

AUSTRALIA'S DYNAMIC MONTHLY

NOVEMBER 1972 50c

# electronic*s*

BARRAGETT

## TODAY

INTERNATIONAL

ALL ABOUT  
FIBRE-  
OPTICS



A FOUNTAIN  
OF LIGHT  
ON YOUR TABLE!



they  
speak  
for  
them-  
selves

SONY

**JACOBY**   
**KEMPTHORNE**

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SN 4730

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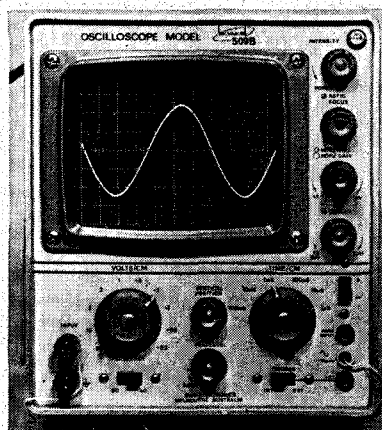
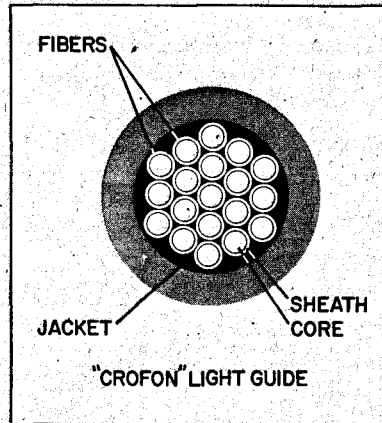
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Cover: Fibre-optics in the home: this 'space-age' table lamp is produced by the Illuminated Fibre Products division of Kimberley Plastics Pty. Ltd. in Melbourne. (Full story on fibre-optics – page 16).



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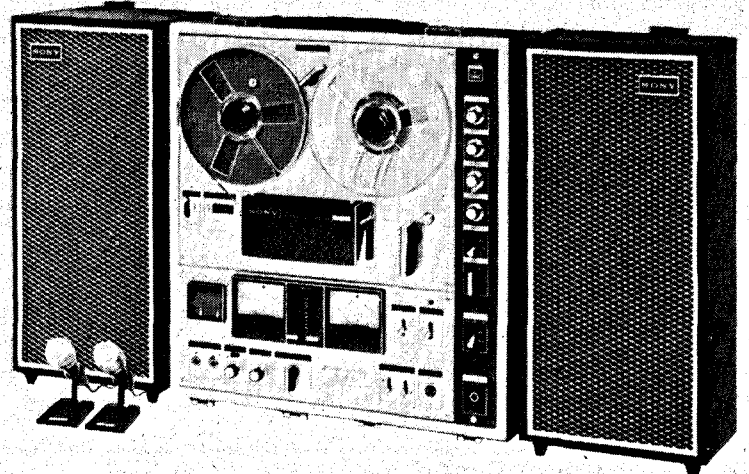
**ONLY  
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**Old price \$622 Our price \$399**

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Phone 63 9321**

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3 HEAD, 3 SPEED,  
STEREO TAPE DECK  
DISCOUNT SPECIAL!**

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# NOW WE ARE THREE

## *French edition launched*

**W**e are happy to report that the international network of Electronics Today is still expanding — and the end is not yet in sight.

Last March, on this page, we told you of a United Kingdom edition of Electronics Today International, which is now well and truly established.

What we did not tell you at the time — for obvious reasons — was that negotiations were then in progress for the launching of a French edition, to be produced as a joint venture with Societes des Editions Radio, a subsidiary of Hachette, France's biggest magazine and book publishers.

Now the security veil can be lifted: the first issue of the French edition, titled 'Electronique Pour Vous International', goes on sale this month.

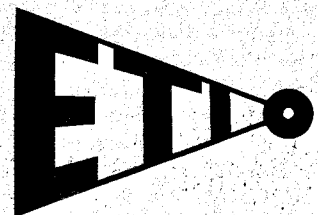
This latest addition to our international network is also by far the biggest. Initial print is 135,000 copies, and the first issue will carry over 60 pages of advertising.

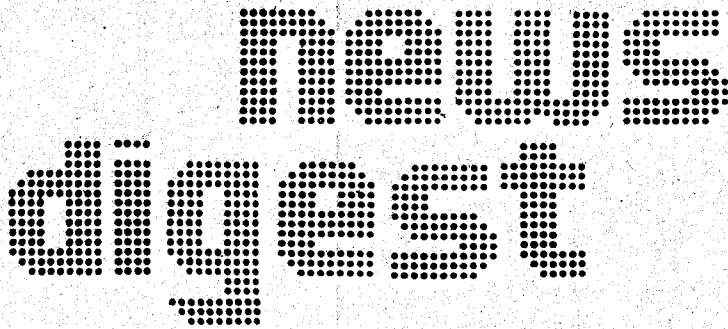
Editorial Director of the French edition is Christian Darteville, who previously edited the professional electronics magazine 'Toute l'Electronique', and is also well-known as the author of several books on various aspects of electronics.

In welcoming this newcomer to our international network, we may be forgiven for a small show of pride.

Ever since the First Fleeters landed in this country, Australia has been invaded by both overseas and local editions of British and American magazines, and in recent years many of our once-indigenous publications have been taken over by overseas interests.

We are the first Australian publishers to reverse this trend.





## COLOUR TV ON DISK

A Philips development team has succeeded in creating a new system by which colour programs lasting thirty to forty-five minutes can be recorded on a disk resembling a gramophone record of normal LP size.

For the play-back of these video long-playing records, a player has been developed that is equipped with an optical pickup system and can be connected directly to a TV set.

The system combines pulse code recording techniques with 1500 rpm turntable speeds to obtain the signal output density needed for video and audio playback. This is identical with the approach taken by Telefunken on the Teldec system it plans to market late next year. (This system was described in detail in *Electronics Today* — April 1971).

However, Philips substitutes an optical pickup for the contact pickup chosen by Telefunken, reportedly providing sufficient groove density to get up to 45 minutes of continuous playback per side. Each side holds 60,000 frames.

The small helium-neon laser, which Philips says is inexpensive and can be mass-produced by a new specially developed production method, feeds through an automatic-focusing lens and the beam is reflected up by indentations on the metallized vinyl record to a photo diode, amplified and processed, and fed directly to the input of any TV set.

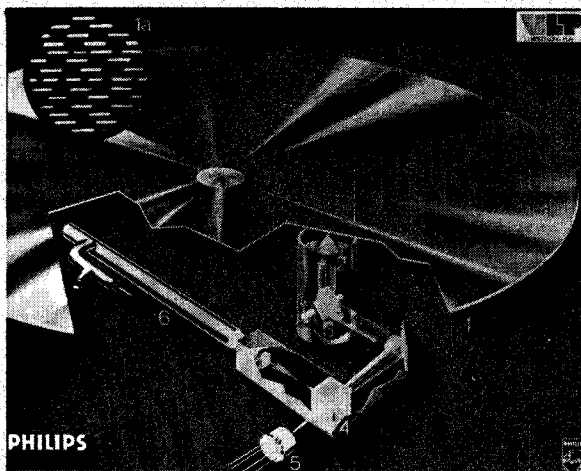
Philips uses a track monitoring system in the pickup head, and feedback is used for continual compensation to keep the groove in line.

As the system operates without contact between pickup and record, usage life should be extended.

The system is extremely flexible in use (providing, for instance, stills, slow-motion, or even reverse-motion pictures from the recorded scenes).

*Schematic representation of the new Philips VLP system.*

1. Video long-playing record. Detail (1a) shows the pattern of pits. (pits appear white).
2. Spring-suspended lens with automatic focusing of the light beam.
3. Hinged mirror for following the track.
4. Beam-splitting prism.
5. Photodiode (detector).
6. Light source.



This opens up new possibilities in the diffusion of information in picture and sound.

The consequences of the Philips video long-playing system for such widely varying purposes as education, information retrieval and, of course, entertainment, will undoubtedly be far-reaching.

The unit is not yet available commercially.

## NUCLEAR COMMUNICATION

A revolutionary communications technique using *neither electromagnetic radiation nor electric current* has been developed at the US Argonne National Laboratory by physicist Richard C. Arnold.

The totally new method uses *ultra-lightweight* nuclear particles called muons. These particles have so little mass that they are able to penetrate dense shielding.

Using Argonne's high energy synchrotron, Arnold has successfully transmitted and received coded messages over distances exceeding 150 yards — through two feet of dense concrete, a caravan full of computers and a metal building.

Although proven technically feasible, it is not yet known whether or not the technique is practicable commercially. If it proves so to be it will find applications in inner city communications.

## AVIS RENT-A-CAR TO GO ELECTRIC?

Latest news in the quest for a practical electrically powered vehicle is that the US Atomic Energy Commission is researching a new type of battery.

Still very much in the experimental stage, these batteries use sodium or sulphur salts and are stated to be very much cheaper and lighter than their lead-acid equivalents. Some authorities are quoting prices as low as 25 cents/kW/h compared with the typical 48 \$8/kW/h for lead acid batteries.

Car rental companies are now looking very seriously indeed at electric vehicles for city hiring. Avis Rent-A-Car for one are known to be very interested in the electric vehicles being produced by Anderson Power Products in Bedford, Mass.

(Turn to page 13)

# MATCHING COMPATIBLE STEREO... THANKS TO WHARFEDALE



True. You can get yourself into a lot of strife if you buy stereo components from seven different manufacturers and an equal number of hi-fi dealers. And matching stereo equipment is a job for an audio expert.

To save you the trouble (and the unnecessary expense) Wharfedale's engineers have designed an electronically balanced range of fully compatible stereo equipment. With Wharfedale's experience and "know-how" how can you go wrong? After all, Wharfedale have been marketing

high fidelity equipment for a longer time than any other recognised manufacturer! For over forty years!

*In the new Wharfedale range you will find:—*

- THE LINTON STEREO AMPLIFIER
- THE LINTON TURNTABLE • THE

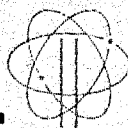
DC9 CASSETTE RECORDER • MODEL DD-1 STEREO HEADPHONES

• YOUR CHOICE OF NO LESS THAN EIGHT HIGH QUALITY SPEAKER SYSTEMS RANGING FROM 20 TO 40 WATTS DIN RATING.

See and hear the Wharfedale range at your nearest Bleakley Gray franchised dealer. *Listen carefully and critically.* You can depend on Wharfedale quality *absolutely.*

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Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 2 5322. W.A.: Athol M. Hill Pty. Ltd., 1000 Hay Street, Perth. 21 7861.

**Zero 100:  
the most sophisticated turntable  
in the world.**



Garrard

*Garrard*



# Nice work if you can afford it.

## but for smaller budgets here are some other models from the same stable



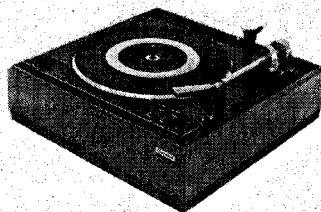
Model SL95B



Model SP25 Mk III



Model 2025TC



Model SL72B



Model AP76



Model SL65B



Model 60B



Model 40B

## Zero 100:

The Zero 100 is the newest model number to bear the proudest name in high fidelity record playing equipment. Garrard's reputation has been re-earned year after year for over half a century by pedigree performance. Now, once again, Garrard lives up to its reputation with an automatic unit advanced beyond any others now available in performance and convenience. This brilliant new star features zero degree tracking error together with twelve other major advances. Now, more than ever before, there's a Garrard turntable for every component music system.

## Garrard

Plessey Ducon Pty. Limited  
Villawood, N.S.W. 2163

For further information contact  
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64 Winbourne Road, Brookvale,  
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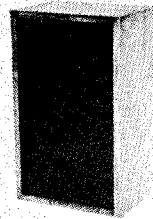
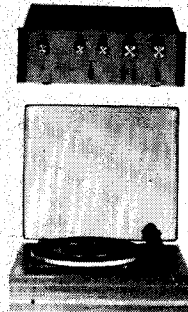
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# AUTEL SYSTEMS PTY LTD

SYDNEY'S GIANTS OF STEREO HI-FI SALES

THIS MONTH'S SPECIAL SYSTEMS ARE:-

\$299

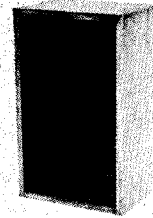
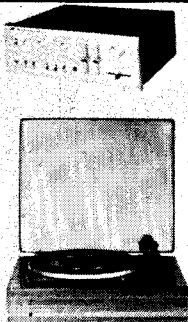


Dual 1214 Hi-Fi Series Turntable complete with imported base lid and Cartridge

Choice of Sansui AU101 - Pioneer SA500A - Kenwood KA2002 Amplifiers

Autel Speakers - Nivico 8" roll surround base driver with the hemispherical dome tweeter.

\$339



Dual 1214 Turntable Nivico VN300 Amplifier

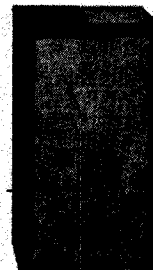
Autel Speakers. Same specifications as above.

\$359

AS ABOVE BUT WITH

Peerless 20-2 Speakers. Perfect flat frequency response for the connoisseurs.

\$599



Teac AG300 Tuner Amplifier (36 R.M.S. at 8Ω per channel)

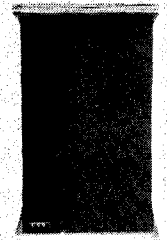
Dual 1214 Turntable

larger Advent Speakers

WE ARE NOW N.S.W. DISTRIBUTORS FOR:-

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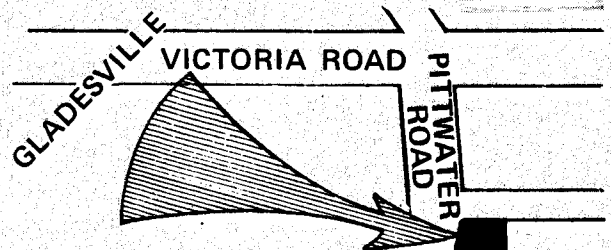
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## AUTEL SYSTEMS PTY LTD

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OPEN THURSDAY NIGHT



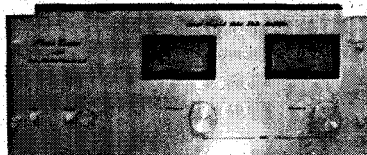
# POWER and CLARITY

The benefit of Phase Linear power is clarity – through effortless reproduction without overload clipping distortion. Power that floats the highs and projects the bass. Power that gives your music reproduction, at any listening level, a depth, definition and solidity, that is clearly audible, and audibly clear.

Phase Linear amplifiers will drive any quality speaker system with a tightness and precision that transforms the sound. But the non-resonant transmission line ESS speakers have a clarity and separation that set them apart from other designs. The Phase Linear 700 and the TS-1 combination is recognised as being one of the ultimate sound systems now available.

## *Phase Linear*

700 WATTS R.M.S.



MODEL 700

\$1185

400 WATTS R.M.S.



MODEL 400

\$795

**ESS** ELECTROSTATIC SOUND SYSTEMS INC.



TRANS-STATIC 1 .....\$2240  
 TRANS-LINEAR 11 .....\$1160  
 ESS V11 .....\$896  
 Per pair.

### "STEREO REVIEW" APRIL 1972

In closing, we would like to quote a line from the Phase Linear brochure on the Model 700 amplifier. Under the title of "Why 700 Watts?" they present a reasoned justification for its use. After writing our own conclusions, we reread their material and found ourselves in complete agreement. One line, which we originally dismissed as sheer hyperbole, now seems quite conservative. "We wonder if 700 watts is enough." So do we.

### "HIGH FIDELITY" JUNE 1972

All the theory and verbal explanation in the world cannot adequately describe the sound of a great loudspeaker driven by an ample amplifier fed with high-grade program material. The experience is exhilarating and it rather defines "high fidelity" at any given state of the art. The Trans-Static 1 is such a loudspeaker.

Wilfred H. Jones & Co. (Aust.) Pty. Ltd.,  
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 Phone 43-3228

*Sole Australian Agents for:*

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Please send me details of  PHASE LINEAR  ESS

NAME .....

ADDRESS .....

..... P'code .....

# IF YOU HAD ALL THE MONEY IN THE WORLD

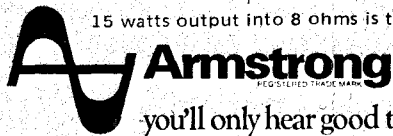
Once you know something about hi-fi stereo, you start to get fussy. The smallest difference between two systems sounds gigantic. Any suggestion of distortion for instance, is sheer thunder and lightning. And that's how it should be (otherwise 'hi-fi' has absolutely no meaning). But then comes the problem: Money. How many people can afford the kind of performance you're after? Well, we believe that you for one. Because the price of the Armstrong 521 hi-fi stereo amplifier costs you no more than many inferior products on the market.

Hi-Fi Sound's reviewer found it 'impeccable'. ("The overall performance is impeccable and I can find no fault".) And if you had all the money in the world, you'd find it hard to buy anything better than that.

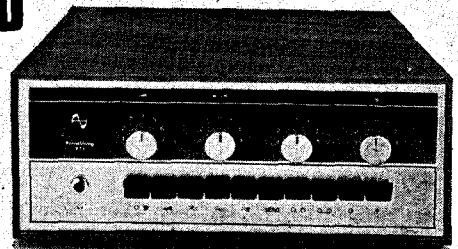
#### SPECIFICATIONS OF THE 521

Power output: 25 watts each channel into 8 ohms R.M.S. Frequency response: 20-20,000 Hz  $\pm 1$  dB. Total harmonic distortion: Less than 0.5% for all power levels up to 25 watts output and all frequencies throughout the audio range, total harmonic distortion at 1kHz at 15 watts output into 8 ohms is typically 0.1%.

15 watts output into 8 ohms is typically 0.1%.



you'll only hear good things about us *Made in England*



521 Stereo Amplifier  
523 AM-FM Tuner  
526 AM-FM Stereo Tuner amplifier

## THE BEST STEREO EQUIPMENT MUST HAVE AN ERA TURNTABLE



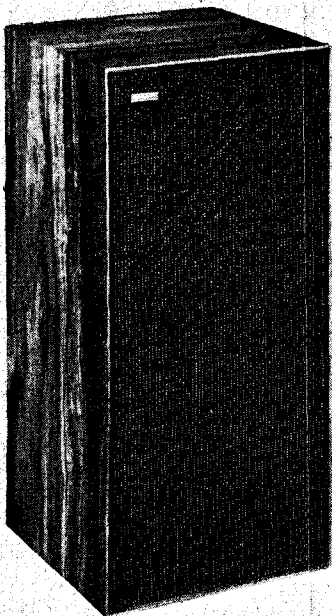
**ERA**

- The ERA arm can track at 1/10th of a gram. • Its pivot eliminates all friction. The pivot is in fact the intersection of the counter-balanced spring blades. • The tracking weight is applied directly to the pivot by changing the angles of the blades, in this way the inertia or the arm is not increased with the tracking force as in all other arms. Features:

- 33/45 rpm. • Hydraulic arm lift. • Total wow and flutter 0.04%. • Slide-in head for all pick-ups. • Suspended mass is 2Hz. • 50 or 60 Hz. • Power requirements 1.6μ
- The motor of the ERA turntable rotates so regularly that it does not need a heavy platter. • The ERA motor's speed is rigorously stable because it is keyed to the frequency of the AC current. • The oversized ERA motor allows fast-starts. It could drive a 30-pound weight. • As in all professional turntables the drive is through a belt. It is made of a special neoprene and ground to its specification within 0.002 of an inch. This drive eliminates wow and flutter.

**SUPERIOR SUSPENSION:** While listening to a record, hit the turntable vertically with your knuckles, the arm does not jump one groove.

## THE WORLD'S FINEST MEDIUM SIZE STUDIO MONITOR

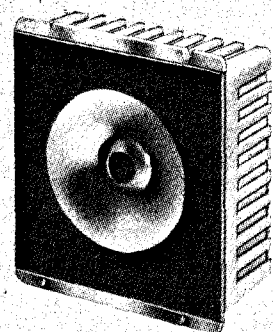


ROGERS **BBC**

The Rogers BBC Studio Monitor Speaker offers a standard of performance unequalled by any speaker of similar size. The speaker combines all the qualities sought in a unit designed for monitor use; ultra smooth response, excellent transient response, a most remarkable lack of colouration and very low harmonic and intermodulation distortion. Based on a design of the British Broadcasting Corporation's research department, the speaker is the result of many years research into speaker cone behaviour, the most significant aspect of the design being the main drive unit employing a special plastic cone. The speaker is produced under licence from the BBC and conforms to their specification LS3/6, but, with the important addition of a third drive unit, a modification exclusive to Rogers. Intended primarily for monitoring purposes in the smaller studios, where high power levels are not required, the speaker will give superlative reproduction in domestic high fidelity installations where the associated equipment is of a sufficiently high standard. Each speaker is supplied with an individual response curve graph taken on Bruel & Kjaer automatic curve tracing equipment. Retail distribution of the speaker is restricted to a limited number of carefully selected specialist high fidelity dealers.

Brief Specification: Overall Frequency Response: 40Hz-25kHz.  $\pm 3$ dB 50Hz-14kHz. Power Handling Capacity: 25 watts, speech and music. Impedance: Standard 15 ohms, to order 8 and 25 ohms. Drive Units: Three. Overall Dimensions: Enclosure 12" x 12" x 25". Height including stand 37". Finish: Teak.

## THE SIMPLEST HI-FI LOUDSPEAKER KIT IN THE WORLD



JUST ONE FULL RANGE JORDAN-WATTS DRIVING UNIT - 20 Hz - 20,000 Hz 12 watts. Here is rich full bass and sparkling clarity throughout - at less cost than a tweeter assembly.

**JORDAN WATTS**  
LOUDSPEAKERS  
THE VOICE OF HIGH FIDELITY

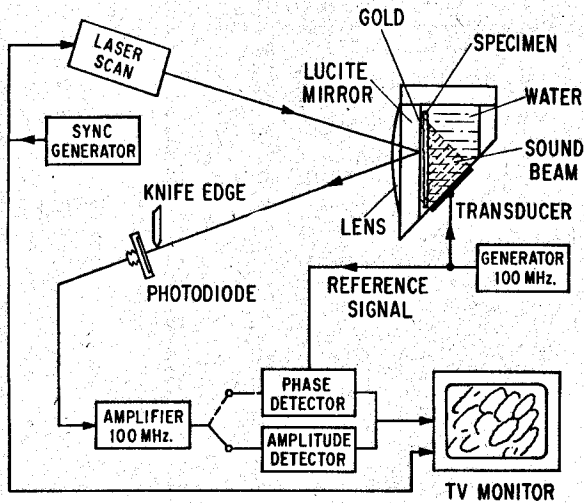
Catalogues and additional information on request. Mail Order and Wholesale enquiries promptly attended.

Sole Agents for Australia

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VIC. 3000.  
Tel: 63 6257



## ACOUSTIC MICROSCOPE

Acoustics and holographics have been combined in a microscope developed by USA's Zenith Radio Corporation.

The specimen to be observed is immersed in water and ultrasonic energy — at 100MHz — is passed through it.

The ultrasonic energy — now carrying spatial information derived from the specimen — is superimposed on a plastic mirror thus causing a minute ripple pattern to appear on the mirror surface.

A laser beam scans this surface. Ripples cause the laser beam to be deflected and this deflection is picked up, converted into an acoustic hologram, and displayed on a TV monitor.

At present, resolution of the acoustic microscope is one-thousandth of an inch. However by increasing the ultrasonic energy frequency from the present 100MHz to 5000MHz it is hoped that the resolution of this new instrument will approach that of conventional optical devices.

Advantage of the new technique is that as sound is a mechanical wave motion whilst light is an electromagnetic wave motion, an acoustic instrument can magnify details that are not apparent when seen through an optical microscope. This is of special importance in biological studies.

## CRYOGENIC ELECTRON MICROSCOPE

In Munich, Siemens research workers are developing a new type of electron microscope which they hope will eventually be able to produce images of atoms. The technique involves ultra-low temperatures near absolute zero.

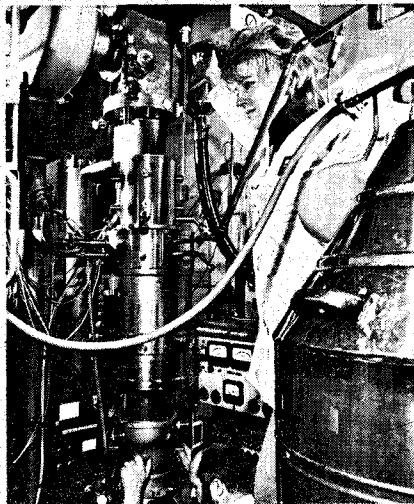
A fundamental limit affecting all microscopes is their resolving power. The best electron microscopes now resolve about three ten-millionths of a millimetre.

To improve resolution further, the

electron beam which creates the image would have to pass through a stronger magnetic field. In the conventional design "magnetic lenses" consist of an iron-cored coil whose strength cannot be increased beyond the point where the iron is magnetically saturated.

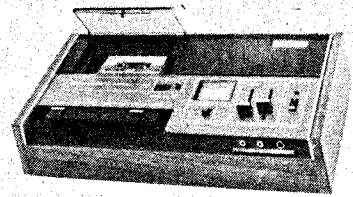
Instead of the iron core, Siemens employ an iron-free system making use of superconductivity, i.e. the phenomenon which allows an electric current to flow without resistance at temperatures near absolute zero (-273° Celsius). This method has produced a magnetic field strength twice as high as the previous possible limit. A further advantage is light weight. A conventional iron system in a high-energy electron microscope with a "beam voltage" over a million volts weighs two tons, while the superconductive design including the low-temperature cooling equipment would only weigh 45lbs or less than one hundredth of the weight.

Although considerable problems have yet to be overcome, particularly regarding superconductive material, results obtained so far indicate that the experimental microscope is based on a sound principle and promises one day to lead to the aspired goal.



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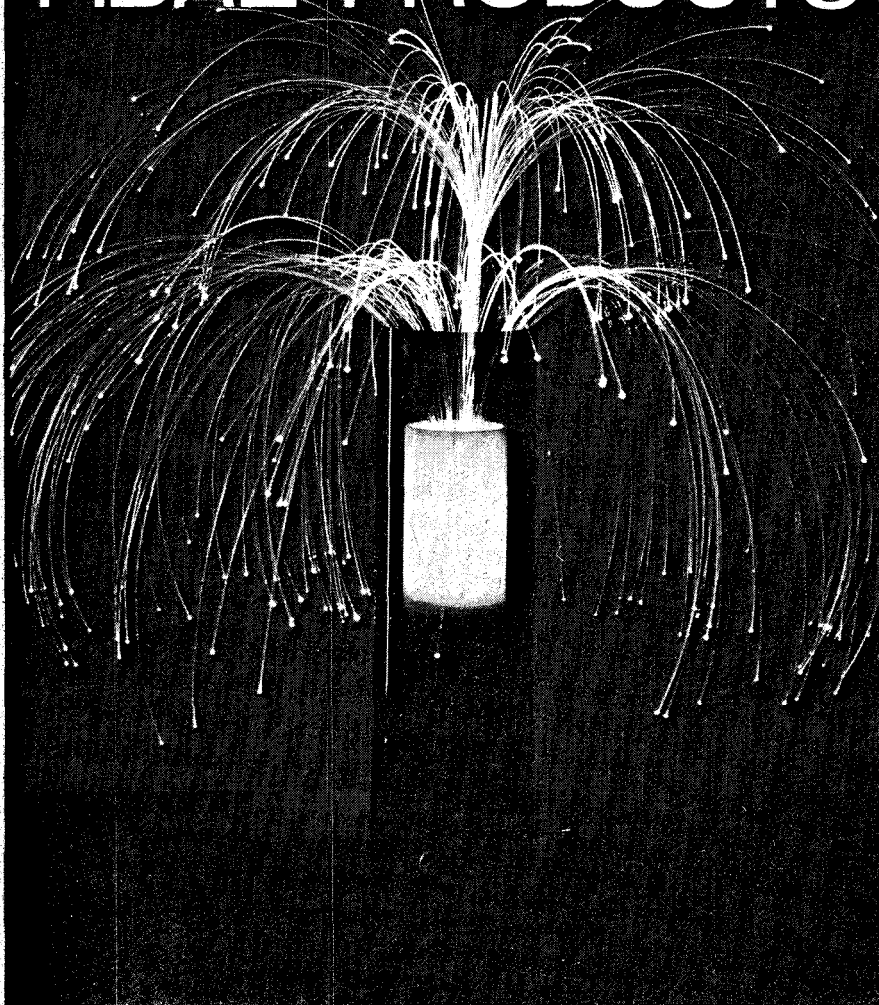
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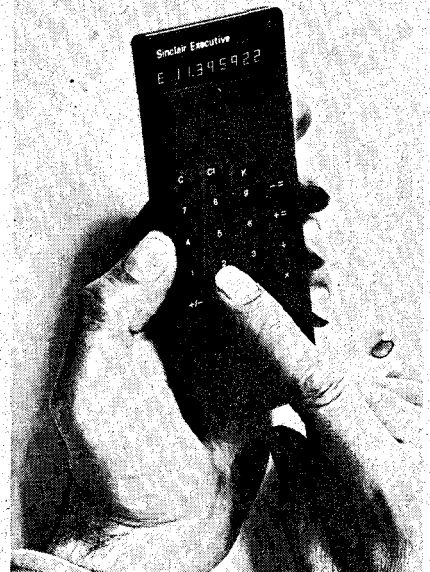
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## news digest

### WORLD'S SMALLEST ELECTRONIC CALCULATOR?



What is claimed to be the world's smallest electronic calculator, at just over ¼ inch (0,250mm) thick, has been introduced by a British electronics manufacturer Sinclair Radionics Ltd, London Road, St. Ives, Huntingdonshire, England. Called the Sinclair 'Executive' it measures 2 inches (50,8mm) wide by 5½ inches (139,7mm) long and is claimed performs all the functions of large desk machines. The total weight, including batteries, is 2½ ounces (71g approx.)

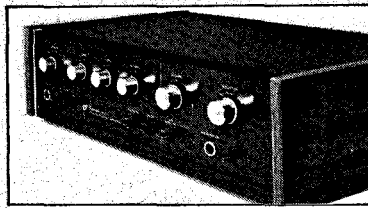
The illuminated display has a capacity of 8 digits and the machine will add, subtract, divide and multiply virtually instantaneously. Other features include automatic squaring, reciprocals, fixed or floating decimal point operation, and a memory for locking-in instructions to repeatedly multiply or divide by a pre-determined factor (this greatly speeds a series of calculations with the same factor, eg. currency conversions or discount prices). Power for the calculator comes from three low-cost 'hearing aid' batteries measuring about ¼ inch (19mm).

#### EXTRACT FROM HANSARD — MARCH '71

Former Prime Minister, John Gorton, "They advised it and the Minister for Defense had rung me up in the middle of the night to check that with me"  
Leonard Reynolds (Labour — NSW), "Lucky to get you at home"

# Select Sansui stereo amplifiers for...

Superior design  
Superb engineering  
Sparkling performance



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

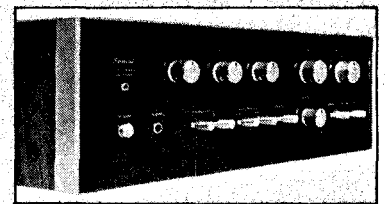
There are six audibly superior control amplifiers in the Sansui range . . . from 30 watts RMS to 100 watts RMS. All feature *all-silicon* transistor design — and distortion is considerably less with Sansui control amplifiers, as output stages are semi-complementary Darlington designs without *input or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

The startling difference you will notice with any Sansui stereo amplifier is the *tonal*

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

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

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



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

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

Bleakley Gray Corporation Pty. Limited,  
28 Elizabeth Street, Melbourne, 3000.

Please send me complete details about the Sansui amplifier Model.....  
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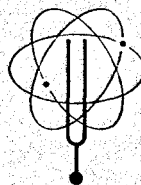
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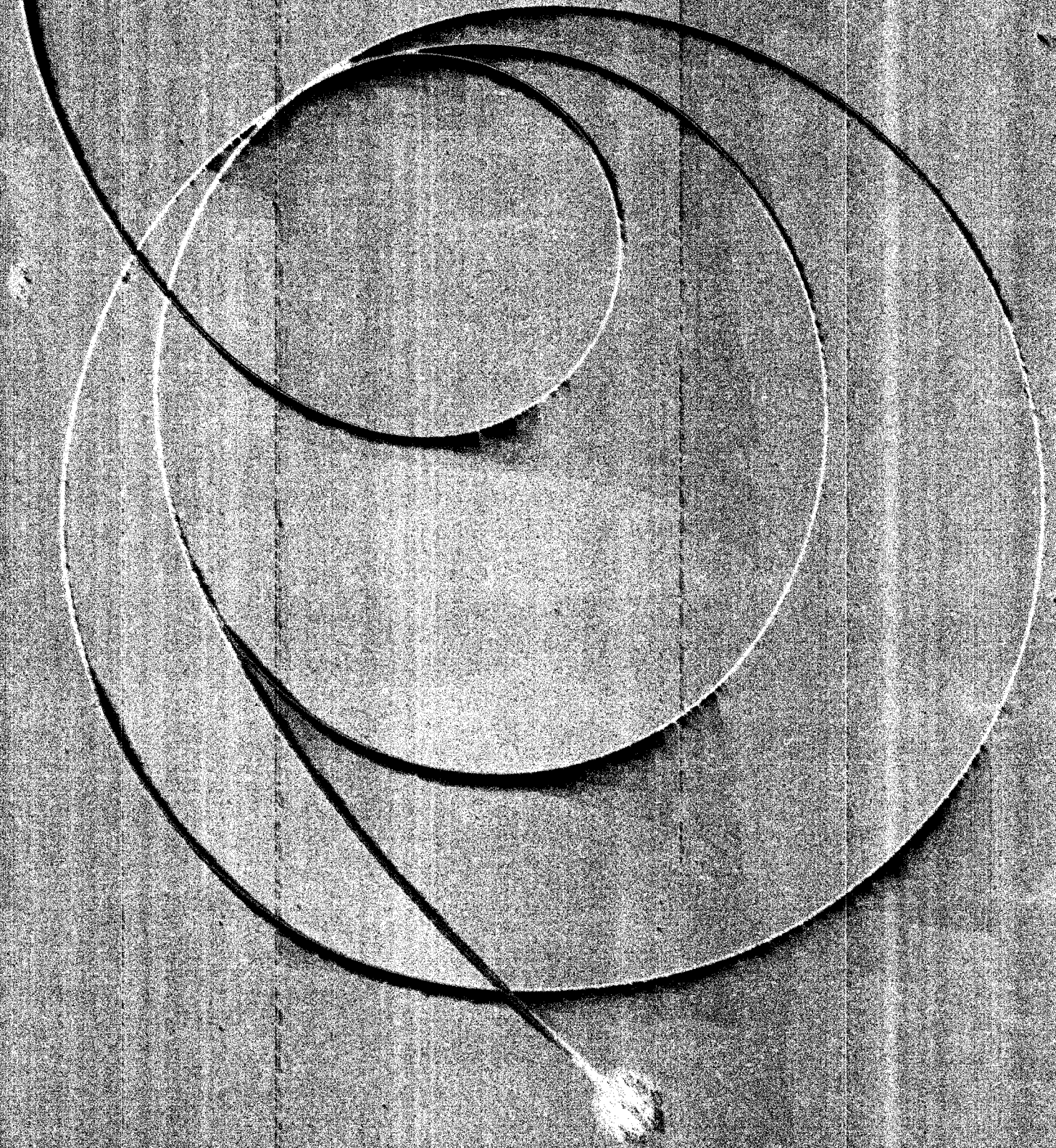
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Sansui equipment is manufactured by:— Sansui Electric Co. Ltd., 14-1, 2-chome,  
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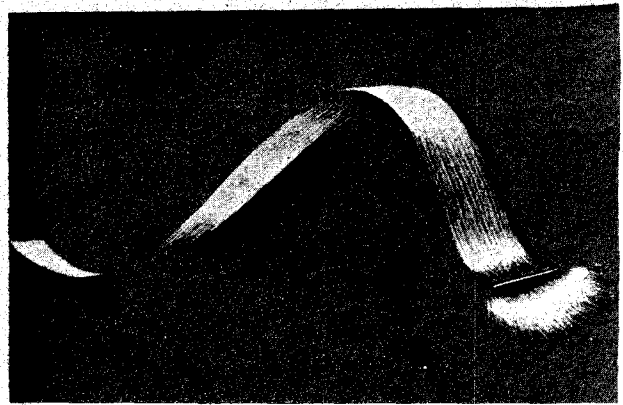
# FIBRE OPTICS-





# TODAY!

Yesterday a laboratory curiosity; today a developing scientific field, fibre optics is finding uses in the home, automobile, industry and science. Here is how it works; how it is used.



As early as 1870, the British physicist John Tyndall demonstrated that light could be made to follow a curved path. He directed a light into a tank of water, from which a stream flowed through a hole punched in the side of the tank.

The stream of water contained part of the light from the tank, and tended to illuminate the spot upon which it fell. However, not until 1950, did an intense investigation into optically-coated fibres begin, with simultaneous efforts starting in the Netherlands, England and the U.S.

As the 1960's unfolded, fibre optics came of age, and both the news media and sales representatives were touting this new technology as a solution to many problems. In the U.S., giant electronics and optical companies leaped into the production of light pipes for every application imaginable and as requests for prototypes were received by these corporations, their research and development also expanded. However, every product must eventually pay its own way, and many of these corporations soon tired of simply drawing fibres and building prototypes. The finished assembled fibre optic product rarely materialized.

In the 1970's, this situation resulted in two types of fibre optic

But in the beginning of 1970 this situation changed and today fibre-optic components are finding increasing commercial application throughout science and industry.

## HOW FIBRE OPTICS WORK

Light transmission through a fibre-optic guide is basically a wave phenomenon, in which the fibres serve as wave guides for electromagnetic radiation at visible frequencies. Wave-guide phenomena must be understood and used when fibre optics which have a diameter comparable to the wavelength of light are used, transmitting energy in complex patterns. But for the components discussed here, energy transmission theory can be approximated by conventional geometric optics, in which "rays" of light are traced through the system and used to explain the system's operation.

The entire theory of fibre optics hinges on the principle of total internal reflection, a refraction effect, as the light rays travel along a fibre. Refraction occurs whenever light passes from one material to another. It occurs because light travels at different speeds in different materials. In Fig. 1,

a light ray travelling in a material that has an index of refraction " $n_1$ " and an angle of incidence  $\phi_1$  is bent as it crosses the interface into a second material whose index of refraction is " $n_2$ " by an angle  $\phi_2$  according to the following relation, Snells Law:

$$n_1 \sin \phi_1 = n_2 \sin \phi_2$$

Angle " $\phi$ " is always measured with respect to a perpendicular to the interface of the two materials, and the direction of the light ray may be reversed without changing the path of the light ray. For this equation to be precise, the light should be monochromatic.

This refraction effect accounts for "apparent" distances when looking at an underwater object. When looking straight down, refraction causes a body of water to appear shallower than it actually is.

A light ray travelling from a material having a high refractive index  $n_1$  (an optically dense material) to a material having a low refractive index,  $n_2$  (an optically rare material), crosses the interface and penetrates material 2 only if angle of incidence  $\phi_1$  is less than critical angle  $\phi_c$  as in Fig. 1-b. At incident angles greater than the critical angle, the light can not cross the interface, and instead is totally

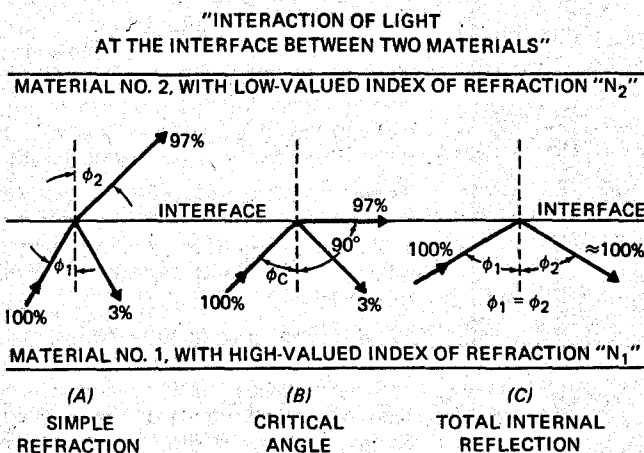


Fig. 1. How light behaves as it moves from one type of material to another. Light may be refracted (a and b) or totally reflected as at c.

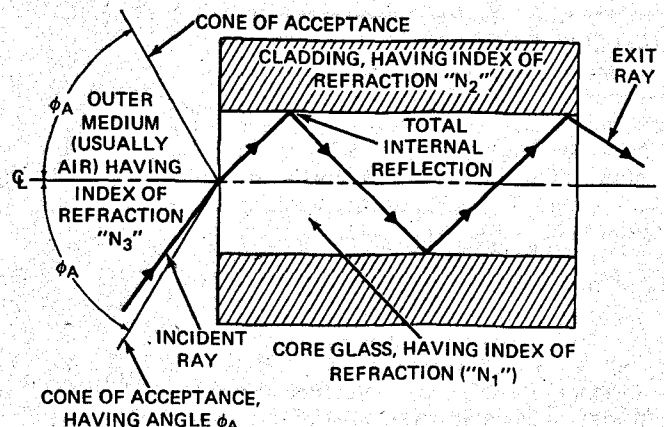
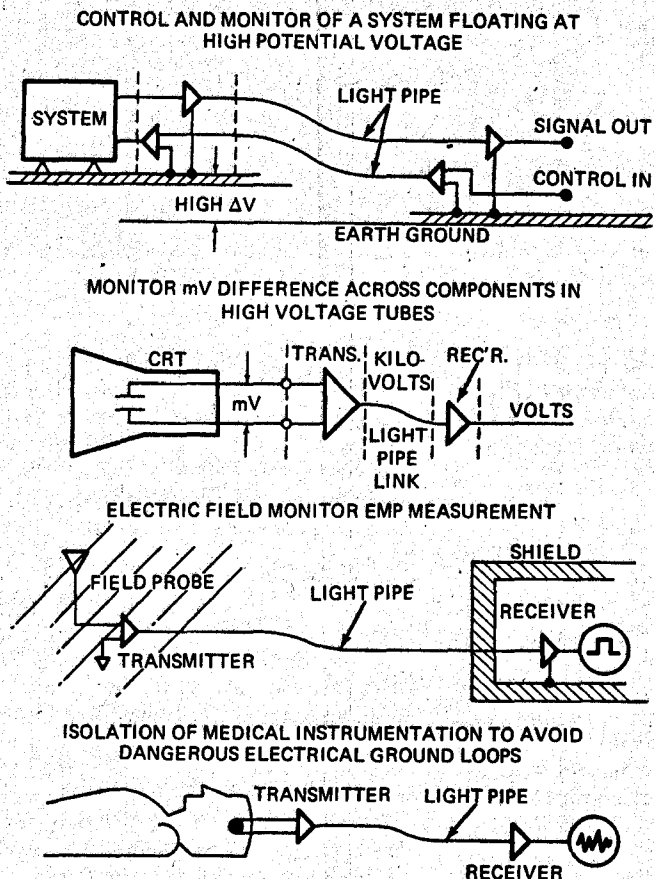


Fig. 2. Action of light ray inside fibre-optic filament. Cladding must have refraction index for total internal reflection.

# FIBRE OPTICS-TODAY!



reflected back into medium 1 as in Fig. 1-c. This critical angle is determined from Snell's Law to be:

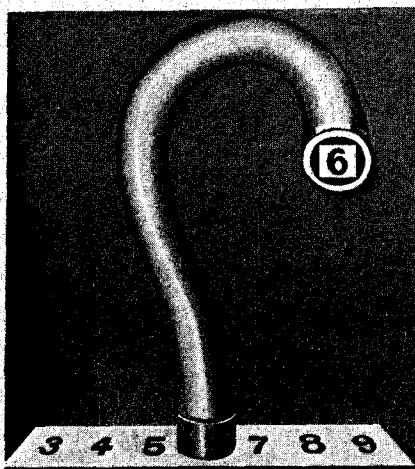
$$\sin \phi_c = n_1/n_2$$

The principle of total internal reflection is found in many optical instruments where glass prisms rather than silvered surfaces are used to reflect light, since even the best silvered surface absorbs a fraction of the incident light. To apply this principle to a fibre-optic light-guide filament, a cylindrical core glass with an index of refraction  $n_1$  is clad with a second glass that has an index of refraction  $n_2$ . For total internal reflection to occur,  $n_1$  must be greater than  $n_2$  and the incident light ray must fall within the angle of acceptance. This angle of acceptance is given by:

$$\sin \phi_1 = \frac{\sqrt{n_1^2 - n_2^2}}{n_3}$$

$\sin \phi_a$  is also called the Numerical Aperture (NA), and represents the maximum angle at which a ray of light which is incident on the transmitting core glass can be trapped within the fibre. Beyond this maximum angle,

rays are either reflected off the core face, or escape the core/cladding interface. The higher the numerical aperture becomes, the greater the angle of acceptance and the greater the light gathering power exhibited by the fibre. These relations are summarized in Fig. 2. In photographic terminology, the f/number =  $1/2$  (NA), where a low f/number indicates a large light gathering ability by the



Flexible plastic fibre optics transmits images in full colour. Light loss is 20% per foot plus 10% at each end.

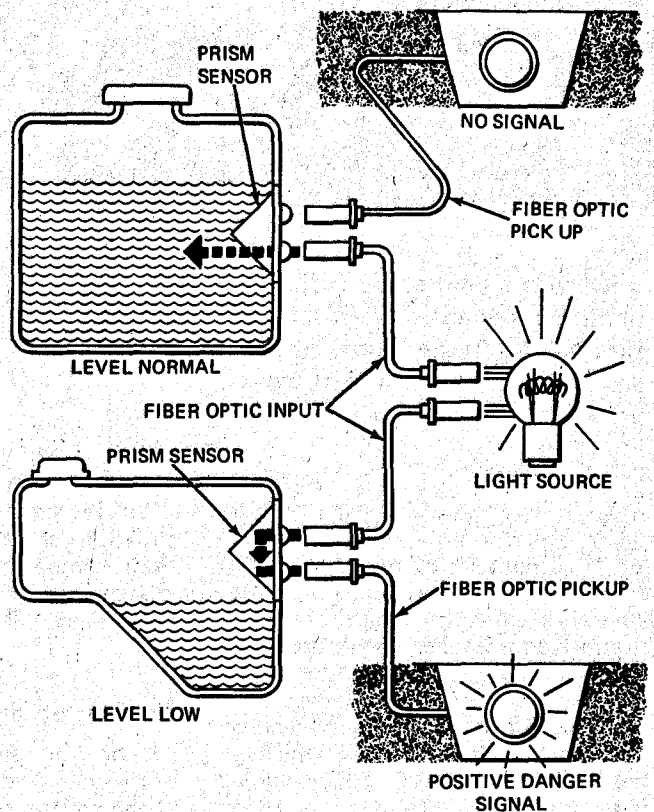


Fig. 3. Fibre-optic system monitors two liquid levels. Single lamp provides isolation between receiver and transmitter.

Fig. 4. Fibre-optics monitors two liquid levels. Single lamp excites the optics and provides alarm signal when needed.

lens. Since  $n = 1$  for air, the NA can never exceed 1, and the f/number can never be less than 0.5.

Light loss during transmission through a typical fibre depends on several factors. The length of the fibre attenuates the light ray in relations to the absorption coefficient of the core glass, which is dependent on the colour of the surface light. Over the wavelength range of  $4.5 \times 10^{-5}$  to  $10.0 \times 10^{-5}$  cm, average absorption loss is 7% per foot of length. Special core glasses can be obtained, however, to transmit ultraviolet.

The ends of a fibre optic bundle also have losses. The areas between fibres do not transmit light, and light energy incident on the clad glass portion of each filament is poorly transmitted.

These losses are referred to as packing-fraction losses. They occur for a 30% loss of the incident energy falling within the acceptance angle of the device.

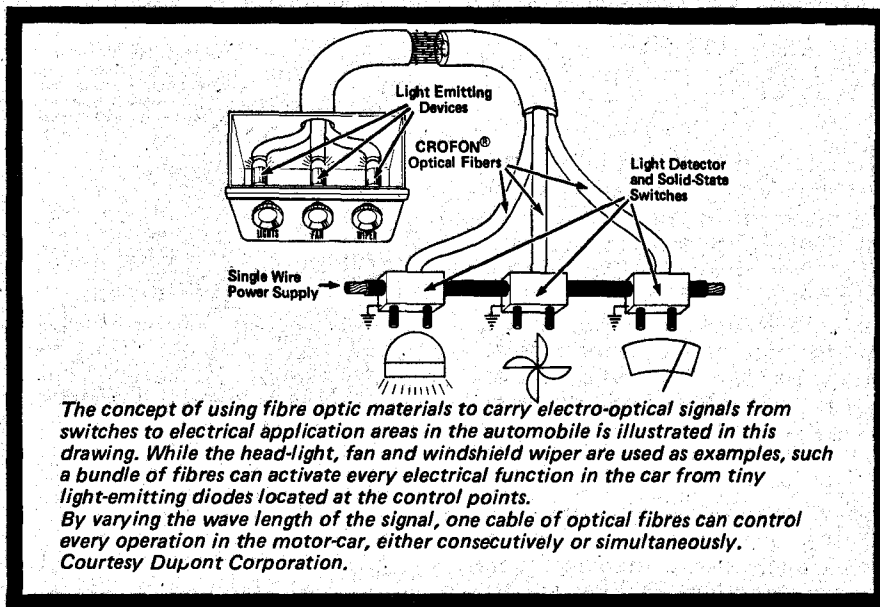
End losses also include those that occur at the air/fibre interface on each end of a device. Each reflection loss accounts for about 4% of the incident energy. For a one-foot bundle, these losses can be multiplied to yield about 50% transmission efficiency. For longer lengths, this figure should be

multiplied by 93% per foot (7% absorption loss per foot).

