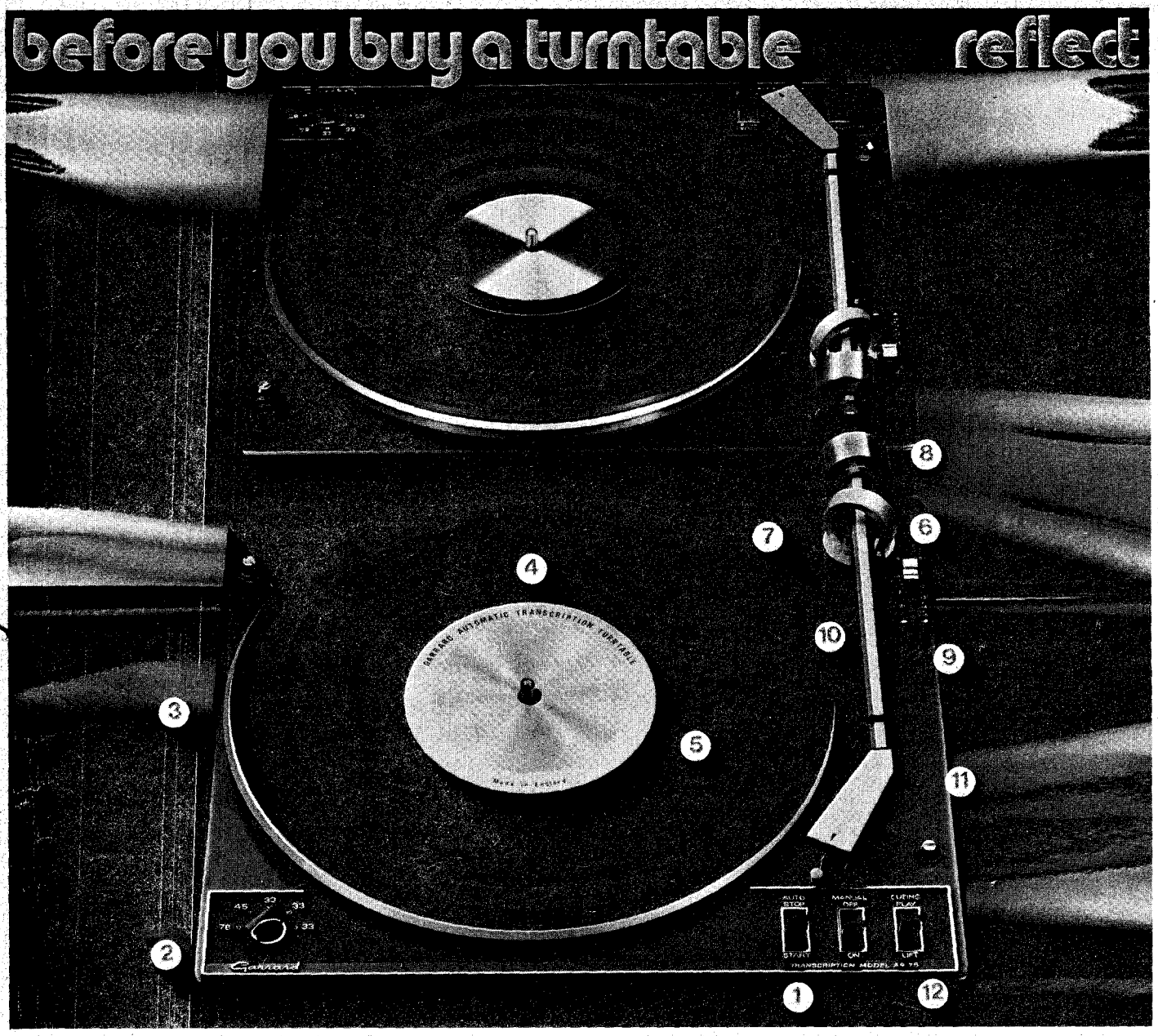

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AD24

Soldering Iron Temperature Control

— extend the life of your soldering iron tip with this simple modification

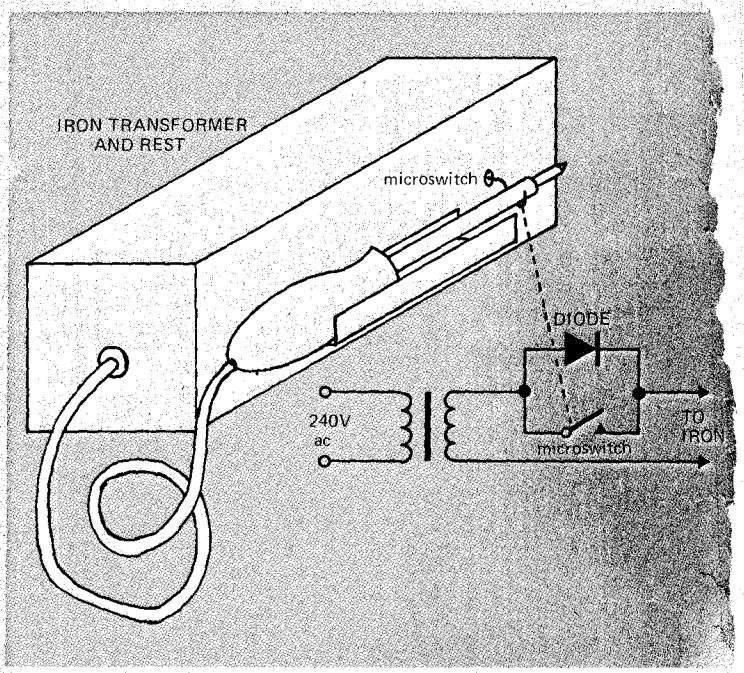
The circuit shown in this article can be easily fitted to any low voltage, constant heat soldering iron. Life of the tip will be extended many times.

When the iron is on the rest, a microswitch is actuated and this switches a silicon diode in