Although a single unclad rod, such as Lucite, can be used to transmit light, transmission efficiency is quite poor. The key to an efficient light transmitting rod is in the smoothness and purity of the reflecting surface. With an unclad glass or plastic fibre, the smooth outer surface along the length of the fibre can easily be scratched or contaminated with dirt and fingerprints. In addition, when single glass fibres are bunched together in a matrix, light can jump from fibre to fibre (cross-talk), degrading the transmission characteristics of the array.

Cladding provides several advantages. The critical angle remains constant along the length of the fibre, and the critical interface (between core glass and clad glass) is protected, and stays as smooth as when manufactured. Further, cladding provides a way to separate the individual fibres to prevent light leaks. In some optical arrays, a layer of opaque material is applied as a second cladding, resulting in light absorption outside the acceptance angle.

Fibre-optic devices come in a multitude of sizes and forms, but most

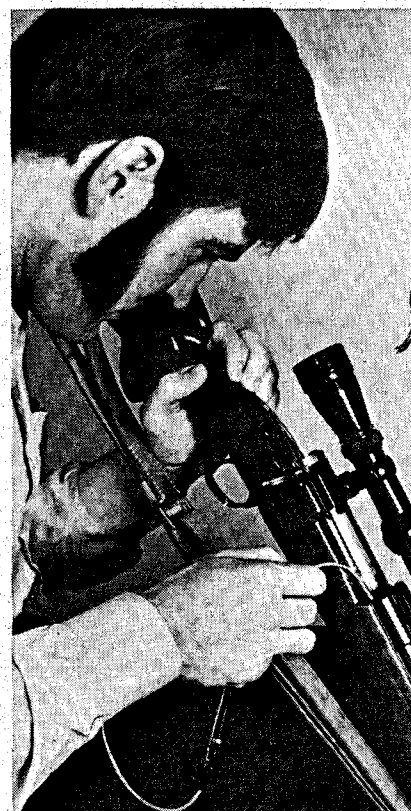


are based on the single clad-glass fibre or filament.

The simplest way to draw a single clad-fibre that has discrete index of refraction between core and cladding is the rod-in-tube method, in which a rod of glass (the intended core) is inserted inside a glass tube (the intended cladding) and then fed into a

furnace which heats the glass to a temperature just below melting. Then the heated end is drawn out into a fibre that has, on a smaller scale, the same relative core-to-cladding refractive index ratio as the original rod-in-tube.

The conventional single-fibre optic filament can be made in any size from



*This is neither a scene from "2001" nor a satellite's view of the eye of a hurricane. It's a glimpse down a rifle barrel illuminated at the chamber end by a Corning Flexiflash fibre optic unit. The unit is proving useful for gun enthusiasts in examining rifling, the chamber, the wear in the barrel's throat — all areas that can effect a weapon's accuracy.*

# FIBRE OPTICS-TODAY!

20 microns up to ¼-inch in diameter (and occasionally larger and smaller). The larger size is frequently called a rod. These filaments are made of either glass or plastic. Glass has the advantages of being sturdier, resisting high temperatures without damage, resisting most chemical environments, and is generally more efficient than plastic. Plastic fibre-optic filaments, however, are generally less expensive than glass, and can frequently be used without end polishing if they are cut cleanly.

Single fibres by themselves are not very useful, except to demonstrate how fibre-optic bundles are made.

But an equipment designer should not waste his time fabricating

**"why-how-where"**  
safe, cool light for everyone!  
The history, principles,  
methods of working with, applications  
and project suggestions  
concerning plastic fiber optics.  
A basic handbook.



*This booklet forms part of fibre-optic experiments kit made by International Rectifiers, the kit, and other fibre-optic materials are available from STA Electronics in Melbourne.*

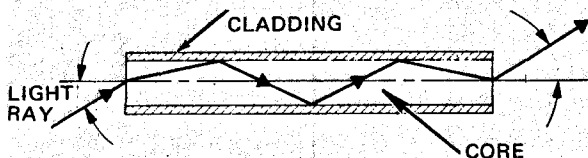
fibre-optic bundles and arrays since this approach presents more problems than it solves. Excellent design kits of production fibre-optic devices are available from several sources. These kits make it possible to build a prototype instrument without worrying about a sloppy fibre-optic component.

An interesting offshoot from the basic fibre fabrication technique is the SELFOC fibre, recently introduced by Nippon Electric. It is a lenslike glass fibre-optic light guide in which there is no separation of core and clad glass. Instead, the refractive index of the fibre changes continually in a radial direction from a maximum value at the centre to a minimum value around the circumference. As there are no internal reflections, the fibre itself acts as a lens, and the transmission efficiency appears to be greater than with a conventional fibre-optic

## BASIC DATA ON FIBRE OPTICS

The principle by which Fibre-Optic work is called total internal reflection

Total internal reflections will exist at any smooth interface between two transparent materials having different refractive indexes, such as between glass and air. Contamination such as one fibre touching another, or dirt deposits on the interface, interferes with total internal reflection by absorbing or scattering a fraction of the light. This problem has been solved by in the case of fibre optics by applying a transparent "cladding" of low reflective index over the higher refractive index of the fibre. This permits highly efficient light transmission through the fibre core.



The amount of light transmitted depends upon (a) the intensity of the light source, (b) the loss characteristics of the cladding and core structures, (c) the length of fibre and the number of fibres per bundle.

## PERFORMANCE CHARACTERISTICS

The general performance characteristics of commercially available fibre optic materials is listed below. The information is more representative than conclusive because of the wide difference in specimens and techniques in construction.

### OPTICAL CHARACTERISTICS

Acceptance angle	70 degrees F
End losses	10% average (depends on end finish)
Line losses	10% per foot exponential
Transmission range	0.4 to 0.9 microns
Bend radius	20 times fibre diameter
<b>PHYSICAL CHARACTERISTICS</b>	
Bend radius	Smaller fibres can be lightly knotted without breaking
Density	1.04 grams per cubic cm.

### ENVIRONMENTAL CHARACTERISTICS

Temperature (Maximum continuous exposure)	180 degrees F
Minimum temperature	Operates at cryogenic levels. Remains flexible to approximately 50°C.
Heat distortion temperature	100 degrees C at 264 psi.
Moisture absorption	None
Chemical resistance	Unaffected by alkalies, non-oxidizing acids, salt water, photographic solutions, etc. Damaged by acetone and other strong solvents.
Aging	Three years history of dark storage reflects negligible transmission variations.



firing of explosives at a remote distance. Typically, the laser head would contain a neodymium pulsed laser set to deliver one joule of energy into the fibre-optic bundle. At the receiving end, a power cartridge contains the propellant and an optical glass window that admits the laser light to the propellant. Such a device can be used to fire explosive bolts in rockets to separate stages, and since the firing mechanism has only a glass fibre input, it cannot be accidentally set off by static electricity or electromagnetic interference.

Another novel use of a fibre bundle is transmission of data. The isolation signal amplifier shown in Fig. 3 provides both a means of isolation and a means of data transmission. Each system consists of a transmitter, receiver, and connecting fibre-optic cable. Using a battery power source in the transmitter, the system can operate with immunity in areas of high ground-plane and common-mode voltages. The system is used to isolate medical instrumentation, safety measure high voltages, and isolated measurement of rf fields.

Although fibre-optic bundles can be used simply to supply light in an inaccessible area, a much wider application is in photoelectric sensing circuits. Although a light and photocell could be used without a fibre-optic guide, for simple object detection, the light and photocell would be subjected to any mechanical stress that affected the measuring site such as vibrations on a conveyor system. With a fibre-optic guide, both the light and the photocell can be located at a remote point, increasing their reliability and serviceability.

In punched-card readers, a photocell-lamp combination has been superior to the earlier method of brushes and contacts. However, the lamps have a short lifetime because of the vibration set up by the card-handling equipment. By using a

filament. In addition, a SELFOC filament produces no phase differences during transmission. The phase of the exit signal is the same as the entering signal.

Perhaps the most interesting use of a single fibre is in the fibre-optic laser developed by American Optical for photocoagulation of the retina-choroid portion of the eye to treat detached retinas. A small cabinet contains the flashlamp and the portion of the laser-fibre that is excited. Output energy travels along the single large, 300-micron diameter, clad laser fibre to a handheld probe, that is directed toward the desired spot by a surgeon. This application allows the precise positioning of intense energy with minimal danger to patient or the physician.

### MAKING FILAMENTS INTO BUNDLES

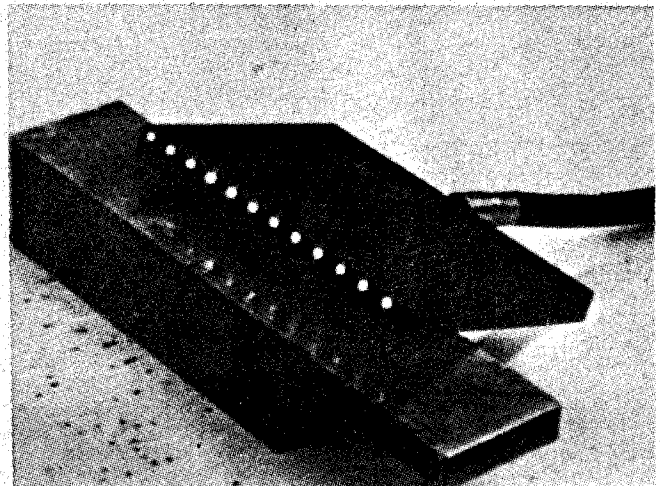
When a number of fibre-optic filaments are grouped together into a bundle, a fibre-optic light guide results. It is a bundle of single fibre-optic filaments, that are either epoxied or fused together at the ends and left free to flex in between. Since no effort is made to align the fibres at the ends of the bundle, the light transmitted through the bundle is scrambled or noncoherent, and the main application of these bundles is simple light transmission.

A noncoherent bundle is perhaps the

most useful fibre-optic component available. This device comes in many sizes and shapes, although all have potted, ground and polished ends, and the ends are usually held in metal ferrules.

The combination of the fibre bundle provides a source of cool, intense light for readouts, displays, photography, or medical uses — any situation that calls for intense, heat-free light.

The simplicity of a bundle of fibres which serve no purpose other than transmitting light is deceiving. Since light is energy, a fibre-optic bundle can be used to transmit raw energy to a load. One device could be a solid state laser system designed for failproof



*Single light source is a feature of this punched-card reader. Light shines on far end of 12-branch fibre-optics light guide.*

# FIBRE OPTICS-TODAY!

single incandescent light source, and a 12-branch fibre-optic light guide, reliability is increased while the total number of lamps required is decreased.

A more interesting use for lamp-photocell combinations in a reflection sensing to sense a mark on a card. In use, a two branch (bifurcated) bundle is used, with light travelling from the control unit to the tip of the bundle along one branch, or set of fibres. This light illuminates the area of interest, while light reflected from this same area is picked up by the other light guide in the same bundle, and carried back to a photocell in the control unit. These units are widely accepted in industry for such things as mark sensing, colour matching, colour change determination and edge sensing. With proper selection of light source and light guide, a unit like this can detect a spot as small as 0.002", 50 or more feet from the sensing site. This type of sensing can be applied easily to an optical tachometer. IBM has also considered applying reflection sensing to temperature monitoring so a central control panel would monitor the temperature of remote devices that have been painted with a temperature indicating paint. When a given temperature reaches the alarm point, the paint changes colour say from white to black. The level of reflected light that is carried back along the fibre bundle to the indicator lens changes accordingly.

## AUTOMOTIVE APPLICATIONS

It has recently been proposed that car instrument panels be illuminated from a single bulb. This light would be focused on to a many-branched fibre-optic bundle, with each branch being routed inside the wiring harnesses to a different point on the panel.

In the USA, this year's Chevrolets have an optional level-indicator system that can be installed on the windshield washer tank. The system consists of a sending unit, a light conducting fibre-optic bundle, and a lens assembly for the instrument panel. Similar in design, but suited for washer tanks or any application where you want to sense a liquid level is a liquid-level monitor evaluation package.

## COHERENT FIBRE-OPTIC BUNDLES

Manufacturing a bundle of fibres whose beginnings and ends are aligned in the same orientation produces a coherent bundle that can be used to convey an image, instead of simply transmitting light. This type of bundle

is collectively called a flexible fibroscope, and enables the observation of inaccessible places such as the inside of the human stomach or the inside of a jet turbine.

## SHEET OPTICS

Individual fibre-optic filaments can also be arranged side by side in a sheet. If the sheet of fibres is arranged in a circular shape at one end, and a different shape at the other end (such as a straight line), the light accepted by the end formed into a straight line will be delivered at the other end in the form of a lighted circle. This is the line-to-circle-converter, and it has many applications in facsimile transmission.

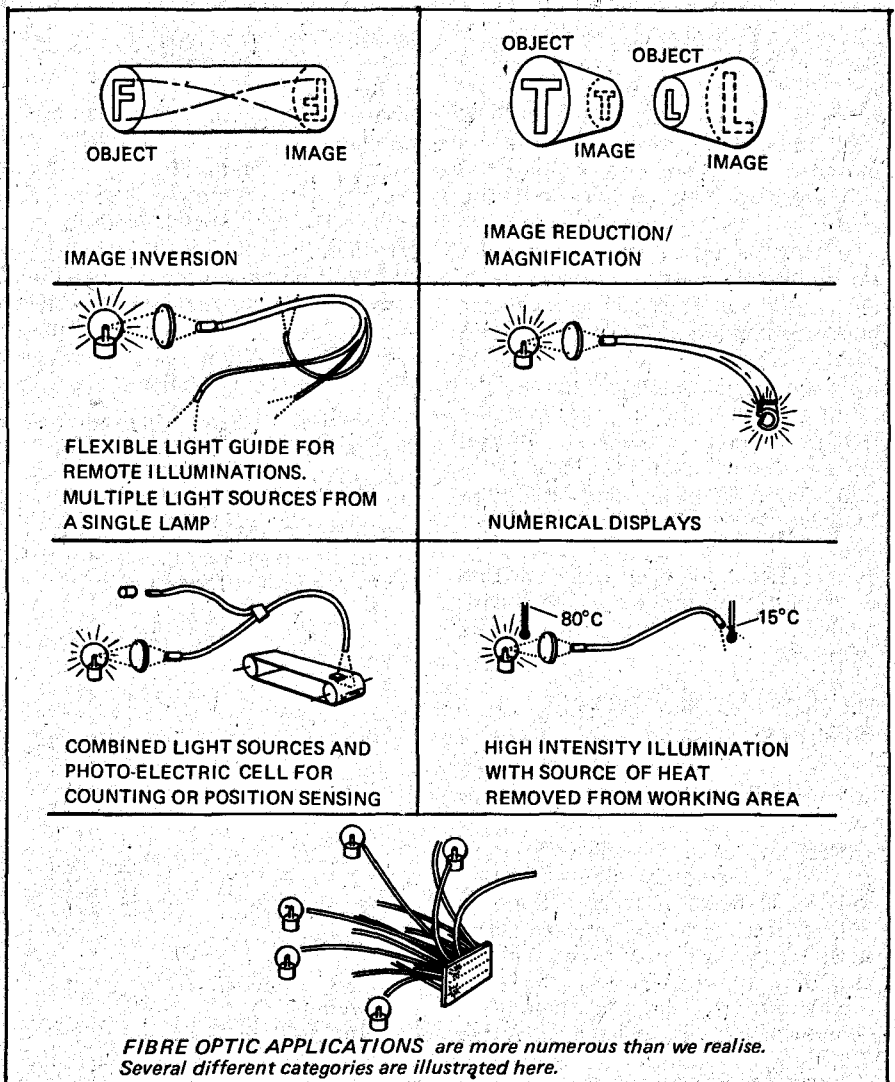
Sheet material can also be used to project and detect a light curtain. This type of arrangement is frequently used on large punch presses to insure that a part has been ejected, prior to the start of a new punch cycle.

Another important area of fibre-optics applications is mosaic fabrication. Here, many glass fibre-optic filaments are fused together into a plate or mosaic, having many

parallel light channels. This is a difficult process, and some companies first surround each filament with an opaque coating (called extramural absorption) to deter crosstalk between adjacent filaments in the finished mosaic. They are used as image magnifiers, inverters, intensifiers, and a faceplates in special-purpose cathode ray tubes.

A long-standing problem is obtaining a hard copy of an image on a CRO. Conventional CRO's simply do not deliver a sharp enough image, because of the scattering effect of the light as it passes through the phosphor layer through the glass faceplate. However, if the faceplate is a fibre-optic mosaic that has a phosphor coating over the internal ends of the fibres, then as the phosphor layer is scanned and excited by an electron beam, the emitted light travels only along the parallel filaments in its path to the outside world.

This configuration produces a very sharp image on the outside face of a CRO and can be used to contact print a dry photosensitive paper directly, resulting in a crisp hard copy picture.



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# There's stereo and stereo.



Once upon a time there was only one way to hear stereo.

One forward facing speaker poured sound into one ear. And one forward facing speaker poured sound into the other ear.

To hear anything resembling balanced stereo, you had to sit at the apex of the critical sound paths. And you had to sit still. All of which struck Stig Carlsson of Stockholm University as decidedly unsatisfactory.

So after years of research he created the Carlsson omnidirectional speaker.

It works like this.

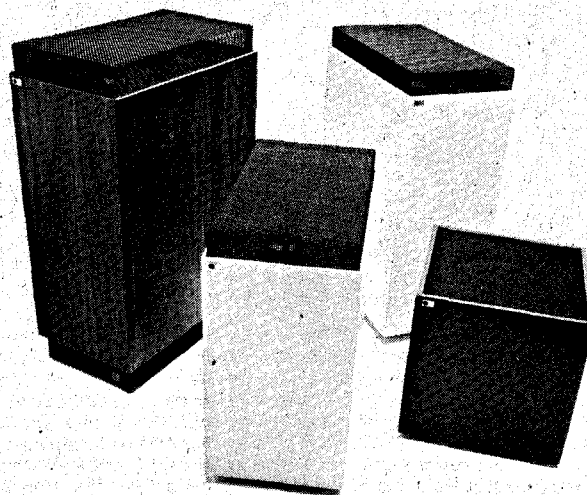
The sound is projected out of the top of the speakers.

And then moves outwards in all directions—it bounces round the room like a ball in a squash court.

Until it reaches your ears. Just like in real life. The effect is quite staggeringly different.

Just how different we want you to judge for yourself.

By going to your nearest Sonab dealer. Phone or write to us—and we'll give you his address. And send you some free literature, too.

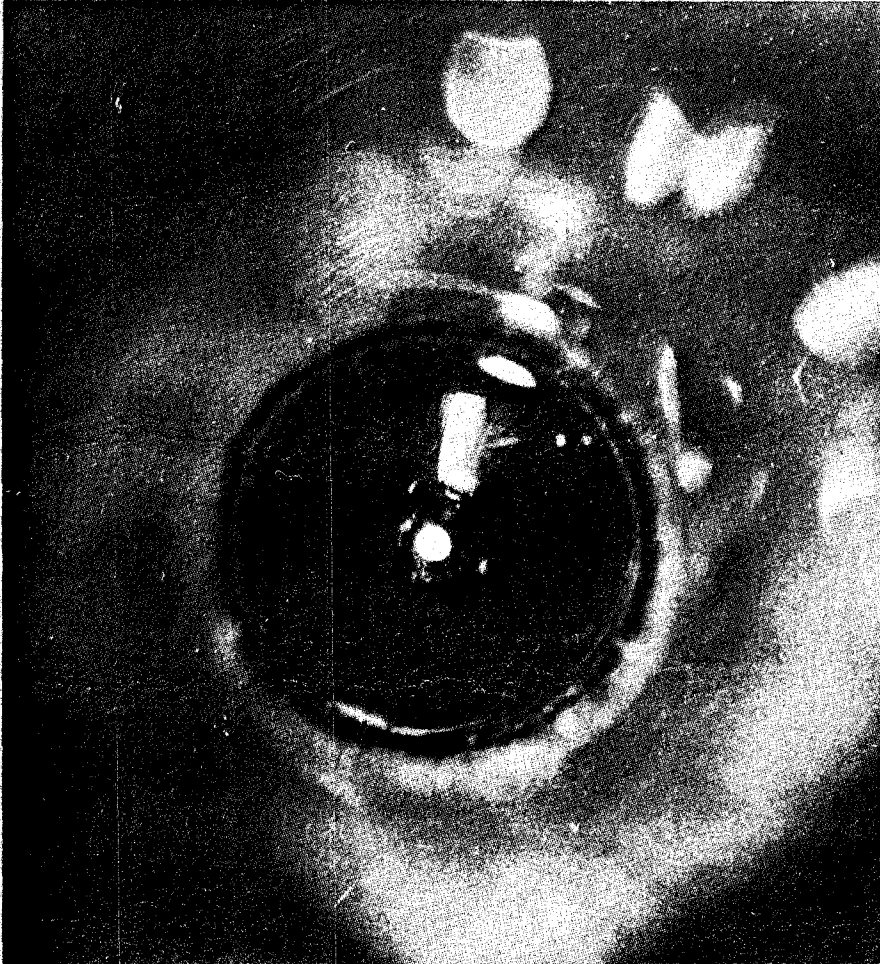


## Sonab

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Telephone: 929 4288/4554

# OPTICAL COMMUNICATIONS

150 million 6MHz TV channels can be accommodated on one single communications channel.



**'EXPLOSION'** analogies seem to be in vogue — even Paul Erlich called his book about population increase 'The Population Bomb' — and now we are constantly bombarded (there's another one! — Ed.) with warnings about everything from power usage to pollution.

Another of these so-called 'explosions' concerns the generation of information, and closely allied with this is the problem of the ever-increasing need for communications both within and between countries and continents.

By way of illustration, the number of new books published in the USA has risen from 7000 per year in 1945 to over 40,000 in 1972. The number of overseas telephone calls is 20 times greater now than 15 years ago and is still increasing at a dramatic rate. Other media such as telex traffic, satellite television coverage, facsimile and high speed data links all add to the staggering increase in demand for extra channels and increased bandwidths.

On international communications services these needs are being met by two current technologies. Firstly there are communications satellites of ever increasing complexity — the latest Intelsat satellite for example, has a capacity of 5000 voice channels or 12 television channels. — Secondly, new submarine cables are being developed to carry ever-increasing amounts of traffic. Cables scheduled for installation in the late 1970's will provide 10,000 voice channels or more.

Transcontinental traffic is largely carried by microwave links supplemented by co-axial cable systems. Obviously the largest amount of information possible should be carried on any one channel. This requirement naturally imposes wide frequency bandwidth requirements, and as a corollary, very high carrier frequencies. A typical microwave link, for example, would operate at 12 GHz and have a bandwidth of 12MHz. Adjacent channels share the same antenna path but have slightly different carrier frequencies.

*Using hollow glass waveguides — tiny tubes with inner diameters about one half the thickness of a pencil lead — a Bell Telephone Laboratories (BTL) scientist has succeeded in miniaturizing gas lasers. Spaced at intervals along a light path, miniature gas lasers could amplify light signals to compensate for transmission losses.*

*In most gas lasers, including the new waveguide lasers, coherent light is generated by means of an electrical discharge similar to that which causes a neon sign to glow. For many gas lasers the gain (the increase in intensity that the light experiences in passing through the gas) increases as the diameter of the discharge tube is decreased. But, a smaller inner diameter is only part of the key to obtaining the required gain for gas laser action in very short lengths of tubing. In conventional gas laser designs, for example, tubes with small inner diameters would block the passage of some of the laser light and more than off-set the benefit of higher gain.*

*To overcome this problem, waveguide gas laser tubes are fabricated with inner walls that are very straight and highly polished. By focusing light into this special tube in such a way that in passing down the tube it experiences multiple reflections at the walls, a beam can be efficiently transmitted with low losses. Light is actually "guided" down the axis of the tube where it can be amplified by a gas discharge.*

*In this way, much higher amplification can be obtained for a given length of tube than in conventional lasers.*



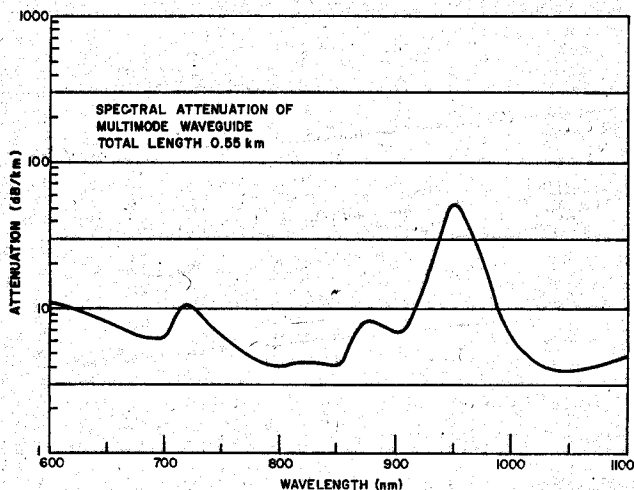


Fig. 1. This graph illustrates the spectral attenuation of a Corning multi-mode waveguide at various frequencies.

INFORMATION CAPACITY OF COMMUNICATION MEDIA		
MODE	CHANNEL BANDWIDTH	CAPACITY BITS PER SEC
Telephone	3 kHz	$6 \times 10^4$
AM Radio	10 kHz	$8 \times 10^4$
FM Radio	200 kHz	$2.5 \times 10^5$
Records or Tape	15 kHz	$2.5 \times 10^5$
Television	6 MHz	$9 \times 10^7$
Microwave Link (1200 Phone Channels)	20 MHz	$7.2 \times 10^7$
Coax Cable (10,800 Phone Channels)	57 MHz	$6.5 \times 10^8$
Millimetric Waveguide 250,000 Phone Channels	70 GHz	$15 \times 10^9$
Laser Optical	10 THz	10 <sup>11</sup>

But in the future, instead of tens of thousands of voice channels per link, we need to develop a technology providing *tens of millions* of voice channels per link, and this implies bandwidths of the order of 1GHz. How will this be possible?

### OPTICAL COMMUNICATION SYSTEMS

One answer lies in the new laser technology and in the even newer fibre-optic technology. These two techniques when used together provide a communication medium with staggering information transmission capabilities.

Conventional lasers operate in the region between 0.3 micron and 5.3 micron — that is 60 Terahertz +. In this bandwidth,  $200 \times 10^9$  voice channels could be accommodated, or, 150 million, 6MHz wide, TV channels. On a single laser beam, millions of voice channels, or thousands of TV channels could be accommodated.

Practical optical communication systems should commence service within the next decade and by that time most of the technology should be readily available.

Light sources in the form of lasers and light emitting diodes are available now — as are suitable detectors such as PIN diodes. One area however that is still receiving intensive research effort is the conducting medium. Obviously, line of sight transmission will not be possible under all conditions, and some means of piping the light around corners must be developed. This is where fibre-optics will find its most extensive application.

### FIBRE-OPTIC SYSTEMS

Transmission of information via fibre-optic systems was only

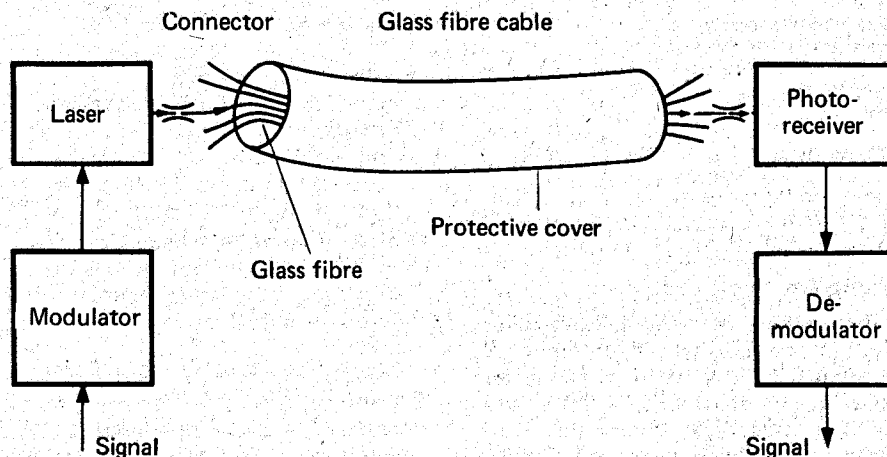
practicable over very short distances until recently. The main problem was attenuation of the light (i.e. signal) level due to losses within the fibre itself; in fact losses in the best available fibre have been 20dB/kilometre or more. (At 20dB per kilometre only 1% of the input light emerges at the end of a fibre one kilometre long.)

But even with a loss of 20dB per kilometre the technique is practical, for current engineering methods using light sources and detectors allows a 30 to 50dB loss to be tolerated. This means that fibre-optic transmission is now possible over distances greater than one kilometre which is essential in any practical system. (A repeater station every kilometre or so is normal in coaxial cable systems). Furthermore, glass fibres are mechanically flexible, simple and trouble-free in contrast to more complicated alternative optical transmission techniques.

In the USA, Corning researchers have

recently reduced attenuation losses in glass fibre-optic waveguides to only four dB per kilometre at 850 and 1060 nanometers — (which are convenient wavelengths for laser light sources). Losses between 600 and 900 nm are all 12 dB/km or less. (See Fig. 1.) Corning first attained an attenuation loss of 20 dB/km in 1970, and scientists said then this development greatly enhanced the prospect of high information-capacity optical communication systems. The more recent four dB/km performance arose from composition research and improved multimode fibre-preparation techniques. Corning's goal is now said to be fibre with losses of only two dB/km.

Multimode low-loss waveguides are fabricated by drawing down a rod of core glass sealed to a tube of the cladding glass. This is impractical for single-mode waveguides, because the core must be very small. However a new technique, of drawing down a tube with a film of the core glass



Optical communication transmission via glass fibres

# OPTICAL COMMUNICATIONS

inside, has been developed to circumvent this difficulty.

The bandpass of single-mode optical waveguides is limited by guide dispersion and dispersion of the glass materials. Calculations show it to be over  $10^{10}$  bits per second per kilometre of length.

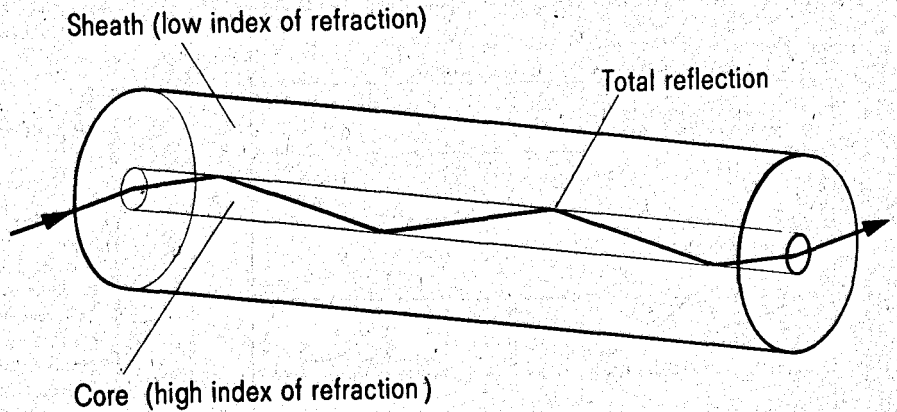
Multimode waveguides are difficult to evaluate accurately but the approximate bandpass can be shown to be approximately  $10^8$  bits  $\text{sec}^{-1} \text{km}^{-1}$

As stated before, the most important parameter of a fibre waveguide is its attenuation. Losses are due to both scattering and absorption. Scattering arises from imperfections, core diameter variations, and intrinsic refractive index fluctuations within the material. Absorption arises from intrinsic material properties, impurities, and unwanted oxidation states of the glass components. Water, present as  $\text{OH}^-$ , is an especially important impurity as its presence increases absorption. Most of these quantities can be evaluated explicitly and correlated with observed attenuation and most of these factors may be minimized by using a high silica content glass system. These glasses have low dispersion and hence higher bandpass as well as low intrinsic scattering. A representative attenuation curve for titania-silica waveguide (Fig. 1.) illustrates the low loss that can be achieved. The contributions to the loss can be further understood through measurement of the loss mechanisms outlined above. For example, a single mode guide showed the following contributions:

	633 nm	800 nm
Bulk material scattering (measured separately)	5	2
Residual measured scattering	2	2
Water absorption (estimated from tails of ultra violet peaks)	0	5
Residual measurement absorption (impurity or intrinsic)	9	11
<b>Total</b>	<b>16 dB/km</b>	<b>20 dB/km</b>

## BASIC OPTICAL LINKS

Attenuation of typical waveguides show a strong water absorption peak at about  $9500\text{\AA}$  with minor water absorptions at about  $7200\text{\AA}$  and  $8700\text{\AA}$ . Therefore, there are good transmission regions around  $8000\text{\AA}$  and  $10,000\text{\AA}$ . At the latter wavelength, losses below  $10 \text{ dB/km}$  are



Light ray conduction in a glass fibre.

possible. For single mode waveguides either GaAlAs or Nd:YAG lasers would provide satisfactory sources. For multimode guides a solid state incoherent source emitting near  $8000\text{\AA}$  (like GaAlAs) is preferred because of its simplicity. Since low loss waveguides have low numerical aperture (see previous article), it is important to reduce the angular spread of the source power. Thus, the important quantity for the source is its radiance ( $\text{W/sr m}^2$ ) since this determines how well the emitted light can be collimated and coupled into the waveguide.

Coupling into the detector is only a minor problem, and hence noise generation is the main consideration. Furthermore the lack of detector sensitivity at  $1.06$  micron mitigates against sources at this wavelength.

## OPTICAL FIBRE PARAMETERS

Glass fibres, as used for optical communications, may be likened to optical waveguides and indeed are so-called. The propagation characteristics of such optical waveguides are defined by a parameter  $V$ .

$$\text{where } V = 8.9 \sqrt{\frac{Rc}{\lambda} \cdot \bar{n} \cdot \Delta n}$$

and  $Rc$  = radius of core.

$\lambda$  = wavelength of conducted radiation

$\bar{n}$  = average refractive index of the glass

$\Delta$  = difference in refractive index between core and cladding.

Optical waveguides where  $V$  is less than  $2.4$  are classified as single-mode. These require laser sources for efficient coupling and have the highest bandpass.

Waveguides where  $V$  is greater than  $2.4$  are classified as multimode. These operate with solid state diodes (LEDs) which produce non-coherent light, and because of their relative simplicity have many present applications. This is

in contrast to the single-mode laser systems which are still very much in the development stage.

## CALCULATING SYSTEM LOSSES

The minimum discernable signal (MDS) is taken as the point where the Signal to Noise Ratio (SNR) equals 1. This may be computed from:-

$$\text{MDS} = B^{1/2} [(NEP)^2 + B(TEP)^2]^{1/2}$$

where  $B$  = Bandwidth

$NEP$  = Noise Equivalent Power

$TEP$  = Thermal Equivalent Power

Now from published data, a typical PIN photodiode has an NEP of  $10^{-7}$  watts at  $100 \text{ MHz}$  and an avalanche photodiode an NEP of  $10^{-9}$  watts ( $100$  times better). Therefore if a SNR of  $20\text{dB}$  is required with a source power of  $10 \text{ mW}$ , a PIN diode allows a transmission loss of  $30\text{dB}$  and an avalanche photodiode  $50\text{dB}$ . Any other desired system performance can be calculated in a similar way. These principles are applicable to present source-transmission line - detector systems and illustrate design parameters for such basic optical links.

## FURTHER NEEDED WORK

Individual fibres can be coated and used as a single transmission line, but at the moment, bundles of many fibres functioning in parallel appear more practical for incoherent sources. They offer a large cross section for source coupling efficiency, while retaining flexibility. Additionally they offer redundancy to offset fibre breakage. The redundancy question can be handled in terms of a single parameter for any length bundle when the breakage is random. The experiments in bundle construction and incorporation of bundles into cable have just begun. The future will require development of suitable cables and associated hardware, such as couplers, before totally qualified system components become available. ●

# Ever thought about efficiency?

You buy a twenty watt amplifier and go looking for a pair of speakers. You choose a pair that sound fine in the showroom but disappointing at home. Could be that they are low efficiency speakers and your twenty watt amplifier is overloading and distorting on the loud bits.

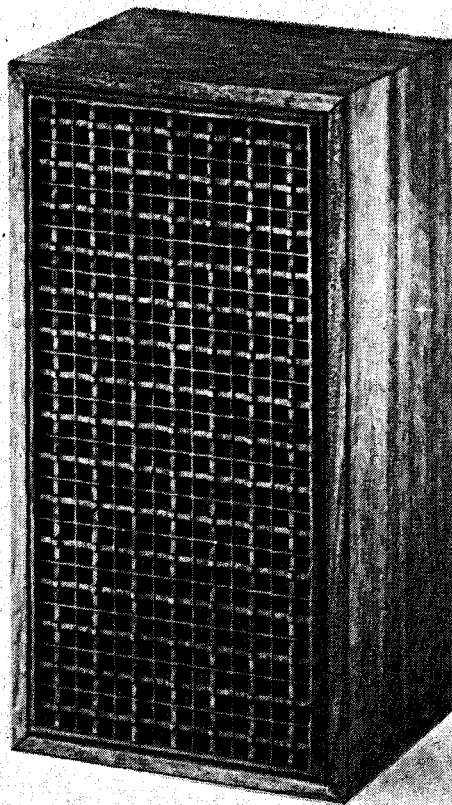
So you trade your twenty watt amplifier for a forty watt job . . . and you blow your speakers.

You're caught between the devil and the deep blue sea.

Unless of course you buy Rectilinear . . . . The high efficiency loudspeakers that flatter your amplifier because they don't make it work so hard.

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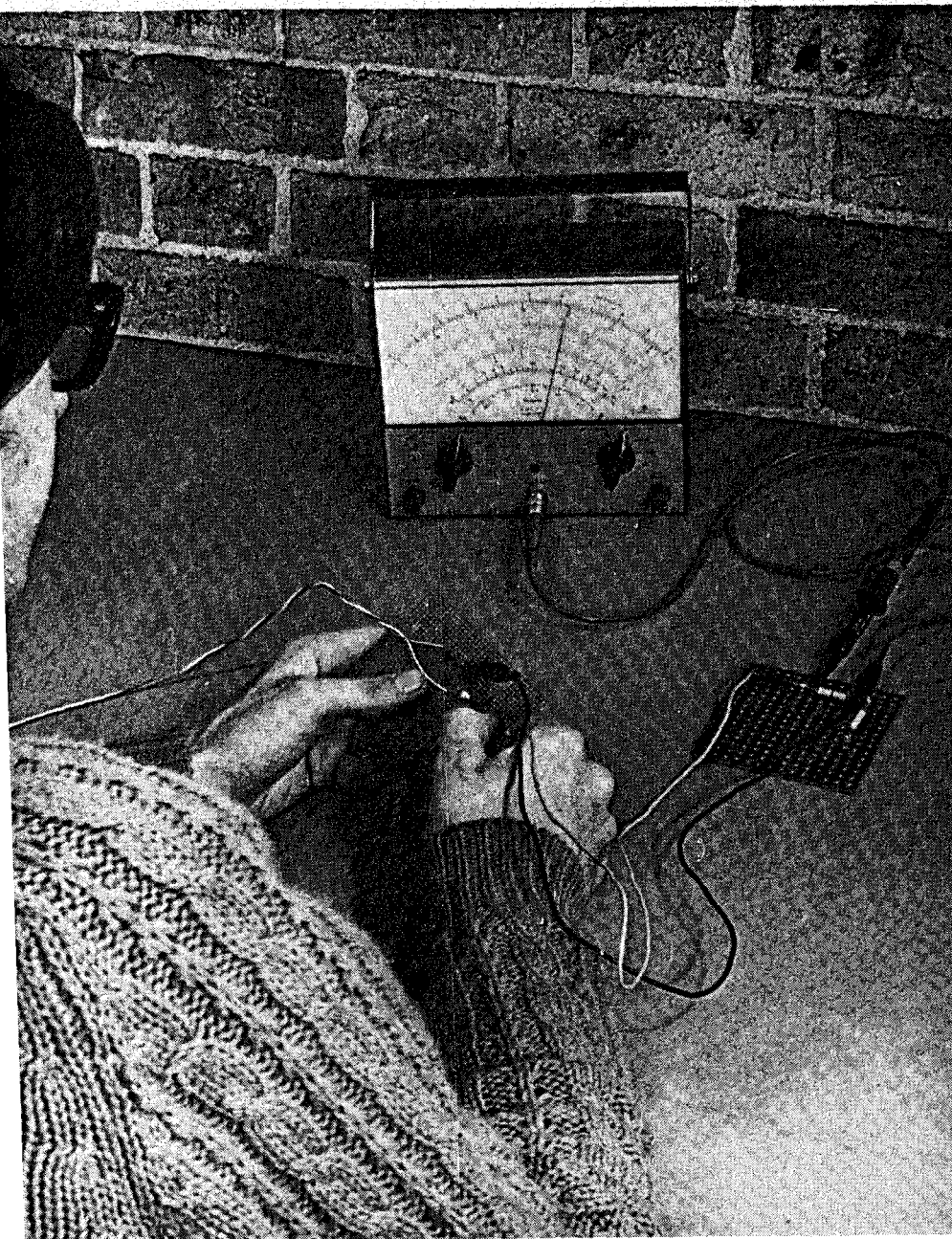
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LER 025

# THE SOPHISTICATED VOM

External components extend applications for volt-ohmmeters



Many engineers think of the VOM as being capable only of simple measurements of voltage, resistance and current. Furthermore, accurate and flexible operation has been considered the exclusive province of the "full size" instruments, with the pocket-size units relegated to the role of elementary servicing aid.

With the simple addition of a few readily available components to the circuit external to the VOM, the instrument is able to measure such values as current and voltage differential, capacitance, and micro-volt attenuation, to mention a few which will be discussed here. Though specialized instruments may be used to make such measurements, one may not be at hand when needed, or else the rarity of such measurements may make it economically impractical to buy one. The VOM may conveniently fill the breach.

## SEGMENTAL VOLTMETER

Suppose we wish to detect or measure very small voltage variations in a dc signal. For example, consider 50 mV differences in a 14-volt signal. This is difficult to achieve using the VOM "straight." That is, the 50-volt range would have to be used to cover 14 volts, and 50 mV is not very readable on this range.

To read the 50 mV, it is necessary that the VOM function as a segmental voltmeter, with most of its lower range suppressed. To accomplish this, a bucking reference voltage is inserted in the circuit as in Fig. 1. If the reference were 12 volts, the meter would have to read only the 2-volt difference on its 2.5-volt range. On this lower range, the 50-mV variations could be clearly observed, a feat not possible on the 50-volt range.

If the reference voltage is precisely known, this segmental technique increases the accuracy of the total voltage reading. If not precisely known, the technique still facilitates the detection and more accurate determination of the voltage variation or difference.

It is always desirable when applying a bucking voltage to use a level that is close to the measured value, yet lower than the latter's smallest value. (It is possible to use a reference voltage higher than the measured value, but this requires subtraction of the difference reading.) For instance, suppose the reference in Fig. 1. were 13.5 volts, the 0.5 volt difference could then be read on the 1-volt range, a range which permits even closer determination of the 50 mV variations than the 2.5-volt range.

### DIFFERENTIAL CURRENT-VOLTAGE METER

A VOM will function as a current or voltage sensitive differential meter to measure the difference between two individual signals. The preceding is an example of a differential voltage measurement using a fixed value on one side so that an absolute measurement results.

Where simple differential between voltages is desired, the connections of Fig. 3. would be used, except that the second unknown voltage would replace the battery.

For current differential measurements, two resistors are required. The resistor value is dependent on the maximum current differential to be measured. The value may be determined by using the formula:

$$R = \frac{R_m I_m}{I - 2xI_m}$$

where R is the resistor value,  $R_m$  is the resistance of the VOM on the range being used,  $I_m$  is the current sensitivity of the VOM on the range

being used, and I is the desired full scale current sensitivity.

Assuming the use of a 20,000 ohm/volt meter the 1.0-volt range and the need for 1.0 mA sensitivity, we would have:

$$\begin{aligned} R_m &= 20,000 \text{ ohms} \\ I_m &= 0.00005 \text{ (20,000 ohms/volt)} \\ I &= 0.001 \end{aligned}$$

$$R = \frac{20,000 \times 0.00005}{0.001 - 0.0001} = 1,111.1 \text{ ohms}$$

Fig. 2 shows the circuit which would be used. Of course, the VOM can serve simply as a null balance in such a circuit. Furthermore, it may also be used with ac inputs instead of the dc shown if external rectifiers are used.

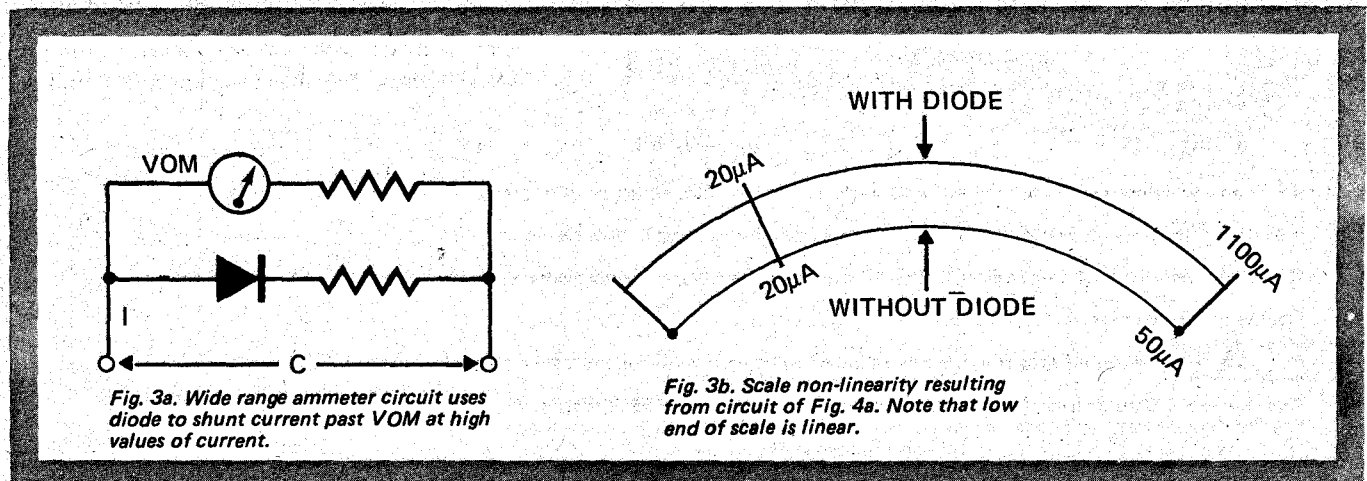
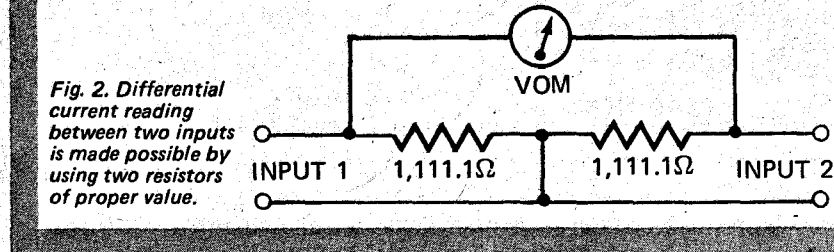
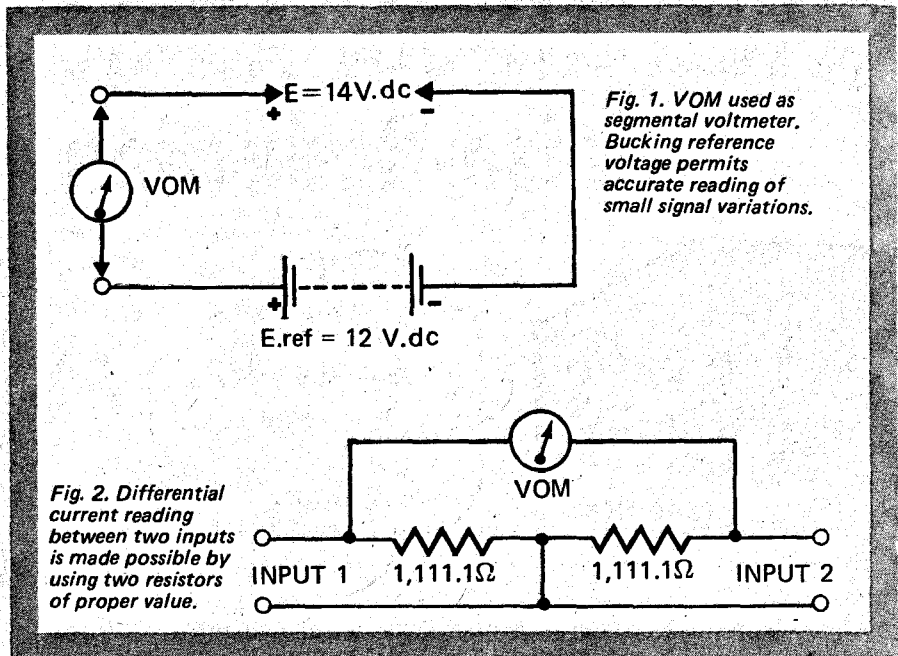
### WIDE RANGE AMMETER

There are conditions wherein a widely varying current can not be measured properly on a single range. A low scale will not cover the high end of the excursion, and a high scale will

not permit accurate reading of the low end. The solution is to make the scale nonlinear by shunting the VOM with a silicon diode as in Fig. 3a. The resulting readings will be as illustrated in Fig. 3b, with the low end remaining essentially unchanged by the diode, but the high end reading currents more than 20 times greater than before.

Until the diode starts to conduct, the shunt is effectively open, and the deflection is linear as without the diode. When the input voltage increases to the point that the diode conducts, more current is shunted past the meter. Where  $50\mu\text{A}$  caused full scale deflection without the diode, a current of  $1100\mu\text{A}$  might be needed with the diode. Exact scale distribution is dependent upon the values  $R_m$ ,  $R_1$  and  $R_2$ .

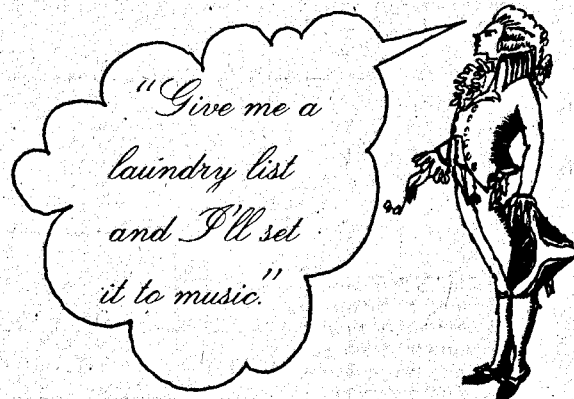
Since the diode is a nonlinear resistance, using this approach in voltage measurements should be restricted to voltages of at least 20 volts full scale or substantial scale errors may result.



# TEAC's AN-60, AN-80 and AN-180 Noise-Reduction Units.



TEAC AN-60



**If Rossini were alive today, he would set their specs to music.**

Rossini once made this boast and could probably have delivered. But a recording of the music on the best of today's cassette or reel-to-reel machines with their inherent noise and hiss could never capture the clean, crisp sound of the Rossini laundry list.

With the introduction of TEAC's AN-180 Dolby\* Noise-Reduction Unit, Rossini's Laundry Largo and just about anything else you record will have the same brilliance and luster as the original.

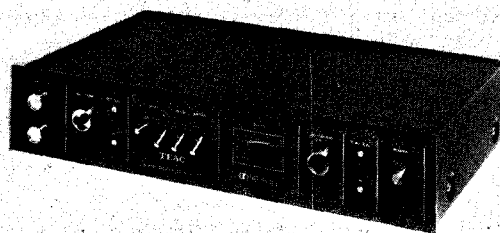
Our Dolby circuit removes machine and tape noise with such thoroughness that there is a signal-to-noise ratio improvement of 3 dB at 600Hz, rising to 5 dB at 1000Hz and 10 dB at 4K Hz and above.

Because we manufacture the ICs used in our Dolby circuit to extremely tight tolerances, ours operates at distortion levels of less than .3% — lower than many competitive units. So you see there is no question that you should have a TEAC Dolby Noise Reduction Unit.

We designed the deluxe AN-180 not only to Dolbyize fine decks, but to afford them features they might be missing.

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

TEAC AN-80



TEAC AN-180

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

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

- Frequency Response, 20-15,000Hz  $\pm$  5 dB ● Increased SN Ratio, 10 dB at 10,000Hz ● Harmonic Distortion, below 0.3%
- Signal to Noise Ratio, better than 65 dB ● Channel Separation, better than 55 dB

If you just need the best no-nonsense Dolby with none of the frills, ask your dealer about the TEAC AN-80 and AN-60

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AMI 143

# THE SOPHISTICATED VOM

## CAPACITANCE METER

The VOM does a creditable job of measuring capacitance. The simplest method compares the unknown capacitor with a known one, as in Fig. 4. The capacitances of  $C_1$  and  $C_2$  are inversely proportional to the a-c voltage across each:

$$\frac{C_1}{C_2} = \frac{E_2}{E_1}$$

Since the VOM impedance may be low as compared with the impedance of low capacitance units, the loading error should be minimized by using capacitors of approximately equal value. Another way to minimize error is to use a higher ac source frequency to decrease the capacitive reactance. If the known capacitor is accurate within 1%, the unknown capacitor can be determined within 5% by this method. (Caution: Do not attempt to make capacitance measurements on electrolytics by this method. Capacitance values will be in error and the capacitors may be damaged.)

The VOM can also make capacitor measurements without a known capacitor if the accessory circuit of Fig. 5 is used. The resistor values depend upon the VOM sensitivity. For

5000 ohms/volt ac, the resistors should be:

- R<sub>1</sub>..... 12,500 ohms
- R<sub>2</sub>..... 2,370 ohms
- R<sub>3</sub>..... 232 ohms

By switching one of these resistors into the circuit, less current passes through the meter, thereby making the instrument less sensitive for higher capacitances. The resistor values are selected to facilitate conversion of the VOM voltage readings on the 10 volts ac scale to microfarads as shown in Table 1. When an unknown capacitor is inserted in the circuit, the switch is in Position 3. If the capacitance is less than 0.1  $\mu$ F, the voltage reading will be below 1 volt, so we switch instead to Position 2. A reading of say, 2.5V would indicate approximately 0.025  $\mu$ F.

## MICROVOLT ATTENUATION METER

By making up a simple precision

voltage divider network, any unknown ac or dc input voltage may be calibrated for millivolt or microvolt output. See Fig. 6. This can be a handy circuit for checking choppers, audio amplifiers, etc.

Let's use 1 megohm for  $R_1$  and 1 ohm for  $R_2$ , both 1% resistors. If 2.5 volts — as read on the VOM — are tapped off the input, the output would be 2.5  $\mu$ V.

There are hundreds of other specialized uses for the VOM — testing the ignitor in an ignitron, measuring amplifier phase shift, tracing receiver r-f signals, and so on. All that may be needed are a few external components, at times a bit of inventiveness, and a willingness to recognize the VOM as a truly versatile instrument capable of handling a number of the measurements frequently made by expensive specialized equipment. And those specialized instruments may either not be available or may not be conveniently portable. ●

TABLE 1 — CAPACITOR TEST

Unknown Capacitor $\mu$ F	Approximate Pos. 1 Reading A-C Volts
.001	0.6
.002	1.1
.003	1.5
.004	1.9
.005	2.5
.006	3.0
.007	3.6
.008	4.0
.009	4.4
.010	4.8
	Pos. 2
.01	1
.02	2
.03	3
.04	4
.05	5
.06	6
.07	7
.08	8
.09	9
.1	10
	Pos. 3
.1	1
.2	2
.3	3
.4	4
.5	5
.6	6
.7	7
.8	8
.9	9
1.0	10

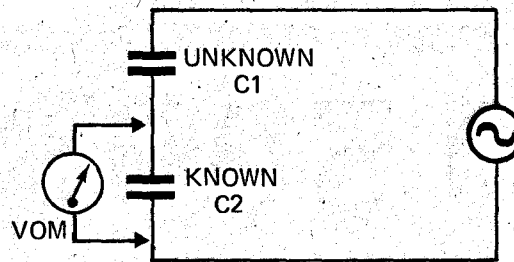


Fig. 4. As a capacitance meter, the VOM measures voltage across known and unknown capacitors.

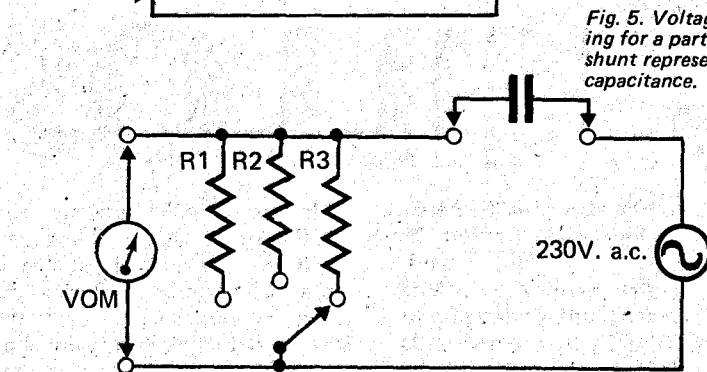


Fig. 5. Voltage reading for a particular shunt represents capacitance.

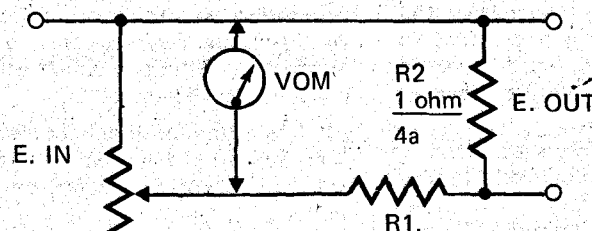
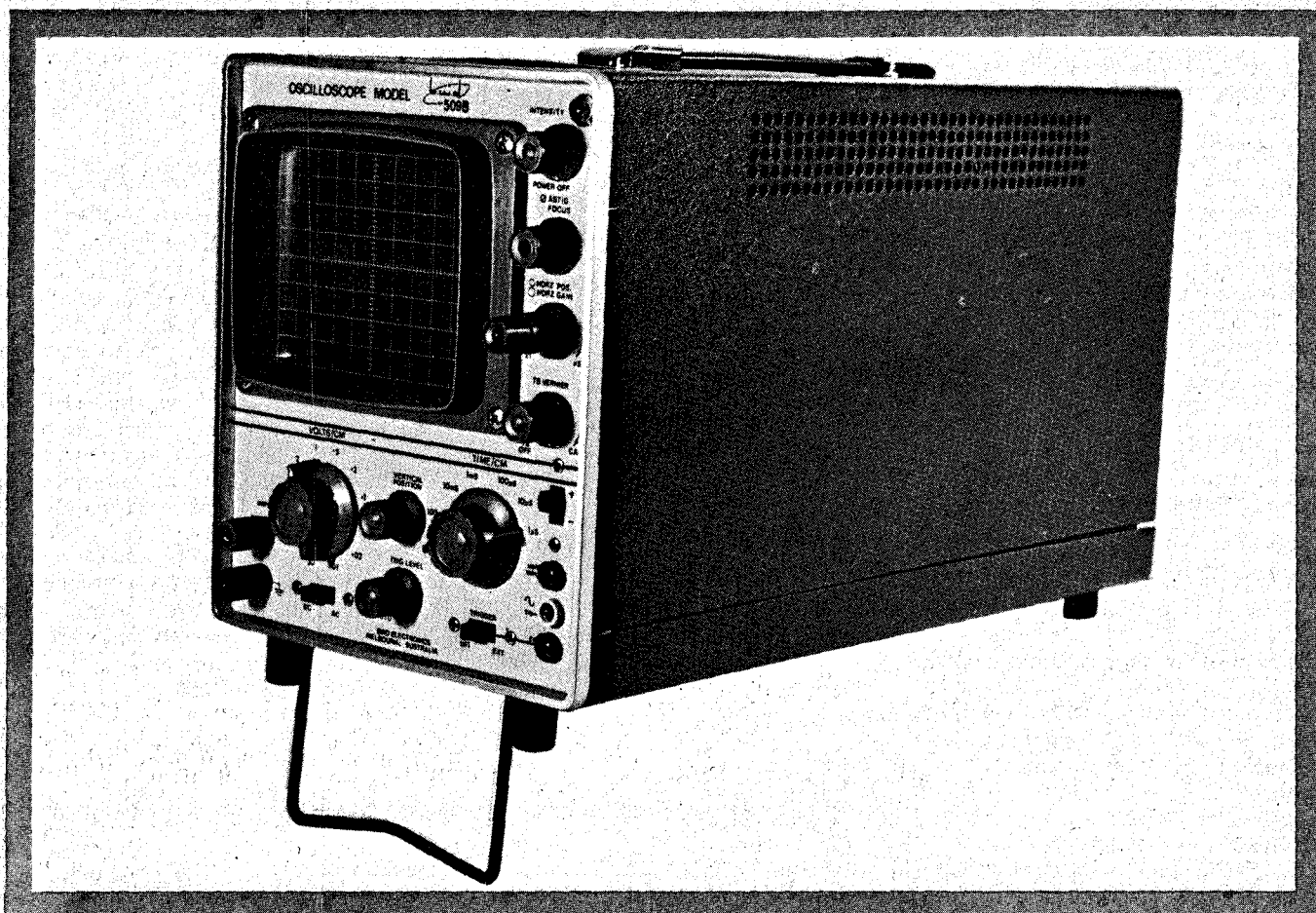


Fig. 6. Microvolt attenuation meter circuit employs voltage divider.



# BWD 509B OSCILLOSCOPE

**S**OME months ago a well known technical journalist writing in *Electronics Australia* said about service oscilloscopes, . . . "one needs a CRO capable of working up to a couple of MHz . . . Imported units with this order of performance are available for quite reasonable prices."

Unconsciously perhaps, this factual statement put into perspective the excellent value for money that is represented by a *non-imported* oscilloscope — the Australian designed and made BWD 509B.

There are many classes of cathode ray oscilloscopes produced today, ranging from the simple monitoring units which feature limited "X" axis facilities and basic time base circuitry, through the range of high speed oscilloscopes with facilities such as optional plug-in units allowing greater flexibility in measurements, to the storage oscilloscopes and special purpose oscilloscopes.

Most of the technically advanced oscilloscopes offer delay lines to facilitate examination of the leading edge of a periodic transient signal, and other optional facilities including differential amplifiers, summing input, high frequency sampling and multiple traces, but, for the average user, these facilities are required for only a small proportion of the time. In fact, the average user requires only a small number of functions which generally include the following:—

1. The option of direct coupled or ac operation up to a frequency of the order of 5MHz, or greater, on the X axis.
2. A rise time of the order of 50 nanoseconds.
3. A bandwidth of 1MHz or better on the horizontal amplifier.
4. A calibrated X amplifier, preferably with one, two or five steps

from 20 volts per centimetre down to 20 millivolts per centimetre or better.

5. A calibrated time base, preferably covering from 100 milliseconds/centimetre to one microsecond per centimetre, together with a variable horizontal gain control.

6. An internal graticule with simple internal calibration signal and trigger control.

It is clearly apparent that it was the average user that BWD had in mind when designing this unit for the facilities outlined above (together with a few others) are all incorporated.

The BWD 509B is a lightweight (7.2kg) oscilloscope measuring 23cm high, by 18cm wide by 41cm deep. It features a 5" diameter, flat-faced cathode-ray tube. The instrument is also available with a long persistence P7 phosphor tube as an optional extra.

Voltage ranges are from 5mV to 500V between dc and 7MHz. The



graticule is 8cmx10cm subdivided to 2mm.

The vertical amplifier and attenuator provide sensitivities of 10mV to 50 volts/cm in x1, x2 and x5 steps with a rise time of 50 nanoseconds for 4cm deflection. Input impedance is 1 megohm in parallel with 40pF thus making the CRO compatible with leads available from most other manufacturers.

The time base covers the range 1  $\mu$  sec/cm to 100 milliseecs/cm in six decade ranges with an uncalibrated vernier. Triggering is switched to provide selection of internal or external, positive or negative, auto or selected level. The internal auto triggering functions adequately between 3Hz and 11MHz with a 1cm deflection on sine or square wave.

The horizontal amplifier has a bandwidth from dc to 1.3MHz and covers the range 600mV to 6 volts per centimetre.

Vertical to horizontal amplifier phase shift is less than 1° from dc to approximately 150kHz.

### MECHANICAL CONSTRUCTION

The construction of the 509B is particularly pleasing for, although it

only costs \$205.00 (plus tax) the internal and external finish is comparable with other equipment costing considerably more.

The first thing to catch our eye was the very well anodised front panel incorporating some of the best ergonomic features initiated by the Tektronix Company in the late '50s.

The case, whilst not expensive, is solidly constructed from electro-galvanised steel with a plastic coated aluminium top cover and base. These neatly fit around the aluminium mouldings used on the front and back of the oscilloscope.

The construction of the inside of the instrument is also simple. The panel controls, attenuators and switches are located immediately behind the front panel. The attenuators use medium cost components which are capacitively compensated and selected during manufacture to provide the required bandwidth. Without these capacitors the performance would be limited to something around the order of 0.5 MHz, but with them installed the unit tested was found to be only 3 decibels down at 7.8 MHz.

The 5U1P1 flat faced cathode ray tube, is fully shielded and is positioned above a large phenolic printed circuit

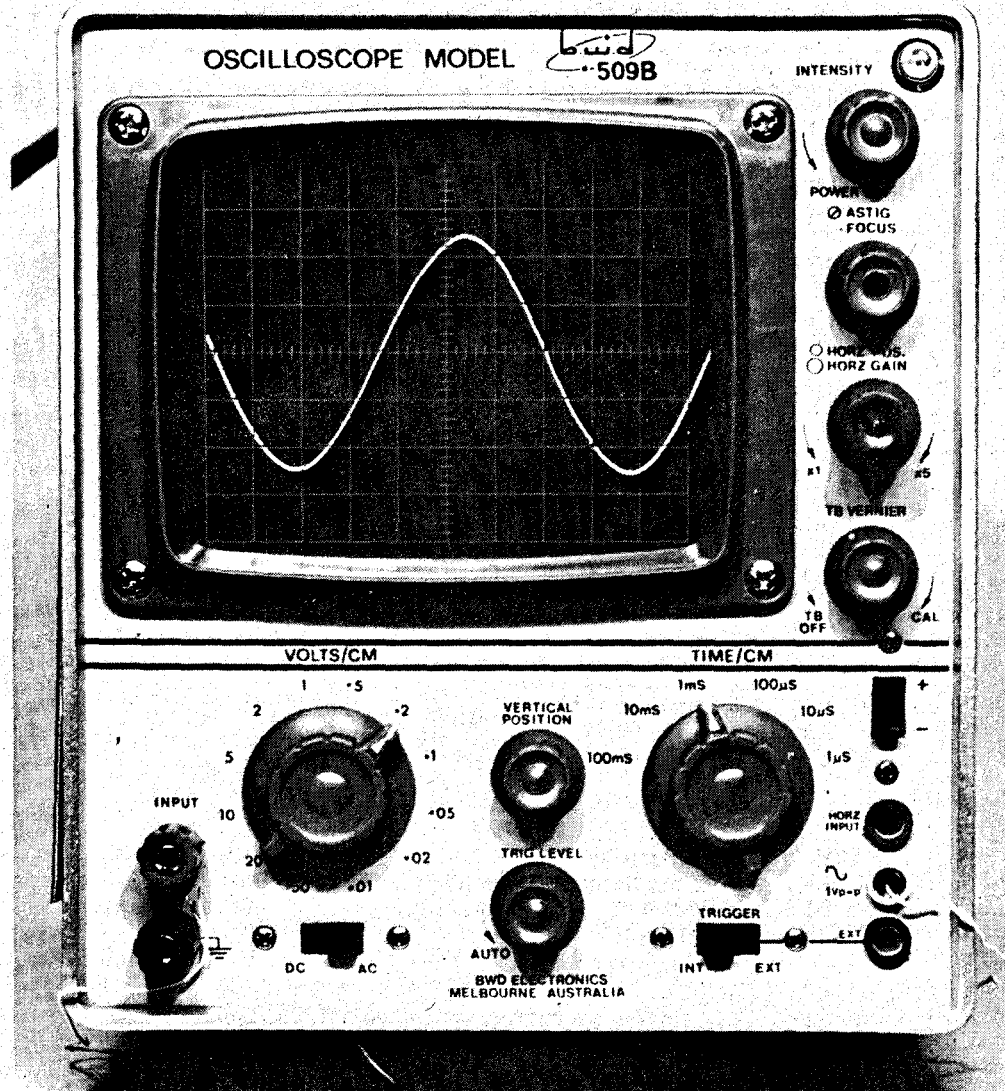
board mounted horizontally above the base of the chassis. This is well laid out using high quality components. Metal-oxide resistors are used in most areas to ensure maximum stability.

The transistors and semi-conductors (there are no valves) come from a number of sources, but appear to be mainly of Australian manufacture. The only components which seem to be imported are the CRO tube, the selenium high voltage rectifiers and some of the electrolytic capacitors. Component positions are clearly marked on the upper side of the board adjacent to, but not underneath, the component concerned. This allows servicing to be carried out without the difficulties one gets when the component lies on top of the identifying symbols.

The mains transformer is mounted at the rear of the unit under a magnetic shield and appears to be well impregnated to reduce high voltage breakdown, the common problem of all oscilloscope transformers.

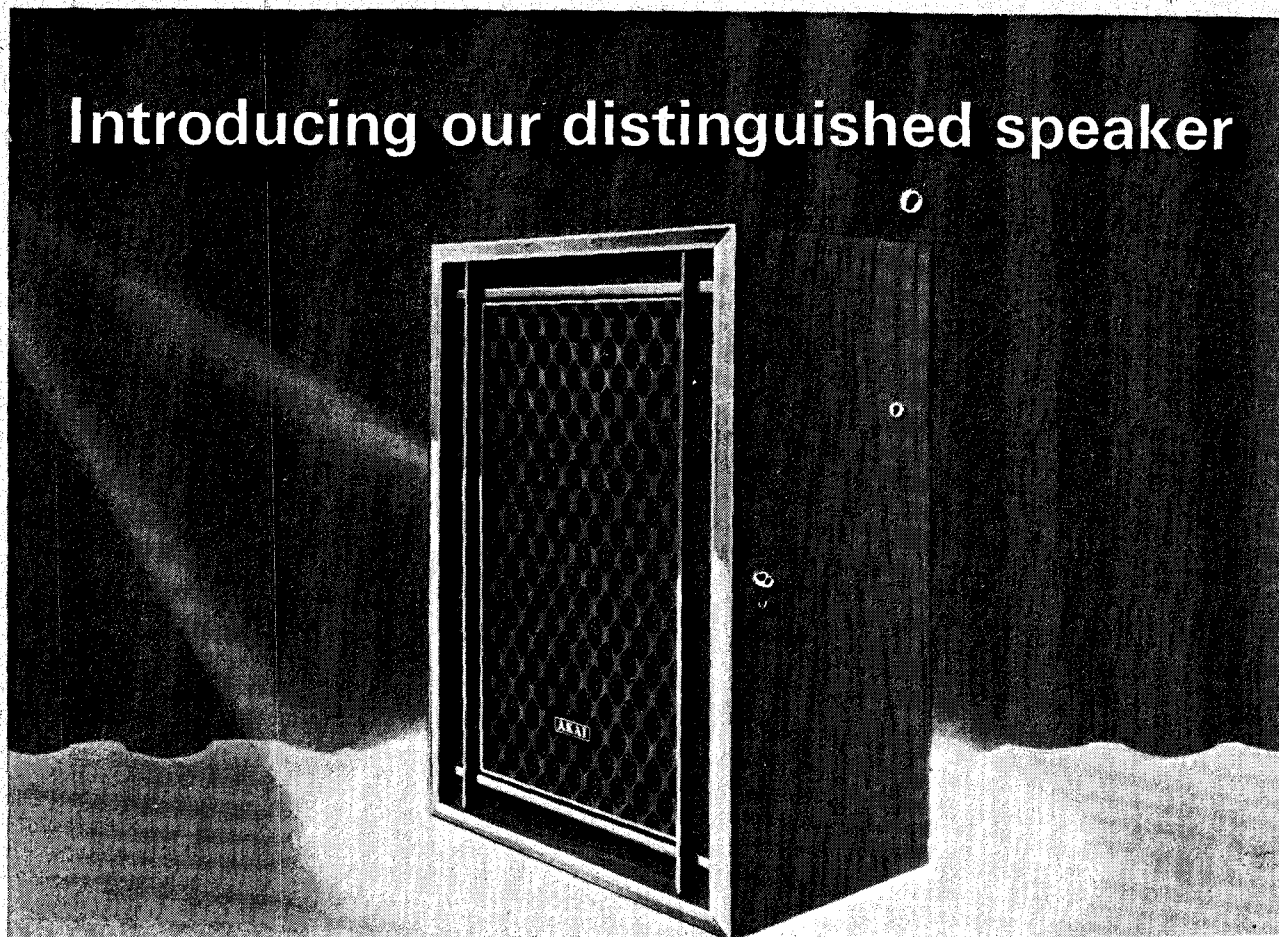
The oscilloscope comes complete with a handbook, power cord and circuit diagram and, unlike most electronic instruments in its price bracket, it is also supplied with a reasonably detailed test certificate

Australian designed and made oscilloscope is excellent value for money.



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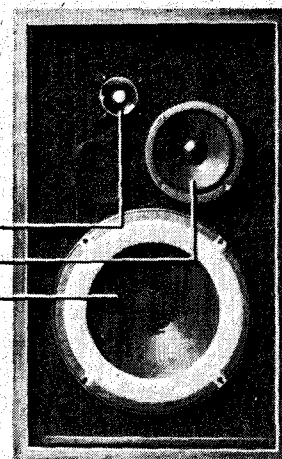
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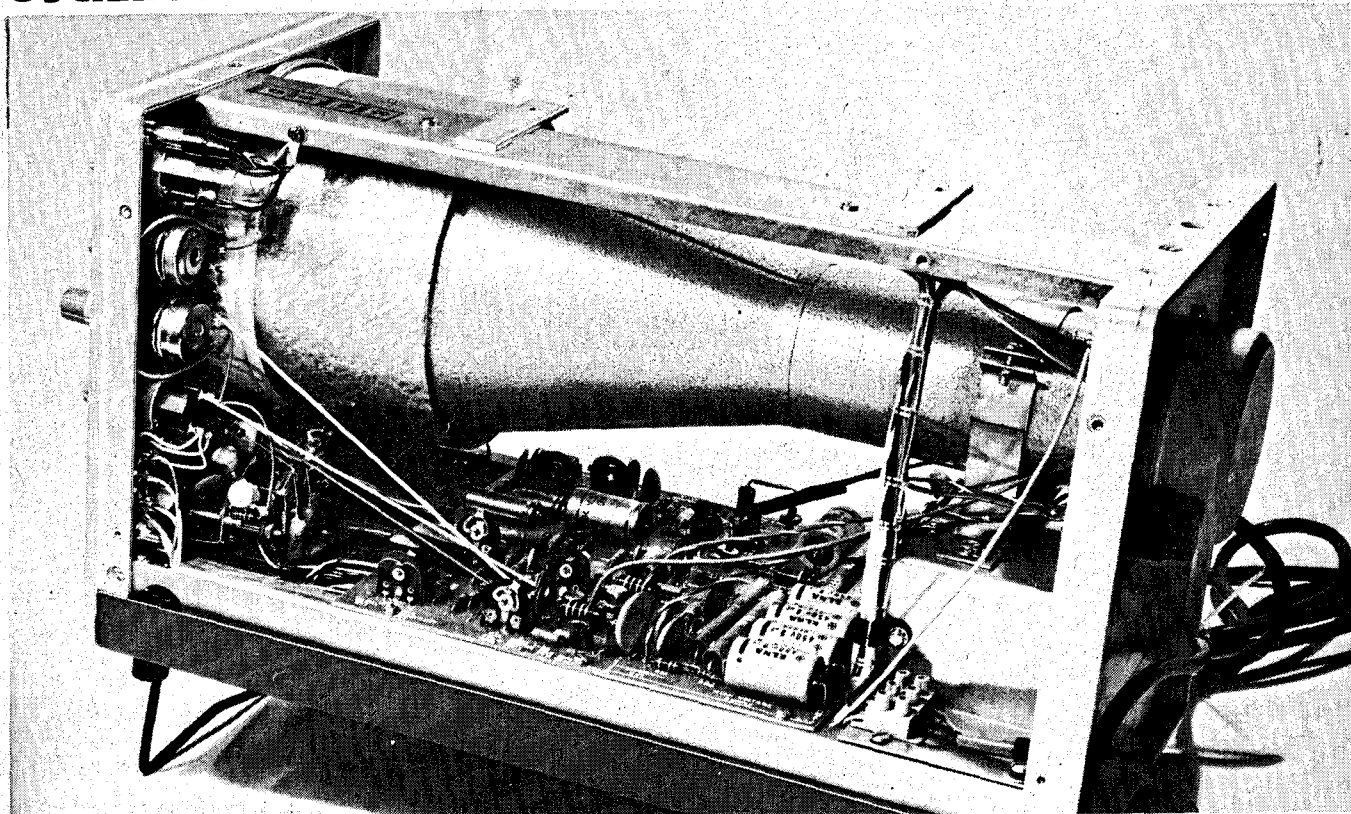
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# AKAI

# BWD 509B OSCILLOSCOPE



## MEASURED PERFORMANCE OF BWD MODEL 509B OSCILLOSCOPE SERIAL NO 16121

FUNCTION	SPECIFICATION	ACTUAL
<b>Vertical Amplifier</b>		
Attenuator calibration	5%	2%
Input capacitance	<40pF	37pF
Bandwidth @ 4cm deflection	7MHz	7.8MHz
<b>Time Base</b>		
Calibration 10ms - 1μsec range	5%	2%
Calibration 100ms range	10%	4%
Horizontal expansion	x5	x5
<b>Trigger</b>		
Int. auto + or - 1cm deflection	5Hz - 10MHz	3Hz - 11MHz
Int. level range	±3cm	±3cm
Ext. auto + or - 1V deflection	10Hz - 10MHz	10Hz - 10MHz
<b>Horizontal Amplifier</b>		
Sensitivity (approx.)	0.6V - 6V	0.7V to 7V
Bandwidth @ 6cm deflection	1MHz	1.3MHz
<b>General</b>		
Cal. output	1V p-p	1.0V p-p
<b>Weight</b>		
7.2 kilograms		
<b>Dimensions</b>		
Height 23cm, width 18cm, depth 41cm.		

Recommended retail price \$205 plus tax.

giving the performance actually measured at the end of the production line.

An unusual claim made by BWD is that the actual performance of the instrument is better than its published specification — and this is indeed the case, for without a single exception, every parameter that we measured exceeded BWD's claims. For example:—

Function	Specification	Actual
Vertical amplifier attenuator accuracy	5%	2%
Vertical bandwidth @ 4cm deflection	7MHz	7.8MHz
Time base accuracy		
10ms - 1μ sec	5%	2%
100ms range	10%	4%
Horizontal amplifier bandwidth	1MHz	1.3MHz

The circuitry, although very simple, provided extremely stable triggering on the Auto position, even at sweep rates as high as one microsecond per centimetre, and clean traces with low distortion and no visible astigmatism.

On test the oscilloscope exhibited no vices and performed faultlessly during the whole of a two month period.

It is not hard to see why BWD has a production line producing hundreds of these units for both the local and export market, for in terms of value for money the 509B must be one of the best buys currently available in electronic measuring equipment. ●



*KL-2090 Speakers*

**KLX-5 COMPACT SPEAKER SYSTEM.** Superb performance with maximum input of 15 watts. Faithful reproduction from 50 Hz to 20,000 Hz. Attractive walnut boxes have inclined back for better sound direction. Set up on wall, in bookshelf or any handy spot. \$59 pair (RRP).

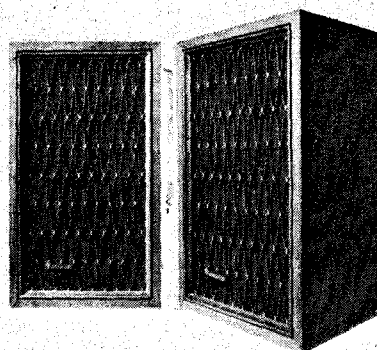
**KL-2090 2-WAY 2-SPEAKER SYSTEM.** A compact size speaker system with a clear and elegant tone. Remarkable bass response for its size is due to use of a comparatively small unit and a bass reflex system. Sensitivity 98 dB. Freq. response 55-20,000 Hz. Can be wall mounted vertically or horizontally (as in the rear use for 4-channel). Attractive modern grille. \$129 pair (RRP).

**KL-2080 2-WAY SPEAKER SYSTEM.** Designed to have high output 100 dB sensitivity, with 8-inch free-edge woofer and cone-type tweeter. Max. input 25 W with freq. response 45 Hz to 20,000 Hz. Attractive walnut finish and metal grille. \$175 pair (RRP).

# Some

# ...they all

Not as it might be, or could be—but as it actually is . . . that's how Kenwood speakers are built to reproduce music. Each speaker in the Kenwood range is engineered for exacting over-all high efficiency in true total-tone reproduction. The KLX-5 compact speaker system is especially designed for wall or bookshelf mounting with an inclined back to



*KL-5080 Speakers*

**KL-4080 3-WAY 4-SPEAKER SYSTEM.** Two cone-type tweeters, one cone-type mid range and one 12" woofer, with damped pipe duct, provide this system with both refined treble and real bass sound. Max. input 50 watts. Range 35 Hz to 20,000 Hz. A 3-step tone selector for clear, normal or soft. Sensitivity 101 dB. \$355 pair (RRP).

**KL-5080 4-WAY 5-SPEAKER SYSTEM.** Five speakers, reproducing natural hi-fi sound over 30 Hz to 22,000 Hz, include 1 1/4" metal cone-type super tweeter and 12" free-edge-type woofer. Sensitivity 102 dB with max. input 70 watts, 3-step tone selector. \$424 pair (RRP).

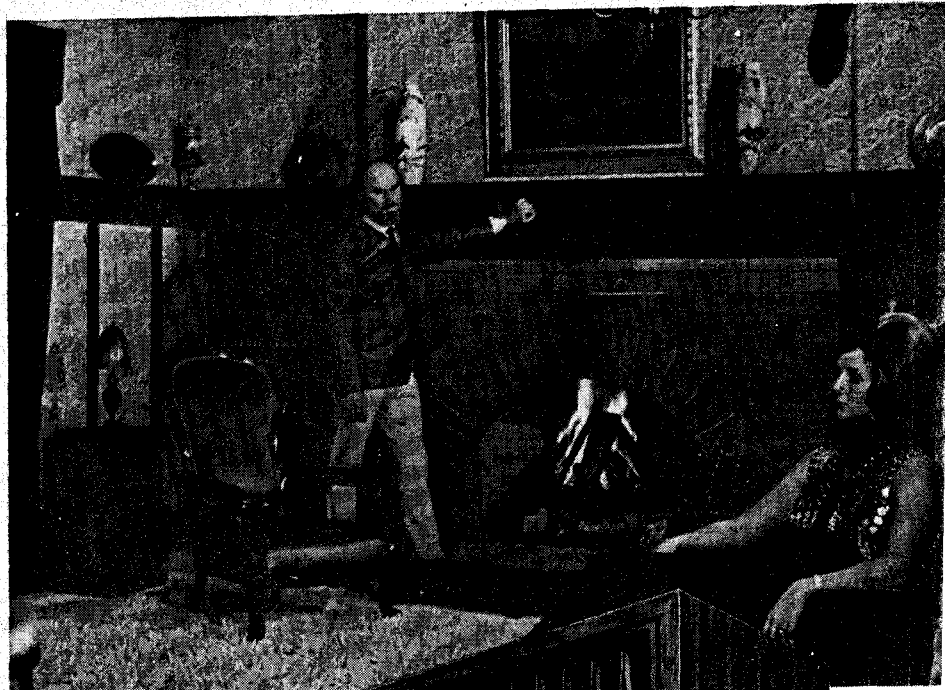
**KL-7080 5-WAY 6-SPEAKER SYSTEM.** You must listen to this speaker system to appreciate its fidelity and ability to reproduce ANY passages free from distortion. Freq. response 25 Hz to 22,000 Hz with metal cone super tweeter adding every minute nuance on the high frequencies over 10,000 Hz. Max. input 80 watts. Acoustic suspension eliminates distortion and dullness. A luxurious reproducer. \$475 pair (RRP).

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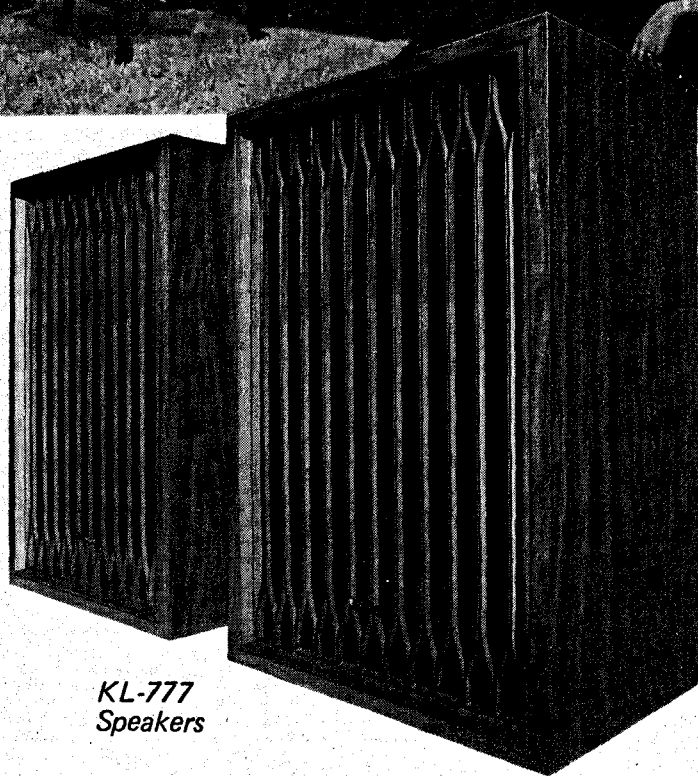
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*KL-777  
Speakers*

# BEATING THE LASER BUG

The laser bug is no myth — it exists right now. Here's how it works — and how to beat it.

ON September 13, the front page lead story in Sydney's Daily Telegraph described sophisticated laser eavesdropping equipment allegedly used by the Australian Security Intelligence Organisation (ASIO) to monitor conversations in rooms up to two miles away.

Later that same day Senator Greenwood — the Federal Attorney-General — denied that ASIO had either used, or was using, these devices. No statement, however, was made denying that ASIO had bought them, or was intending to use them in the future.

Whether these devices are being used by ASIO or not, there is no question but that they exist.

In fact, we need look no further than Macquarie University, where Mr Laisk, a physicist, and his third-year students have built a laser snooping device — at a cost of a mere \$1500 — and have monitored conversations in a room 30 yards away. Mr Laisk estimates that his equipment could be mass-produced for about \$700 — although its range would, of course, be far short of the two miles or so claimed for the 'ASIO device'.

## WHY ARE THEY USED?

The laser bug has many advantages over more traditional techniques.

Possibly the greatest advantage is that no equipment whatever needs to be installed in the premises to be bugged — nor, in fact, does access have to be gained to the premises at any time.

A second advantage — and, to many people, one that is more important than the first — is that the device to some extent obviates the need for telephone tapping.

Although commonly believed to be honoured more in the breach than in the observance, telephone tapping is controlled by the Telephonic Communication (Interception) Act, passed in 1960. Under the terms of this Act, ASIO — or anyone else for that matter — must obtain the Attorney General's permission before a telephone tap is made.

## HOW LASER BUGS WORK

The basic principle is very simple. Any sound generated within a room will cause the windows — and, to a lesser extent, the walls — to vibrate very slightly in sympathy with the generated sound. This effect can readily be demonstrated by applying

one's ear to the end of a stick, the other end of which is pressing against the glass. Any sounds within the room will be heard quite clearly.

An even more dramatic demonstration is to turn up the volume of a record player in a small room — when the window glass can often be seen and felt to be moving.

The laser bug exploits this effect. Sound within the room being monitored causes minute vibrations in the window glass (and in the walls). The laser beam is directed against this window. It is therefore now impinging on a surface that is moving at a velocity which is changing in sympathy with the sound inside the room. The changing velocity of the glass surface causes a doppler shift in the laser beam frequency. The reflected beam is therefore frequency modulated by the speech within the room.

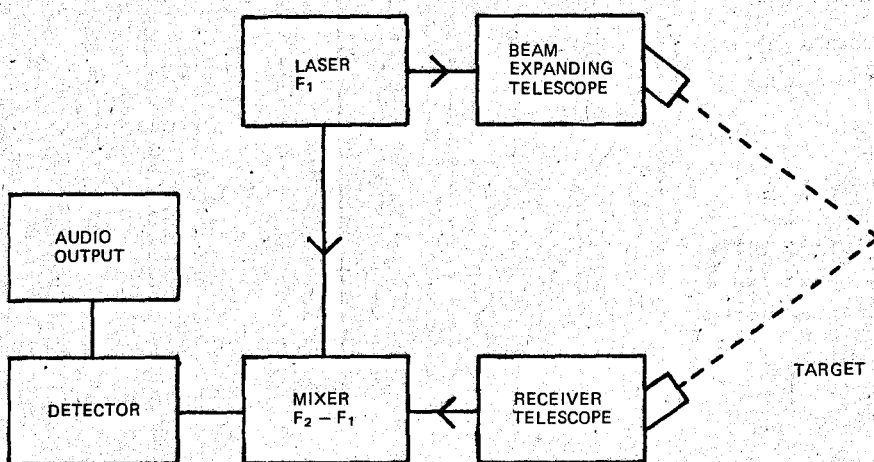
The buggers (for want of a more couth phrase) receive the reflected — and now frequency modulated — beam, and mix this beam, together with a sample of the transmitted (and hence unmodulated) laser beam, in a PIN photodiode. The output of the diode is therefore the varying difference frequency between the outgoing and incoming signals.

This signal is then further amplified and then detected. In Mr Laisk's equipment the final detector is a special high speed diode from Monsanto. In more elaborate systems, a double heterodyne principle may be used to provide extra gain before detection.

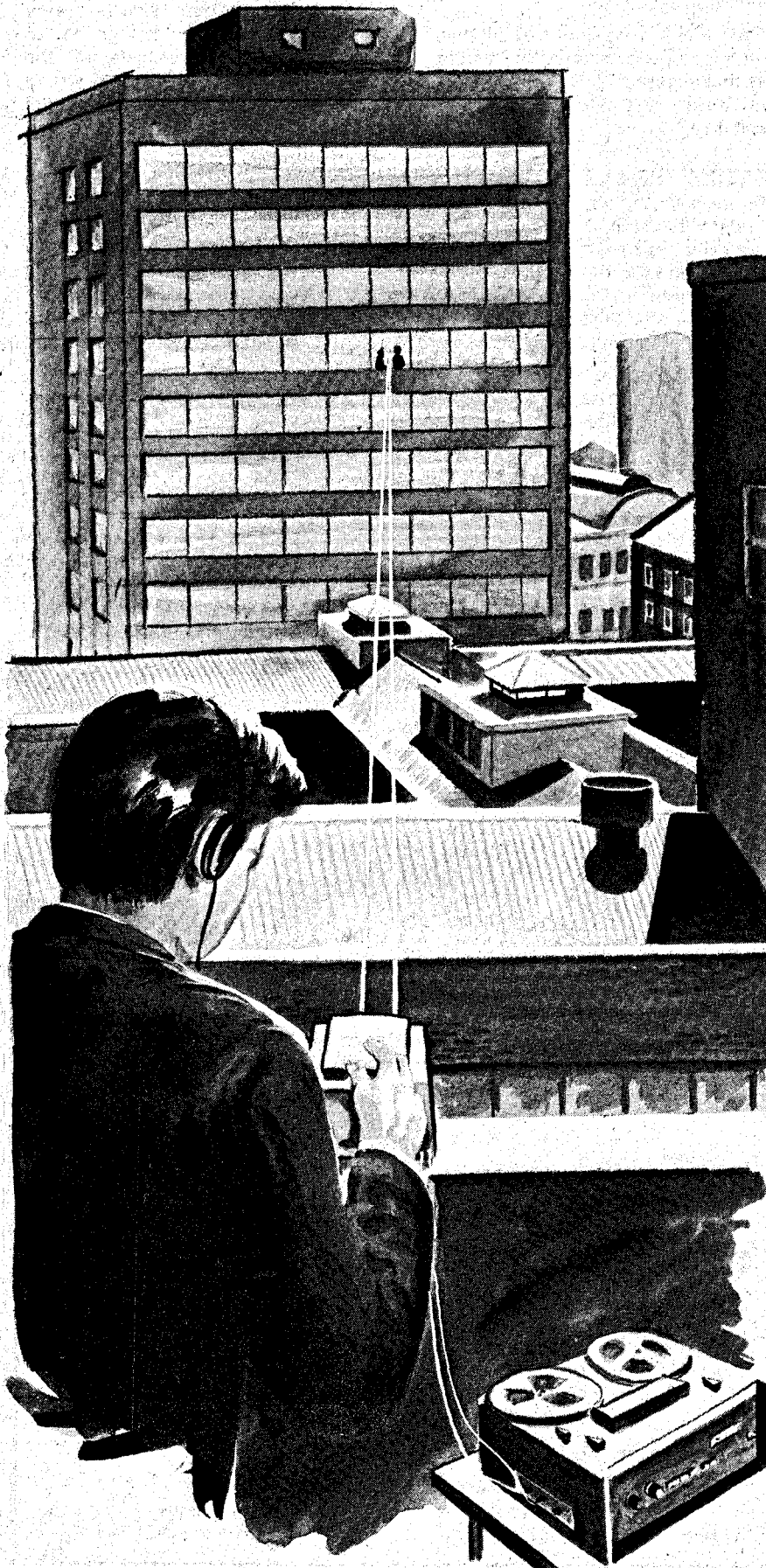
At first sight it would seem essential — in order to receive the reflected beam — to have the receiving and transmitting devices set up so that the beam is normal (at right angles in two planes) to the window glass.

In practice, when the incident ray strikes the glass, diffuse reflection takes place (as well as normal reflection) — i.e., some of the energy is reflected in all directions. Therefore the laser may strike the window from practically any angle, and sufficient energy will be diffusely reflected to provide a usable signal.

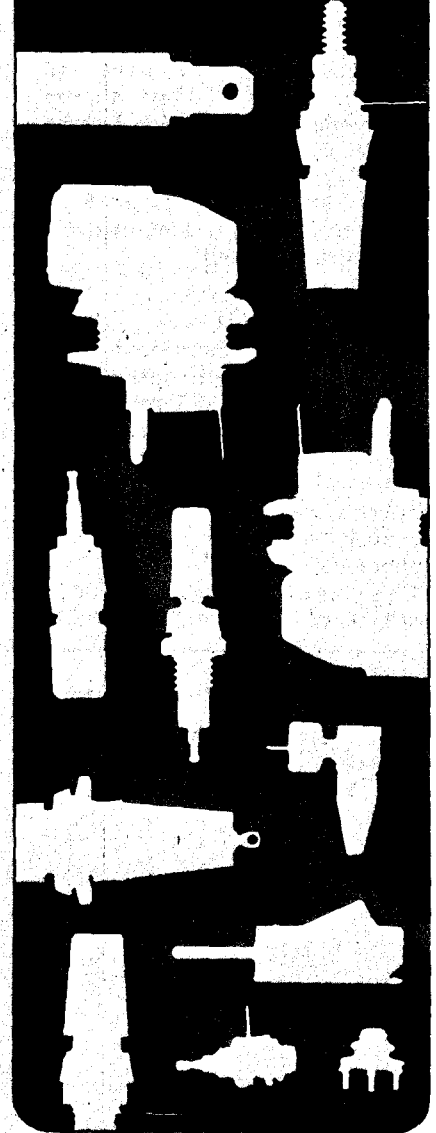
And this technique is feasible with relatively unsophisticated detectors such as PIN diodes at distances of 50 metres or more. Where greater range is involved, more sensitive detectors are required — probably operating at very low temperatures in order to provide an increased



Basic laser bug principle.



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# BEATING THE LASER BUG

signal/noise ratio. As reported by Dr Sydenham in his transducer series, one commercially available IR detector system is capable of sensing the detail of a TV tower through 70km of thick fog.

Instruments are available commercially which with slight modifications can be used for snooping. These are known as Laser Velocimeters and are being bought in large numbers for use in industrial control applications. There is no doubt that modified versions of such instruments are being used for surveillance purposes.

## WIDE BANDWIDTH

Bandwidth of the modulated signal is very wide. For a laser operating at say 1000mm (i.e. 300 Terahertz), a glass movement of only a few microns at a few kilohertz will necessitate a bandwidth in the receiver of nearly 1GHz! Again, this is readily achievable with modern technology.

The sensitivity of these instruments is extraordinarily high.

Conventional laser interferometers can now detect movements of one angstrom ( $10^{-10}$  metres) and it is reported that detection of 1/100th angstrom movements has been achieved.

Thus there is no doubt at all that laser snooping is technically feasible and that equipment is commercially available with the required capability.

## BEATING THE LASER BUG

As we have shown, the laser bug is a relatively simple device. It is practically certain to be used by many organisations — especially by those engaged in 'aggressive market research' — or industrial spying as it should really be called.

The easiest way to defeat it is merely to ensure that no confidential discussions ever take place in a room with an outside wall, but such is the sensitivity of the device that even then the conversations should be conducted at a very quiet level.

A more sophisticated approach is to install heavy double glazed windows — with the air space open to atmosphere, the outer pane should then be mechanically excited by a white noise generator (it would also be desirable to install a 'one

way' mirror material on the outer pane to prevent optical coupling across the cavity). White noise should also be introduced into the air space of cavity walls.

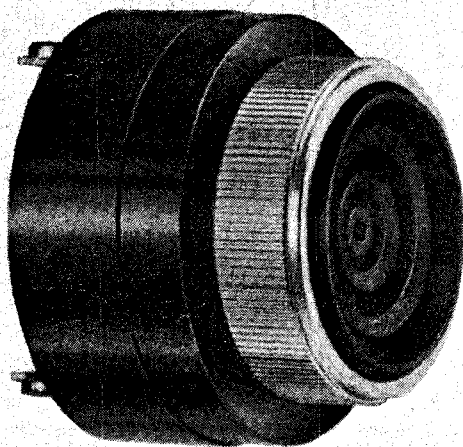
In a less serious vein — a very effective approach would be to paint the entire outside of the premises matt black. This would totally absorb the energy of the laser beam thus preventing reflection!

Quite simple equipment can be used to detect the beam — but bear in mind that whilst most commercial interferometers use visible light, the laser snooping devices operate in the infra red part of the spectrum and hence cannot be seen. Nevertheless the heat energy can be detected quite readily.

So if you feel yourself getting hot under the collar, who knows? Maybe ASIO, SMERSH, or some other interested parties are after you.