series with the iron, approximately halving the input power. Full power is delivered to the iron the instant it is lifted from the rest.

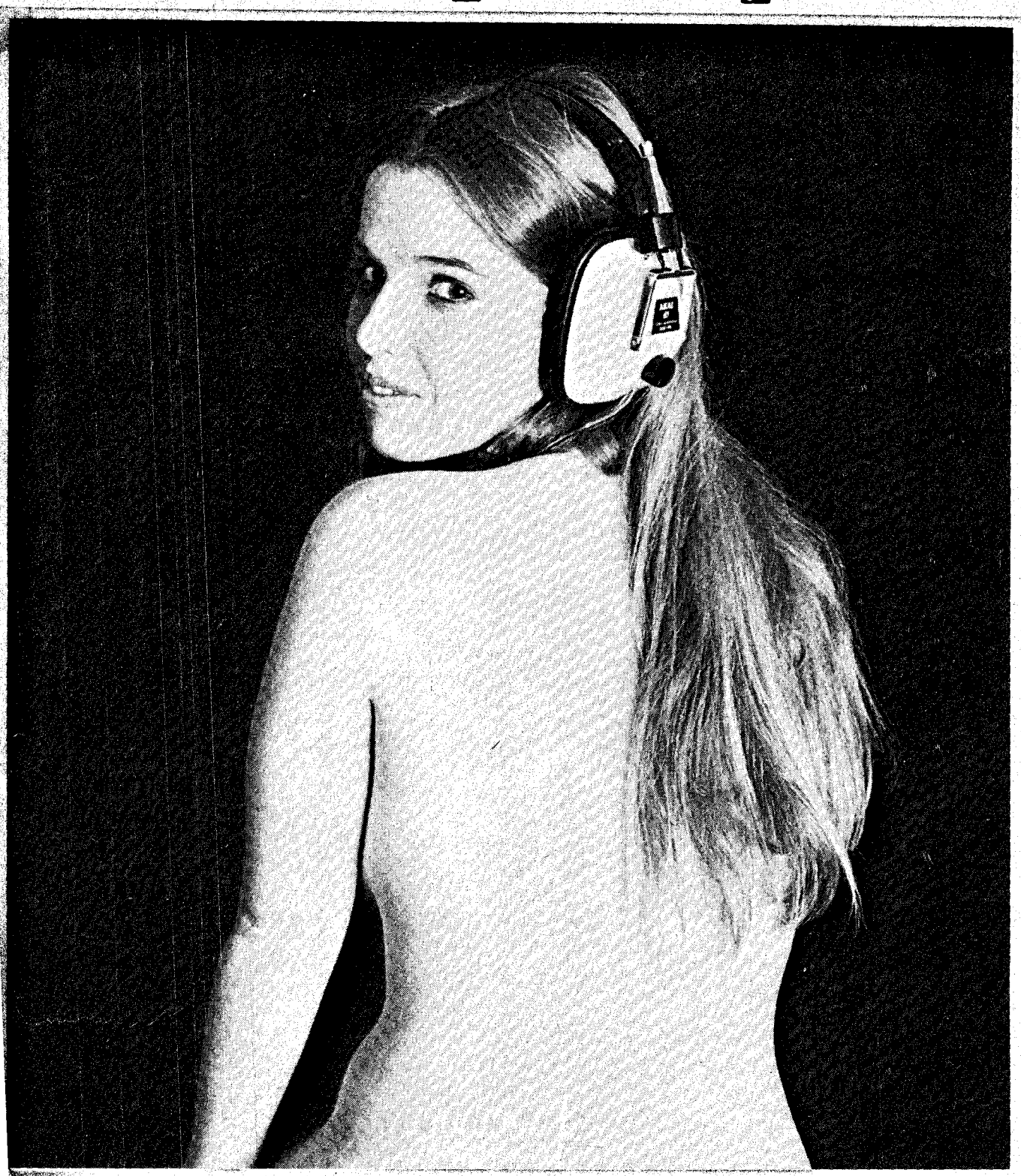
Any silicon diode can be used for this purpose providing its voltage rating exceeds that of the secondary of the soldering iron transformer. The current rating of the diode must not be less than half the current drawn by the iron, i.e., a diode rated at one amp can be used to control a soldering iron that draws two amps.