**Electronics Today International would like to thank the many academics, scientists and industrial organizations who supplied us with background material for this article.**

**They are not named — at their unanimous request!**



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## CC 9100

### featuring

Auto and manual recording levels  
Battery or mains power  
Tone control  
Recording level & battery power indicator  
DIN socket

#### Technical data

Dimensions: 265 x 150 x 65 mm  
10.5 x 6 x 2.5 inch  
Weight: 1.7 kgs  
Tape speed: 4.75 cm/s (1 7/8 ips)  
Wow and flutter: in general less than:  
0.4% (DIN)  
Batteries: 4 baby cells  
Mains voltage: 110/220 V  
Frequency response: 100-8,000 Hz  
Output power: 600 mW  
Erase capacity:  
on BASF LH Cassettes: 60 dB  
on BASF CrO<sub>2</sub> Cassettes: 50 dB  
Recording mode: Automatic and manual



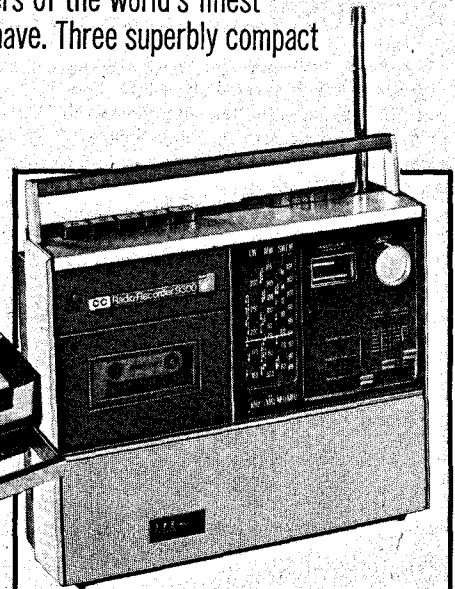
## CC 9200

### featuring

Auto ejection of full cassettes  
Manual or Auto recording levels  
Batteries or mains power  
Recording level & battery power indicator  
DIN socket

#### Technical data

Dimensions: 203 x 296 x 68 mm  
8 x 12 x 2.5 inch  
Weight: 2.5 kgs  
Tape speed: 4.75 cm/s (1 7/8 ips)  
Wow and flutter: in general less than:  
0.3% (DIN)  
Batteries: 4 Mono-cells  
Mains voltage: 110/220 V  
Frequency response: 80-10,000 Hz  
Output power: 1500 mW  
Erase capacity:  
on BASF LH Cassettes: at least 60 dB  
on BASF CrO<sub>2</sub> Cassettes: at least 50 dB  
Recording mode: Manual and automatic



## CC 9300 RADIO RECORDER

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built in mixer unit  
Auto ejection of full cassettes  
Recording level & battery power indicator  
plugs into car cigarette lighter  
Illuminated station scale  
FM & long, medium & short wave reception  
Telescopic aerial plus inbuilt ferrite rod

#### Technical data

Dimensions: 299 x 251 x 90 mm  
12 x 10 x 3.5 inch  
Weight: 3.15 kgs  
Tape speed: 4.75 cm/s (1 7/8 ips)  
Wow and flutter: in general less than:  
0.3% (DIN)  
Batteries: 6 V (4 x IEC-R20)  
Mains voltage: 110/220 V  
Frequency response: 80-10,000 Hz  
Output power: 2000 mW  
Erase capacity:  
on BASF LH Cassettes: at least 60 dB  
on BASF CrO<sub>2</sub> Cassettes: at least 50 dB  
Recording mode: Automatic and manual  
Radio receiver: 4 wavelengths—  
LW, MW, SW, FM  
Telescopic aerial: for FM and SW  
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# MODERN FOOD PRESERVATION

## -the use of x-ray radiation

New technique could revolutionize the food preservation industry.

IN 1895 Wilhelm Röntgen discovered the existence of electromagnetic radiation at wavelengths of  $10^{-10}$  to  $10^{-12}$ m. They became known as X-rays. The penetrating power of X-rays has enabled the interiors of visibly opaque objects to be seen, and much of our knowledge of the atomic structure can be credited to the use of the X-ray diffraction technique.

Slower to be released was the potential of X-rays for preserving food, and their use in other biological applications such as insect disinfestation in grain, flour, tobacco, raw wool and leather and also for the deliberate causation of mutations in plant breeding. X-rays can also be used to inhibit the sprouting of vegetables such as potatoes, onions and carrots. Cold sterilization of medical products is also feasible using X-ray irradiation.

The powerful ionising effect of X-rays enables food stuffs to be preserved by eliminating the pathogenic and spoilage bacteria.

Irradiation methods, including gamma ray isotope radiation which is also useful for preservation, are of particular interest in the preservation of food, especially in instances where the usual preservative methods are not viable. Heating, for example, may damage the product, and the addition of preservatives may not be desired. With radiation methods there is no chemical residue, the aroma is unchanged and pasteurization penetrates throughout the food.

The effect produced depends much upon the dose given as can be seen from the various groups shown in Figure 1.

In a number of countries the use of irradiation has already progressed from the laboratory to pilot plant stages as possible commercial processes. It is quite likely that food preservation could become the major use for radiation sources in the near future.

In the sea-food industry, radiation pasteurising is an economically valid proposition. Fishing trips for fresh fish

(not deep frozen) and, in particular, crustaceans such as shrimps, have one basic problem.

The trawler can only stay out for as long as the first-caught fish will stay fresh enough for subsequent sale or processing. In salt-water fishing the ports are very distant from the fishing grounds and it is common for a trawler to return only half full. In deep-sea trawlings, a trip is not really economic unless it is at least two-thirds full upon return. Storage on ice is not always feasible so irradiation with a low dosage on the trawler itself is an attractive proposition for maintaining the keeping qualities of the food without causing damage or changing the natural aroma.

Shrimping has other problems as well. The hard shell must be removed for the majority of marketing and this is usually done on land using labour at home. The quantity caught depends much upon the tides at the fishing grounds which vary from day to day. These variations coupled with the real possibility of late arrival at port means there is often no labour available for immediate processing. A method to prolong the freshness by two to three times is attractive from many points of view.

In the German Federal Republic (West Germany), the Federal Fishery Research Institute located in Hamburg, has been conducting research into methods and practice of preserving the quality of fish and other sea creatures on behalf of the Fishing Industry. For the past five years it has been operating a high powered X-ray ionisation plant (200 kV at 32mA) for research into food preservation. More recently they have installed a higher powered unit (200 kV at 150 mA) on the fish research vessel "Walther Herwig" in order that fish can be irradiated immediately after they are caught.

(Continued overleaf)

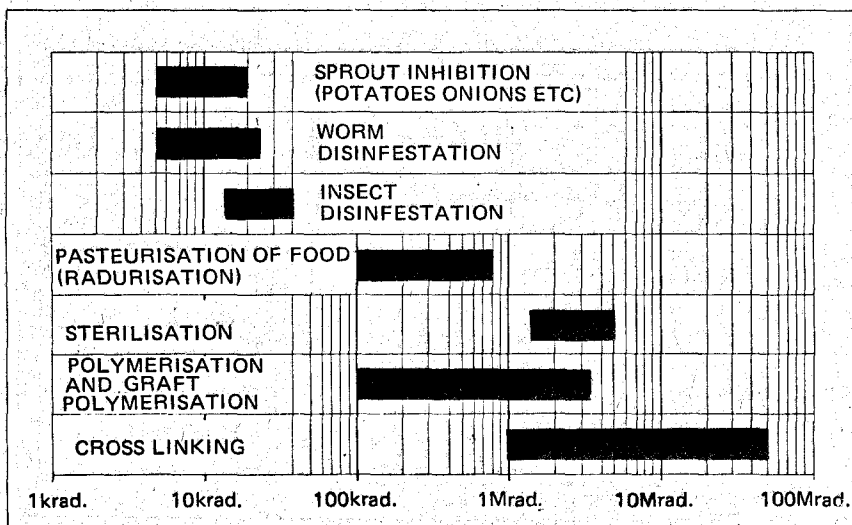


Fig. 1. Dose ranges for the main use of ionising radiation — the phenomena produced depends largely upon the dose.

# MODERN FOOD PRESERVATION

The fresh fish is packed into cylindrical containers which automatically pass through a zone of radiation in a continuous manner. A container is seen being removed from the experimental ship-board unit in (Fig. 2).

Some 50-70kg of fish can be pasteurized per hour with a mean dose of 100 k rad. in this pilot plant. AEG-TELEFUNKEN, who designed the equipment, have already planned tandem units which will be able to process at the rate of 1-3 tons per hour.

Although the plant is heavy and large compared with the small containers it

processes, it is, in fact, smaller and lighter than the equivalent isotope radiation plant. It can also be switched off when not needed and maintenance is simplified as there is no health hazard when the power is disconnected.

## HIGH POWER X-RAY TUBE

The heart of the unit is a high-powered X-ray tube of unusual design. It consists of a cylindrical, water-cooled anode of about 150 mm in diameter around which is the cathode as seen in (Fig. 3). When used in a vertical orientation it forms what is termed a pot anode. The same basic



Fig. 2. Removing the fish cylinder from the X-ray treatment plant on-board the ship "Walther Herwig".

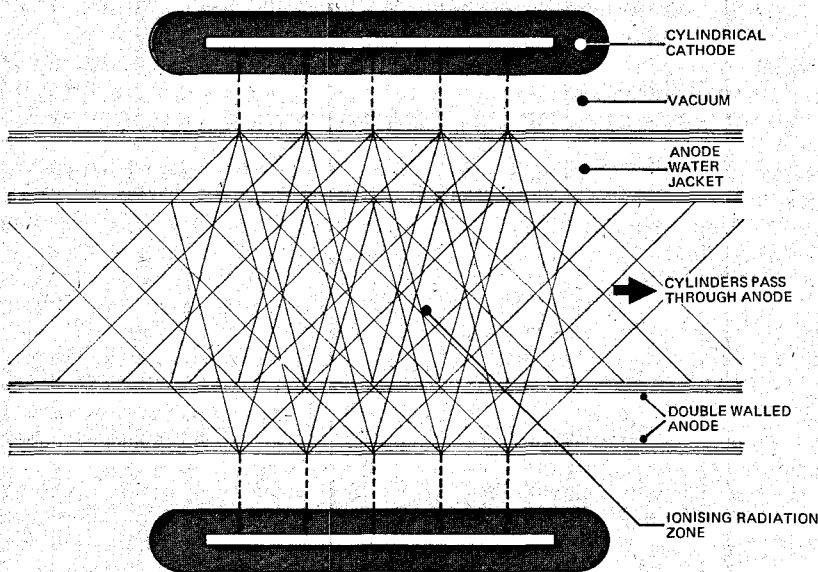


Fig. 3. Diagrammatic layout of the cylindrical X-ray tube.

1. Radiation lock
2. Anode cooling water
3. Double-walled flow-through anode
4. Cathode
5. Vacuum
6. Radiation lock
7. Air outlet
8. Depot
9. Outfeed magazine with transport units
10. Lead shielding
11. Oil-filled cathode insulator
12. Transformer for cathode heating with high high voltage cable and plug
13. Ion getter pump
14. Infeed magazine with transport units

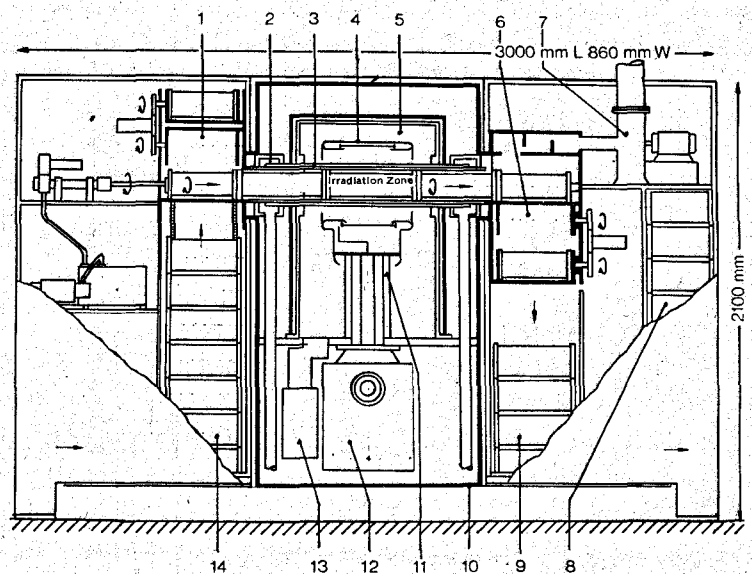
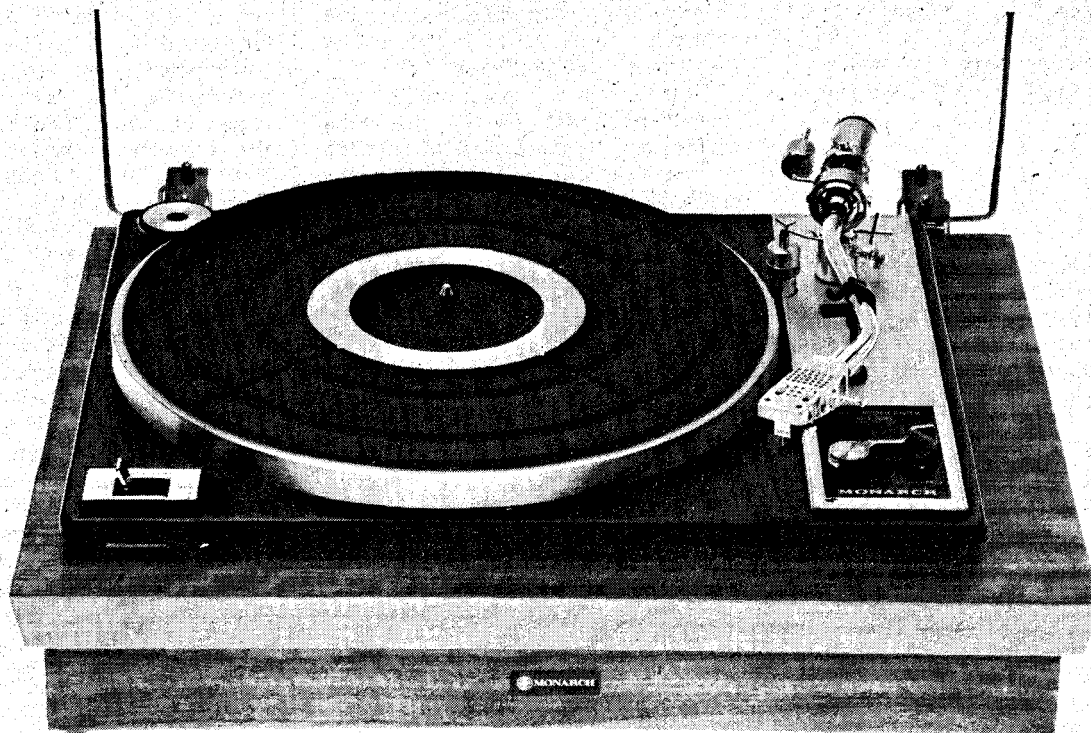


Fig. 4. Cross sectional view of the shipboard installation using the flow-through anode configuration.



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# MODERN FOOD PRESERVATION

form of X-ray tube enables cylinders to be passed horizontally through the internal radiation zone as seen in the simplified diagram showing the interior of the AEG ship plant (Fig. 4).

Distribution intensity of the ionising radiation in the irradiation zone is reasonably homogenous inside the cylinder and the type of fluid in the zone makes little difference to the distribution. Plots of iso-dose lines in the cavity are given in Fig. 5 — the desirable intensity is given as 100% in the tube centre. To ensure maximum

uniformity of irradiation for the contents, the cylinders are rotated as they travel through the radiation.

The dose rate can be adjusted by two simple methods. Firstly the tube current can be controlled to give the desired radiation rate as seen in the graph of Fig. 6. Secondly, the speed of travel of the cylinder can be varied.

The entire equipment is, naturally, fully shielded to protect the operators from both the high voltages and from stray radiation. The cylinders which move up the infeed magazine transport, are sent horizontally through the irradiated zone and are then let down the outfeed conveyor. The in and out-feed arrangements are provided as safety radiation locks.

The provision of 200 kV at up to 500 mA requires a large transformer and cooling of the anode by circulating water is essential. The

entire X-ray system is surrounded by a lead shield.

Irradiation is not yet fully commercial, for many factors still need to be established and clarified. In the German Federal Republic, for instance, the "Food Irradiation Promotion Group" of Bremen formally applied in December 1971 for permission to treat fresh salt-water fish by this method.

The Food and Agriculture Organization of the United Nations (FAO) and the International Atomic Energy Agency (IAEA) are holding an international symposium in Bombay, India, later this year, on the subject of radiation preservation of food. This assembly will bring the world's experts together and will consolidate the experiences of many people possibly leading to wholesale use of this new method of preserving foodstuffs. ●

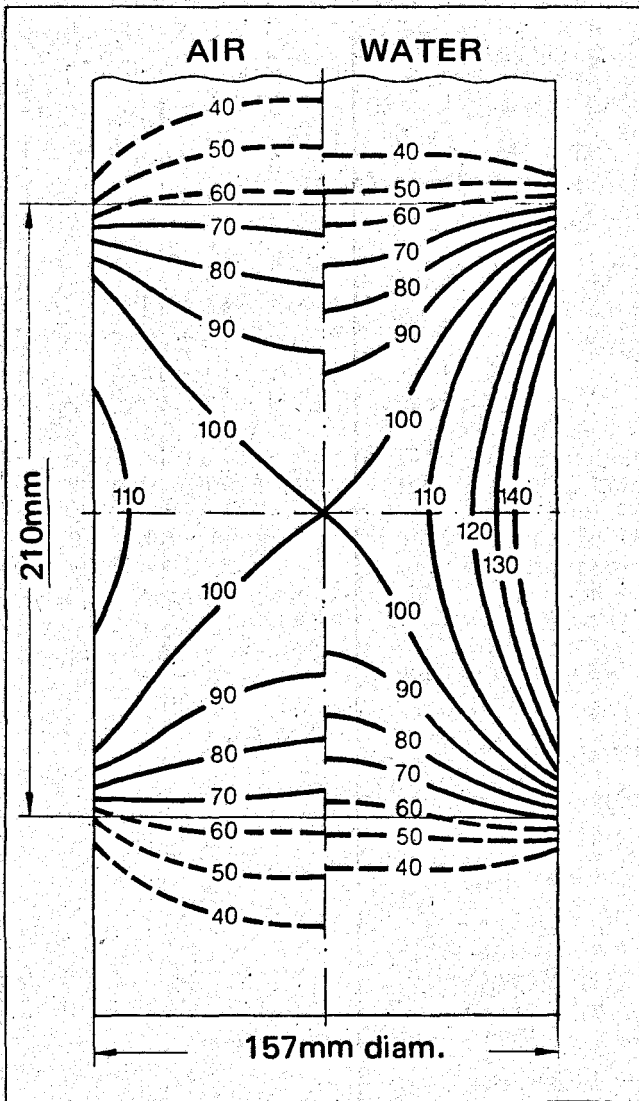


Fig. 5. Intensity distribution inside the irradiation zone of the X-ray tube.

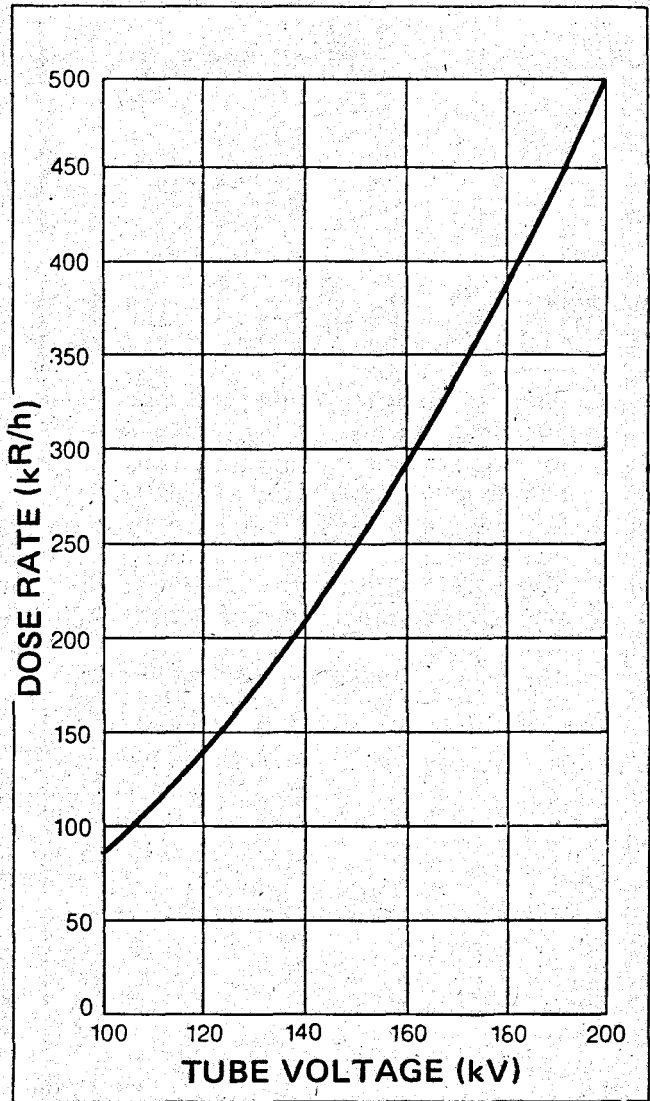


Fig. 6. Dose rate in the centre of the irradiation chamber (with a tube current of 32 mA).

# THE CHAMPIONS

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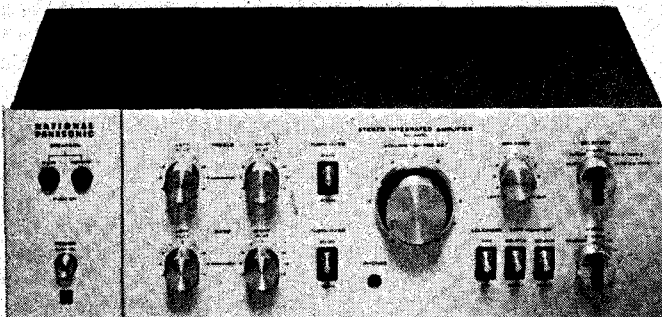
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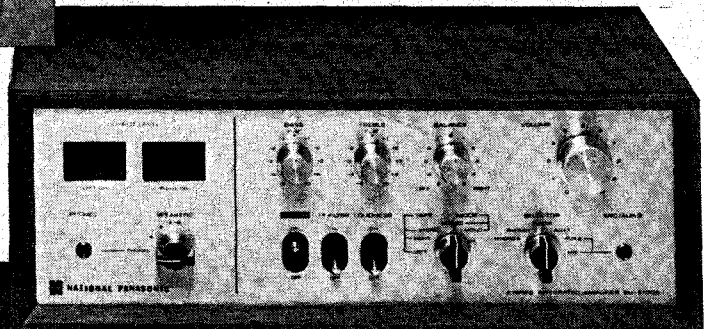


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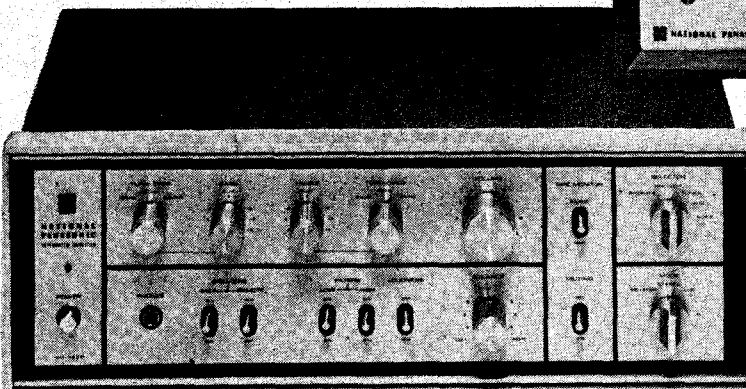
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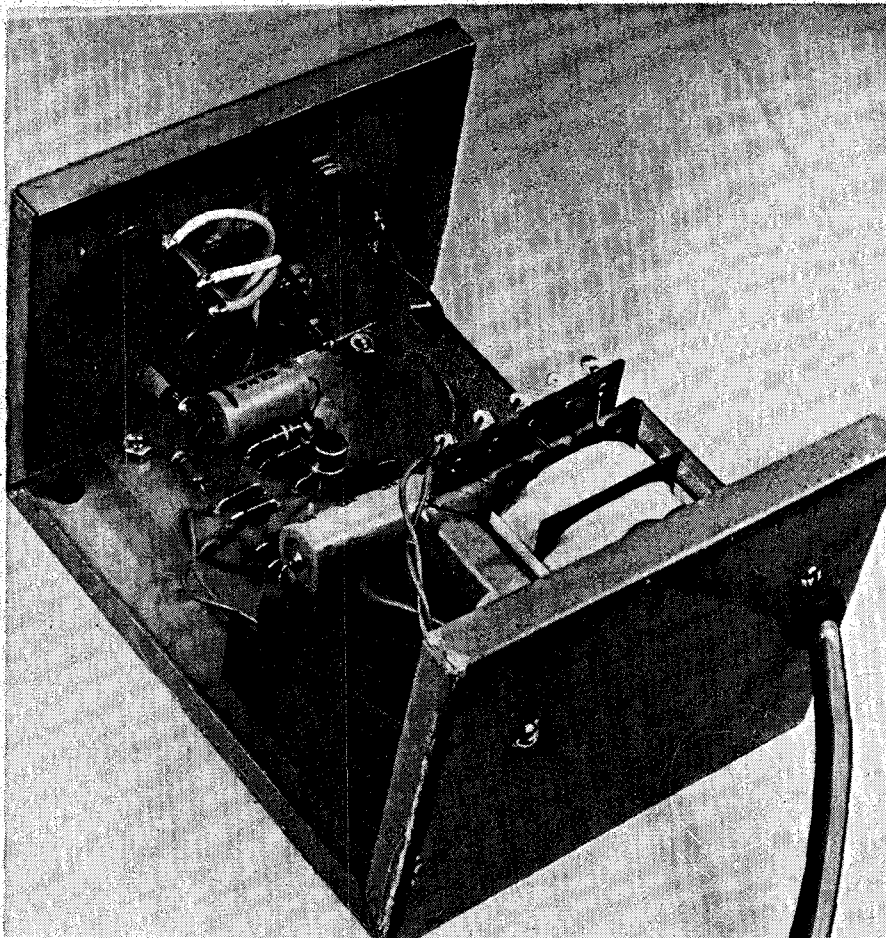
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# IC POWER



IN June 1971 we published constructional details of a 'Logic IC Power Supply' which was specifically intended to power RTL and TTL circuitry. Since then we have received a surprisingly large number of requests to provide details of a similar unit with an extended voltage range.

Here then are details of a simple yet versatile power supply capable of delivering 1 amp up to 10 volts and ½ amp up to 15 volts.

The unit may readily be adapted to operate over other voltage and current ranges.

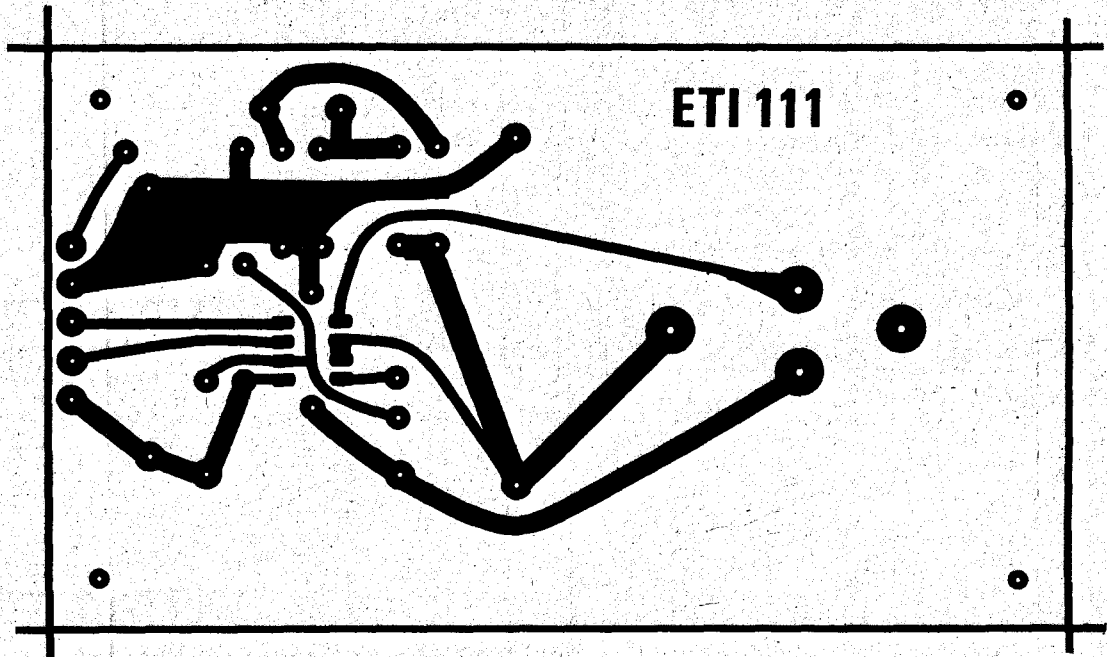
As with the previous unit, refinements such as output voltage and current metering, variable current limiting etc. may be added to the basic circuit.

## VOLTAGE REGULATOR IC

The control circuit of this supply is formed by the integrated circuit precision voltage regulator — shown as IC1 in Fig. 1. This IC is now produced by a number of companies including SGS, Fairchild and Motorola (respective type numbers are included in the parts list for this project).

The integrated circuit is a monolithic voltage regulator constructed on a single silicon chip using the planar epitaxial process. The device consists of a temperature compensated

**ETI**  
**PROJECT**  
**111**



*Foil pattern for logic power supply (actual size).*



# SUPPLY

Simple, adjustable power source has innumerable applications.

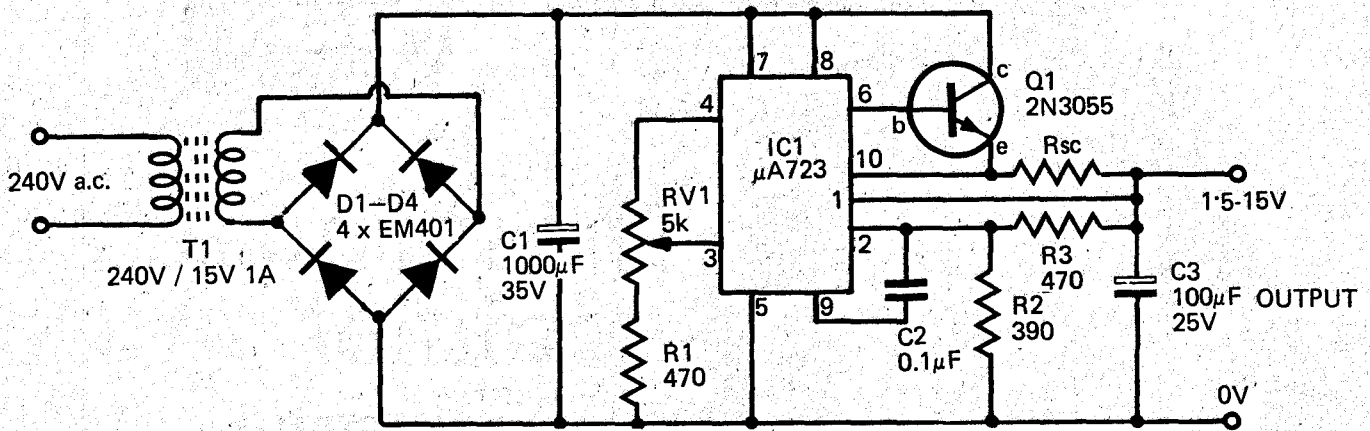


Fig. 1. Circuit diagram of regulated supply.

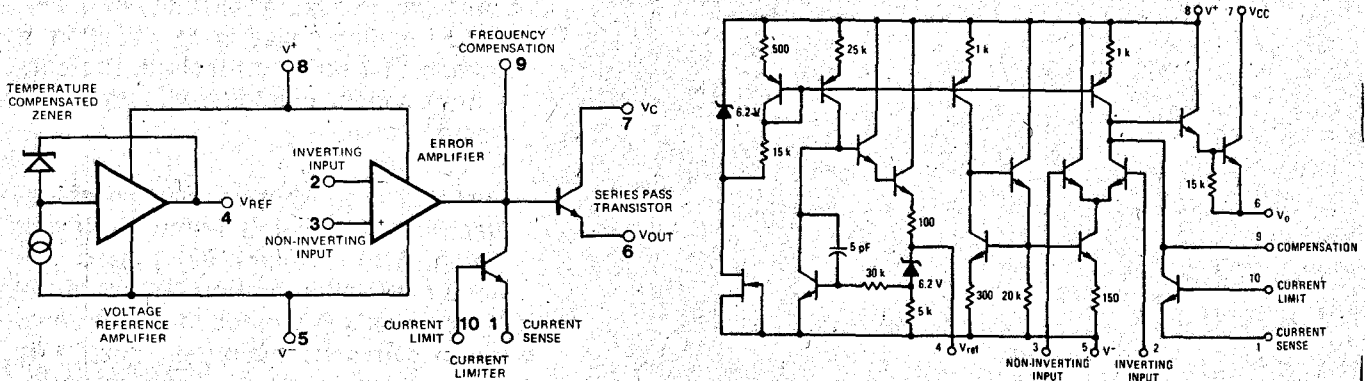


Fig. 2. Simplified schematic of  $\mu A723$ .

Circuit schematic of IC  $\mu A723$ .

reference amplifier, error amplifier, power series-pass transistor and current limiting circuit. Additional external npn and pnp pass elements may be used when output currents exceeding 150mA (from the IC) are required. Provision is made for adjustable current limiting and remote shut-down. In addition to this the IC features low standby current drain, low temperature drift and high ripple rejection.

## CONSTRUCTION

Our prototype unit was built on an epoxy glass board, however the constructional method is not critical and the unit may alternatively be built on matrix board, tag strips etc.

The power transistor is mounted on a 2" strip of extruded heatsink which in turn is located on the printed circuit board by the same screws that locate the transistor. One of these screws is

## HOW IT WORKS

Figure 2 shows a simplified equivalent circuit of IC1. The voltage reference amplifier produces (typically) 7.15V at pin 4, this voltage has a maximum temperature coefficient of 0.015%/°C.

The  $V_{ref}$  voltage is taken to potentiometer RV1 which enables it to be varied between 0.7V and 7.15V. The error amplifier (within the IC) drives a power transistor (also within the chip), and this in turn drives the external series pass transistor Q1.

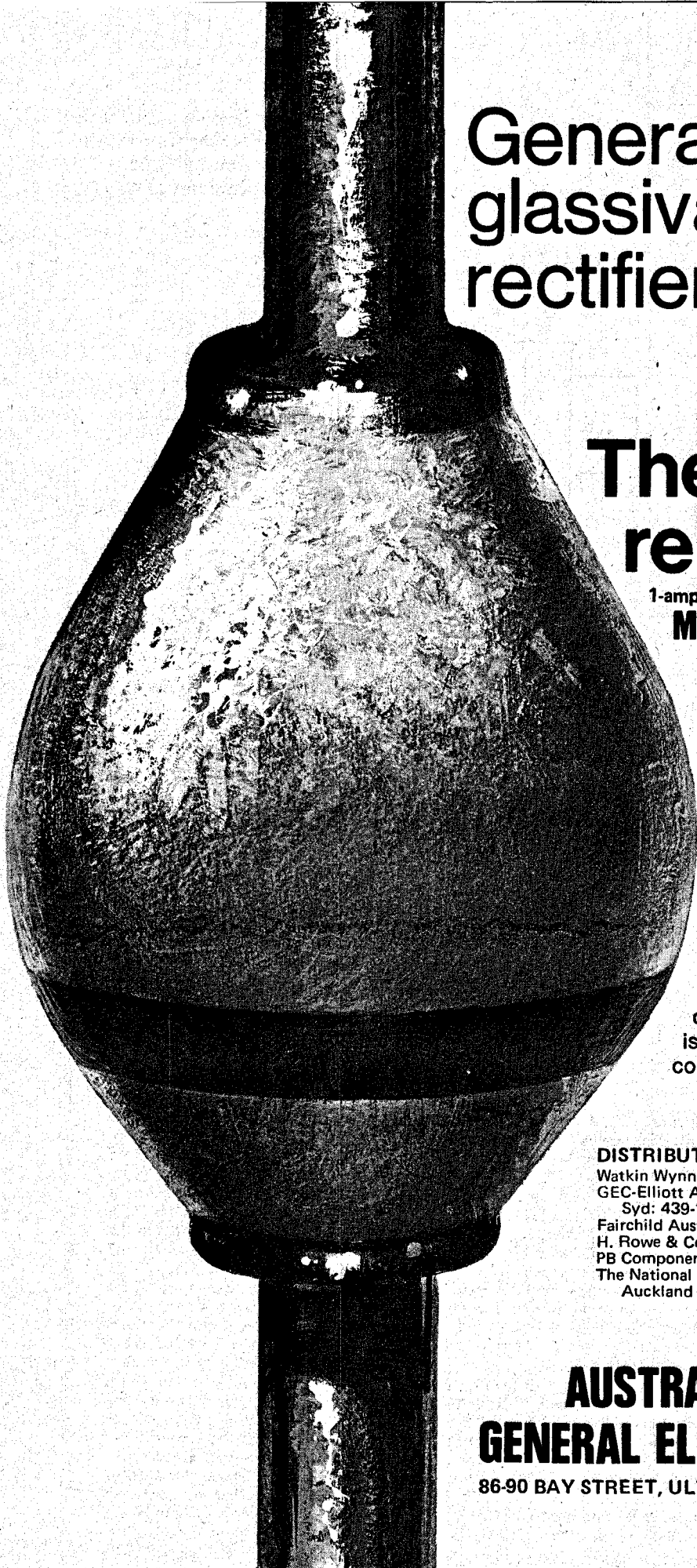
The output of Q1 is divided by R2 and R3 ( $\approx 2.2$ ) and this voltage provides the feedback signal for the error amplifier. Hence the output voltage will be approximately 2.2 times the voltage on RV1.

Current limiting is determined by the voltage drop across RSC. If this exceeds 0.6V, the current limit

transistor within the IC becomes forward biased and bypasses any further increase in drive current from the output stage.

The max. output voltage and current of this unit is a function of the transformer, filter capacitor, and the heatsinking of Q1. The prototype unit used a 15V centre tapped 1A transformer (AR 2155) and this provided 1A up to 10V and ½A at 15V. The drop in output current is due to rectified dc voltage decreasing on load. If a higher voltage transformer is used — or one with a higher current rating, thus providing better regulation — then higher output currents may be expected.

The maximum output voltage may be altered by changing the ratio of R2 and R3. Note that the maximum no-load voltage across C1 should not exceed 35V.



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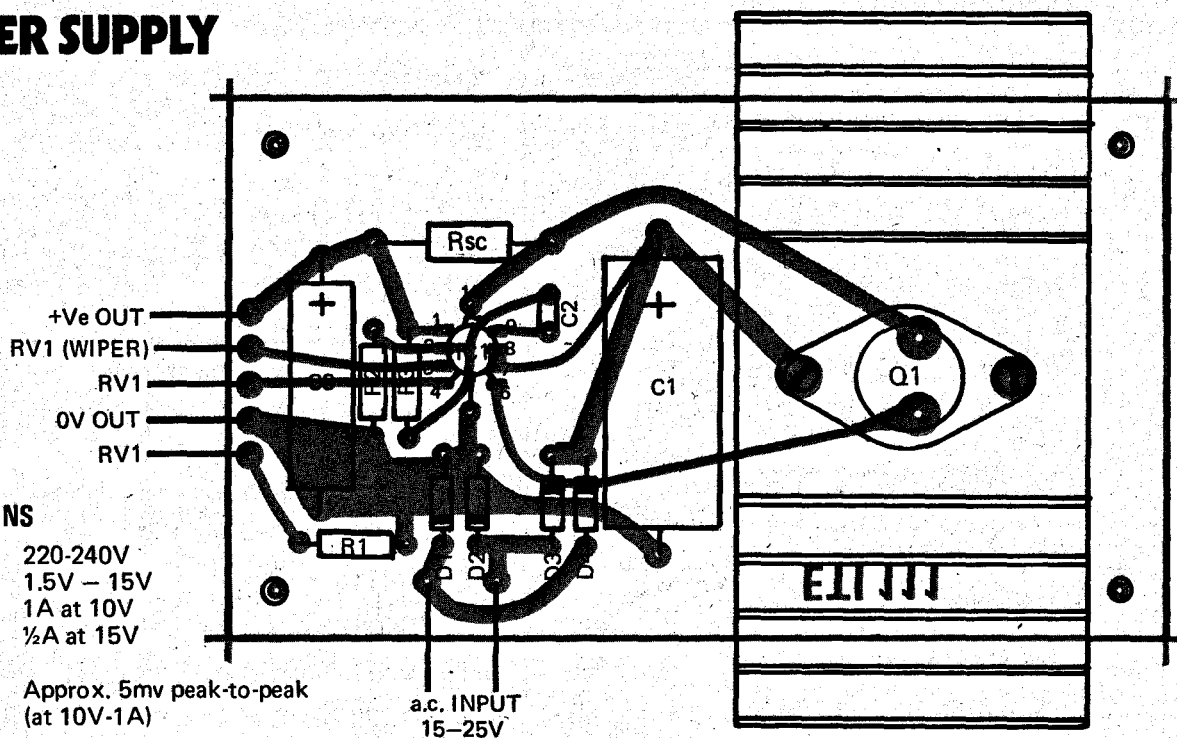
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# IC POWER SUPPLY

Fig. 3. Layout of components on circuit board.



## SPECIFICATIONS

Input Voltage 220-240V  
 Output Voltage 1.5V - 15V  
 Output current 1A at 10V  
 ½A at 15V

Ripple Approx. 5mv peak-to-peak  
 (at 10V-1A)

Regulation 0-100mA = 4mV (10 Volt)  
 0-1.0A = 20mV (10 Volt)

also used for the electrical connection for the collector of the transistor.

The IC may be soldered directly into the circuit - ensure that the device is correctly orientated - and avoid excess heat. Recommended maximum lead temperature during soldering is 300°C.

A load sensing resistor (RSC) is used to provide overload protection. In our prototype we used a short length of resistance wire cut to length to limit the current to the desired value. An interesting alternative is to substitute a 20 ohms 5 Watt wire-wound potentiometer for RSC. This enables the current limiting facility to be steplessly varied. With this feature the user can start experimenting with a very low current limit and then increase the current when the circuit is operating correctly.

The basic circuit described in this article can be modified to provide other ranges of voltage and current. The main design limitations are that the voltage across the IC must not exceed 40V and that the output current from the IC must not exceed 150mA, or 800mW of power.

Transistor Q1 (2N 3055) is capable of dissipating up to 115 watts but if power levels of this magnitude are envisaged then a second transistor should be added, in a Darlington pair configuration, to transistor Q1. This will reduce the loading on IC1. A larger heat sink will also be required.

## INCREASED RIPPLE REJECTION

The integrated circuit chosen for this project has a typical ripple rejection of 74 dB. This is more than adequate for most applications. However by additional filtering at the non-inverting input (pin 3), the ripple can be even further reduced. A typical performance, using a 4.7µF capacitor across the non-inverting input and Vref is approximately 86 dB.

## RSC - TYPICAL VALUES

Value of RSC	Current Limiting
10 ohms	65mA
1 ohm	650mA
0.5 ohms	1.4A
0.2 ohms	3.2A

## PARTS LIST ETI 111

R1	resistor 470 ohm ½W 5%
R2	resistor 390 ohm ½W 5%
R3	resistor 470 ohm ½W 5%
RSC	see text
RV1	potentiometer 5K linear
D1-D4	diodes EM401, 1N4005 or similar
Q1	transistor 2N3055
IC1	integrated circuit 0A723 (or SGS L123, or MC1723CG) (metal can types)
C1	capacitor 1000 µF 35V electrolytic
C2	capacitor 0.1 µF 100V
C3	capacitor 100 µF 25V electrolytic
T1	transformer 240V primary 15-20V sec @ 1A

### PC board ETI 111

on-off switch, terminals, knob, 3 core flex and plug,  
 metal box approximately 4½ x 3½ x 6 etc.

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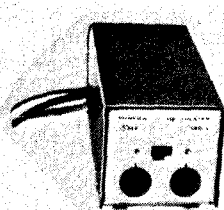
# ROTEL AMPLIFIERS

210 310 610  
8 WATTS TO 32  
WATTS RMS



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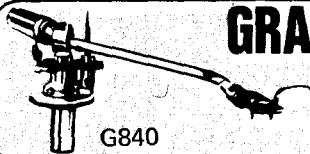
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# HOMES FOR OHMS

A SIMPLE WORKSHOP PROJECT by A.J. LOWE

**C**AN you find a 680k resistor in 10 seconds or less? Can you lay your hands on a dozen 1k resistors in the same time? Can you check, within a minute, whether you have a 47 ohms, a 3.3k, an 820k, and a 1.8M needed for a project?

If your answer is 'Yes' to all these questions, then this project is not for you. But, if the storage and finding of resistors is time consuming, annoying and gives you a pain in the head — read on. Your problem's solved. Here's a resistor store which can hold up to 1275 ¼ watt resistors, and enable you to answer 'Yes' to all those questions, and a lot more like them.

The store comprises a rack of two plates of 18 gauge aluminium, separated by sides 2¼" deep. (Fig. 1). The rack carries 75 plastic 'pill tubes' about 3½" long x 5/8" diameter. Each tube is for one value of resistor, so that the rack can hold all values from 5.6 ohms up to 8.2 megohms. Each tube will hold about 17 ¼ watt resistors (Fig. 2).

The rack is supported, at a convenient angle for bench use, by two pivoted legs which fold away when the rack is to be put on a shelf or in a drawer.

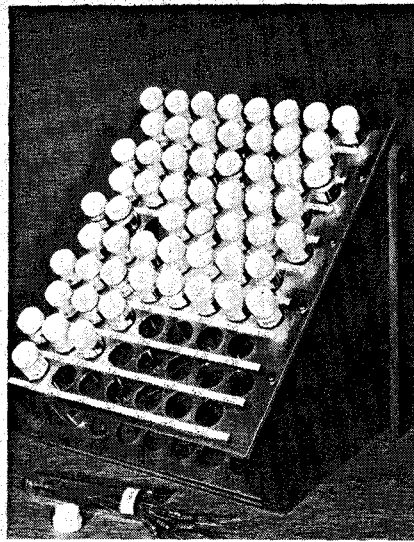
The first thing to buy is a set of pill tubes. That is their correct name in the pharmacy trade. Some persistence may be needed with your pharmacist; another source of supply is the scientific supply companies. The original rack used '4 gram long' pill tubes made by Duranol of Melbourne. They cost just over \$2 a hundred.

Having bought the tubes, work out the size of aluminium needed to accommodate the tubes with the staggered layout shown in the photograph. If you get tubes exactly as specified above then copy the layout shown in Fig. 3. You'll need two plates each 10" x 8".

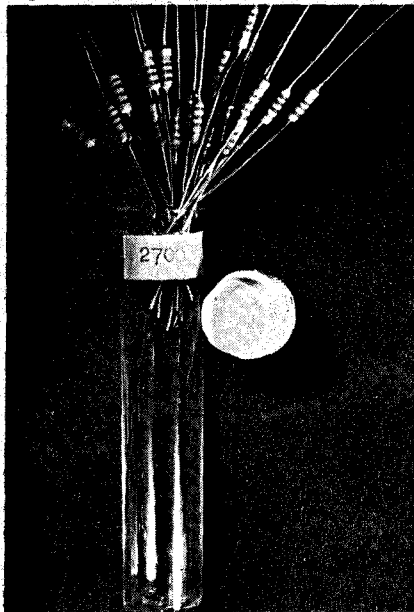
Mark out one plate very carefully, and then clamp it to the second plate, edge to edge. Drill two or three small holes, on hole centres, through both plates and then bolt them tightly together. Next drill through both plates all the pilot

holes needed for a chassis punch. Separate the plates and make the final holes with an 11/16" chassis punch.

Now, assemble the top plate to the side pieces — 2¼" x ½" pine, using wood screws. Make two narrow spacers to give clearance for the baseboard. They should be ¼" thick and the same width — ½" as the side pieces. Cut a base-board from ply or Masonite and attach it with  
*Fig. 1.* (Turn to page 55)



*Fig. 1.*



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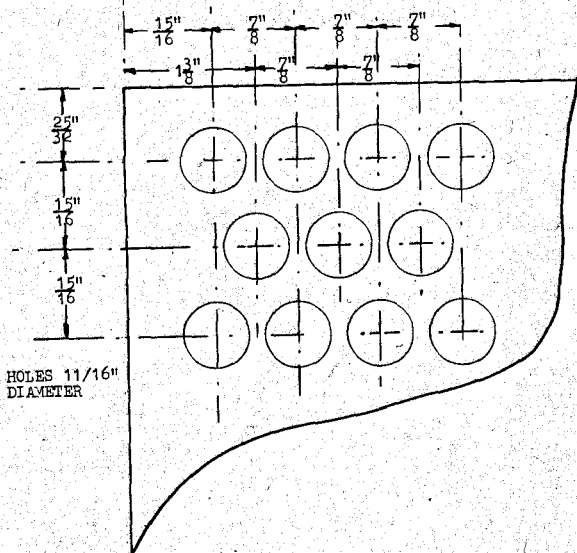


Fig. 3.

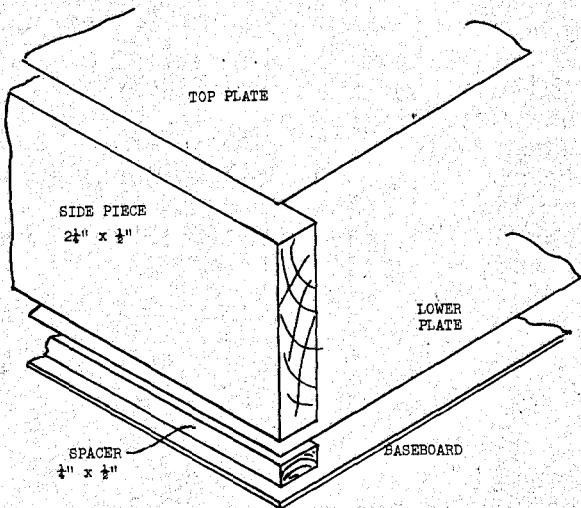


Fig. 4.

countersunk wood screws running right through the base, the spacer, and the lower plate into the side pieces. The legs may be attached and pivoted as shown.

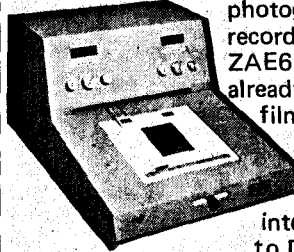
Labelling is done by typing resistance values on a number of 1/4" strips of adhesive-backed press-on paper — (Fasson or similar), and sticking them directly to the aluminium plate. Each store tube — not the lid, is labelled with the same material.

If you have real difficulty in getting pill tubes, then glass test tubes with stoppers would make a substitute — although these are rather more fragile. If you need to store larger quantities of resistors, enquire about larger pill tubes, and work it out from there.

There's a fair amount of work in punching all those holes, but the time used is saved many times over in the ready availability of resistors of all the values you'll need. ●

# DATA EXTRACTION

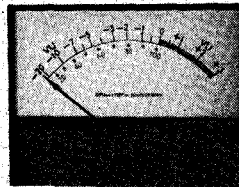
Designed for analysis of polaroid and other photographs as well as chart records up to 150mm wide the ZAE6 is the newest member of an already large family of chart and film analysis systems. The ZAE6 has two 3 digit D.V.M's built in and can also be provided with data interface units for connection to Digital Printers, Desk Calculators, Teletype Units or medium and high-speed tape punches.



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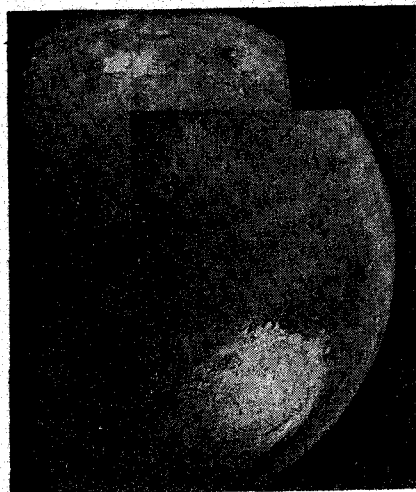


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# MARS-FIRST PICTURES



NASA

**T**HE northern hemisphere of Mars — from the polar cap to a few degrees south of the equator — is seen in this mosaic of three photos taken by the National Aeronautics and Space Administration's Mariner 9 spacecraft on August 7, 1972. The north polar ice cap is shrinking during the late Martian spring and the area shows complex sedimentary systems. Fractured terrains partially flooded by volcanic extrusions are visible in the center of the disk. In the bottom photo are the huge Martian volcanoes and the west end of the great equatorial canyon (lower right). The volcanic mountain Nix Olympica (lower left) is 500 kilometres (310 miles) across at the base and stands higher than any feature on Earth. When Mariner 9 went into Mars orbit last November, only Nix Olympica and the three aligned volcanoes to the right protruded above a planet-wide dust storm. When the dust settled, clouds of water or dry ice crystals continued to obscure the area north of the 50th parallel until recent months. The northern hemisphere now appears free of atmospheric obscuration. The three photos, among 7,273 obtained by Mariner 9, were taken 84 seconds apart from an average range of 13,700 kilometres (8500 miles). They have been computer-enhanced by the USA's Jet Propulsion Laboratory's image processing team.

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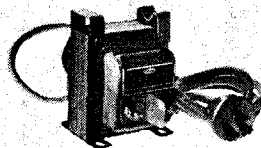
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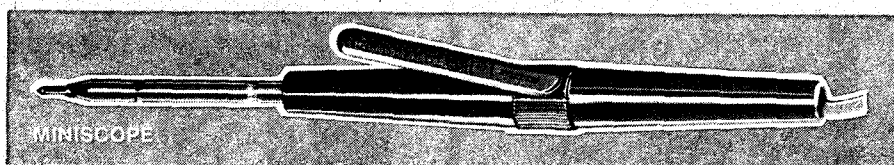
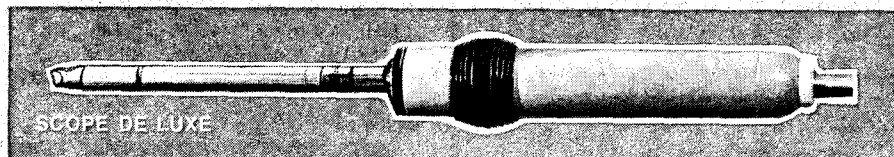
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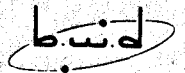
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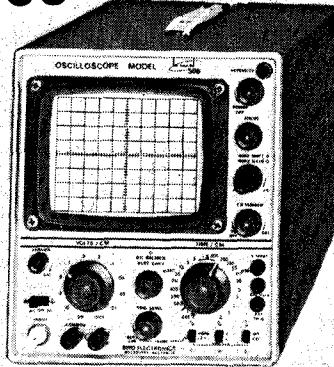
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T.B. 200nS - 1S/cm. 2Hz - 10MHz trigg

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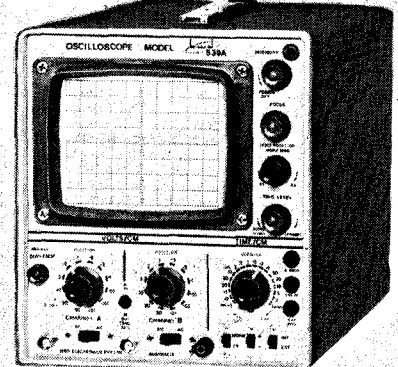
**506**



Ampl. DC to 15MHz.  
5mV - 50V/cm.  
T.B. 50nS-10S/cm. 15MHz trigg. Isoi grnd.

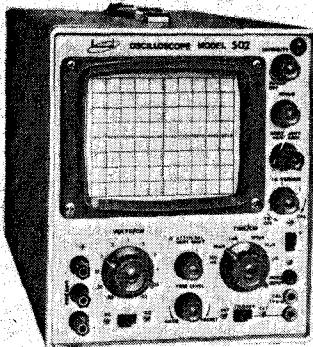
**\$304**

**539A DUAL TRACE**



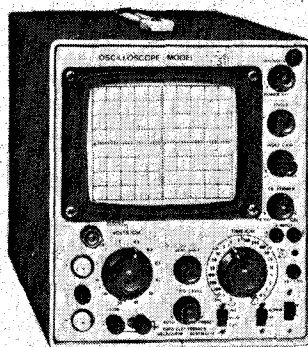
Ampl. DC to 10MHz.  
10mV - 50V/cm. T.B. **\$365**  
200nS-2S/cm. Triggering 2Hz-10MHz.

**502**



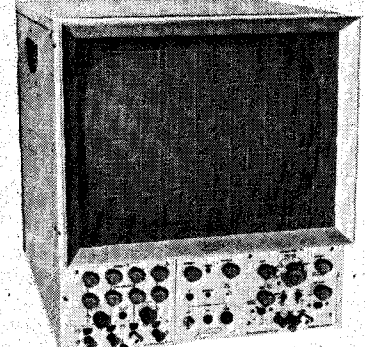
Differential Ampl. DC to  
3MHz. 20mV to 50V/cm. **\$350**  
T.B. 200nS-1S/cm. Isolated grnd.

**511**



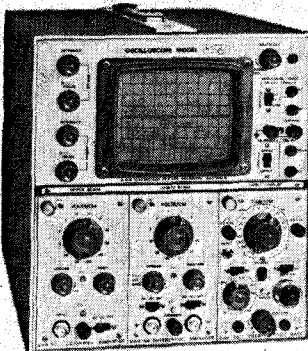
Differential Ampl. DC to  
10MHz at 10mV 5Hz 4MHz **\$430**  
at 1mV T.B. 40nS-10S/cm. Isolated grnd.

**1722**



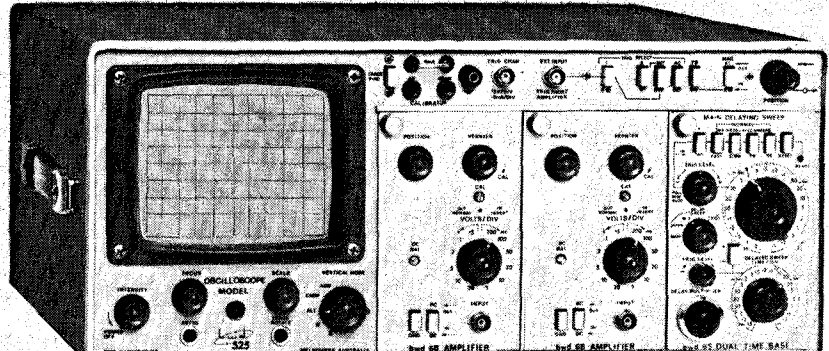
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# LIFE ON MARS?

Top Soviet scientists G. Petrov and V. Moroz describe Russia's latest space probes.

**S**cientific equipment on board a space vehicle has to meet rigorous requirements as to its volume and weight. Hence in making the choice in the composition of scientific equipment on the USSR man-made satellites to be put in orbit around Mars it was necessary to keep in mind the basic target of the project, which was "Is there Life on Mars?"

The history of the exploration of Mars started with the "discovery" of canals. These were later found to be an optical illusion. More recently it seemed organic molecules had been discovered in the dark regions of the planet, but this too proved to be erroneous.

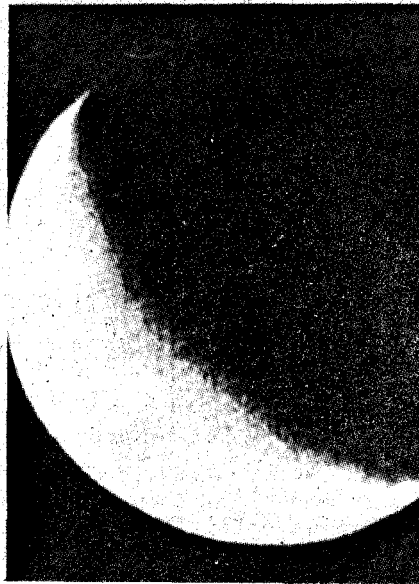
But no matter how many times we are disillusioned, one thing is quite certain — if life *does* exist on any of the solar system's planets, (apart from Earth) it is most likely to be on Mars.

We know the Martian climate is severe, but this does not mean that life does not exist there. It is a fact that the adaptability limits of living organisms are very wide — particularly in their simplest forms.

The general trend in the exploration of Mars is to make preparations for sending automatic biological laboratories equipped with instrumentation capable of identifying complex organic compounds and micro-organisms. Before such laboratories can be sent however, it is necessary to explore the planet thoroughly. To study it "far and wide" and to look at its surface for some 'oases' — areas more suitable for life than others. But how can they be found?

The biosphere, must in all probability, be concentrated in such 'oases' if it exists at all under the severe Martian conditions. These areas are expected to possess greater warmth, to be situated on the lowland and to have a relatively high humidity.

The temperature of the planet's surface can be measured at a distance by means of its infrared radiation. We can even estimate the ground temperature at some depth below the surface from the ground radio emission. The surface relief can be studied, with the aid of photographs, although they do not allow easy determination of the elevation difference between remotely situated



*Photograph of the planet Mars transmitted from the Soviet automatic station "Mars-3". Taken by a camera with a focal length of 52 mm at a distance of about 50,000 km. The photograph, obtained by the spectrozonal method through a blue light filter, clearly shows the limb and terminator of the planet.*

large areas, despite the fact that this is of primary interest.

The simplest method of solving this problem from a man-made satellite would involve a systematic determination of the thickness of the Martian atmosphere over different regions from the intensity of the absorption bands of carbon dioxide which essentially makes up the planet's atmosphere. Lastly, an appraisal of the atmospheric humidity can be obtained by measuring the steam content in the atmosphere.

## ASTROPHYSICAL EXPERIMENTS

The problem of life on Mars, is, in fact, a crucial one. But, as can be seen, tackling the problem involves a great many other issues, the study of physical conditions on the planet generally. Ultimately, the list of astrophysical experiments selected for *Mars-2* and *Mars-3* was as follows:

— measuring the surface temperature by means of its infrared radiation:

- studying the relief from the optical thickness of the atmosphere in the carbon dioxide absorption band;
- studying the photometric properties of the surface and the atmosphere;
- measuring steam content in the atmosphere;
- measuring the temperature (and, simultaneously, the dielectric constant) of the ground from the planet's radio emission;
- studying the ultraviolet radiation of the atmosphere in the resonance peaks of hydrogen, oxygen and argon.

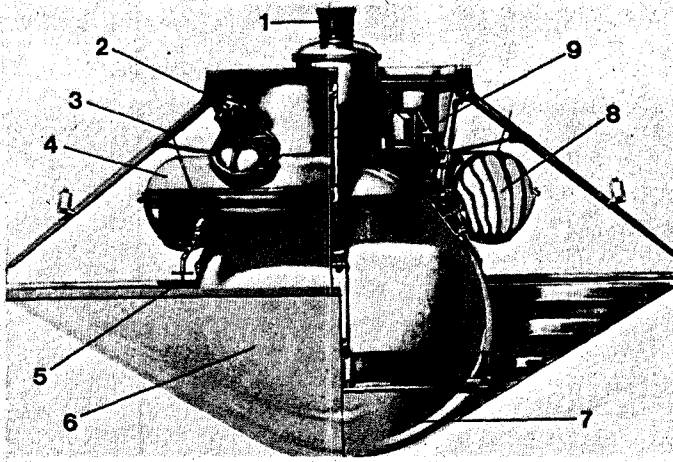
Each experiment was to be performed by specially manufactured instruments meeting the rigorous space requirements — ability to function in superhigh vacuum, vibro-resistance, low weight, and minimal power consumption. The instruments for the first three experiments listed above have been combined in a common housing and have the appearance of a single unit — the photoradiometric complex.

The infrared radiometer consists of two miniature telescopes, one of which is directed at the planet and the other into outer space. The entire radiometer is small enough to be held in the hand and weighs slightly more than 1 kg. It can easily measure radiation from an object at a temperature of  $-100^{\circ}\text{C}$ .

Martian temperatures can be very low. In the first measurements made from *Mars-3* the temperature along the route passing through the equator was at the time not above  $-15^{\circ}\text{C}$ . At a distance of 1500 km the temperature is averaged over an area of 30 km diameter. In observations from the earth it is rarely possible to measure infrared radiation even from areas twenty times as large. Moreover, by means of measurements made from man-made satellites of Mars it is possible to obtain the temperature of the planet's nocturnal side, which is beyond reach of observations conducted from the earth.

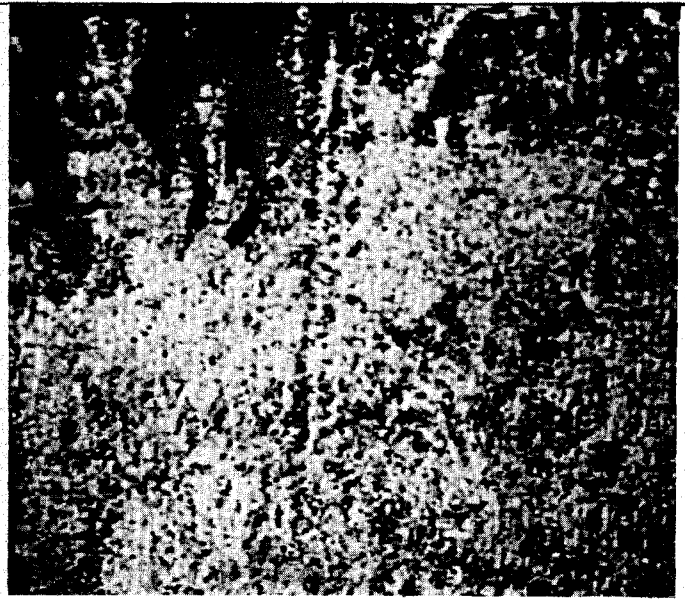
Another infrared instrument — a photometer for relief exploration — operates on short waves (about  $2\ \mu\text{m}$  in length) where the planet's radiation is exclusively reflected sunlight. This solar radiation, reflected from the surface, passes twice through the atmosphere, downward and upward,

# LIFE ON MARS?



*Descent capsule of "Mars-3"*

1. descent capsule motor 2. pilot parachute motor 3. antennae for communication with orbital station 4. parachute container 5. antenna of radioaltimeter 6. aerodynamic drogue 7. automatic Martian station 8. main parachute 9. devices and equipment of automatic control system.



*This photograph shows a region of hills and foothills in the equatorial part of Mars which was less covered by dust storms at the time when they were photographed. In the evening, when the sun is low, certain areas of the surface are covered with deep shadows.*

the length of its path depending on the altitude of the surface area studied and on the angles of incidence and reflection. All other conditions being equal, the lower the surface altitude, the greater the path length and the stronger the attenuation of light in the carbon dioxide absorption band. The instrument intended for measuring this effect consists of a telescope focused on the surface, a radiation receiver and a number of band-pass filters, the centre frequencies of which are placed at predetermined points within and outside the absorption band.

The first explorations of the Martian relief were performed from the earth by means of the spectroscopic method. The best resolution by this method however, was areas of Mars about 100 km in diameter. Even with

the spatial resolution as rough as that, it is possible to observe elevation differences up to 12-15 km. It has been established, for instance, that two huge upland ridges separated in longitude by about 180° are crossing the planet's surface from south-east to north-west.

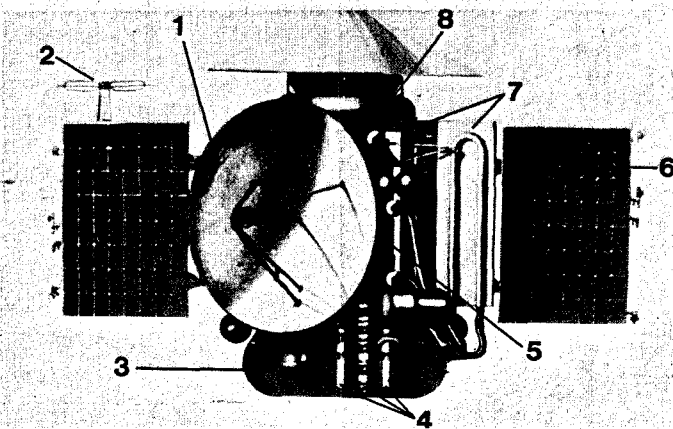
Man-made satellites orbiting round Mars are enabling the relief pattern to be studied in greater detail.

The third instrument in the photoradiometric complex measures the planet's brightness in a number of narrow spectral intervals in the visible rays within the 4000 to 7000 Å range. It studies the brightness distribution at the planet's edge and in the terminator region (boundary between diurnal and nocturnal sides, twilight zone). Brightness here is largely determined

by the planet's atmosphere, particularly its aerosol, i.e., dust, component. It accounts for numerous phenomena observable on Mars — clouds, dust storms, bluish haze. The investigations are expected to throw light on the nature of this phenomena.

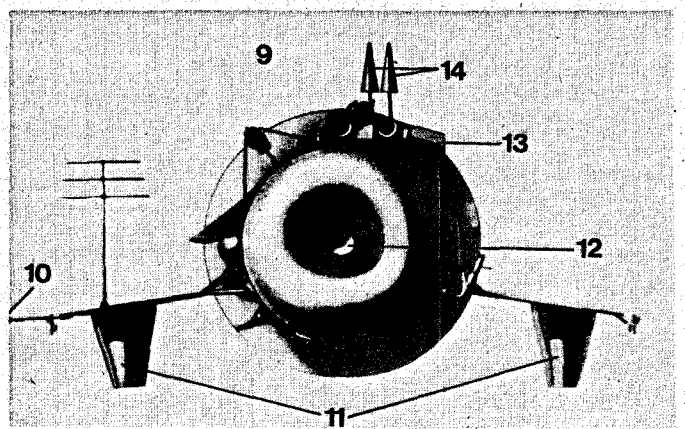
## MEASURING STEAM CONTENT

The measurement of steam content is very difficult. For a long time in Mars' spectrum even traces of steam absorption lines could not be detected by observation from earth. It has been finally proved, however, that steam does exist in the Martian atmosphere, but its quantity varies. In the most "humid" periods, precipitated water may amount to 0.1 mm. i.e., 100 times as little as in the terrestrial atmosphere. But in some periods its



*Soviet automatic station "Mars-3"*

1. parabolic high-directional antenna 2. antenna of scientific stereo equipment 3. instrument compartment 4. optical-electronic devices of the astro-orientation system 5. propulsion system tank unit 6. solar battery panel 7. radiators of thermoregulating system 8. descent capsule 10. magnetometer 11. antennae for communication with the descent capsule 12. correcting and braking engine 13. optical-electronic device of the autonomous navigation system 14. low-directional antennae.



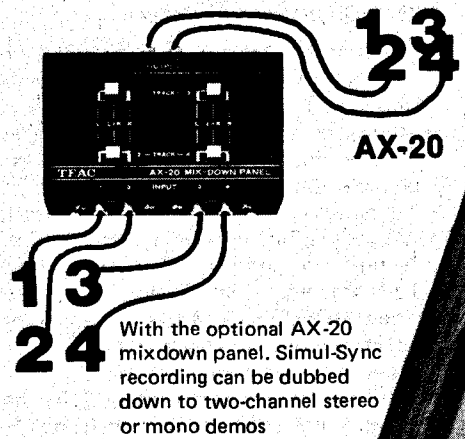
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If you'd like to know more, write to us for the TEAC Catalogue, price list and franchised dealer list.



## LIFE ON MARS?

quantity may be 1000 times as low and the steam absorption lines disappear altogether.

As average variations on the planet are so great, it can be assumed that in some separate areas the variations may be even more pronounced. Our aim is to look for such regions where the steam content consistently exceeds the average level.

But how is it possible for the steam absorption lines, being weak as they are, to be measured from a satellite?

To circumvent this difficulty, it became necessary to develop a special instrument capable of measuring the intensity of weak absorption lines if their location is known beforehand. The instrument easily detects the infinitesimal quantity of steam which is present along a 1 m path in a room. About as much steam is contained along the path running across the entire depth of the atmosphere around Mars.

### RADIO ASTRONOMY

It is possible to take a look underneath the planet's surface, to learn something about the properties of its soil without landing on it, by turning to radioastronomy methods. Radiotelescopes are mounted aboard Mars-2 and Mars-3, which receive radio waves, emitted by the planet in the 3 cm wavelength band, and measure their intensity and polarization. The measurement data permits the temperature of the ground to be determined at a depth of a few dozen centimetres, as well as the density and composition of the ground.

Even the largest radiotelescopes on the earth pick up radio emissions only from the planet as a whole. Though of

moderate size the radiotelescopes aboard the Martian automatic probes permit radio emission from surface areas some 100 to 150 km in diameter to be measured.

A great deal can be learned about a planet by studying the topmost layers of its atmosphere. For instance, by studying the hydrogen content in Venus' upper atmosphere, done for the first time by the Soviet automatic probe *Venus-4*, it became possible to draw a confident conclusion about the extremely low rate of water escape from the planet's interior.

A similar experiment, but in a perfected version, is being undertaken on the Mars-2 and the Mars-3 probes. Installed here is a multichannel ultraviolet photometer measuring the glow intensity of Mars' upper atmosphere in the most pronounced lines (the resonance lines) of atomic hydrogen, oxygen and argon. The envelope of atomic hydrogen extends to a depth of many thousands of kilometres around the planet. The automatic probes will enable the form, structure and time variation of the envelope to be determined.

After carbon dioxide, gas argon is possibly the most abundant gas in the Martian atmosphere. Argon is produced in the course of the radioactive decay of the substances in the planet's crust. Its quantity in the atmosphere will give an idea of the intensity of the process involved. For the moment the theory concerning the quantity of Argon in the Martian atmosphere is only an assumption to be verified by the "ultraviolet experiment." The results may prove to be very interesting to scientists.

All these instruments, with the exception of the ultraviolet photometer, "look" in the same direction as the photographic cameras installed aboard the Mars satellites.

The resultant photographs will permit the sites being measured to be accurately located on the map.

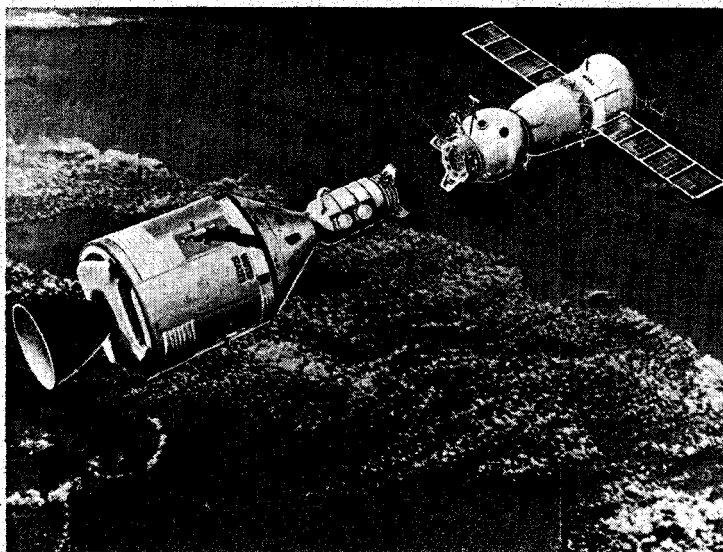
An important element of the entire programme is the measurement of the density of the Martian atmosphere and of the electron concentration in the planet's ionosphere. This is done by studying the behaviour of radio waves in the periods coinciding with the man-made satellites sinking beyond or emerging from behind the planet's edge. A separate instrumentation complex, now described here, is used to measure various parameters of interplanetary plasma. Its behaviour in the vicinity of Mars indirectly depends upon the planet's interior structure, on the magnetic and electric properties of its interior. These "plasmic experiments" will help us understand the planet's inner structure.

It is interesting to draw a comparison between the Soviet "Mars" programme and that of the *Mariner-9*, its American counterpart. The American programme centres on direct photography. The arsenal of astrophysical instruments aboard *Mariner* is, on the whole, less versatile, being confined to an infrared radiometer, long-wave infrared spectrometer and ultraviolet spectrometer. Instruments studying relief, radio emission of photometric instruments are not installed. On the other hand, the American instruments incorporate possibilities not covered by the Soviet ones, so the programmes are, in fact, complementing each other.

The processing of the information from the man-made satellites circling round Mars will take many months. But the first tapes containing graphical and numerical recordings are already being processed. — G. Petrov and V. Moroz, USSR. ●

## SPACE CO-OPERATION

A model of the USSR's Soyuz and the US Apollo Spacecraft are shown in simulated rendezvous and docking in Earth orbit. The Docking and Crew Transfer Module is shown attached to the Apollo Command Module. The International Rendezvous and Docking Mission planned for 1975 will be a joint flight by three American Astronauts and three Soviet Cosmonauts. The Agreement was signed in Moscow May 24, 1972 by President Nixon and Premier Alexei Kosygin and the Mission will provide mankind with the first capability of rescuing men in distress in space.

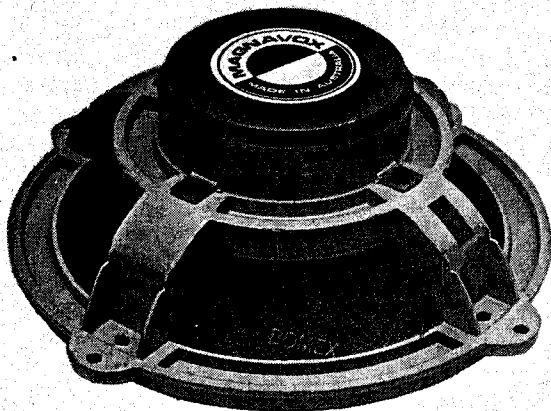


# INSTROL

# 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.

## MAGNAVOX 8-30 SYSTEM at reduced prices.



Featured in "Electronics Today". It handles 30 watts RMS, features a new high performance 8" speaker, two 3" tweeters, and is available in cabinet 20 7/8" x 12 7/8" x 8 7/8" (1 cu. ft.) or 23 7/8" x 15 1/2" x 10 7/8" (1.6 cu.ft.). Available in teak or walnut veneer.

### COMPLETE SYSTEM

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

### SEPARATE COMPONENTS

Enclosure kit (1 cu ft) \$16.50 (maple), \$17.50 (teak)  
Enclosure kit (1.6 cu ft) \$26.00 (maple), \$28.00 (teak)  
Built Enclosure (1 cu ft) \$29.00 (walnut), \$30.00 (teak)  
Built Enclosure (1.6 cu ft) \$38.00 (Walnut), \$40.00 (teak)  
speakers & crossover only \$26.00 (one side only)

## NEW E.T. MAGNAVOX 8-30 DESIGN

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

### COMPLETE SYSTEM

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The Melton kit employs a 12" bass and a tweeter, cabinet 22 3/4" x 13" x 10", 25 watts RMS.  
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Kit of Parts (Broadway 251) \$33.00  
Built and Tested (Broadway 201) \$36.00  
Built and Tested (Broadway 251) \$46.00

### SEPARATE COMPONENTS

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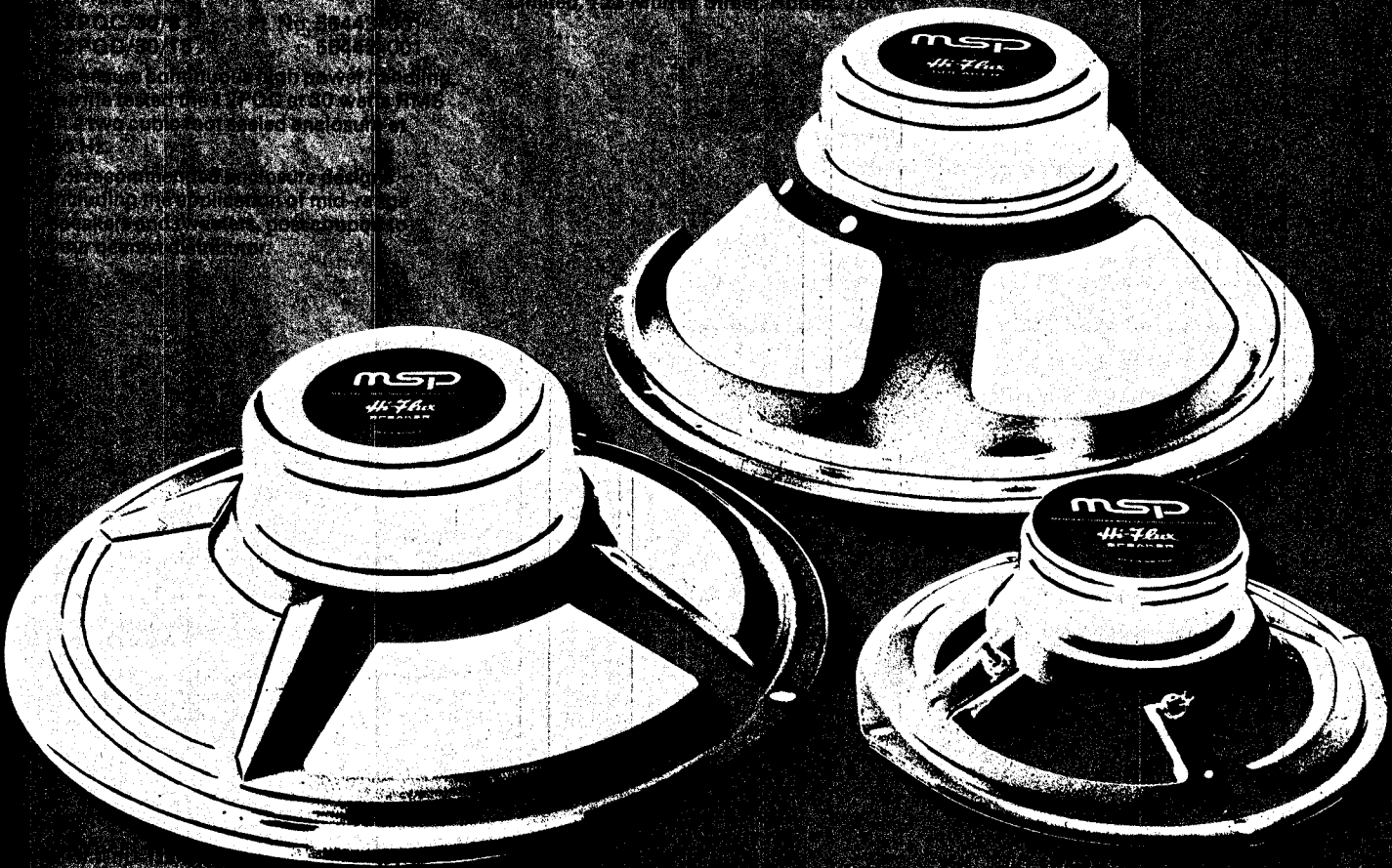
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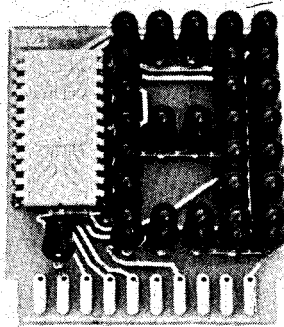
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# KENWOOD HEADPHONES MODEL KH-71

Latest headphones  
from Kenwood have  
very smooth low  
frequency response



**electronics**  
TODAY  
INTERNATIONAL  
**product test**

No speaker system yet devised has a truly flat frequency response. In fact, even if there were such systems, their response would still be modified and coloured by the room in which they were placed. Many audiophiles use headphones to eliminate at least the second of these problems.

Apart from this there are a number of very valid reasons for using headphones.

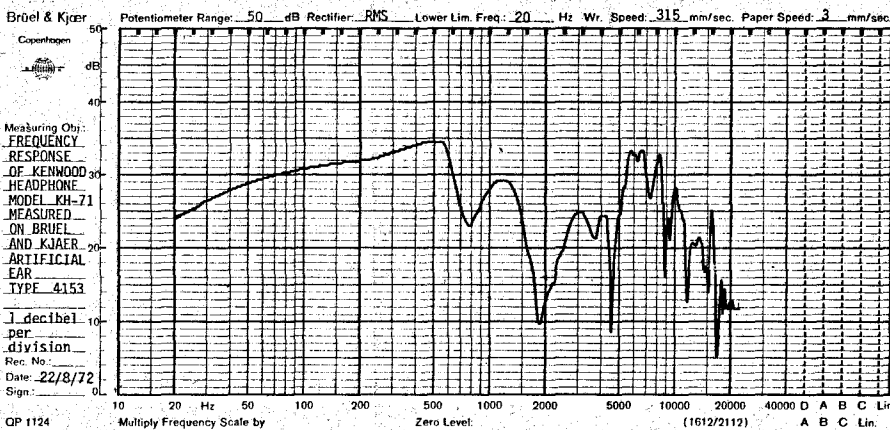
The most obvious of these is that loudspeaker reproduction of music at true concert hall levels is practically impossible in high-density living areas.

At the other end of the dB scale, our increasingly noisy environment results in higher background noise levels which result in the masking of pianissimo music levels.

So not only must we reduce the overall sound level to less than realistic levels but we also lose any quiet passages in the general background noise.

Headphones can minimize some of these problems because, firstly, they are closely coupled to the ear and therefore can produce very high sound pressure levels with milliwatts of input power; secondly, they are usually effectively sealed around the ear, and this results in reasonable attenuation of external noises; thirdly, their very small input power ensures that any leakage around the earpiece — into the room — is virtually inaudible.

Manufacturers of headphones use numerous designs with markedly different physical and electro-acoustical characteristics to obtain their aims. Thus, because of these different design philosophies it is



not always possible to judge the quality of headphones by price alone.

### CONSTRUCTION

The construction of Kenwood KH-71 Headphones is unusual for a number of reasons. The driver unit at first glance appears to be a simple 3" diameter cone type tweeter, but on closer examination proves to be rather more than this, for the main diaphragm is relatively soft and has a rigid dome approximately 5/8" diameter in the centre with a vent hole through its middle. It would appear that the soft diaphragm is for the low frequency and the rigid centre dome for the high frequency response. The frequency response (measured on our Bruel and Kjaer artificial ear) confirms this characteristic of dual response with one peak occurring at approximately 500 Hz and another at approximately 7000 Hz.

The drive unit is enclosed in a vented plastic housing which is internally lined with a foam plastic. This partially loads the speaker diaphragm when it is driven by a low frequency signal and is to some extent responsible for the very smooth low frequency performance that is obtained.

This housing is mounted on a light steel frame which allows it to pivot in two planes so that pressure is exerted

equally around the ear cushion. This steel frame is then connected to the headband. Regrettably the combination of these features results in one of the heaviest headphones we have yet seen.

The weight of the headphones without cord was approximately 460 grams and the weight of the coiled cord approximately 190 grams.

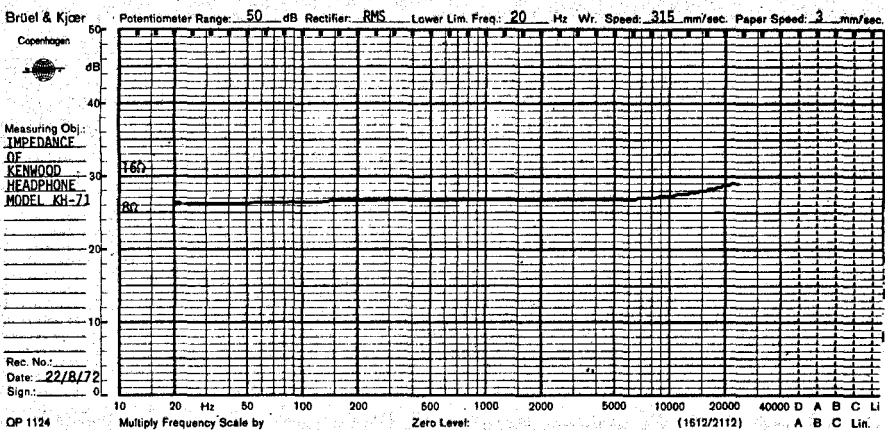
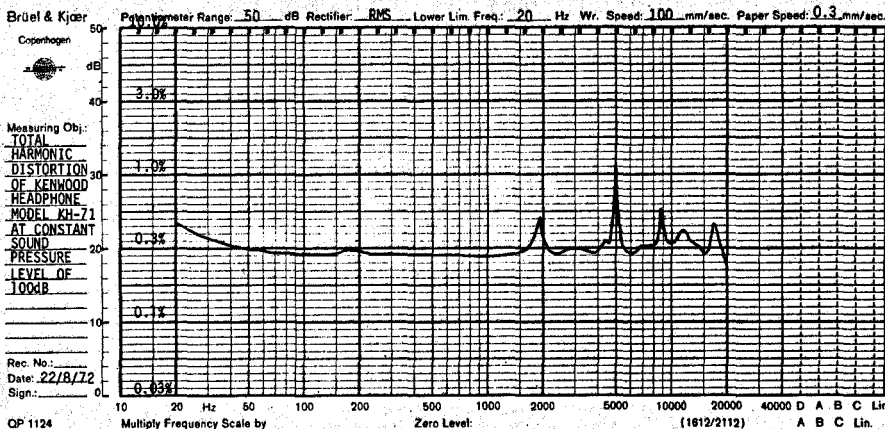
To distribute the weight over the crown of the head, the headband is fitted with a large foam pad covered with leather similar to the metal cups over the speaker units. The padded section is approximately 8" long by 2" wide.

Nevertheless during the subjective tests the weight of the headphones plus cord became noticeable after half an hour or so, and the main neck muscles started to ache after approximately one hour's continuous use.

This effect is partially due to the lateral pull of the heavy coiled cord and can be reduced considerably by anchoring the cord in such a way that its full length does not hang in a catenary.

### SUBJECTIVE TESTING

During our subjective test we listened to numerous records, varying from hard rock to sedate classical. In every instance the smooth bass was apparent



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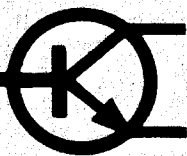
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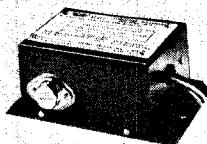
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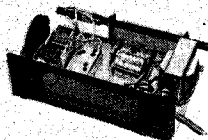


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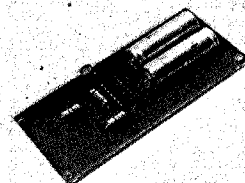
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## KENWOOD HEADPHONES MODEL KH-71

and resulted in clean fundamental tones.

But at higher frequencies (above 500Hz), the frequency response has a number of notches — caused by resonances in the drive units — which result in noticeable colouration. These resonant notches are readily apparent in our frequency response curve reproduced in this review; they also show up on the distortion curve as distinct peaks.

Apart from the notches in the region of 800Hz and 2000Hz, the higher frequency notches are relatively sharp and do not result in a significant difference to the listening quality.

The notches in the region of 800Hz and 2000Hz produce a slight loss of presence particularly with such instruments as alto-saxophone, french horns and piccolo, which have predominant fundamental components in this region. Nevertheless even with this slight colouration, orchestral pieces and classical work had an added

crispness not normally obtained with speakers in the average living room.

The measured performance was very interesting with the total harmonic distortion being less than 0.3% for average listening levels, i.e. below 100 decibels. Due to the vented enclosures around the speakers the reduction of external noise is relatively low, being 2dB(A) on the set we tested. The measured impedance of the headphones in free air was most unusual. The impedance was flat up to 5kHz at which point it gradually rose to 12Ω at 20KHz. The voltage sensitivity was typical for 8Ω headphones. Normally the voltage required for 100dB is in the region of 0.1V to 0.5V.

The Kenwood Headphones combine an impressive appearance with quite reasonable performance and the coiled lead is an excellent feature which we feel should be included on all headphones.

At their recommended selling price of \$40 they are a little more expensive than a number of otherwise comparable units — however their general appearance and standard of finish does to some extent compensate for the slight price disadvantage. ●

### MEASURED PERFORMANCE OF KENWOOD HEADPHONES MODEL KH-71 (TESTED ON BRUEL & KJAER ARTIFICIAL EAR TYPE 4153).

Frequency Response  
Refer Spectrogram

Total Harmonic Distortion

	100dB	120dB
100Hz	0.3	0.7%
1kHz	0.3	2%
6.3kHz	0.3	0.4%

Sensitivity Input Voltage

(For 100dB) 0.15V

Impedance

100Hz	12.5Ω
1kHz	14Ω
10kHz	16Ω

External Noise Reduction  
(Typically) 2dB(A)

Length of Cord

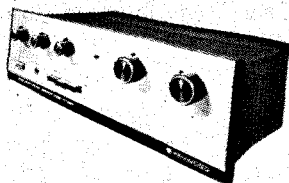
Variable from 1 Metre to 3 Metres

Total Weight 652 grams (including cord).

Recommended Retail Price — \$40.

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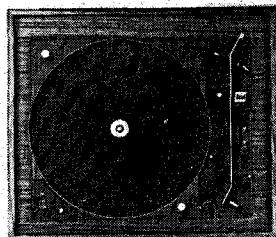
KENWOOD  
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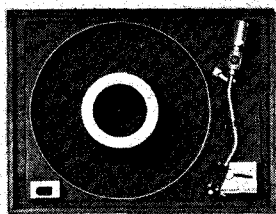
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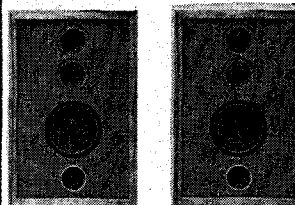
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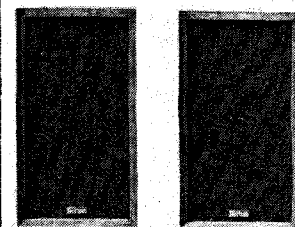
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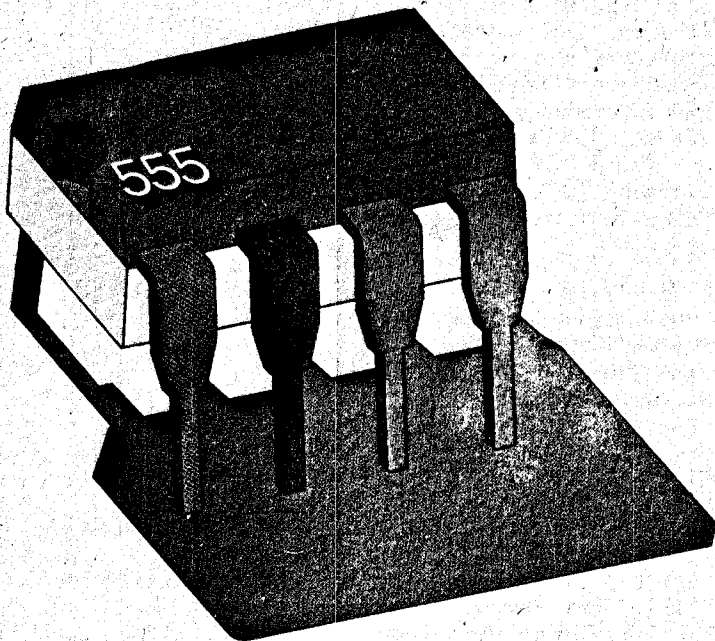
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# LINEAR IC



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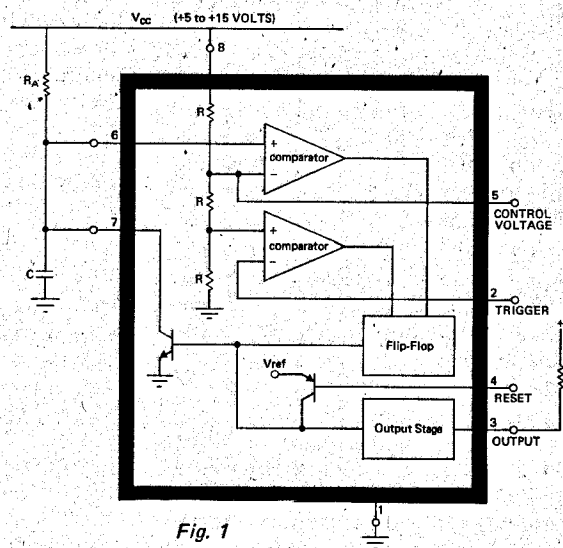


Fig. 1

**E**LECTRONIC timers have innumerable applications, and, providing the time period over which measurement of control is required does not exceed a minute or two, such timers are simple enough to design and manufacture.

But there are many applications where timing devices must operate over periods of an hour or more and whilst such timers *can* be produced they are complex, and it is often cheaper and simpler to use a mechanical equivalent.

Generally, electronic timers use some type of voltage dependant switching device that continuously samples the changing voltage across a simple RC network: at the beginning of a timing cycle the capacitor (C) commences to charge via the resistor (R) and, as the voltage across the capacitor slowly increases, a voltage level is reached at which the switching device is activated.

It is difficult to obtain long-duration timing circuits in this manner because the relatively low input impedance of most switching devices (such as transistors, unijunctions, etc.) in effect acts as a second resistor in parallel with the timing capacitor — preventing the capacitor charging beyond a certain level.

Another disadvantage of many voltage dependent switching devices (such as UJT's) is that their

manufacturing tolerances are quite wide and as a result their spread of characteristics results in large differences in performance when used in timing circuits.

A new linear integrated circuit, designed by Interdesign Inc. and manufactured by the Signetics Corporation largely overcomes this problem. Specifically intended for use as a general purpose timing element,

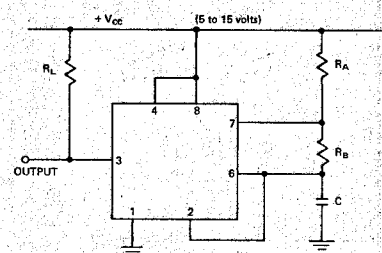


Fig. 2. Astable Operation

In this mode of operation the IC will free-run as a multivibrator. The external capacitor charges through  $R_A$  and  $R_B$  but discharges through  $R_B$  alone. Thus the duty cycle is set precisely by the ratio of these two resistors.

Frequency of oscillation is:

$$f = \frac{1}{T} \frac{1.44}{(R_A + 2R_B)C}$$

$$\text{Duty cycle is } D = \frac{R_B}{R_B + 2R_B}$$

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# TIMER

the Signetic 555 uses an inbuilt comparator to sense the RC voltage. This comparator has an extremely high input impedance and consequently has negligible shunting effect across the timing capacitor. Typical component values for a one hour timer are a 10 megohm resistor and a 330uF capacitor.

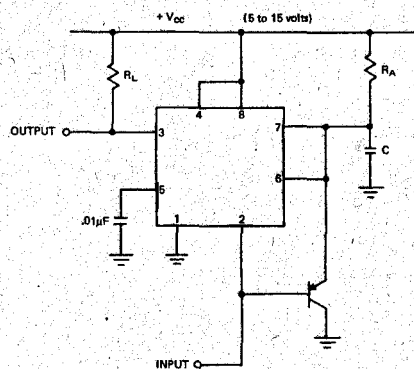
The IC is internally compensated for component tolerances and temperature drifts. It requires only one external resistor and one external capacitor to enable it to be used for time delays ranging from fractions of milliseconds up to one hour with an accuracy and repeatability of better than 99%. (The spread of characteristics is much closer than with UJTs).