In practice — a typical iron will draw approximately half an amp at 32 volts; in this case a very low current diode can be used, however the most easily obtainable will be a one amp type such as IN 4002.

The microswitch should be a rotary sensitive type with wire actuator. ●



Darling, don't forget we've got a date



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Australian Hi Fi Audio Show 1971
Koala Motor Inn Oxford St. Sydney

DEAD MEN SPEAKING?

(Continued from page 69)

All present agreed that the voice could not have appeared on the tape by any explainable means. These experiments, and the scientific manner in which Dr. Raudive went about them, convinced the publishing house that here was something new and important, which should not only be published but should also be the subject of further research.

The present writer was given the resulting book to review and initially approached the whole thing with the scepticism which is natural to us all, but nevertheless determined to give the thing a serious perusal and thought. On the basis of the book alone, I cannot say that I was in any way convinced. Such statements as those below, by various people who had been present at experiments, seem to throw doubt on the whole thing:

"One may, whilst listening in, discern the resonance and frequency of voices — one hears the sounds, but the sense of hearing has the utmost difficulty in recognising them as words; only after intensive and concentrated listening does a tangible word emerge."

In other words, I thought, you hear it because you want to hear it.

Again, according to Theo Locker, Doctor of Philosophy:

"The experimenter's habit of confusing words when speaking German seems to be repeated in the language of the voices. It strikes one as odd when well-known men and women express themselves in words of a language they did not know in life. The language used most often is Latvian, the experimenter's mother tongue."

Dr. Raudive, of course, speaks several languages, and this could account for the fact that the voices use words from several languages, mixed up sometimes in the one phrase.

It must be kept in mind, however, that Dr. Raudive himself could be part of the communication link, and the entities are merely using words picked from his subconscious memory which are the most apt for their purpose. Perhaps language is of no import beyond the grave.

Whatever the truth, it seemed probable that both Dr. Raudive and the phenomenon are genuine and should be further investigated. Subsequent to reading the book I received an LP recording of some of the tape voices and was able to hear for myself.

Initially, when listening to some of the first examples on the disc, I thought that, as the background noise level was so high and the voices so indistinct, it was pure coincidence. Later examples, however, dispelled this feeling. I recognised without doubt that one of the voices was that of a woman speaking German. Further, a man's voice had a recognisable character to it, and the length of his statement ruled out completely, to my mind, any chance that it was coincidental bursts of random noise.

Now I can only agree with Father Leo Schmid, a Swiss Catholic priest, who reports:

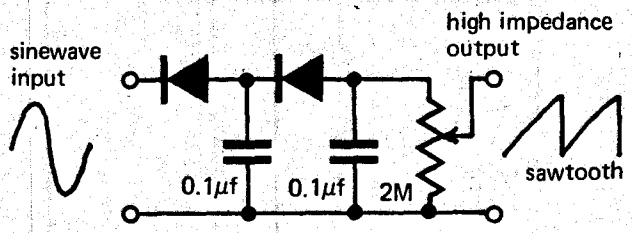
"I do not wish to engage in any controversy over the interpretation of this strange phenomenon, but I am personally in no doubt that this is no manifestation of the experimenter's subconscious, nor is it a radio trick; it is evidently the attempt of people in the 'hereafter' to make contact with us."

I will, of course, leave you to make your own decision. ●

"Breakthrough", and the associated LP record, will be available from Modern Books & Plans Pty. Ltd., 18 Bathurst Street, Sydney 2000, in approximately three months' time. Price is expected to be in the vicinity of $10.

TECH-TIPS

SIMPLE SAWTOOTH GENERATOR

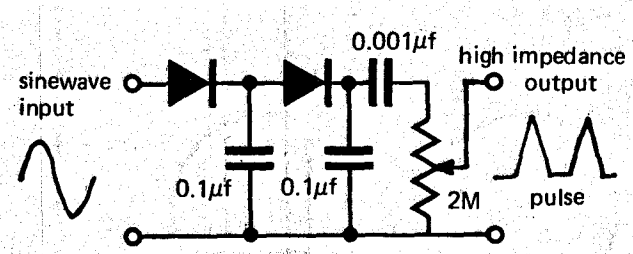


Here is a circuit that can be used in simple oscilloscopes or RF sweep generators. It works best with low frequency sinewave inputs.