Two inbuilt high-current transistors connected in an inverting output stage enable the IC to supply about 200 mA to a load — which may be connected either to  $V_{CC}$  or ground. Loads may be connected for either 'normally on' or 'normally off' operation.

## TYPICAL APPLICATIONS

Figure 1 shows how the IC may be used as a 'one-shot' timer (all components inside heavy black lines are of course within the IC).

In its quiescent state, capacitor C is shorted out by the internal npn transistor. The timing cycle is initiated



**Fig. 3. Missing Pulse Detector.**  
Here the timing cycle is continuously reset by the input pulse train. A reduction in frequency, or a missing pulse, allows completion of the timing cycle and hence an output signal. For this application, the time delay must be set to be slightly longer than the normal time between pulses.

by reducing the voltage on IC pin 2 to less than  $1/3rd V_{CC}$ . This may be achieved by a slow reduction in voltage level, by a negative going pulse, or simply by shorting pin 2 to ground.

The triggering signal applied to pin 2 toggles a flip-flop which removes the short from the timing capacitor C and simultaneously energizes the load. The voltage across C now increases exponentially at a rate determined by the values of R and C. When the voltage across C reaches  $2/3 V_{CC}$ , the internal voltage comparator resets the flip-flop which in turn rapidly discharges the capacitor and at the same time de-energizes the load.

The time that energy is supplied to the load is  $1.1RC$  and this time interval is independent of the supply voltage.

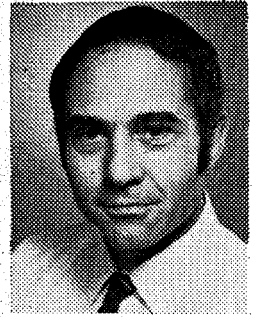
A characteristic of this timer is that once triggered, the circuit remains in this state until the set time ( $1.1RC$ ) has elapsed — even if further triggering pulses are received during the set period. This renders the circuit immune to false triggering due to contact bounce etc. In fact in this form the circuit makes an excellent pulse stretcher.

If it is required to reset the timer *before* the set time has elapsed, this may be done by applying a negative pulse to the reset terminal (pin 4). This discharges the timing capacitor and causes the cycle to start all over again.

Apart from its obvious value as a simple 'one-shot' timing device the IC may be used for many other purposes. These include free-running pulse generation (from 0.0001Hz to 500kHz) missing pulse detection, frequency division, pulse-width and pulse-position modulation, and test sequencing.

Timing may be adjusted over an extremely wide range by varying RA and C. An additional timing variation of approximately three to one may also be obtained by applying an external control voltage to IC pin 5. ●

The Signetic 555 integrated circuit is available in Australia from Tecnico Electronics 53, Carrington Road, Marrickville, NSW.



## ALEX ENCEL'S COLUMN

We've been fortunate enough to land a scoop buy of Akai 4000D tape recorders and we must advise those interested to hurry in because the supply is extremely limited. And if you want to compare the price with anywhere else to reassure yourself that Encel prices are the best on these excellent machines, see if anyone else can beat our figure of \$209.

\* \* \*

### MODULAR SYSTEMS ARE IN!

We've found many people coming in and asking about modular systems, so that they can put the turntable one place, and the speakers far removed. To cater for this trend, we've developed many systems among which is the new "Diana". This basic system, priced at \$198, incorporates the famous British belt-driven Connoisseur BD1 turntable with its equally famous SAU2 arm, fitted with Micro broadcast-standard magnetic diamond cartridge, ensuring featherweight tracking and long record life. The table comes with base and acrylic cover, and the system also employs a good quality Interdyn amplifier, and AS96 speakers. We can also supply this system with the Rotel 210 amplifier at a total cost of \$214, and we have several alternative speaker choices to suit you. Remember, this is our lowest cost modular system. We can formulate them to any budget, and at any price, we can probably give you the widest choice, and certainly the best value in Australia.

\* \* \*

Have you tried A.M. radio lately? The Interdyn A.M. tuner is proving extremely popular with our clients who like to listen to radio at its best. This unit, which plugs into the auxiliary input of your stereo system, means you can enjoy radio reception with top quality. The specially backlit dial incorporates the stations of all 7 States, and it's housed in a teak or walnut cabinet for modular mounting, or can be mounted in your own cabinet. Solid State 240 volts operation. Come and hear it — you'll be delighted at its performance, and also at its attractively low price. \$61.50

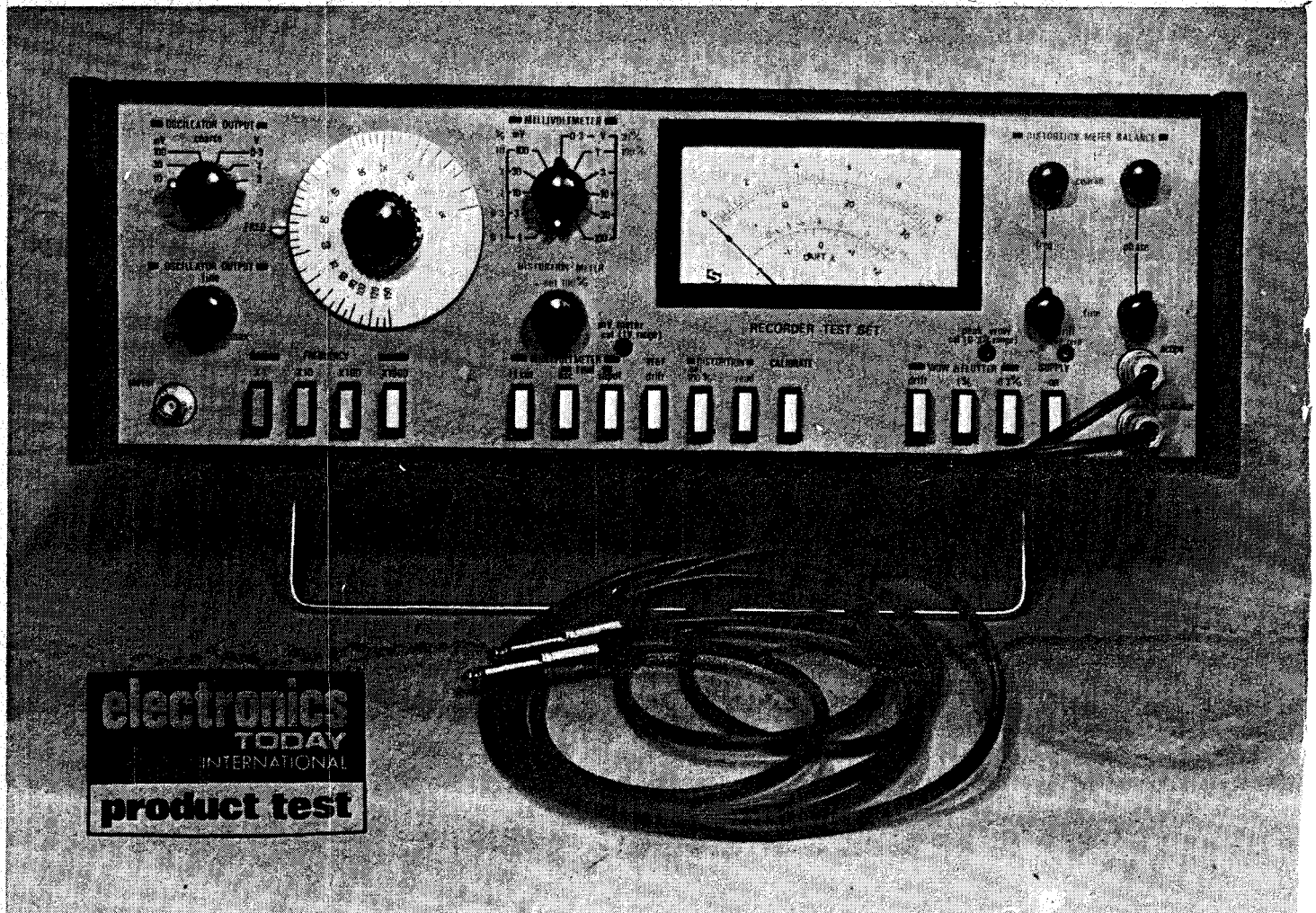
- \* Stereo systems from \$198 to \$3900
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# FERROGRAPH RECORDER TESTS

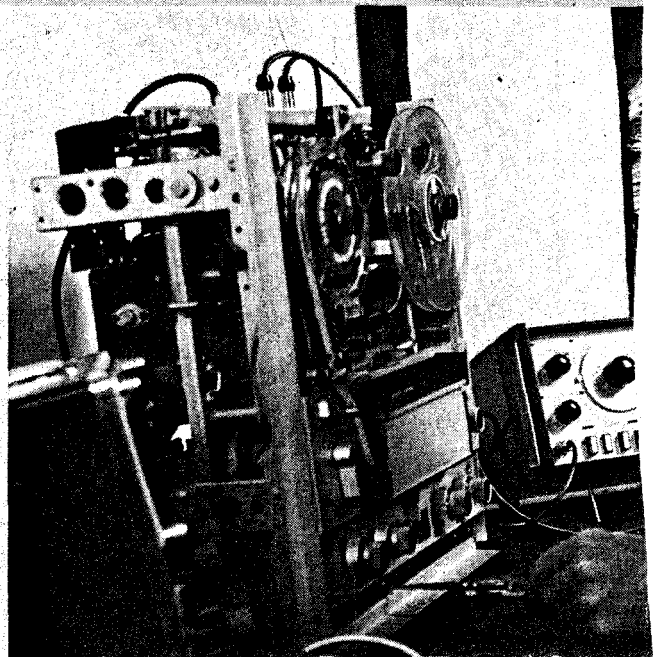


## STOP PRESS

Ferroglyph have just announced production of a Mk II version of the unit described in this review.

Improvements include a more stable regulated power supply, simplified distortion meter controls (balancing the distortion bridge is a slow tedious affair on the Mk. I unit), addition of a wow and flutter range of 0.1% fsd, and a millivolt meter calibrated in dBm as well as volts.

Temperature stability of the oscillator is claimed to be improved by a factor of four, and independence of mains voltage fluctuations by a factor of 10.





Multi-function test set is specifically intended for tape recorder maintenance and repair

# SET

**T**HE Ferrograph Recorder Test Set incorporates all the necessary sources and measuring facilities to measure the main performance parameters of tape recorders and amplifiers. It is designed to cater for the needs of repair technicians specialising in tape recorders, amplifiers and similar audio equipment. The following parameters may be measured with the test set:—

- a) Frequency Response
- b) Distortion
- c) Signal to noise ratio
- d) Wow and flutter (Peak weighted to DIN 45507)
- e) (Frequency) Drift
- f) Gain
- g) Sensitivity

The external appearance is very business-like with its standard rack-mounting enclosure finished in dark grey paint and the front panel finished in light grey paint. All controls are arranged in an orderly array, the only exception being the meter input and the oscillator output sockets which are located at opposite ends of the panel away from their respective controls.



## MEASURED PERFORMANCE OF FERROGRAPH RECORDER TEST SET MODEL RTS-1 SERIAL NO 150

### Oscillator Output at 150Hz

Range	Measured Output	Meter Reading
10mV	9.8mV	9.4mV
30mV	30.5mV	29.4mV
100mV	97mV	93mV
0.3V	.305V	.295V
1V	.96V	.93V
3V	2.8V	2.97V

Range	Frequency	Measured Output	Meter Reading
3V	15,000Hz	2.85V	2.98V
	150,000Hz	2.75V	2.84V
1V	15,000Hz	2.85	2.96V
	150,000Hz	2.78V	2.84V
0.3V	15,000Hz	.305V	.295V
	150,000Hz	.31V	.296V

### Input Attenuator

Range	Error
10V	0
3V	Reference
1V	0
0.3V	0
100mV	-0.2mV
30mV	-0.2mV
10mV	0
3mV	0
1mV	0

### Meter Scale Accuracy

dB scale — ± 0.5%  
voltage and distortion scales — ± 1%  
drift scale — ± 0.2%  
wow and flutter scales — ± 0.5%

### Oscillator Scale Accuracy

Scale Setting	Range	Measured Frequency Hz
15	X1	16
150	X1	153
15	X10	150
150	X10	1508
15	X100	1503
150	X1000	14940
15	X1000	15400
150	X1000	145900
15	X10	151
20	X10	202
25	X10	251
30	X10	302
40	X10	402
50	X10	500
60	X10	598
70	X10	703
80	X10	803
90	X10	906
100	X10	1009
120	X10	1205
150	X10	1506

### Wow and Flutter

Test frequency 3.143 kHz  
Short term accuracy 5 parts in 10<sup>5</sup>  
(1 hour period)

Distortion Meter Range	Source Distortion	Meter Reading
30%	30%	34%
10%	10%	9.6%
3%	3%	2.9%
1%	1%	.94%
.3%	.3%	.29%
.1%	.1%	.1%

Effective Range of Coarse Frequency Potentiometer 530Hz to 1700Hz  
Effective Range of Fine Frequency Potentiometer 5Hz at 1kHz

### Dimensions

44/mm wide x 143mm high x 254mm deep including handles.

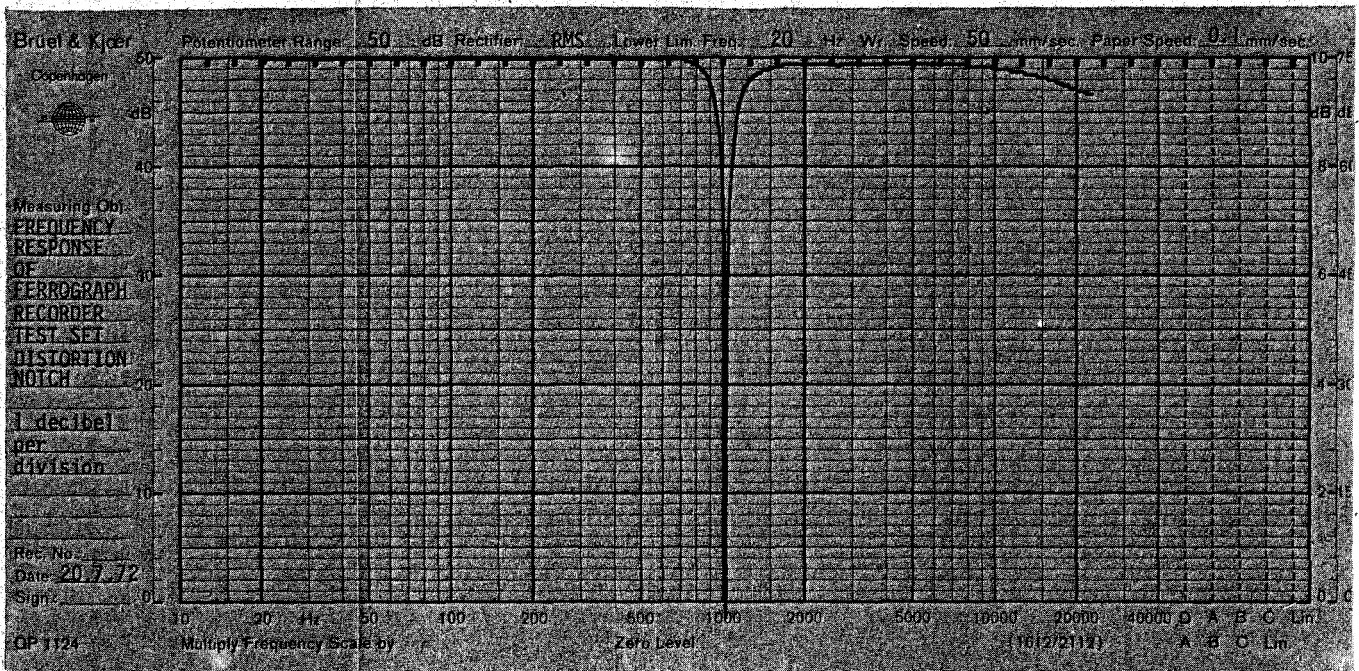
### Weight

5.9 kg

### Price

\$695 excluding sales tax

# FERROGRAPH RECORDER TEST SET



Seven pushbuttons provide the following facilities:—

- low frequency cut with 3dB point at 400Hz
- oscillator read
- input read
- wow and flutter and drift mode
- 100% distortion set
- distortion read
- calibrate for peak wow and flutter, drift and voltmeter.

The righthand end of the front panel contains the distortion meter balance controls and the wow and flutter range buttons. The balance controls consist of two coarse controls and two fine controls — for frequency and phase respectively. Below these are four pushbuttons and two B.N.C. output sockets. The four push buttons are for

- drift read
- wow and flutter read, 1% full scale

iii) wow and flutter read, 0.3% full scale

iv) mains ON switch.

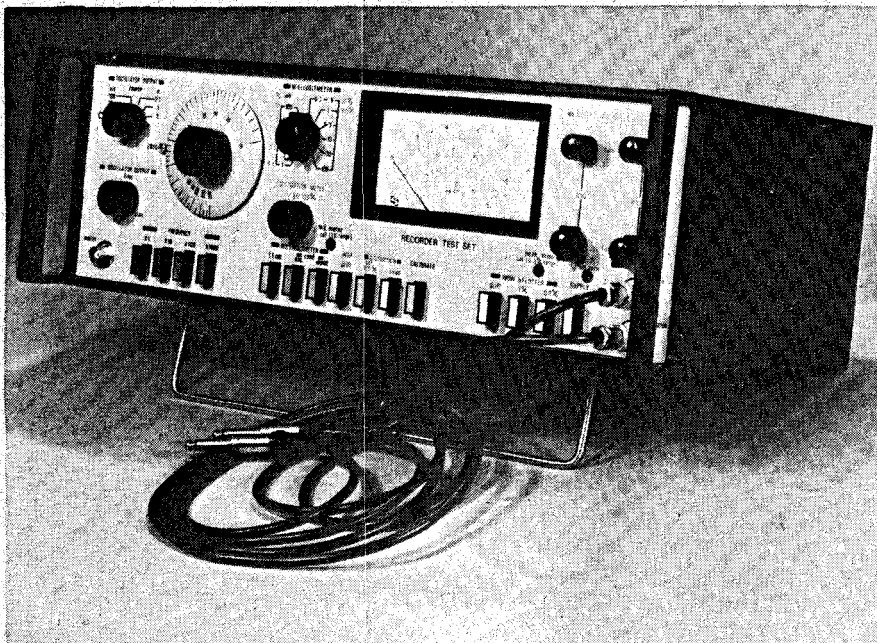
The two B.N.C. sockets are for 'scope output and oscillator output. The signal at the scope output is obtained just prior to the meter rectifier so that the signal may be further analysed by external equipment.

The left-hand end of the front panel contains all the oscillator controls. These consist of a frequency calibrated dial (calibrated from 15 to 150), four frequency range select pushbuttons for X1, X10, X100 and X1000 and two level controls; one with five 10dB steps from 10mV to 3V and the other a continuously variable fine control providing 15dB adjustment. The next set of controls located between the meter and the dial determine the meter mode. These consist of:—

- a meter range switch
- a distortion meter control knob
- a set of seven push buttons for mode selection.

The meter range switch has ten 10dB steps from 1mV to 100V. The steps from 1mV to 1V are also used for distortion ranges from 0.1% to 100% — these are also in 10dB steps. The distortion meter control knob is used for adjusting the meter on the 100% range for different sensitivity source signal. The meter has four scales, one from 0. to 10, one from 0 to 30, one in dBm from -12 to +2 and the last one for percentage drift from -2% to +2%.

(Continued on page 77)





Many of us probably wish from time to time that the noise in our environment could be kept down to a level comparable to that of this wildcat padding past.

Sound level meters, such as these three instruments from the Rohde & Schwarz line, are aids in the battle against noise: the portable small Precision Sound Level Meter Type ELT, the portable and battery-operated Impulse Sound Level Meter Type EGT, which can be accommodated in a carrying case together with the Octave Filter PBO, or the Impulse Sound Level Meter Type EZGA, suitable for rack-mounting installations.



**ROHDE & SCHWARZ**

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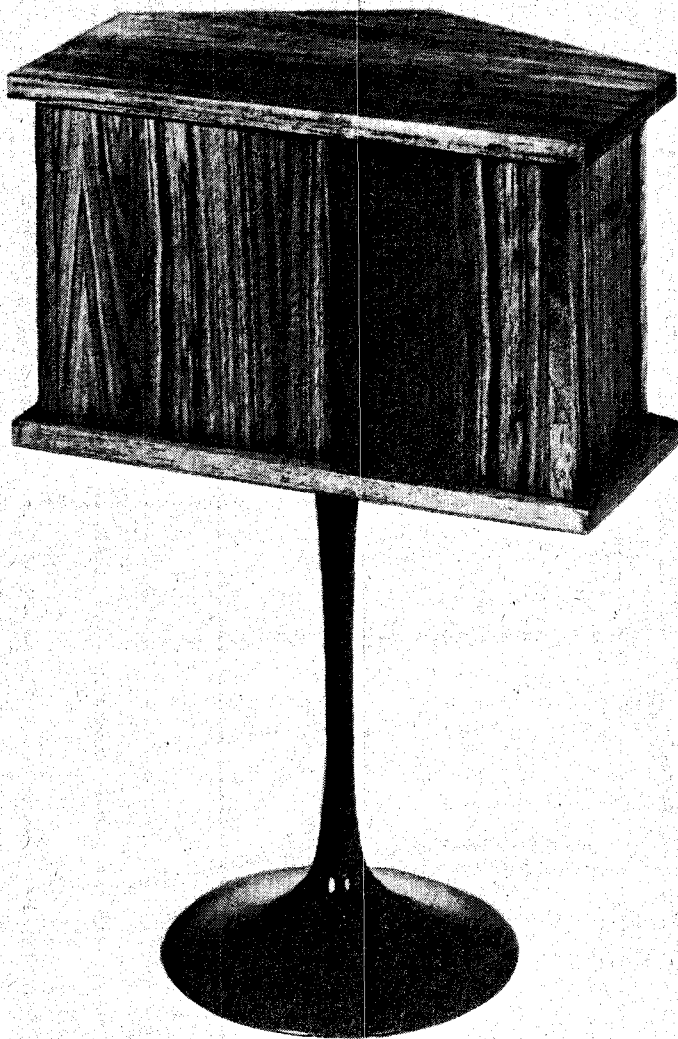
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# The rave reviews keep coming...

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

Larry Zide—American Record Guide—December 1969.



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London Court  
Perth, 6000

VIC: Douglas Trading  
191 Bourke Street  
Melb. 3000

TAS: P. & M. Distributors  
87 Brisbane Street  
Launceston, 7250

QLD: Stereo Supplies,  
100 Turbot Street  
Brisbane, 4000

SA: Sound Spectrum  
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## 1. Norman Eisenberg—High Fidelity

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

## 2. Julian Hirsch—Stereo Review

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

## 3. Bert Whyte—Audio

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

## 4. Hi-Fi Buyers Guide

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

## 5. Stereo & Hi-Fi Times

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

## 6. Elementary Electronics

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

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

You can hear the difference now.

**BOSE**

# FERROGRAPH RECORDER TEST SET

With the exception of the distortion bridge the instrument is very easy to calibrate and operate. Separate adjustments are provided for calibration of the millivoltmeter, 100% distortion set, calibration of the peak wow and flutter, and zero drift set. Balancing the distortion bridge is slow and tedious, requiring very close tuning by the single turn coarse control potentiometers before the fine control potentiometers become effective.

For wow and flutter and drift measurement a nominal 3.15 kHz LC oscillator is switched to the oscillator socket when the meter mode switch for wow and flutter or drift is selected. This oscillator was found to have a short term accuracy of 5 parts in 10<sup>5</sup> which is more than adequate for measurements down to 0.01%.

The only items located on the back panel are an English type three pin mains socket, a mains fuse holder, and a voltage selector plug. As well as four rubber feet on the base of the unit there is a hinge down wire bracket which raises the front for easier reading when used on a bench. One feature missing is a light to indicate that the mains power is on, however, we understand that more recent units have this feature. The "Operating Instructions" supplied with the unit are spiral bound and consist of 12 pages of operating and maintenance instructions and 2½ pages of technical specifications (but no circuit diagram).

The internal layout of the test set is very well arranged with most of the wiring between the six printed circuit boards eliminated by the use of three 'mother boards'. These 'mother boards' contain sockets to accept the printed circuit boards and all of the push button switches. All rotary switches and potentiometers are also mounted on the printed circuit boards and are fitted with removable extension shafts to simplify removal for maintenance (if required).

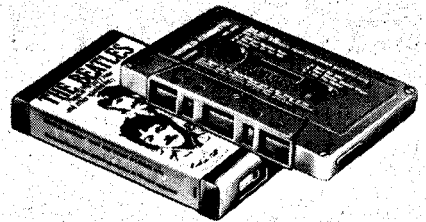
The Ferrograph Recorder Test set is ideal for aligning tape recorders before and after repair or maintenance, but due to the narrow frequency range of the distortion bridge, has limited application for testing amplifiers. The measured performance of the unit was equal to or exceeded the manufacturer's specification in all respects.

At a cost of \$800.00 the Ferrograph Recorder Test set represents an excellent compromise for the technician who cannot afford to buy expensive individual instruments to measure the various parameters of a tape recorder's performance.

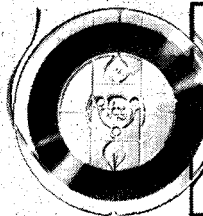
# you only have to take one a year



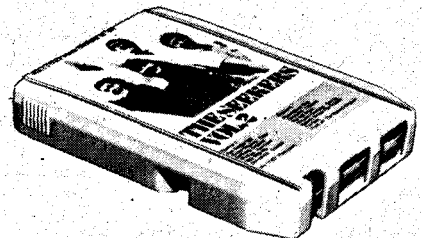
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# INVERTER FOR FLUORESCENT LIGHTING

Specifically designed for portable use, this 12V dc to 240Vac inverter operates at 2kHz for optimum efficiency.

**ETI PROJECT 516**

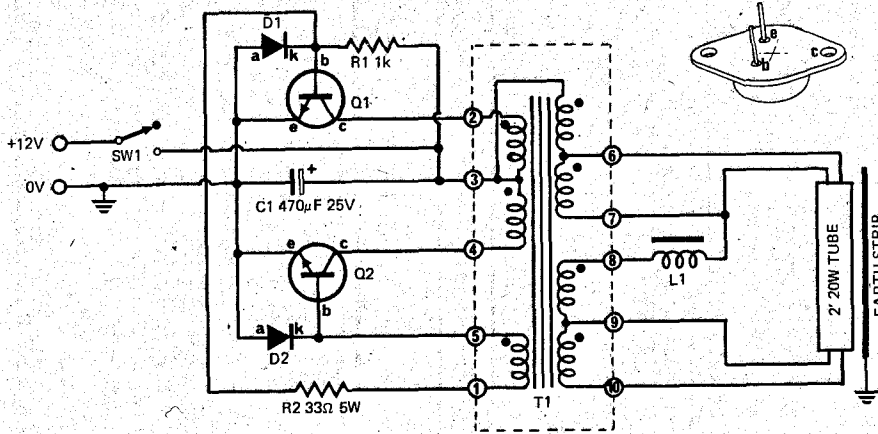


Fig. 1. Circuit diagram of complete unit.

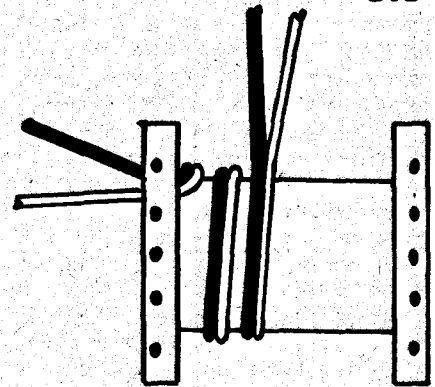


Fig. 2. Bifilar windings of the two primary windings of the transformer. These two windings must be wound in this fashion.

**A**N ever increasing number of people spend their leisure time camping, caravanning or boating. And recent developments in the associated equipment and technology ensure that few home comforts need be left behind.

Lighting is very much in this category — and for many campers and caravanners it is achieved merely by running an extension cord from their vehicle's 12V battery to a suitable globe.

This is of course very cheap and

simple, but has a major drawback in that incandescent globes are very inefficient generators of light. Hence, for comfortable lighting levels to be achieved, it is necessary to use 48W or 60W globes. Even then the resultant light output is insufficient for any but the smallest space.

But even a 48W globe draws a constant four amps from a 12V battery and many a camper has found himself with a flat battery after the light had been used for any protracted length of time.

Fluorescent tubes, on the other hand, are far more efficient. Typical outputs are 12 lumens per watt for incandescent globes and 60 lumens per watt for fluorescent tubes (including ballast losses).

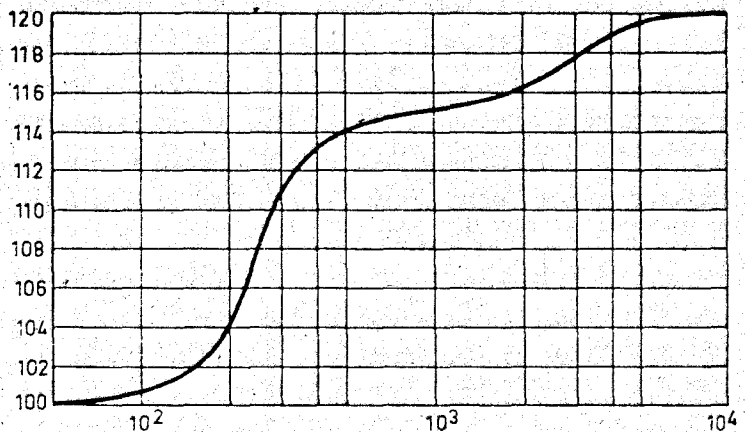
At frequencies higher than 50/60Hz, fluorescent tubes become more efficient still, in fact a further 15% to 18% output (for the same energy input) can be achieved by operating them at 2kHz to 3kHz.

We have taken advantage of this phenomenon in this constructional

## PARTS LIST ETI 516

- R1 — resistor 33 ohms, 5 watt, 5%
- R2 — resistor 1k, ½ watt, 5%
- C1 — capacitor, 470uF, 25V, electrolytic
- Q1 — transistor 2N3055
- Q2 — transistor 2N3055
- D1 — diode, EM401, 1N 4005 or similar
- D2 — diode, EM401, 1N 4005 or similar
- T1 — transformer, see table I
- L1 — choke, see table II

2ft. 20 watt rapid-start fluorescent tube  
insulating washers for transistors Q1 and Q2.  
toggle switch.  
diecast box (optional)  
five pin 270° DIN plug and socket (optional)



This graph shows how light output increases with increasing supply frequency.

# New Product

50 MHz Counter Kit

- Decade Counting Module for Frequency Counting, time measurement, event counting etc.**
1. 50MHz or 20MHz counting capability
  2. Module kit consists of 8290 or 7490, 7475, 7447 & Minitron 3015-F
  3. Single Plane 7seg. Readout
  4. Lamp Test, Selectable Ripple Blanking
  5. Decimal Point
  6. PC - Glass Epoxy Plug in Board
  7. Well documented application note with step-by-step assembly and hook-up instruction.

### Gate Module F

1. Module consists of 7440, 7400, 7476 & 74500
2. Adj. Reset Generator
3. Reset & Strobe outputs
4. Gate uses Schottky TTL
5. PC - Glass Epoxy Board
6. Application note & assembly instruction

### Input Amplifier & Pulse Shaper Module

1. 1 meg. ohm inp. impedance
  2. 20mV sensitivity at 50MHz
  3. Diode protected FET input
  4. Freq. Response 10Hz to 70MHz  $\pm 2db$
  5. Glass Epoxy PC - Board
  6. Application note & assembly instruction
- ALL Modules operate of +5 Volt rail.

### 50 MHz Counter Kit Price List

50MHz Decade Module	\$22.50 ea.
20MHz Decade Module	\$19.50 ea.
Gate Module F	\$15.75 ea.
Input Ampl. Module	\$16.20 ea.
P/P	\$0.25
Frequency Standard & Clock Divider	to be announced

### Integrated Circuits

SN 7490N	\$2.20 ea.
SN 7441AN	\$2.75 ea.
SN 7475N	\$2.20 ea.
SN 7400N	\$1.00 ea.
SN 7410N	\$1.00 ea.
SN 7430N	\$1.00 ea.
SN 7440N	\$1.00 ea.
SN 7472N	\$1.85 ea.
SN 7473N	\$2.00 ea.
SN 7447N	\$3.20 ea.
LM 709 OP-Amp	\$1.50 ea.
LM 305 Pos. Reg.	\$3.80 ea.
LM 304 Neg. Reg.	\$4.90 ea.
TIL 209 LED	\$1.50 ea.
LM 380 2 Watt Audio IC, 12218V rail, 50Kohm input Imp, Voltage gain of 50, short circuit & overload protection	\$2.85 ea.

Postage on IC 10c ea.

## SPECIALS

RF - Power Transistor BLY89, 25 Watts out at 175 MHz, Rail 13.6V, Balanced Emitter. Only \$9.00 ea. P/P 20c

Transistor Dc-DC converter, Transformer ideal for CD Ignition, 12 Volts inp, 320 Volts at 150mA output. P/P 20c \$3.00 ea.

### Transistors

AD 140	\$1.00 ea.
2N 3055	\$2.00 ea.
BC109	60c ea.
BC107	50c ea.
BC107	50c ea.
2N 3568	75c ea.
2N 3645	75c ea.
2N 706	45c ea.
2N 3866	\$1.50 ea.
2N 3819	FET 85c ea.
MPF 121	\$1.50 ea.
TIS 88	\$1.20 ea.

P/P 10c ea.

Capacitors Electrolytic  
1000 $\mu$ F - 100 Volts \$1.50 ea. P/P 25c  
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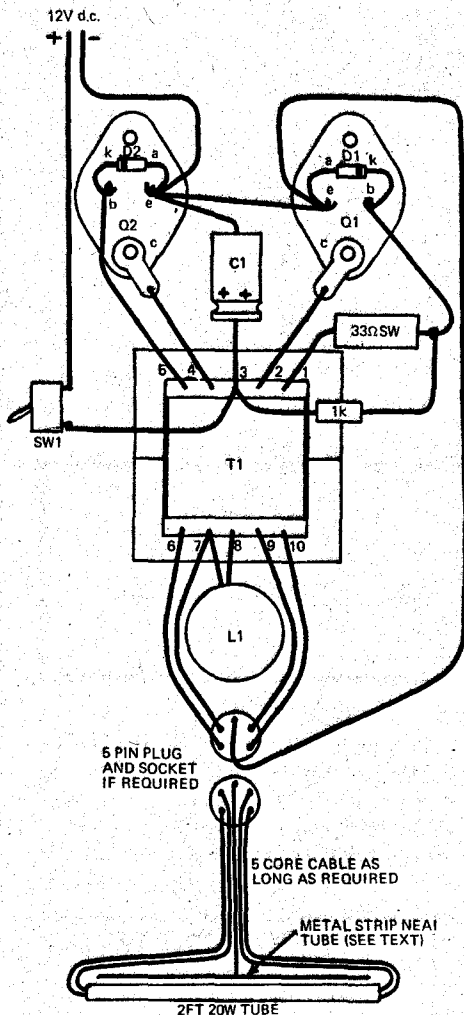


Fig. 3. This drawing shows how the components are interconnected. Actual mechanical layout may take any form required.

project. Hence this inverter operates at a frequency of approximately 2kHz with 12.6V input.

It is designed specifically for use with a 20 watt rapid start tube - in fact it should not be used with any other type. Power consumption is approximately 2.5 amps.

On a basis of light output for power input it is one of the most efficient light sources economically available. A light output of at least 68 lumens per watt should be achieved; and this will provide adequate lighting for the average caravan or yacht.

An unusual characteristic of the circuit is that light output is substantially independent of input voltage from 10 to 15V. The reason why this is so is explained in the 'How it Works' panel.

## CONSTRUCTION

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

Winding details of transformer T1 and choke L1 are given in Tables I and II.

The transformer winding is wound onto a Philips coil former - type 4322 021 31830 - the actual winding is straightforward but rather tedious. The wire must be smoothly wound otherwise it will not fit onto the coil former. Both primary windings are bifilar wound. (This is done by winding both primary 1 and primary 2 at the same time so that they are interleaved - each winding is literally adjacent to the other throughout the length of the windings - Fig. 2).

The remaining windings are wound in the conventional manner - make sure that each is wound in the same direction and that the start and finish of each winding is soldered to the correct pins - as indicated in Table I.

Having finished the winding, insert the two halves of the 'C' core and hold the whole assembly securely together with sticky tape.

The choke L1 is wound on Philips coil former type DT2180. Winding details are given in Table II. The winding is then clamped between a pair of Philips FX2242 cores held together by a 3/16" diameter brass bolt. A 3/16" brass washer is interposed between the two cores - forming an air gap.

TABLE I - Transformer Winding Details

Winding	Start	Finish	Turns	Gauge	Notes
PRIMARY 1	Pin 2	Pin 3	28	20 B&S	Bifilar
PRIMARY 2	Pin 3	Pin 4	28	20 B&S	wound
FEEDBACK	Pin 5	Pin 1	20	26 B&S	
0.005" insulation					
SECONDARY	Pin 8	Pin 9	200	26 B&S	
FILAMENT 1	Pin 9	Pin 10	10	26 B&S	
FILAMENT 2	Pin 6	Pin 7	10	26 B&S	
0.005" insulation					
STARTING WINDING	Pin 3	Pin 6	600	36 B&S	
0.005" insulation					

Notes: Core - 2 X 'E' cores, Philips type E42/21/15  
Coil former, Philips type 4322 021 31830

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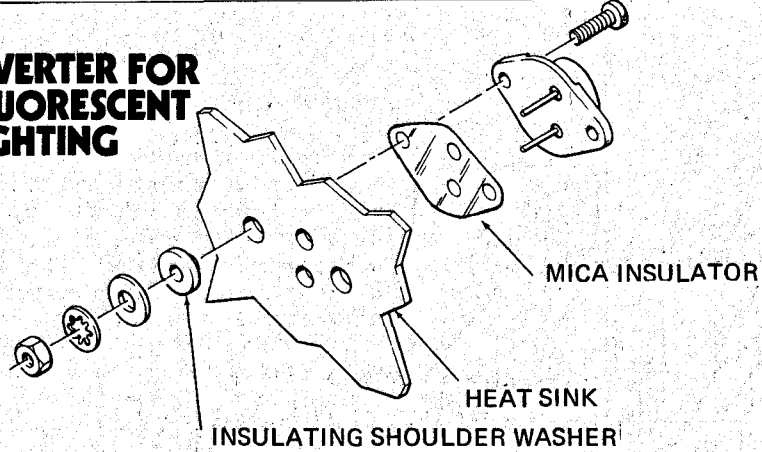


Fig. 4. Insulating washers must be used to electrically isolate each transistor from the heat sink.

### TABLE II — Choke Winding Details

Core — 2, Philips type FX 2242

Coil former Philips type DT2180

Note — coils are held together by 3/16" brass bolt and nut — a 3/16" brass washer is used to form an airgap.

Mechanical assembly details for the complete inverter have not been included in this article as it is possible to assemble the unit in many different forms. For most purposes the unit may be assembled in a die-cast alloy box about 4 3/4" by 3 3/4" by 2" — many will mount the components in the rear of an existing fluorescent light fitting (using the metal-work as a heat sink for the transistors), — other people may prefer to build it into an existing space.

Component interconnections are shown in Fig. 3. The actual layout is not critical. The five pin plug and socket are not essential of course and may be omitted if desired.

The transistors — Q1 and Q2 must be mounted on a suitable heatsink, minimum size about 4" by 6".

Insulating washers must be used to electrically isolate each transistor from the heat sink. (Fig. 4).

All components should now be temporarily connected and the complete unit connected to a 12V supply. Take care not to touch the transistors or the secondary windings of the transformer as all are at relatively high potential and can impart a hefty kick.

With the fluorescent tube alight, check the current drawn from the 12V supply. It should be 2.5 amps ± 0.2 amp. If it is outside these limits vary the choke air gap until it is correct. Increasing the gap increases the current — and vice-versa.

Now disconnect the transformer and dip it into varnish or model aircraft dope to insulate and solidify the winding and core.

When the transformer has totally dried out, reconnect all components.

The fluorescent tube must have an earthed metal shield (i.e. connected to the negative side of the 12V supply) close to it and running the full length of the tube. If the tube is mounted in

Continued on page 83.

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### ERRATA

FET DC VOLTMETER  
Page 68, October 1972

Potentiometer RV8 shown in the parts list as 4.7 ohms should be potentiometer RV8 4.7k.

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a normal metal light fitting this in itself will form the earth. In the case of our prototype unit — in which we housed the tube in plastic for mechanical protection — four lengths of copper wire running the full length of the tube were used.

As this unit operates at 2kHz there will be some noise at this frequency from the transformer and choke. This may be reduced by encasing the main components in heavy felt — further reduction may be obtained if necessary by encapsulating the transformer and choke in epoxy resin ●

### HOW IT WORKS

Transformer T1 and transistors Q1 and Q2 form a self-oscillating inverter. Frequency of operation is governed by the core materials, the number of primary turns and the supply voltage. As specified, the inverter will oscillate at approx. 2kHz with 12.6V input.

The transformer secondary has two 4V windings to heat the tube filaments, an 80V winding to supply the discharge current through the tube and a 240V winding to create a static starting voltage.

Choke L1 is in series with the 80V winding to limit the current in the tube.

Apart from limiting tube current, the choke stabilises tube current against variations in supply voltage. If the operating supply voltage increases, the inverter frequency increases accordingly — and this causes the choke impedance to rise.

This self-adjusting impedance maintains lamp current substantially constant for changes in supply voltage from 10 to almost 15 volts.

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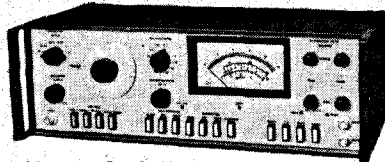
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# SOLID-STATE 'CRT'

New display uses matrix of light emitting diodes.

A completely new form of solid state radar display, which eliminates the conventional cathode ray tube, has been announced recently by Marconi Radar Systems Limited, in England.

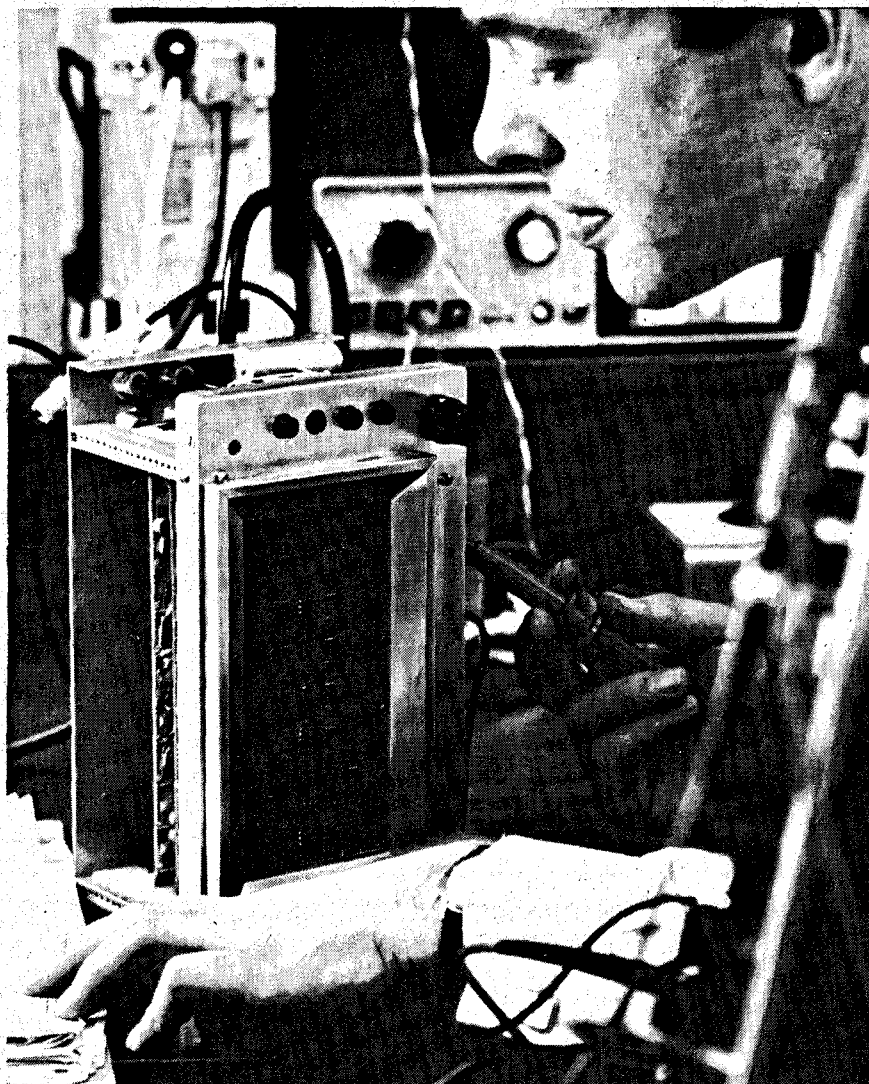
This new display is based on the use of a matrix of light-emitting diodes and it approaches the very thin, 'picture-on-the-wall', type of display which has always been regarded as the ideal form of display presentation. The display itself is less than one inch thick, and, with its associated system, is easily capable of being let into an operator's desk.

The prototype system takes the form of a Distance-From-Threshold Indicator, (DFTI) — a small radar display used in the control tower to provide air traffic controllers with a radar picture of either the approach or the take-off path, as an aid to safe and rapid clearances.

The use of light-emitting diodes (LED's) provides a bright display which can be seen without difficulty in the high ambient light levels of an airfield control tower. Display brightness can be as high as 1000 foot-Lamberts.

The complete display is only a fraction of the size of the equivalent cathode ray tube equipment, and it required less than a twentieth of the power supply. This cuts down the heat dissipation of the complete system, and thus reduces the demand on air conditioning and cooling equipment.

Marconi engineers predict that the reliability of this new type of display will be many times higher than that of conventional displays. The LED device is inherently very rugged and reliable, and even if one should fail, only a minute portion of the complete display would be lost, and it could be quickly and easily replaced. Under normal operation, an aircraft track would have at least two diodes lit at



*This new display is based on the use of a matrix of light-emitting diodes and it approaches the very thin, 'picture-on-the-wall', type of display which has always been regarded as the ideal form of display presentation.*

*The prototype system is a small radar display used in the control tower to provide air traffic controllers with a radar picture of either the approach or the take-off path, as an aid to safe and rapid clearances.*

*The prototype unit is seen in operation in the laboratory, displaying three simulated aircraft tracks on an approach path.*

any one time to give a directional 'tail' as it moves across the screen.

## HOW IT WORKS

The new display uses a matrix of gallium arsenide phosphide diodes, mounted in groups and wired directly on a double sided printed circuit board. The diodes are wired in 'rows' and 'columns' such that any one diode can be energised by supplying a voltage across one row and one

column. The spacing of the diodes can be sufficiently close to provide  $\frac{1}{4}$  mile resolution of a radar picture.

Apart from a five volt 15 watt power supply, the only inputs required for this display are the radar turning information and the raw radar signals, after they have been passed through a moving target indication system.

The turning information is converted to a digital form, providing 'x' and 'y' co-ordinates of the radar range and

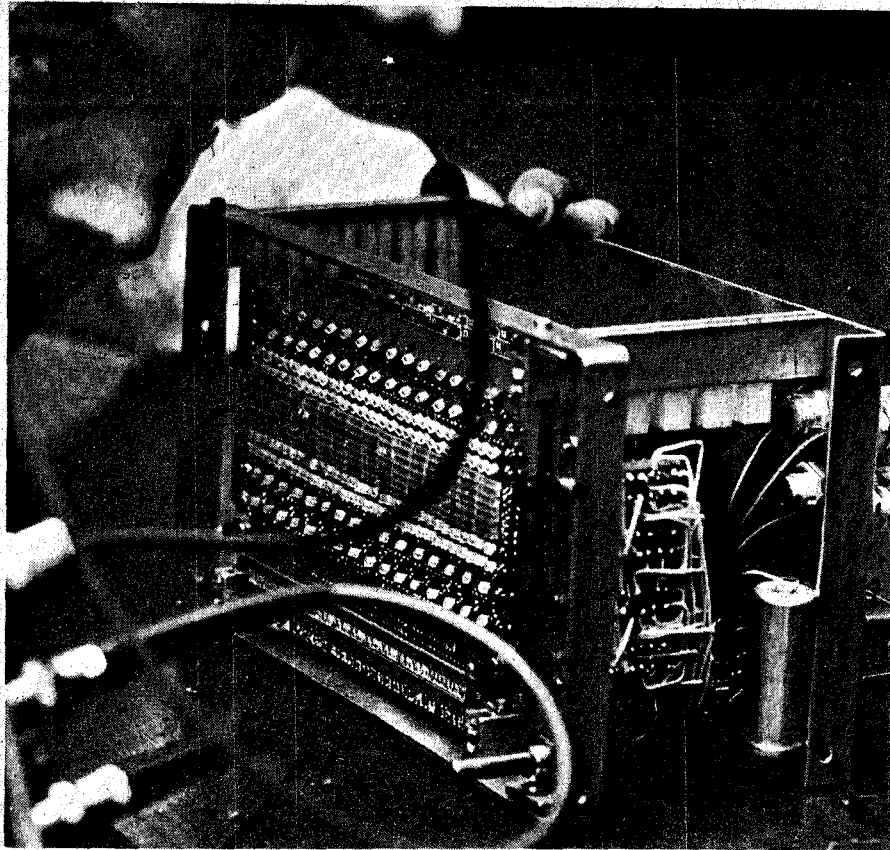
# SOLID-STATE 'CRT'

azimuth throughout the scanning pattern. The radar video signals are passed through a target extractor unit, which provides an input to a small, 512-bit central memory unit. As each radar signal enters the memory, the 'x' and 'y' position co-ordinates are stored, together with a time signal, derived from a central timing clock. This time information is used to control the effect of 'persistence', and the point at which each new signal is erased from the memory.

The memory is scanned sequentially and the stored data used to energise appropriate diodes on the display. The switching current is reduced for each successive occasion on which a particular stored position is scanned, to give the effect of a gradual decay in brightness, similar to the afterglow of a cathode ray tube.

The memory is completely scanned 400 times per second, at which rate there is no observable flicker on the display panel.

The total prototype system, including the plot extractor unit, can be accommodated in a unit measuring 10in by 5½ins, and 5ins deep.



The prototype unit is seen here with the front panel removed to show the light-emitting diodes.

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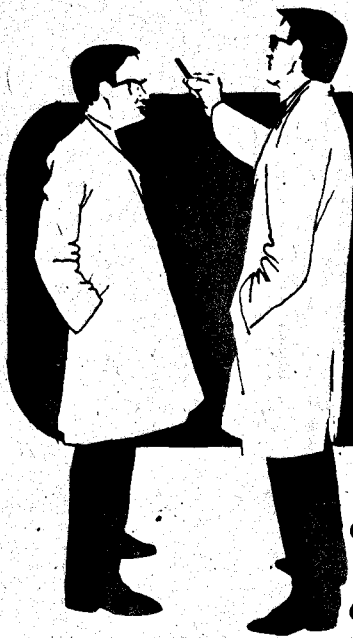
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## PART 7

# TRANSDUCERS IN MEASUREMENT AND CONTROL

Dr. Sydénham explains the history and technique of thermistors and semiconductor temperature sensors.

It was not until the mid 1940's that suitable temperature sensitive bulk resistance materials could be made with stable characteristics. In 1946 staff of Bell Telephone Laboratories reported their work on thermally sensitive resistors from which the name thermistor has derived. Thermistors usually are made from solid semiconducting metal oxides and have a large negative temperature coefficient of electrical resistance. (Positive coefficient thermistors also exist but are less common). Resistance is exponentially related to temperature, Figure 1, and two constants, which are quoted by the maker, enable the characteristic curve to be drawn to within a few percent. A wide range of nominal resistance values (usually quoted at 20 and 25 deg.C) are available — ohms to tens of kilohms. The temperature coefficient

is greater than for conductor resistance sensors. For example, one commercial resistor that is 10 kohm at 0 deg.C is 153ohms at 100 deg.C but, of course, the relationship is highly non-linear.

Thermistors are used in much the same way as resistor sensors — that is, in a bridge network. Lead resistances are usually uncritical being orders of magnitude less in value than the thermistor value.

It is rare to see design procedures for thermistor thermometers in text books as yet but the process is reasonably simple (see the reading list). Factors to be considered are the choice of optimum bridge resistance values, for the sensitivity (in mV/deg.C usually) depends upon these as well as the thermistor type and applied voltage. Bridge currents heat the thermistor so it is necessary to design for a tolerable rise in offset temperature (the

encapsulation insulates the sensor from the environment enough to produce a temperature drop across it); this fixes the maximum bridge excitation voltage. Finally, the sensitivity can be calculated, typical values will lie between 1 and 100mV/deg.C depending on the offset allowable. There is seldom real need to design for high sensitivity in the bridge as integrated-circuit operational amplifiers can provide adequately stable gain. For best results (but not always needed) the bridge can have ac excitation and use phase sensitive rectification to enhance the signal-to-noise ratio at the output.

Thermistors are available that can operate from cryogenic temperatures to well over 300 deg.C using three different groups. Encapsulations vary from dot size beads to flat disks. They are also available ready mounted, see Figure 2, in devices ranging from 500 $\mu$ m diameter hypodermic needles to the robust sensors used in car engines.

Portable electronic thermometers using thermistors are now commonplace. When first introduced they were said to be unstable and unreliable with time but this is not so now. Well aged units (the manufacturer does this) can hold temperatures stable to 1 millideg.C per month and even better over shorter time periods. Their non-linearity can be reduced by using them in combination with series and parallel fixed resistors but at the expense of sensitivity. For wide range, accurate measurements, the resistance sensor still is superior but thermistors are finding more and more use each day. Electric motors use them (as well as resistance sensors) to sense the hottest temperature of the winding. This is obviously superior to bimetal devices that only monitor the average carcase temperature.

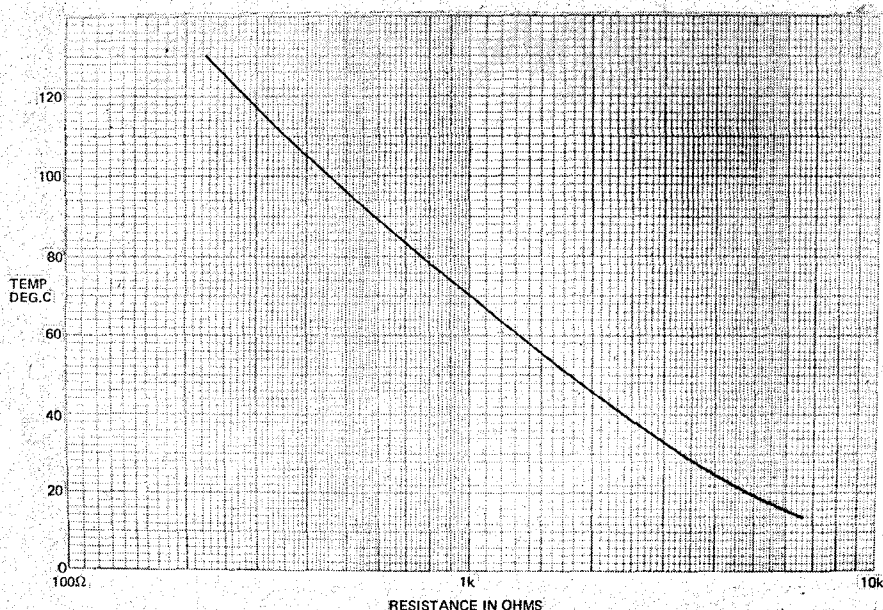
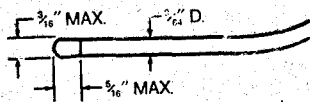
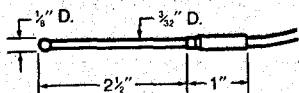


Fig. 1. Resistance variation with temperature of a typical thermistor.

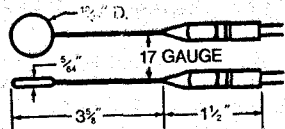




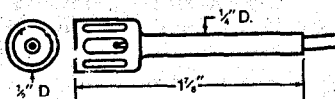
GENERAL PURPOSE — SOILS, RECTAL,  
SLOW AIR RESPONSE



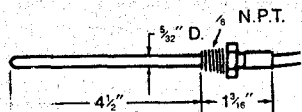
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FROZEN FOOD INDUSTRY



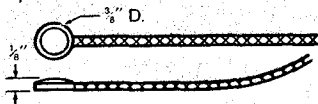
SKIN, ORAL, SURFACES



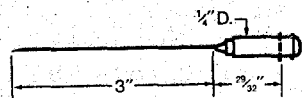
AIR IN GAS STREAMS  
AND INCUBATORS



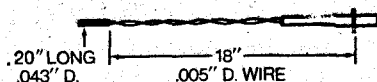
RUGGED STAINLESS STEEL WELL  
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SURFACES



HYPODERMIC NEEDLE

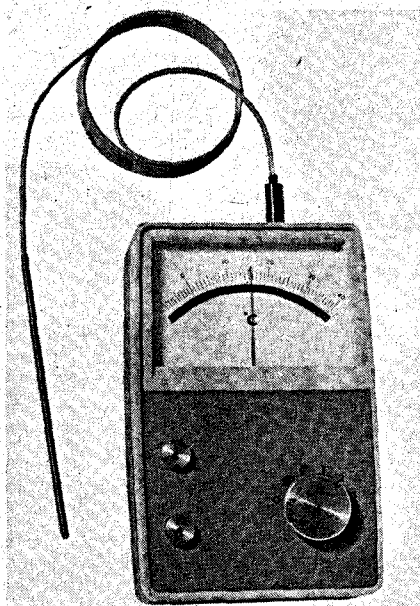


BRAIN IMPLANTATION

Fig. 2. Portable thermistor thermometers are now commonplace and inexpensive. The probes are available to cover most contingencies.

## SEMICONDUCTOR THERMOMETERS

One of the basic shortcomings of early semiconductor devices, especially the germanium types, was their temperature dependency. The relationships between collector current, base-emitter voltage and temperature were known but it was not until 1958 that technical papers began to appear showing how to employ this defect for temperature sensing. Since then a few people have improved the technique to a point where a silicon transistor can be used to make an ultra-linear calculable thermometer for the range  $-50$  deg.C to  $100$  deg.C in which the output signal is decided only by the temperature and knowledge of two basic physical constants. This method is not described in books on



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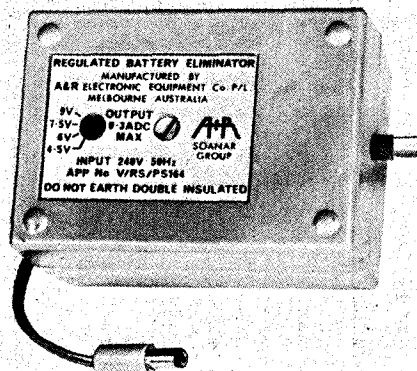
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## TRANSDUCERS IN MEASUREMENT AND CONTROL

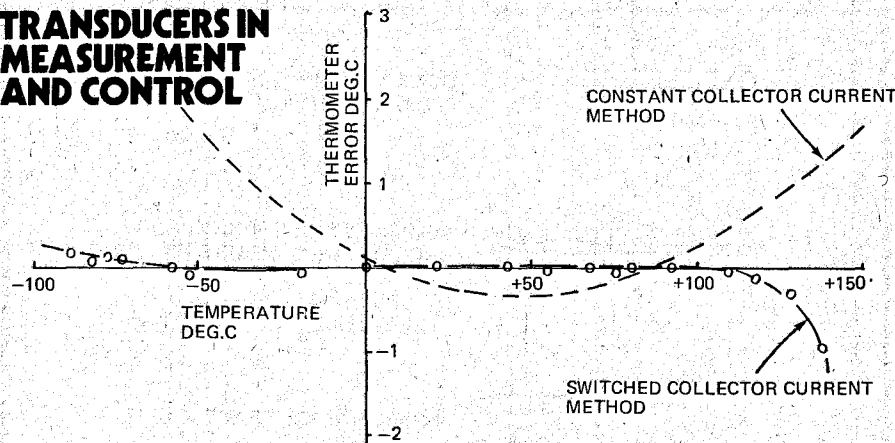


Fig. 3. Calibration curves for the transistor temperature sensor produced at the South African National Research Institute for Mathematical Sciences.

thermometry and therefore suggested reading is given at the end of this article.

If a silicon transistor is supplied with a constant collector current it can be shown theoretically that the base-emitter voltage  $V_{be}$  is proportional to the absolute temperature and is reasonably linear as shown by the curve of Figure 3. In this simple case  $V_{be}$  is not entirely independent of the transistor materials or geometry. However, if the collector current is cyclically switched between two current levels it can further be shown that the output is now extremely linear (see Figure 3 again) and independent of all parameters of the device except for the ratio of Boltzman's constant to electron-charge (two precisely known fundamental numbers in physics). Sensitivity is reduced by the switching to 0.6 mV/deg.C compared with the approximately 2.0 mV/deg.C for the basic circuit having constant collector current. Linearity falls off above 150 deg.C and below -50 deg.C due to secondary effects becoming significant. Although complete circuit designs were published in 1962 and patents taken on features of the switched current method in 1968, there has been little interest in what appears to be a most useful thermometer principle. Several integrated-circuit manufacturers incorporate transistor junctions for controlling the chip temperature or shutting down the circuit in case of overheating but they do not use the  $V_{be}$  method. Like all methods it has a disadvantage. As  $V_{be}$  is proportional to absolute temperature the device output increases with temperature; at room temperature it delivers around 600 mV. If measurement is needed to high precision, say milli-deg.C, the expensive requirement of a precision digital voltmeter resolving to five or six decades is needed unless stable means of generating an offset voltage can be provided instead.

Thermocouples are similar to this — they generate the offset voltage with the reference couple that must be temperature controlled. By contrast, thermistor and resistor sensors, being passive devices, need only stable calibrated resistors (voltage supply variations are a secondary effect on precision) to make accurate measurements. So no matter which electrical method is employed, measurement precision is ultimately limited by the stability of a secondary physical component.

In the next part of this series, temperature transducers using radiation and acoustic principles will be discussed along with less common methods.

## FURTHER READING

There are many books on thermometry; here is a selection. Few discuss thermistor or transistor methods at any depth so technical papers are also listed.

"Fundamentals of Temperature, Pressure and Flow Measurements". R.P. Benedict, Wiley, 1969.

"The Measurement of Temperature". J.A. Hall, Chapman & Hall, 1966.

"Methods of Measuring Temperature" E. Griffiths, Griffin, 1947. (This gives more detail of the older methods than modern texts).

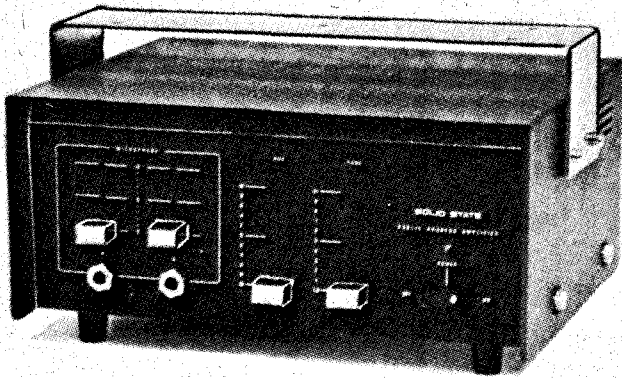
"Measuring Temperature" L.C. Lynnworth and J.J. Benes, Machine Design, Nov. 13, 1969, 190-204. (An interesting summary of new techniques).

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

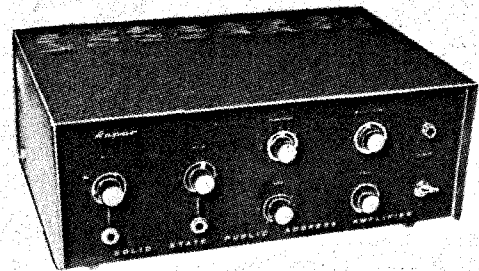
"Precision Temperature Controlled Bath". E.C. Bell and L.N. Hulley. Proc. I.E.E., 1966, 133, 1667-77.

"p-n Junction (Transistor) as an Ultralinear Calculable Thermometer". T.C. Verster, Electronics Letters, 1968, 4, 9, 175-176.

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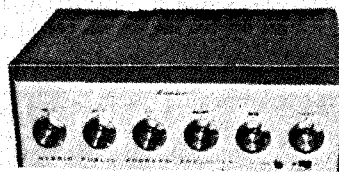
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Size: 230mm. x 145mm. x 340mm.  
Price: \*\$112.70 Tax Included



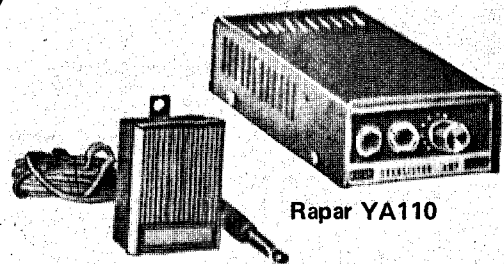
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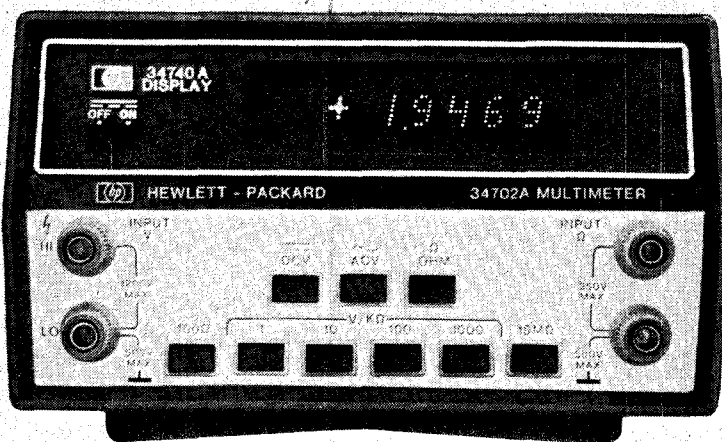
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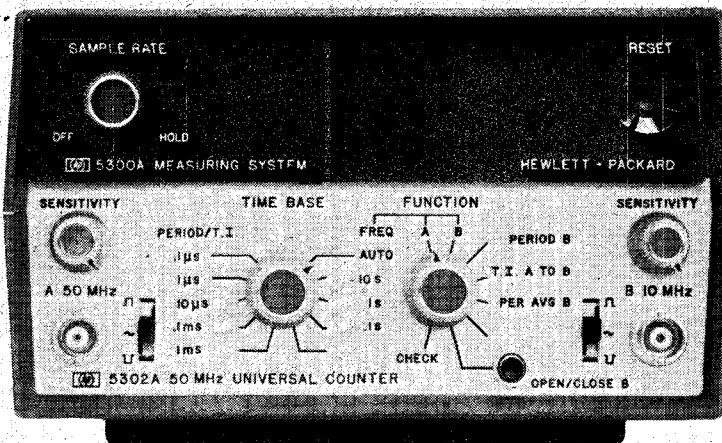
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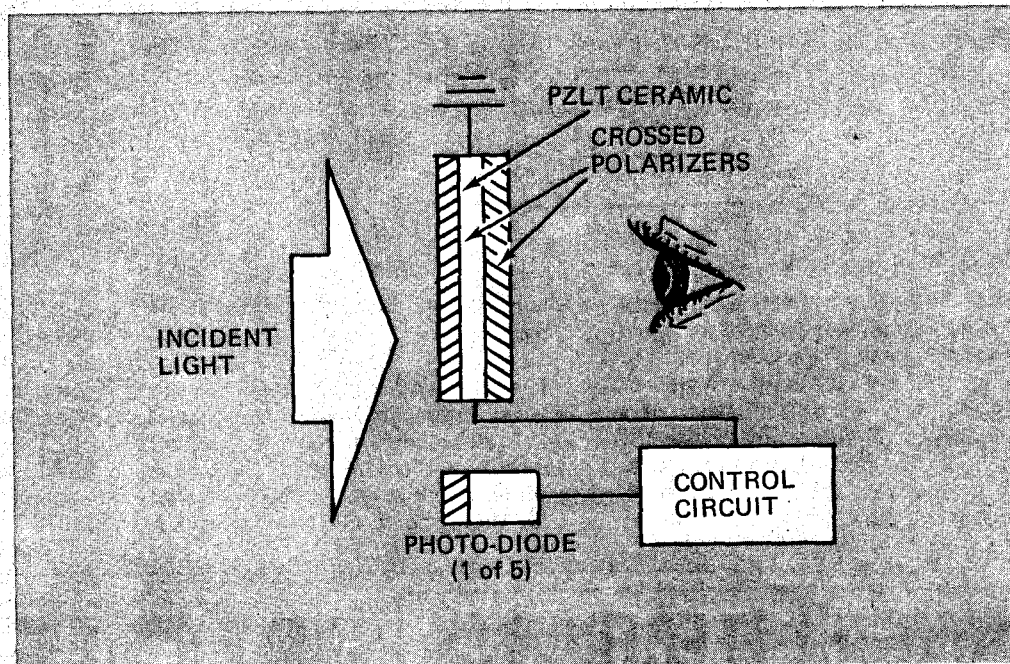
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# Flash-blindness protection

Electro-optic variable density goggles offer protection even from nuclear flashes!



**A** NEW design for instantaneously-actuated variable density goggle lenses has been devised by researchers at Sandia Laboratories in Albuquerque, New Mexico. The lenses in effect furnish the wearer with an "electronic blink" which cuts off the peak brilliance of light flashes. The system can be switched from transparent to near opaque (0.01% transmission) within 50 microseconds (millionths of a second), and returns automatically to the transparent state when light levels drop to a non-hazardous value.

Primary applications for the goggle include flashblindness protection from nuclear flashes as well as from damaging light levels in industrial jobs such as arc welding and metal working. The same general device also may be used to protect sensitive light detectors (such as image intensifiers and vidicon tubes), as an electronic shutter in photographic applications, as an optical switch or light gate, and as a variable density transmission window providing a gray scale over

four orders of magnitude. A fast-reacting window has been developed using this latter property, to provide a constant level of light transmission when coupled with a photodiode detector behind the lens. The device may also be operated at higher voltage levels as a color filter.

The system, which incorporates an all-solid-state electro-optic PLZT ceramic element sandwiched between crossed polarizers, possesses several desirable features. The self-contained power supply — consisting of a 5.4 volt battery, dc-dc converter and electronics — displaces only 12 cubic inches and weighs 10 ounces but has not been fully miniaturized. The battery will power the goggles for about 200 hours. While the converter yields 950 volts potential, maintaining the goggles' "ON" state requires only a few pico-amperes of current.

The newly-developed filter can be stored indefinitely, and is resistant to fatigue. Units developed at Sandia have been triggered several thousand times without measurable degradation.

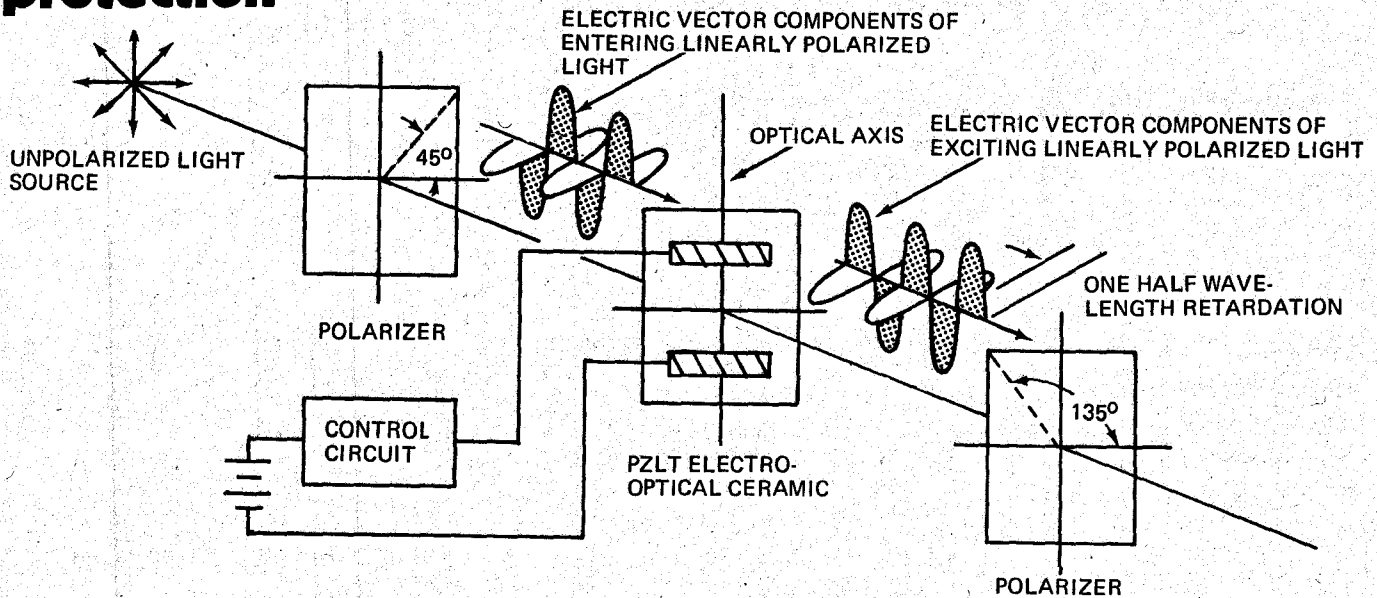
Light transmission through the goggles in their "ON" state is about 21%. The goggles are more transparent than conventional sunglasses (U.S. Air Force regulation sunglasses transmit 15%), and are essentially colorless. When desired, transmission may be set to any level between 21% and the "opaque" value of 0.003% by means of a simple rheostat control.

The prototype goggles contain two lenses measuring 1½ inches in diameter. Similar filters having areas of 100 square inches or more, could be controlled by the same shirt-pocket-size power pack.

The lenses are a sandwich consisting of a polarizer, an electroded PLZT (lanthanum-modified lead zirconate-lead titanate) ceramic, and a second polarizer (analyzer) crossed (oriented at 90°) with respect to the first. The PLZT surface is overlaid with an interdigital electrode array in which the electrodes (either sputtered copper or vacuum deposited chromium-gold) are 2 mils wide and separated by 40-mil gaps.

*(Continued overleaf)*

# Flash-blindness protection



Flash hazard is detected by an array of five photodiodes located between the goggle lenses. The diodes — each of which has a different angle of "visibility" — are integral parts of a discriminator circuit which senses the light-intensity threshold and switches the goggles to their opaque state. Threshold may be adjusted by

changing the values of resistors in the circuit.

The electro-optic variable density optical filter upon which the goggles are based is the subject of a patent application filed by the U.S. Atomic Energy Commission in the names of C.B. McCampbell, G.H. Haertling, J.T.

Cutchen and J.O. Harris. All are members of Sandia Laboratories' electro-mechanical and control component development organization. Haertling is the inventor of the basic PLZT ceramic material. (Full story on PLZT will be published in Electronics Today International in a forthcoming issue).

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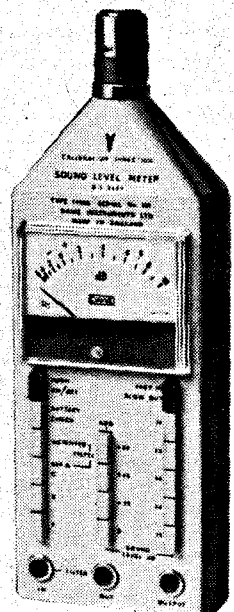
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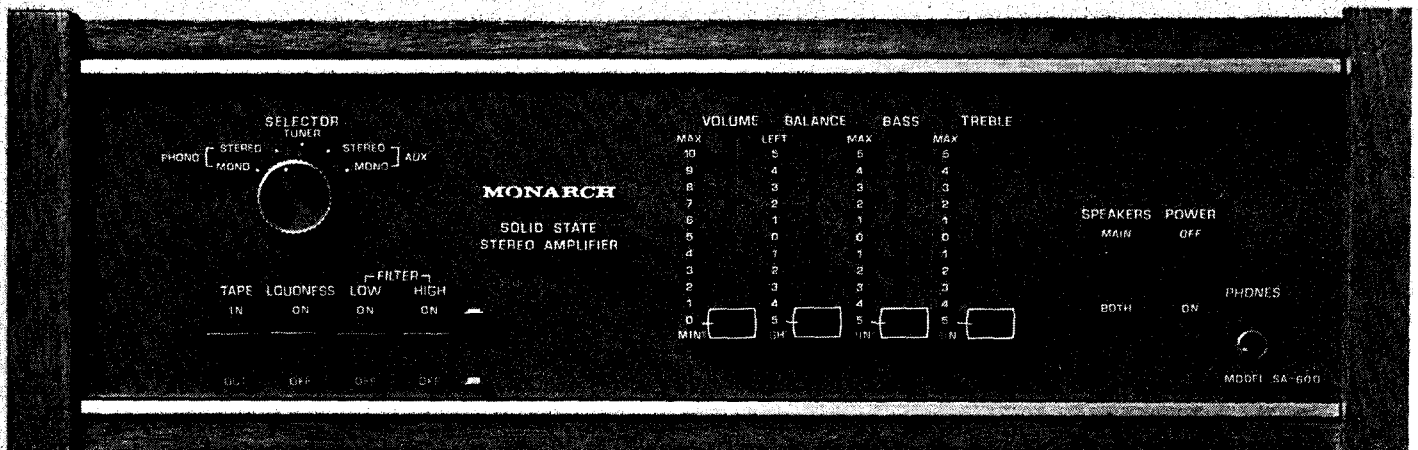


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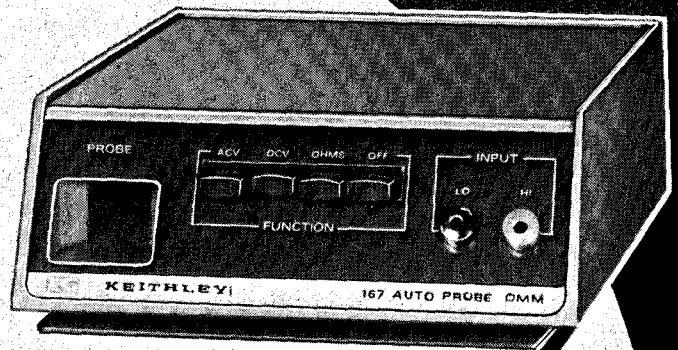
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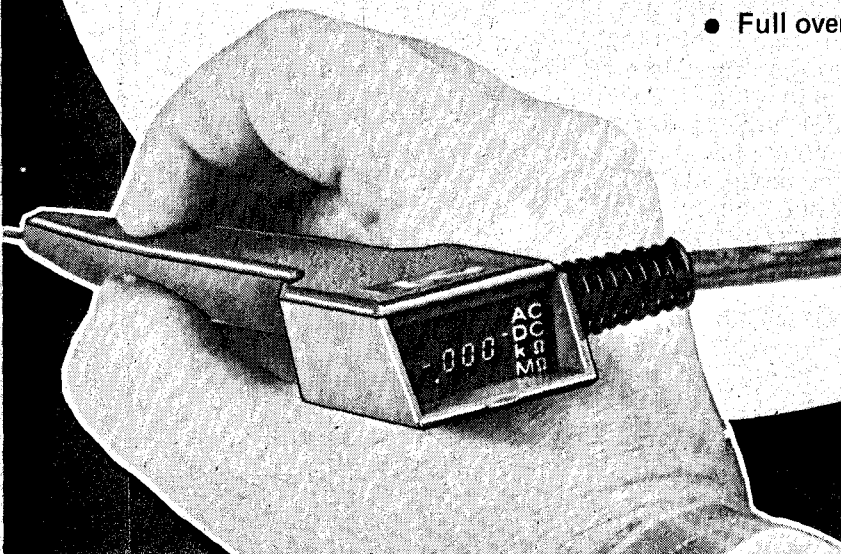
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## STATE OF THE ART

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*"The EME path is particularly noteworthy for VHF-UHF because of the accuracy with which the path loss calculations may be made and for its dependability. These factors permit the EME path to be used for reliable DX communications . . . The great distance to the Moon (high path loss) and the moon's poor reflective properties make this propagation path appeal to those interested in advanced work on receivers, transmitters, and antennas for the VHF-UHF spectrum. Indeed, because of the great path loss involved and the license power limitations, every part of the station facilities must be optimized to achieve success. The first major step in individual station success occurs when reception of echoes is achieved. The echo property of the EME path is unlike any other propagation path since achievement of echoes means that your station is now capable of communication with other similar stations via this path!"*

*"The EME path therefore provides a challenge for the amateur who wishes to upgrade his technical ability and explore new horizons in DX communications."*  
(From "SYSTEM CONSIDERATIONS FOR THE EME PATH", Technical Report No.3, by the Crawford Hill VHF Club, USA).

**F**AST month's cover picture showing the Dapto moonbounce antenna attracted widespread interest. And whilst we published brief details of the technique used, many readers have asked us for a full description of the station and its methods.

Here then are full details of what is at present the ultimate path in amateur communications.

The Dapto Moonbounce Group, led by Lyle Patterson has bridged the EME path on 432MHz. The enormity of the task can be gauged by considering the path loss at this frequency — it is 262 dB! Or looking at it another way, if a transmitter is used which has an output power of 500W at 432MHz, and using an antenna with 26dB gain, then the received power for unity signal/noise ratio will be -152.6dBm.

The Dapto Moonbounce Group have reactivated the old CSIRO Radio Astronomy facilities that now belongs to the Wollongong University College. They first received their own echoes

on March 31st, 1972 at 2130 hrs East. Their first contact was with WA6HXW of California, on 18th April, 1972. However, no reports were exchanged as the Dapto Group did not realise that reception of a full callsign, in parts, during one transmit session constituted a contact.

A block diagram of the Dapto system is given in Fig. 1. Specifications are as follows:—

### Antenna & Feed System:

Thirty-foot diameter parabolic dish, polar mounted with remotely controlled positioning and readout. Operating room is 100 yards away. Gain has been measured at 28dB over a dipole. Width of the main lobe is 5° at the 3dB points.

Crossed dipoles at the focal point are used with a quadrature hybrid feed to obtain circular polarisation. Right-hand circular is used for transmission and left-hand for reception. This is a world-wide standard for EME work. The feed system was constructed by the group.

### Transmitter:

The transmitter operates at 432.000MHz with an accuracy of one part in 10<sup>7</sup>. A high order of stability is provided by a phase-locked crystal oscillator frequency source using an oven mounted 1MHz reference.

Transmitter power output after the bandpass filter is approximately 400 watts. The final amplifier uses a pair of 4C x 250B valves — operating at an input of 1kW by special PMG permission. Only CW mode transmission is used. The transmitter and power supplies are mounted in a cubicle at the base of the dish structure.

The transmitter was constructed by members of the Dapto group.

### Receiving Systems:

A preamplifier is mounted at the feedpoint of the antenna. It has a noise figure of 2.8db and uses a single Philips type BFR91 germanium bipolar transistor. This preamplifier was also constructed by the group.

A 432MHz to 28MHz solid state converter is located in a cubicle at the base of the antenna structure. The converter was donated by STC Pty. Ltd.

The main tuneable IF and audio processor is located in the operating room. This is a Drake 2B receiver which is well suited to the job. It is equipped with an output meter calibrated in dB (0dB being 1mW across 600 ohms, i.e. 0dBm) with 10dB switched attenuators available if required.

The audio is fed into selectable, active filters with 200Hz bandpass and centred at 800Hz and 1200Hz. They may be switched in or out of circuit. The Group has also received an active audio filter which is tuneable, has a 40Hz bandwidth and exhibits no ringing.

The signal is then passed into a chart recorder driver amplifier and dc converter, then through a switched attenuator into the dual speed chart recorder which has selectable chart speeds with 2½ seconds/div. at high speed.

A transmit frequency reference is provided by a coupler/attenuator unit,

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# AMATEUR RADIO

which feeds the 32nd harmonic of the 13.5 MHz transmitter frequency source output into the input of the receiving converter to provide exact indication of transmitter frequency on the receiver/dial.

## Sighting Telescope:

This is mounted on the dish structure coincident with the axis of the main lobe of radiation. A photo-electric cell is mounted at the eyepiece with remote indication in the operating room (a meter.) This allows for an accurate check on the pointing direction of the dish when the moon is visible.

When the moon is not visible, the pointing direction is set by calculated co-ordinates and the dish is then placed on tracking drive to follow the position of the moon — to within 10/hour.

The Dapto Moonbounce Group are the only ones in the world with this facility. They are also the only ones having an antenna system that is fully steerable to any position.

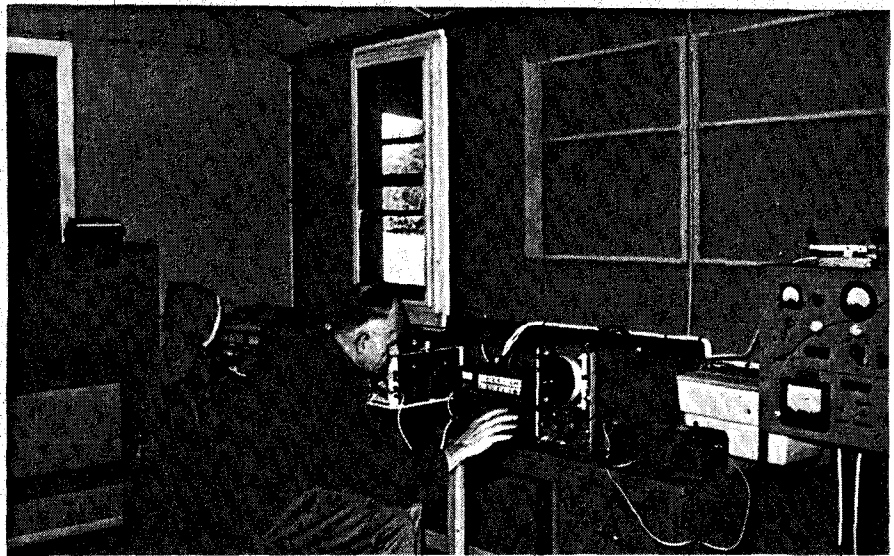
Apart from the dish, its mount and drive, and those commercial units mentioned, all other equipment was constructed by the group over a 2½ year period with assistance from a few WIA members in Sydney.

The project has been made possible by the Wollongong University College making available their Radio Telescope facilities at Dapto near Wollongong.

This is a fine effort by a dedicated group from the Illawarra branch of the WIA NSW Division.

## A NEW 2300 MHz RECORD!

The long-standing distance record of 9 miles held by VK3AXA and VK3ANW for 22 years has now been



Lyle Patterson adjusts the transmitting/receiving equipment at the Dapto Moonbounce site.

well-and-truly broken. After some 18 months work, Bill Cox, VK2ZAC and Dick Norman, VK2BDN established a new record of 28.5 miles on Sunday 3-9-72 at 1215 hrs East. The contact lasted 45 minutes.

Dick, VK2BDN, was located portable at Glenbrook in the Blue Mountains and Bill, VK2ZAC was at his home at Narwee. Liason was carried out on 144 MHz. Dick heard Bill at R5 and S7, Bill heard Dick at R5,54.

Equipment at Glenbrook was as follows:— Transmitter was all home made starting with a 144 MHz exciter followed by a series of varactor doubles to 2304 MHz. Output estimated at ¼ watt. Modulation was NBFM.

The antenna was a four foot diameter dish and dipole feed with 7' of coax to the Tx/Rx.

The receiver was a crystal locked converter with a 1N21D mixer. The first IF was 144MHz, a converter

feeding a mobile communications receiver. All of the above equipment, including the antenna, was homemade.

The equipment at VK2ZAC's was:— Transmitter: 144 MHz exciter followed by a series of valve doublers using 3X x 100A5 tubes with output on 2304 MHz. Power output estimated at 1.5 watts. Modulation was AM.

Bill's antenna is very unusual. It is a 4ft dish mounted on a track that runs up and down his tower. The dish has a dipole feed with coax connected to a 15ft section of homemade waveguide consisting of 4" x 2" galvanised pipe with homemade coaxial transitions.

The receiver is the same as used by Dick VK2BDN, but feeds into a 52MHz converter as the first IF. A transistor preamp is inserted between the output of the 2300 MHz converter and the 52 MHz converter. The tuneable IF is a BC342 ex-surplus receiver modified with a gated beam FM discriminator.

(Continued on page 101)

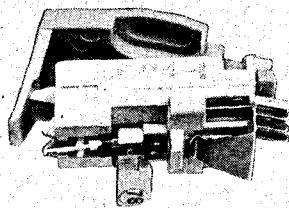
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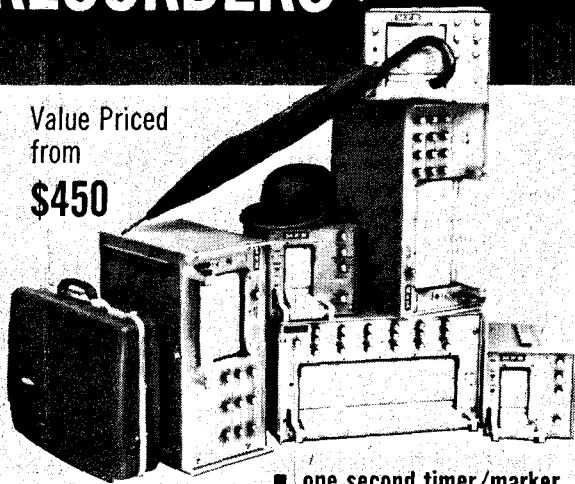
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**THE COURSE SUPERVISOR, W.I.A.**  
14 Atchison Street, Crows Nest,  
2065. N.S.W.

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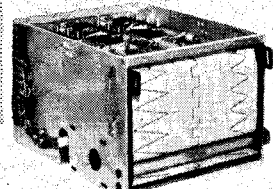
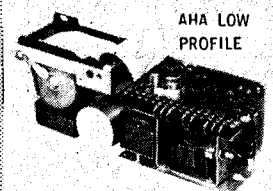
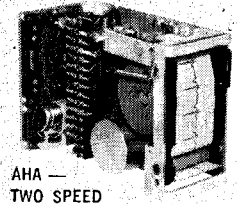
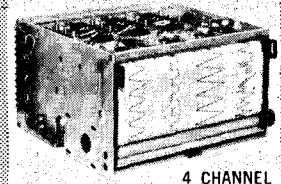
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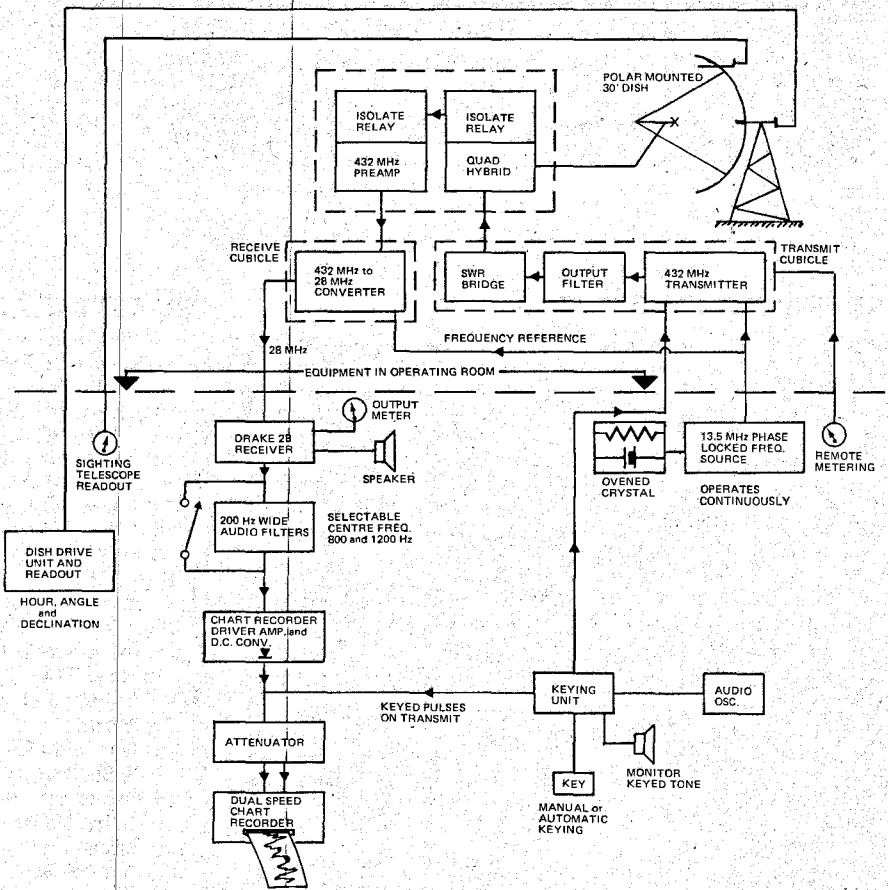
The path from Glenbrook to Narwee is an optical one and the operators were surprised when they experienced fading on the signals.

Further work is in progress to improve the systems.

Again a fine effort. The extensive use of homemade equipment is to be thoroughly commended.

## METEOR SCATTER ON SIX METRES (52MHz)

Two Sydney amateurs, Rod VK2ZQJ and Mike, VK2AM ran a very successful series of skeds during the Perseido shower in August (4th to 11th) with Joe VK7ZGJ (Westbury, Tasmania) and Wally, VK5ZWW of Adelaide. Joe runs AM and his carrier was rarely below the noise so high was the E-layer ionisation due to the satellite trails. Some very long bursts were experienced (10 to 30 seconds or more) and Mike, VK2AM has some very good tapes of the contacts. Rod, VK2ZQJ runs about 300W pep output of SSB, Mike, VK2AM was running about 30W pep output (5SB). Wally, VK5ZWW runs about 80W 5SB and Joe, VK7ZGJ runs 150W AM.



Block schematic of VK2AMW Moonbounce System at Dapto, NSW.



Jack Stein

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# AUDIO NEWS

## NEW SYDNEY AUDIO SHOP



Audiophiles will be interested to note the opening of a new hi-fi shop at 275 Clarence Street, Sydney. The shop is named after and belongs to Mr Jack Stein, former General Manager of Allied Music Systems.

Jack will stock all leading brands of audio equipment giving emphasis to Akai, Sony, Arai, Elac and H.J. Leak equipment. He chose these as his major brands, he says, because of the high standard of equipment and the accompanying prompt service and repair facilities provided by the Australian distributors.

## TEAC IN SYDNEY

The Directors of Australian Musical Industries have announced that a Branch Office has been opened in Sydney.

The Sydney office located at 619 Pacific Highway, St. Leonards will service dealers in N.S.W., Queensland and A.C.T. for the complete range of TEAC Audio Recorders and associated equipment.

The St. Leonards office also incorporates a modern showroom with a working display of the complete range of TEAC equipment for the benefit of the general public who may inspect the full range of TEAC equipment during normal office hours Monday to Friday.

Australian Musical Industries will also have available at their Sydney showroom a full range of TEAC professional recorders designed for broadcast, television and recording studio applications.

Mr. Kenneth Williams has been appointed N.S.W. Sales Manager having previously spent 6 years as Recording and Data Products Manager within the industry.

## MEMOREX AUDIO TAPES

LEROYA INDUSTRIES PTY. LTD. advise that they have been appointed Sole Australian Distributors for Memorex Audio Tapes.

In less than a year Memorex is said to have become the number two tape in the United States, and present indications are that they will be number one within one year.

Memorex types are of the Gamma Ferric Oxide and Chromium Dioxide types and are made in Memorex's own, new, multi-million dollar factory.

A full range of low noise, open reel tapes from 5" (600 feet) to 10½" (3600 feet) are available, together with 8 track cartridges and standard or chromium-dioxide cassettes.

Further details from: Leroya Industries Pty. Ltd., 266 Hay St, Subiaco, West Australia 6008.

## VIDEO CASSETTE STANDARDS

Philips will make its video cassette recording system freely available to other manufacturers in order to promote world-wide standardisation of VCR. The company some years ago offered its audio Compact Cassette system in the same way.

In Europe, 10 companies manufacturing PAL colour TV equipment have already agreed to adopt the VCR system. (PAL has been chosen by the Australian government for this country's colour TV transmissions). Three more companies are expected soon to sign VCR standardisation agreements with Philips.

Now Philips and Shiba Electric Company of Tokyo have agreed that Shiba will submit an official standardisation proposal to the Electronic Industries Association of Japan's standardisation committee. This proposal relates to the NTSC system, the colour television system used in Japan and the United States.

In the USA, North American Philips Corporation has made a similar proposal to the Society of Motion Picture and Television Engineers.

Philips and the Minnesota Mining and Manufacturing Company (3M), St. Paul, U.S.A., also have signed a standardisation contract relating to the Video Cassette Recording system (VCR) developed by Philips. Under the contract, 3M company will sell VCR apparatus in Europe and in other countries where either the PAL or the SECAM colour TV system prevails. The 3M company will market the high energy video tape developed by them in VCR cassettes. Philips plan to use this tape in addition to the chromium-dioxide tape, which is used in the VCR cassettes already for sale.

## HIGH QUALITY PRE-RECORDED CASSETTES

In the USA, the Advent Corporation are shortly to market a range of pre-recorded extra-high quality chromium dioxide cassettes.

Programme material is to be obtained from the Nonesuch Record organisation and will be recorded directly from that company's Dolby A master tapes.

These master tapes are of superb quality and many have been recorded by Marc Aubert who was previously vice-president of Dolby Laboratories in the USA.

Unlike the majority of pre-recorded cassettes - which are recorded at a speed 32 times faster than their normal playback speed - Advent will be recording their new range at a speed ratio of only four to one.

Sound is reliably reported to be quite superb, with little tape hiss and no drop-outs or modulation noise.

## REEL-TO-REEL TOO

Tape recording enthusiasts using the reel-to-reel format will be interested to hear that American Ampex Stereo Tapes are shortly to introduce pre-recorded Dolby B reel-to-reel tapes.

Our information is that they should be on the market by the end of this year.

The recently announced Vanguard quadrasonic reel-to-reel tapes are also now recorded using the Dolby B system.

## DIGITAL RECORDING

Japan's Nippon Columbia company have developed a digital recording technique. The new equipment, said to cost over \$250,000 uses pulse code modulation.

Advantage of this technique is its virtual imperviousness to noise and distortion. Further details will be published as they come to hand.

## BOSE AMPLIFIER?

Although as yet unconfirmed, a usually reliable source tells us that the Bose Corporation are about to market an advanced specification high powered amplifier.

## NEW SONAB TURNTABLE



New from Sonab is their model 55.S turntable. This is an additional turntable to the company's existing model - the 85.S which, in itself, will continue in the Sonab range.

The 55.S is a two-speed record player with automatic stop device. It is belt driven by a 16 pole synchronous motor, assuring, according to Sonab, correct speed, negligible wow and flutter and lowest possible rumble.

The turntable and tone arm are mounted on a separate sub-chassis 'floating' from the main chassis. The 55.S is therefore almost immune to acoustic feedback and external mechanical shocks.

## STOIP PRESS

We have just heard that the US based Jervis Corp. - a group including such prestigious names as JBL, Harmon-Kardon, Rabco etc - have established an Australian subsidiary sales organization.