The high impedance output ensures its suitability for CROs.

Almost any diodes of a suitable PIV rating can be used but high back-resistance diodes are preferable.

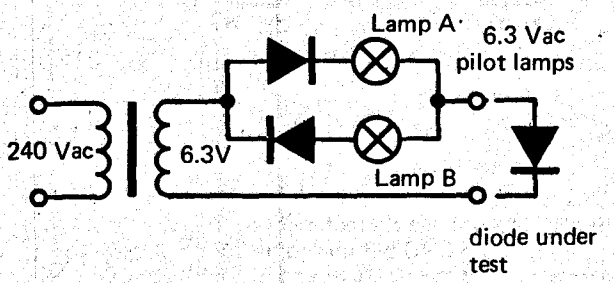
SIMPLE PULSE GENERATOR



This circuit is useful in adjusting noise blankers for producing time marker pulses for a CRO or chart recorder.

The high impedance output is adjustable by the two Megohm potentiometer. Peak inverse rating of the diode should be high enough for input voltage used.

GO/NO-GO DIODE TESTER



If lamp A or lamp B is illuminated the diode is serviceable. If both light the diode is short circuit. If neither light, diode is open circuit.

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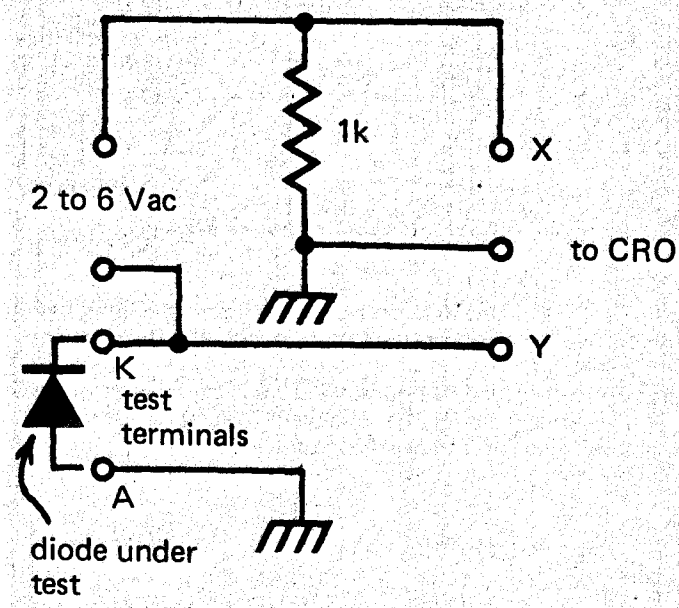
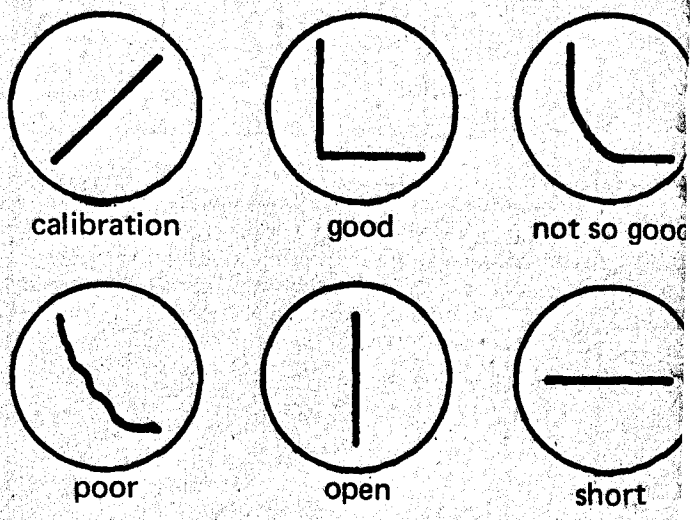
TECH-TIPS

DIODE TESTER





This testing circuit produces an oscilloscope display of a diode's low voltage characteristics.

Calibrate the CRO before use by connecting a 1k resistor across the test terminals and adjusting the X and Y gains to produce a 45° diagonal line.

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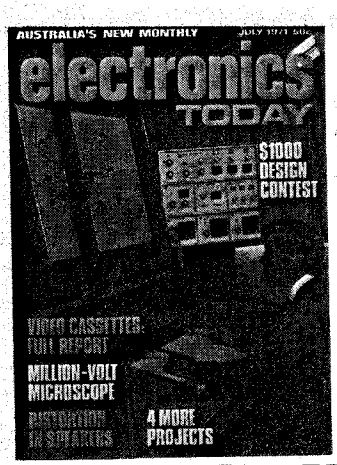

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