The new Australian subsidiary is called Jervis Australia Pty. Ltd., they are situated at 1/111 Old Pittwater Road, Brookvale, N.S.W. 2100. Telephone number is 939-2922.

Manager of Jervis Australia is Bill Martin, formerly with Jacoby Mitchell; sales manager is Warren Stolzack, previously sales manager of Instrol.

The new company will be the sole importers and distributors of JBL, Harmon-Kardon, Dynaco, Empire and Rabco domestic and professional audio equipment.

## LAFAYETTE GUARDIAN "6000" 6-Band

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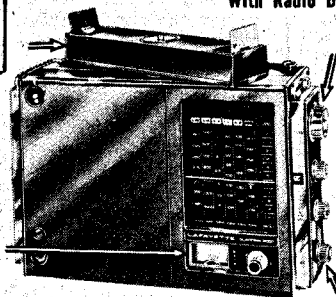
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Add 60 cents for pack/post.

**WIDMAIER SWITCHES.** 2 sets, change over contacts. \$2.00 each. P/P 20 cents.

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**VALVES - 6J6,** 30 cents ea. 6J7, 60 cents ea. 6SL7GT, 60 cents ea. 6AC7 30c each. P/P 20c.

**PHONE JACKS** 3.5 and 2.5mm 10 cents ea. P/post 10 cents.

**COMPUTER BOARDS.** Size 1. Contains 4-0c45, glass encapsulated. 2 min. toroids. 10 diodes \$1.00 ea. P/P 20 cents. Size 2. Average 10 Transistors, 30 diodes, resistors and capacitors. All components have long leads. \$2.50 ea. P/P 40 cents.

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**PUSH BUTTON CAR RADIO TUNERS - BROADCAST** c/w coils. \$5.00 each plus 50c P/P.

**TAPE RECORDER MICROPHONES** c/w switch, lead and double pin plug. \$6.00 each plus 40c P/P.

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**COMPUTER FANS - 7" diameter.** 115v. 35A, 3,200 rpm. Complete with capacitor start. \$12.50 each. P/P \$1.50.

**TRANSISTORS AX1109** same as BF115. RF to 300 megs. 45c each. P/P 10c.

**STEREO TONE ARMS - C/W ceramic cartridge.** \$4.50 ea. P/P 50c.

**CAPACITORS.** Mixed values Mica & Ceramic. Poly bags, \$2 per 100. P/P 30c.

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# COMPONENT NEWS

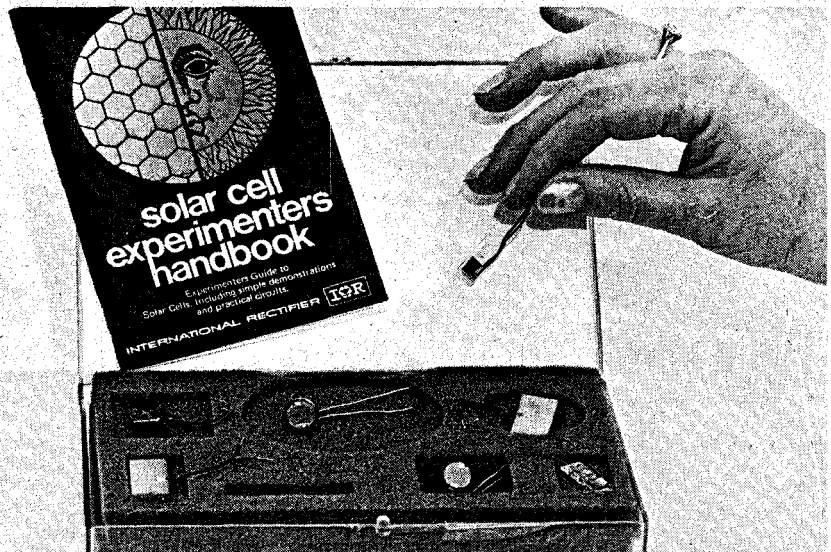
## SATELLITE SOLAR CELLS

A new solar and photocell kit available from Dick Smith's Wholesale contains cells similar to those used in space vehicles.

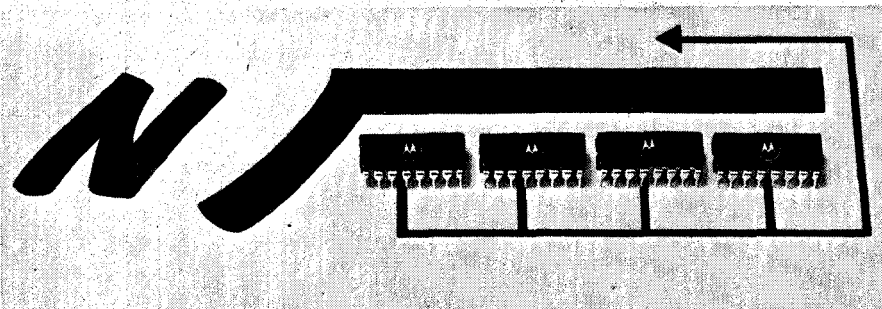
The kit — K241 — produced by International Rectifier includes selenium, silicon and cadmium sulphide cells which just miss the rigorous specifications laid down for space use. They are, however, stated to be ideal for hobbyist applications. The kit comes complete with a detailed instruction manual covering a number of experiments. Circuits include simple sun relays (one for direct ac use only requires a relay), battery — less radios and solar-powered transmitters.

Cells in the kit are powerful enough to drive a small electric motor, also available from Dick Smith.

Further details: Dick Smith Wholesale Company, 162 Pacific Highway, Gore Hill, 2065.



## DIVIDE-BY-N FUNCTIONS



Motorola has recently introduced two low power, CMOS programmable, cascadable down-counters. The MC14522 Programmable Divide-by-N Decade Counter, and its companion Programmable Divide-by-N Binary Counter, the MC14526. Both provide cascadable down counting functions using only micro-watts of quiescent power dissipation. Previously these functions were obtainable only in power consuming bipolar ICs.

These Motorola CMOS, or McMOS, devices are provided as one of over 25 Motorola designed CMOS devices to be introduced this year. As part of a standard CMOS device line, these Motorola designed McMOS parts offer the systems designer a wide choice of logic functions.

These synchronous counters offer standard McMOS family electrical specifications. Output drive current which is typically 0.9mA at  $V_{out}$  of 0.4 V for a  $V_{DD}$  of 5 volts, is sufficient to guarantee low power TTL interface over full temperature ranges. Noise immunity is 45%

typical, and the maximum operating frequency is 5 MHz. Supply voltage can vary between 3 and 18 volts.

Both the MC14522 and the MC14526 can be triggered by either the positive edge or the negative edge of an input signal. Both offer two temperature range versions. The AL version operates over  $-55$  to  $+125^{\circ}\text{C}$  and the CL version from  $-40$  to  $+85^{\circ}\text{C}$ .

These devices have a cascade feedback (CF) input that allows cascade divide-by-N operation with no additional gates required. A clock inhibit input when taken to "one," will cause the devices to stop counting. These counters can be used in applications such as multistage programmable frequency dividers, multistage programmable down-counters, frequency synthesizers, and phase-locked loops. In addition to frequency division capabilities, these devices can also perform cascadable down counting with fully synchronous outputs and asynchronous preset and reset.

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

## ELECTROBITS NEWS RELEASE

Electrobits Pty. Ltd. are now manufacturing in Australia a range of subminiature incandescent indicators based on the T1-3MM lamp.

Two basic types are available, the MEBL and MEFL. Both are stock items in 5 Volt 0.06 Amp 100,000 hours rating of 12 volt 0.06 Amp 16,000 hours rating. Colours available are red, green, blue, orange, white and yellow.

Full details: Electrobits Pty. Ltd., P.O. Box 232, Clayton, Vic. 3168.

## TWO MEGAWATT SCR

A new thyristor from Siemens, a disc eight centimetres in diameter, is capable of switching up to 2 million watts power. In handling 2500 V and a current of 800 A, this switch considerably exceeds the earlier performance of high power thyristors. These electronic components are employed in such tasks as switching the current of large electric motors. They replace the slower mechanical switches which wear more rapidly and require far greater power to actuate (and generate sparks).

## IMPREGNATED CARD STRIP CLEANS ELECTRICAL CONTACTS

A small strip of impregnated card developed by Electrolube Ltd in Britain provides a simple means of cleaning and protecting non-wiping contacts of relays and other leaf-contact switching devices.

The strip will remove all contaminants



from contact surfaces without the risk of damaging them.

The strip, impregnated with a specially formulated contact lubricant, is held between thumb and forefinger, inserted between the closed contacts and worked back and forth a few times. The tarnish-loosening properties of the impregnant and the absorbent nature of the card combine to remove the contaminants. When the contacts no longer stain the strip, all tarnish has been removed. As the strip is withdrawn, it leaves a protective film on both surfaces.

The makers say that when tested on the gold-flashed silver contacts of a miniature relay, use of the strip reduced contact resistance from 25 milliohms to 5 milliohms and increased contact life ten-fold.

Further details: Richard Foot (Australia) Pty. Ltd., P.O. Box 78, Crows Nest, N.S.W. 2065.

### ADVANCED AEROSOL CLEANER



The new Plessey TF Tri-Fix aerosol cleaner is an electronic grade solvent that is claimed by its manufacturers to instantly clean, degrease and restore electromechanical components such as potentiometers, TV tuners, all types of switches, relays, circuit breakers, motors, starters and office machine components.

The serviceman should find the new cleaner particularly useful for car radios, TV receivers, amplifiers and similar equipment, where it is difficult to remove components, or even the chassis from the housing, cabinet or case. Hi-Fi enthusiasts also should find it an excellent tape recorder head cleaner.

A "Spray-inta" tube is available and enhances the value of the new aerosol. A noisy potentiometer or similar component can be cleaned in seconds by simply removing the knob, screwing the "Spray-inta" tube onto the standard thread, attaching the can to the tube, and spraying. The positive connection allows the pressure and solvent combination to do a fast, thorough job.

Further details: Plessey Rola Pty. Limited, The Boulevard, Richmond, Vic., 3121.

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NSW: Encel Electronics Pty Ltd, 260 Elizabeth St., Sydney 2000. Tel 212 3722.

QLD: Stereo Supplies, 95 Turbot St, Brisbane, 4000.

SA: Challenge Hi-Fi Stereo, 6 Gays Arcade, Adelaide, 5000.

TAS: Audio Services, 72 Wilson St, Burnie, 7320.

VIC: Encel Electronics Pty Ltd, 431 Bridge Road, Richmond, 3121. Tel 42-3762.

WA: Albert's TV and Hi-Fi, 282 Hay St, Perth, 6000.

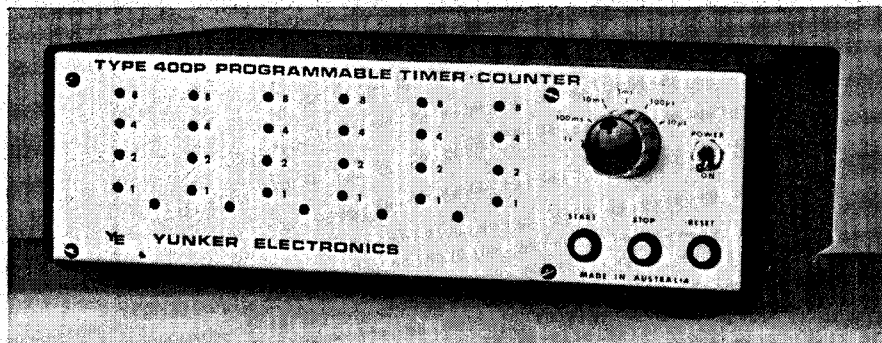
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To: International Dynamics (Agencies) Pty. Ltd.  
P.O. Box 205 Cheltenham. Vic. 3192.

# EQUIPMENT NEWS

## LOW PRICE PROGRAMMABLE COUNTER-TIMER



A new Australian designed and produced Programmable Timer-Counter has recently been released by Yunker Electronics. The 400P Programmable Timer Counter is stated to be suitable for both the teaching of digital techniques and for student use in laboratory experiments. Research workers in universities and colleges will find it an ideal tool for measuring time in various forms - time interval, elapsed time, periodical time, etc. Features, like start-stop-reset, remote or by means of push buttons, and programmability makes the 400P particularly suitable for multimode operation in the field of photography, psychology, medicine, pharmacology, weapon research, etc.

Further details: Yunker Electronics, 757 Glenferrie Rd, Hawthorn, Vic. 3122.

An output signal proportional to the logarithm of the gas absorption ratio is developed, giving a degree of linearisation.

The electronics unit, connected to the analyser by multi-way cable, provides power supplies, signal processing, read-out and alarm facilities.

There are temperature control circuits for absorption cell and detector and a current control for the source. Output signals of 5V and up to 50 mA maximum are provided together with alarms for high/low output and sources failure. A function check meter helps fault-finding.

Further details: Ronald J.T. Payne Pty. Ltd., 385 Bridge Road, Richmond, Vic. 3121.

## DRIFT-FREE INFRA-RED GAS ANALYSER

A highly accurate infra-red gas analyser which will monitor pollution gases, the atmospheres of heat treatment furnaces and process streams in the chemical petroleum, steel and gas industries has been developed by Feedback Instruments Ltd of Crowborough, England.

It employs a single beam system which overcomes possible inaccuracies through fouled absorption cell windows.

The fully sealed analyser, which can be pressurised or purged, contains a coated platinum source in a sealed module and a 600 Hz chopper disc. Chopped energy passes through an absorption cell to the detector unit, where it is focused on to a Peltier cooled indium antimonide detector in a sealed module. Two interference filters are interposed alternatively in the boom by a torsion band oscillator and the detector signal is pre-amplified before reaching the electronics unit. It is then demodulated and applied to a sample/hold circuit, followed by a phase-sensitive detector.

## LOW-DISTORTION, LF GENERATOR



A new low-frequency generator has just been added to Philips growing range of instruments, specifically designed for educational and service applications. Designated the PM 5105, this economically-priced sine/square-wave

instrument is particularly useful for measurements on audio amplifiers, and when employed in combination with the PM 3110 10MHz oscilloscope it provides a perfect combination for demonstrating all types of electronic phenomena.

In announcing the release, Mr Bill Robbie, Philips Test and Measuring Instruments manager, said that a low distortion of less than 1% over its full frequency range and a very stable frequency response were two important features of this generator.

Featuring a Wien-bridge oscillator - that incorporates a differential amplifier to overcome the impedance-matching problems often experienced in low-impedance transistor circuitry - the PM 5105 provides a temperature-compensated variable output of 0-2V rms sine wave and 0-4V square wave. Its frequency range extends from 10 Hz to 100 kHz in four calibrated ranges with continuous tuning over each range scale, and the instrument's response characteristic is flat to  $\pm 2\%$  over this full range when referred to 1 kHz. Operating in its square-wave mode, the PM 5105's output has a 1:1 mark/space ration and a risetime of less than 0.5 $\mu$ s.

Another important feature of this instrument is that it has been designed for simplicity of operation, most of its controls are of pushbutton type. Similarly, servicing problems with the instrument are minimized by placing all components, including the pushbuttons, on easily accessible print plates.

Addition of this instrument to the company's growing range of educational/service instruments means that an oscilloscope and LF generator are now available in this range, and a booklet is available from Philips describing educational experiments that can be undertaken employing the two units.

Further details: Philips Industries Ltd, 95 York Street, Sydney, 2000.

## UNIVERSAL FREQUENCY COUNTER TO 1000MHz

Now available from Takeda Riken is a universal counter capable of directly counting from dc to 1000 MHz.

Typical applications for the instrument - the TR5599 - include measurement of error rates of high speed PCM systems and the measurement of random pulses in nuclear studies. In both of these applications it is necessary to be able to count random pulses with a resolution of 1ns. This is claimed to be within the capability of this instrument.

The high accuracy of the TR5599 is achieved by using a crystal oscillator with a claimed stability of  $5 \times 10^{-10}$ /day. A second Takeda Riken instrument, the TR5599C, is available with a claimed crystal oscillator stability of  $3 \times 10^{-9}$ /day.

(Continued on page 108)

# SPECIFICATION FOR R.F. CONNECTORS

## FROM SINGLE CONDUCTOR

### B.N.C. — ELECTRICAL CHARACTERISTICS

impedance	unimproved: non-constant; all others: 50 ohm
frequency range	0-10 GHz
voltage rating	500 volts peak
dielectric withstanding voltage	1500 volts rms
SWR	improved: 1.3. MIL-Crimps: see chart. Quick-Crimps: 1.25. Orig.-Crimps: 1.3
Other	contact resistance 2.1 mv. RF leakage: — 55 dB. insertion loss: .04 dB. insulation resistance: 5000 megohms

**TO  
TRIAx**

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T.N.C.  
M.H.V.  
U.H.F.  
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7 MM

## FROM SUBMINIATURE

### SMA — ELECTRICAL CHARACTERISTICS

Impedance	50 ohm
Frequency	.141" & .085" O.D. Copper jacket semi-rigid cable: 0-18 GHz Flexible cables: 0-12.4 GHz
Voltage Rating	RG-55, 58, 141, 142, 223, 303: 500 V RMS max. @ sea level RG-122, 174, 188, 316: 375 V RMS max. @ sea level
Dielectric Withstanding Voltage	RG-55 group: 1000 V RMS max. @ sea level RG-122 group: 750 V RMS max. @ sea level
SWR	.141" O.D. Copper jacket cable: 1.05 + .005 f (GHz) RG-55 group: 1.15 + .01 f (GHz) RG-122 group: 1.15 + .02 f (GHz)
Contact Resistance	Center: 2.0 milliohms Body: 2.0 milliohms Braid to bdy: 0.5 milliohms
Insulation Resistance	5000 megohms
R.F. Leakage	60 dB minimum

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Terminations	Solder, Crimp
Finish	Silver, Tarnish Resistant, Beryl. Copper
Features	Field Serviceable, Simple Assembly

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# Kelvin has your tape storage problem solved.

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7" tape reel and flip can — \*\$1.50. Reel features low torque hub, ideal for pre-recorded tapes. Also 7" standard reel with small hub at same price.



Pack of 3 cassette storage containers — \*\$1.00.

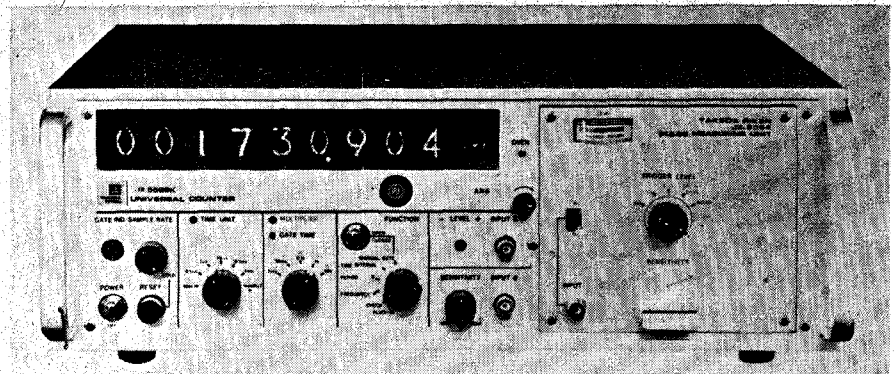
\*Suggested retail price.

# Kelvin

Trade enquiries to:  
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NORTH RYDE N.S.W. 2113.  
Phone: 888 6188.  
Branches in all states.

SPS9.413.516

## EQUIPMENT NEWS

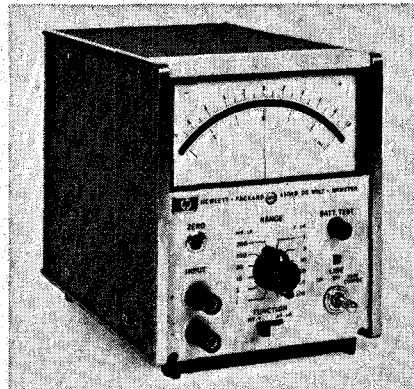


The input circuit permits both ac and dc coupling, essential to random pulse measurement.

Also the trigger level and attenuator controls on the front panel permit measurement of any signal waveform. Because the system is provided with an internal time base signal output terminal on the rear panel from which a 1MHz signal can be extracted — and the stability of this signal is the same as that of the internal time base — the instrument may also be used as a secondary frequency standard.

Further details: DC Electronics Pty. Ltd., 32 Smith Street, Collingwood, Vic. 3066.

### HIGH-SENSITIVITY, COMPACT DC VOLT-AMMETER



Using a centre-zero scale, a new low-priced Hewlett-Packard instrument indicates polarity as well as magnitude of voltage and current on an analog front-panel meter. Called the HP Model 4304 DC Volt-Ammeter, this instrument measures voltages from  $\pm 1$  millivolt to  $\pm 300\mu\text{A}$  full scale. Accuracy for both voltage and current measurements is claimed to be  $\pm 1.5\%$  of full scale.

A FET chopper amplifier assures negligible drift and low noise. Drift is less than 0.2% of full scale; internal noise is less than 1% of

full scale. AC voltages of frequency 50 Hz and above and 40 dB greater than full scale affect readings less than 1% of full scale. The negative input terminal can be floated up to  $\pm 500$  V dc above chassis or mains earth.

The Model 4304B can also be used as a dc amplifier, with a gain of 1000 (60 dB) maximum on the 1 millivolt range. Output is from 0 to  $\pm 1$  V (no load); output resistance is less than 50 ohms. Noise is less than 20 microvolts peak-to-peak.

Battery operation using rechargeable nickel-cadmium cells is also available, as an option. The battery pack consists of four cells and a self-contained charger. Up to 30 hours of continuous operation are obtained from a fully-charged set of batteries.

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

### LOW PRICE FLUKE MULTIMETER

A new multimeter designed to meet the needs of the widest possible number of users throughout science, technology, and industry has been introduced by the John Fluke Company, Seattle, Washington.

With a claimed accuracy of 0.1%, the new Fluke 8000A measures, in 26 ranges, ac and dc voltages from 100 microvolts to 1200 volts, ac and dc currents from 100 nanoamps to 2 amperes and resistance from 100 milliohms to 20 megohms. All instruments are guaranteed to meet specifications for one year.

According to the manufacturer, the Fluke 8000A is the first instrument to use both analog and digital large scale integration. The two chips used — equivalent to over 3,000 circuit elements — help reduce the parts count to about one-third that of typical 3-1/2 digit voltmeters. Because of the low parts count and LSI design the company says that it expects high reliability.

Of sturdy construction, the instrument is designed to withstand a fall from bench height without damage.

Alone among all instruments in its category, the company says the 8000A uses

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2142. Phone: Sydney 637-7700.

30 Ross Street, NEWSTEAD, 4006, QLD. —  
Phone Brisbane 52 2211.



# TDK re-invents tape

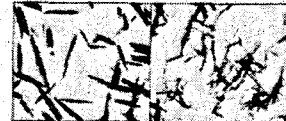
TDK Super Dynamic (SD) Cassettes record the full range of music without missing a note or skipping a beat. Make even low-priced recorders sound great!

When we set out to make a cassette tape as true to sound as the most expensive reel tape we found we had to re-invent cassette technology. The result is TDK Super Dynamic (SD) Cassette Tape and the only combination that meets the most critical professional standards and actually improves the performance of your cassette recorder. There's nothing else like it!

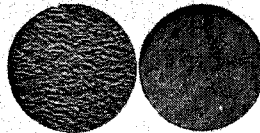
## Look at these TDK exclusives

### Superfine tape coating for super dynamic sound

8 times as many magnetic particles as conventional tape. Superfine Gamma Ferric Oxide particles for better signal-to-noise ratio and much wider dynamic range without distortion.



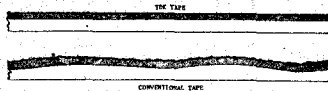
### Micropolished surface for better frequency response



TDK particles are densely and uniformly packed into the tape coating. Mirror-smooth lubricated surface means less wear on the recorder head.

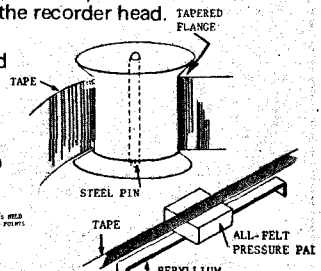
### Good enough for high-speed computers

The thickness of the binder and oxide coating is controlled to within 4 hundred thousandths of an inch. No chance of signal dropouts because the coating is constantly in contact with the recorder head.



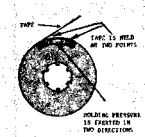
### Tape rolls true, won't ride up and down

Only TDK SD tapes have a tapered flange and a stainless steel pin, (instead of plastic) for perfect head-to-head alignment.



### Unique TDK clamp grips at two points instead of one

Tape won't loosen or break under stress. Precision hubs reduce friction, — keep the wind steady and even.



### Uniform tape-to-head contact at all times

High quality beryllium copper spring holds its tension permanently. Durable all-felt pad won't twist or yield under stress.

TDK CASSETTES have more than 20 precision parts to ensure peak performance even after years of use. Conventional cassettes have fewer than 10 parts.

Don't ask for tape. Ask for TDK. If your dealer doesn't have it, phone us. We'll tell you who does.

## TDK SD CASSETTES

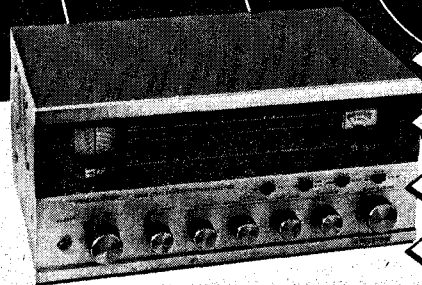
available in C-60, C-90 and C-120 sizes. Also the remarkable value TDK Low-Noise Cassettes. C-30 from about \$1.49 and C60-C90. Also TDK SD and Low-Noise in reels.



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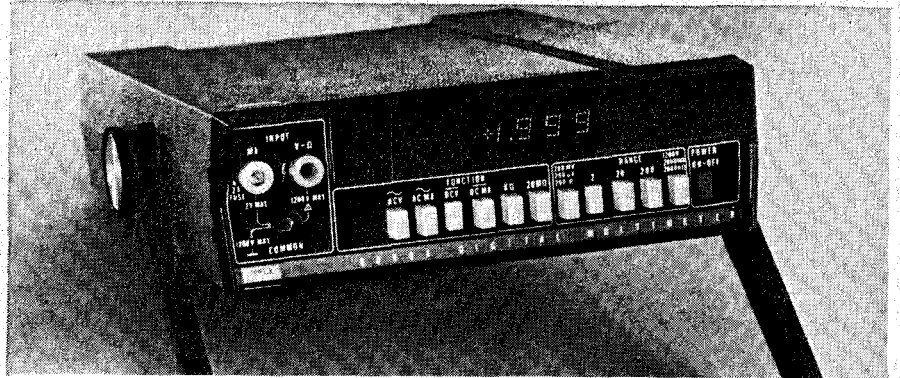
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# EQUIPMENT NEWS



an A-to-D converter with inherent self-zeroing to eliminate offset uncertainty.

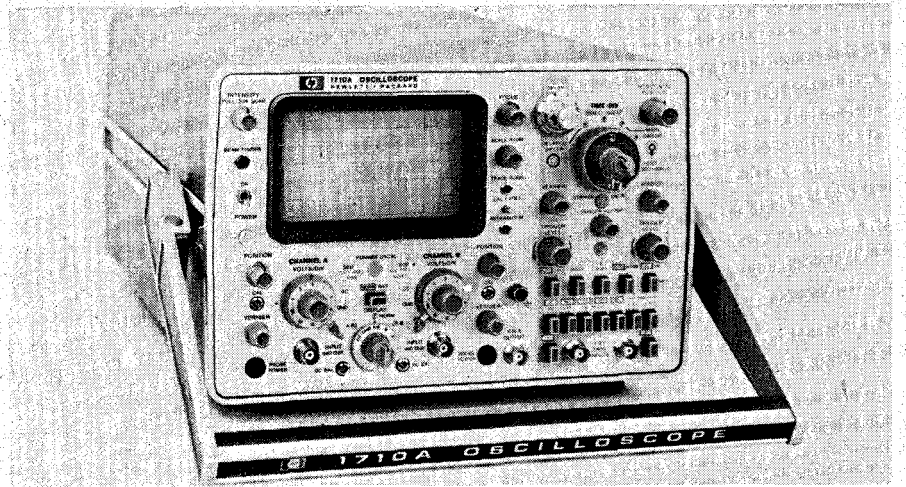
Several low cost optional extras are available including a rechargeable battery pack, BCD data output, an RF probe, a 200 ampere ac current probe, a high voltage probe, and a carrying case.

So that downtime on the instrument can

be kept to a minimum, Fluke has established over 30 factory service centres to provide 48-hour turnaround service in the United States, Canada, Europe, the Far East and Australia.

Further details: Elmeasco Instruments Pty. Ltd., P.O. Box 334, Brookvale, N.S.W. 2100. Telephone: 93-7944.

## ECONOMY FAST PULSE ANALYZER



Clearly showing those fast, infrequently occurring traces which are common in high-speed digital equipment and computer peripherals, such as the index pulses in disc memories, a new portable oscilloscope, (Model 1710A), from Hewlett-Packard is claimed to eliminate the need for more costly extreme bandwidth scopes in many applications. Compressing the cathode-ray scan, simply by pulling out the intensity control, gives a higher-intensity beam, doubling the writing speed. The 6 x 10 cm display (stated to be larger than that of any other 150 MHz portable) decreases to 3 x 5, and previously hard-to-see pulses appear clearly.

Signals with rise-times under 10 nanoseconds, in practice, require 50 ohm

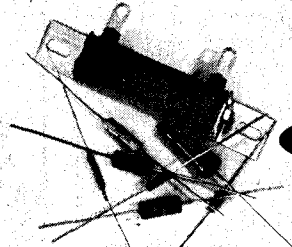
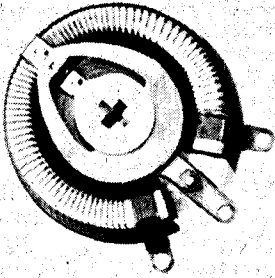
matching circuitry to avoid waveform degeneration, but high impedance probing is entirely satisfactory and a lot more suitable for slower waveforms. Therefore, say the manufacturers the 1710A is the first portable to offer switchable input impedance. Its new attenuator presents either a well-matched 50 ohms or 1 megohm paralleled by 12 pF input impedance.

In every respect, say Hewlett-Packard the 1710A portable performs like a laboratory oscilloscope. Minimum deflection factor is 5 millivolts/division. Unlike other portables of its class, whose bandwidth varies with the sensitivity, this one preserves full 150 MHz response on all deflection ranges including the 5 millivolt/division range.

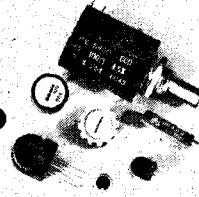
The 1710A portable oscilloscope operates



1. Power Rheostats.

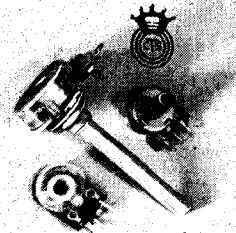
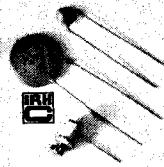


2. Carbon composition, Metalglaze precision film and wirewound resistors.



3. Single and multi-turn Trimming Potentiometers.

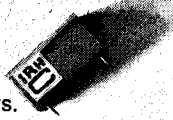
4. Capacitors.



5. Rotary and Slider Potentiometers. Single and Stereo.

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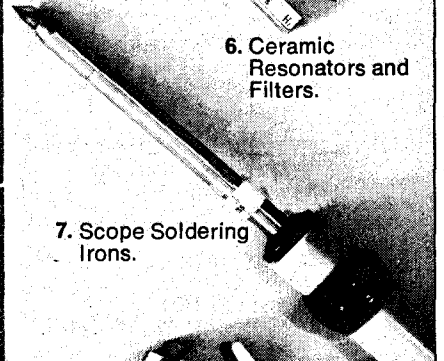
15. Reed Relays.



6. Ceramic Resonators and Filters.



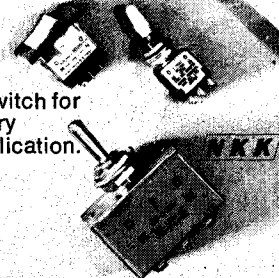
7. Scope Soldering Irons.



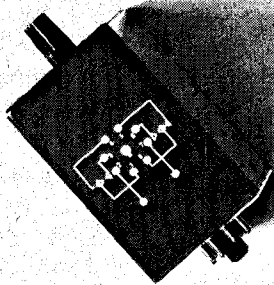
14. Oil Tight Switches.



8. A switch for every application.



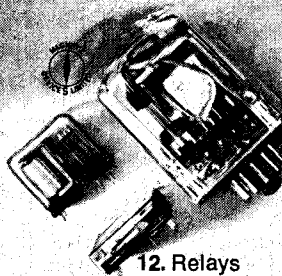
13. Solid State Time Delay Relays.



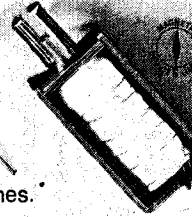
11. Magnetic Reed Switches.



12. Relays A.C. & D.C.



10. Solenoids.



9. Neon Indicator Lamps.



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

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- Qld. Underhill & Day Co. Pty. Ltd. Phone 70 2141. 10 to 15
- N.S.W. Total Electronics. Phone 412 1635. 10-11-13-15
- Vic. Total Electronics. Phone 96 2891. 10-11-13-15

Please send me catalogues on the products indicated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----

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## Kitsets Radio

easy  
to build



Post Free **\$5.70**

Build this TANGENT transistor radio with our easy-to-wire kit. All you need is a small soldering iron to assemble. Complete with crystal earpiece. No technical knowledge required... full instructions how to assemble enclosed. (Price does not include batteries.)

## Amplifier

Latest solid state audio power amplifier Type AMP 5W. Specifications:  
Output power 4.5W RMS.  
Gain 46dB.  
Bandwidth 30Hz to 20 kHz 2dB.  
Harmonic distortion <0.5% at 1W RMS.  
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**\$8.70** In kit form  
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Easy to assemble from kit and instructions or supplied fully assembled and tested.

Use (1) In your new stereo project (2-amps required). (2) Inter-com. (3) Baby alarm.

Optional Extra: Power supply Type PS5W for AMP 5W amplifier will drive two amplifiers.

**\$9.00** Fully assembled/tested  
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**TANGENT ELECTRONIC**

**SALES CO.** 169 Jasper Rd., Bentleigh  
Vic., 3204. Tel.: 97 7600

## EQUIPMENT NEWS

on ac mains power with consumption of 75VA, requiring no fan for cooling. It weighs 31 pounds without the front cover.

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

### ELECTRONIC PHASEMETER FOR EDUCATIONAL PURPOSES

An electronic phasemeter developed by Britain's Farnell Instruments gives clear and definite indication. It needs no setting up, making it particularly suitable for educational use.

Phase differences between two channels are shown on a 180 degree meter, and two lamps of different colours indicate whether one channel leads or lags behind the other. The frequency range is 10 Hz to 100 kHz and the accuracy is claimed to be  $\pm 5^\circ$ .

Input levels may be between 50 mV peak-to-peak and 50 V peak-to-peak. There is protection against overload. Input impedance is 1 Megohm for each channel. Distortion in input signals is to some extent automatically corrected.

Further details: Warburton O'Donnell Ltd, 372 Eastern Valley Way, Chatswood, N.S.W. 2067.

### INTERFERENCE AND INTENSITY ANALYSER

A new radio interference and field intensity analyser has been introduced by Singer Instrumentation.

Special features of the two models, the NM-12AT and NM-25T, include measurement of average field intensity, peak and weighted quasi-peak; battery/ac operation and high spurious rejection and sensitivities.

The NM-12AT model covers a range of 10-250kHz while the NM-25T model extends from 150kHz to 32MHz. Applications include analysis of interference characteristics, interference source investigation, random/impulse broadband noise measurement, qualification testing, communication site selection and directional antenna adjustment.

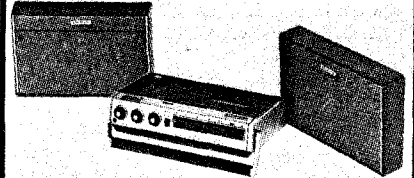
Both models are all solid-state, hand portable meters, and are claimed by the distributors to be precise enough for the laboratory and rugged enough for the field.

Both instruments are stated to be simple to operate, stable, easily read and may be used for 40 hours continuously without recharging the integral battery pack.

They are said to be ideal for surveys to determine the source and analyse the characteristics of radiated and conducted radio interference. Other typical uses include, field intensity measurements for communication site selection; adjustments of directional antennas; investigation of antenna radiation patterns; time station checks; measuring random and broadband noise; qualification testing to applicable specifications and precision laboratory measurements including r-f voltmeter and null-bridge applications.

Further details: DC Electronics Pty Ltd, 32 Smith Street, Collingwood, Vic. 3066.

BUY NOW ON MAIL ORDER



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AMPLIFIERS, SPEAKERS, TAPE RECORDERS, DECKS, CASSETTE RECORDERS, RADIOS. GIVE YOUR REQUIREMENTS AND DESCRIBE EXACTLY YOUR PRESENT SOUND EQUIPMENT.

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**AF-1 Noise Reducing Aerial Kit**



This AF-1 aerial system is for use in noisy locations for clearer reception. It is designed to cover both M/W and S/W broadcast bands (from 500 to 1500 KHZ and 2 to 15 MHZ Approximately). Available in all States. Write for our illustrated leaflet.

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Phone 49 1017, 49 6792. P.O. Box 49  
Thornbury, Vic. 3071



# When it comes to fine stereo amplifiers... a Marantz is a Marantz is a Marantz.

That means Marantz not only makes the finest most impressive stereo equipment in the world, but also the finest least expensive stereo equipment. Take the Marantz Model 1030 stereo amplifier for only \$199. You are getting 15 watts RMS per channel across the entire audio band width. You are also getting the same Marantz prestige, the same craftsmanship, and the same Marantz quality offered in our most expensive equipment.

**\$199**

If you are a purist and willing to pay for perfection, then you want the finest, most expensive stereo console amplifier in the world, the Marantz Model 1200. Yes, it is a cool \$1000 with optional walnut case. It is the best stereo amplifier money can buy and will more than justify your investment.

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Same name, same quality regardless of price. That's Marantz superior quality inherent in the full line of amplifier systems from \$1500 to as low as \$199. **marantz**®  
We sound better.

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what would you expect to pay  
for a pair of

## CELESTION DITTON 25

speakers?

\$800? \$900? \$1,000? \$1,200?

Not at all. Prices in these areas are for the "Joneses" with whom we feel we have to keep up. But you can not only keep up with the Joneses — you can surpass them with a pair of Celestion Ditton 25 speakers under \$550.

Pleasant surprise?

But an even more pleasing factor than the price is the performance! Celestion Ditton will produce all musical frequencies with the utmost realism. Five drive units cover the range from 20Hz to 40kHz.

Electronics Australia said: "One of the most stringent specifications on any speaker regardless of price. Probably one of the finest loudspeakers ever introduced to the Australian market"

The design utilises the highly successful Auxiliary Bass Radiator to extend the low frequency response so that even organ pedal notes etc., are reproduced with superb realism.



Technically: Size 32" x 14" x 11"  
Overall Frequency response: 20Hz to 40kHz  
Power handling capacity: 25 watts RMS, 50 watts peak.  
Impedance: 4-8 ohms  
Drive units: 12" Auxiliary Bass Radiator, 12" long throw bass speaker, 2 pressure type mid and high frequency units, 1 pressure type ultra high frequency unit.

Write for reviews on Celestion Ditton 25 and Ditton 10 Mk II (under \$160 pr.), Ditton 15 (under \$240 pr.), Ditton 120 (under \$180 pr.), or hear them at specialist Interdyn agents.

N.S.W.: Ence Electronics Pty. Ltd. 260 Elizabeth St., Sydney. Tel. 212 3722.  
Q.L.D.: Stereo Supplies, 95 Turbot St. Brisbane, 4000.  
S.A.: Challenge Hi-Fi Stereo, 6 Gays Arcade, Adelaide.  
TAS.: Audio Services, 72 Wilson St., Burnie.  
VIC.: Ence Electronics Pty. Ltd., 431 Bridge Road, Richmond. Tel. 42 3762.  
W.A.: Albert TV-Hi-Fi, 282 Hay St., Perth, 6000. Tel. 2-5993.

SOLE AUSTRALIAN DISTRIBUTORS:

**INTERDYN**

To: International Dynamics (Agencies) Pty. Ltd.  
P.O. Box 205 Cheltenham. Vic. 3192.

## EQUIPMENT NEWS

### NEW STANCIL HOFFMAN LOGGING RECORDERS



A number of improvements incorporated into the new series of Stancil Hoffman logging recorders, now being handled by Plessey Electronics for Australia and New Zealand, are claimed to provide significant operating advantages at almost the same cost as for the earlier models.

The new series, CRM 7-14-28, incorporate the following features:-

Exclusive pre-aligned, in-line heads, provide a 40 per cent increase in channel capacity e.g. up to seven channels on 1/4" tape, 14 channels on 1/2" tape and up to 28 channels on 1 inch.

Automatic gain control is now standard on all channels.

Simple expansion facility provides for increased channel capacity.

Variable speed rewind/forward control is incorporated for rapid message search.

Plug-in colour-coded modules simplify maintenance and channel capacity expansion.

Twenty-five hours continuous recording may now be made on one seven inch reel of tape.

A new accessory device now available is "Digitime," together with an extended 'auto search' facility. Digitime is a unique system for recording time in binary digital-format, updating every second to make possible very accurate message timing. Illuminated digits display times during record and play back, with readings possible at maximum forward or rewind speeds.

Automatic or manual search is available on the new models, the latter being controlled by a variable speed rewind/forward knob.

The new automatic search facility accessory permits any selected time to be automatically located within 2 1/2" of tape length within a few seconds. Operators' time is greatly reduced if searches are carried out regularly.

Further details: Plessey Electronics Pty. Limited, 91 Murphy Street, Richmond, Vic. 3121.

# TEAC brings you the consummate in stereo cassette decks.

Here are three that sum up the best of TEAC technology.

Common to them all is a transport and hysteresis-synchronous drive motor so precise and fool-proof that they can hold their own with some of the best open-reel types. Beyond this, the differences begin. Each model has a package of add-ons for your particular needs.

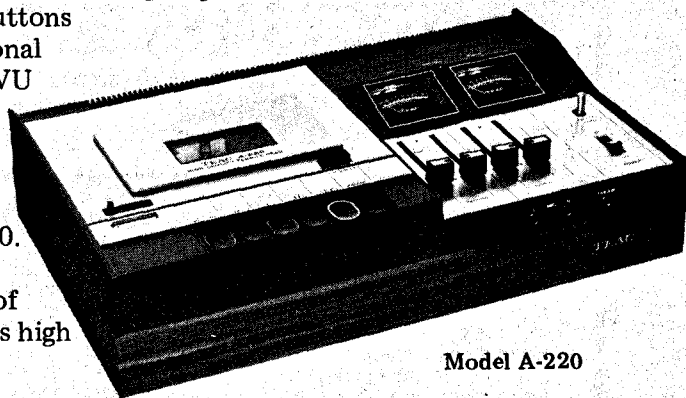


Model A-210

If all you need is a basic superior deck that can economically record and playback on conventional tape within a frequency response range of 30-12,500Hz, you'll want to look into the A-210. It's outer rotor drive motor holds wow and flutter down to a negligible 0.15%. Separate stop and eject buttons. Low-noise solid-state electronics. Contoured fingertip-control pushbuttons for all operational modes. Large VU

meters. Sliding scale record-playback level controls. Standard phone jacks for professional-style 600-ohm mikes and 8-ohm headsets. Strobe-type running light.

If you're looking for a deck that can handle the new chromium dioxide tapes, you should look into the TEAC A-220. It has the add-on feature of a tape selector switch in the CrO<sub>2</sub> position, provides recording and playback frequency response of 30-16,000Hz. As an added convenience, the A-220 incorporates high density ferrite heads and separate record and output level controls.



Model A-220

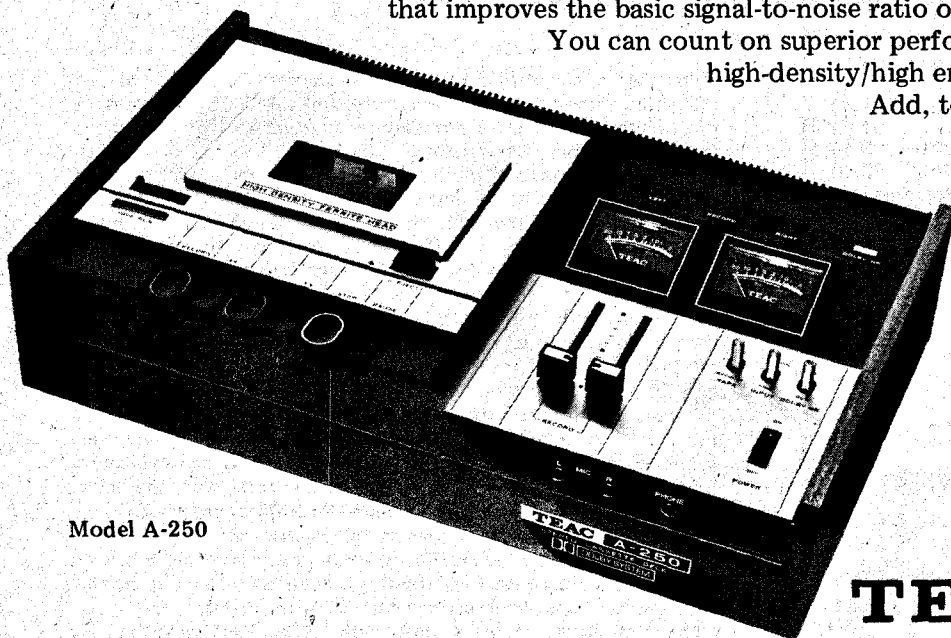
But if you're looking for the definitive Dolby deck with everything you need for near-professional operation, only the A-250 will do. It has TEAC's high-density ferrite heads. These "brown jewels" are so extraordinarily durable that

we warranty them for the original owner's lifetime. Add to these a Type B Dolby System that improves the basic signal-to-noise ratio of the A-250 by an additional 10 dB.

You can count on superior performance from conventional, high-density/high energy, and chromium dioxide tapes.

Add, too, the large expanded-scale VU meters for distortion-free recording at optimum levels and signal-to-noise ratios.

What it all adds up to is that each TEAC cassette deck is the finest available for your particular needs — whatever they are.

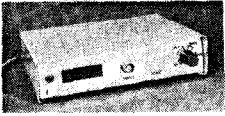


Model A-250

If you'd like to know more write to us for the TEAC Catalogue, price list and franchised dealer list.

**TEAC**. A SOUND IDEA  
 Sole Australian Distributors:  
 Australian Musical Industries Pty. Ltd  
 155 Gladstone St., South Melbourne,  
 Victoria 3205. Ph: 69-7281  
 619 Pacific Highway, St. Leonards, NSW 2065  
 Ph. 439-5752

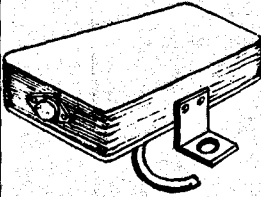
## DIGITAL FREQUENCY METER



Now available in kit form, this 1HZ - 15 MHZ DFM features a led display - kit does not include Readouts.

PRICE: \$74.50 POST \$2.00

## C.D.I.



A proven Mullard circuit that can give GUARANTEED results. All NEW PARTS used with pre-wound primary transformer. Full instruction booklets provided. Unit is

housed in a strong diecast box. Suits positive or negative 12V vehicles.

**SPECIAL PRICE UNTIL CHRISTMAS**  
\$20.50 + \$1.00 Post.

## NEW SYDNEY SALES DEPT

Now open at 230 Sussex St. Full stocks of components & Hi-Fi gear at Australia's best prices. No nonsense, self service facilities available. See the latest Kits on display. Phone 29-1005.

## INTEGRATED CIRCUITS

cut out for future reference

SN7400N	90c	SN7491AN	\$2.00	CA3048	\$12.10
SN7402N	90c	SN7492N	\$1.90	CA3052	\$9.00
SN7404N	\$1.00	SN7493N	\$1.90	LM301A	\$2.10
SN7410N	.90c	SN74121N	\$1.35	LM308	\$12.10
SN7413N	\$1.20	UA301A	\$2.10	LM370	\$5.63
SN7420N	.90c	UA709C	\$1.10	LM372	\$4.80
SN7430N	.90c	UA710C	\$1.90	MC724P	\$1.90
SN7440N	.90c	UA723C	\$3.40	MC725P	\$1.90
SN7441AN	\$3.00	UA739C	\$4.20	MC726P	\$2.35
SN7442	\$2.45	UA741C	\$1.50	MC776P	\$3.50
SN7446N	\$5.20	UA747C	\$8.00	MC788P	\$2.35
SN7460N	\$1.00	UA748C	\$2.05	MC790P	\$3.60
SN7470N	\$1.50	UA749C	\$3.30	MC792P	\$1.95
SN7472N	\$1.30	FUL900	\$1.00	MC799P	\$1.95
SN7473N	\$1.50	FUL914	\$1.00	MC1469R	\$4.75
SN7474N	\$1.50	FUL923	\$1.90	PA263	\$4.85
SN7475N	\$2.00	CA3018	\$1.95	SL403A	\$6.10
SN7476N	\$1.50	CA3020A	\$7.50	SL403D	\$5.50
SN7480N	\$1.60	CA3026	\$2.70	TAA300	\$2.95
SN7482N	\$1.90	CA3028A	\$4.40	TAA521	\$1.10
SN7483N	\$2.60	CA3036	\$2.50	TBA221	\$1.50
SN7490N	\$1.90	CA3046	\$1.95	TBA281	\$3.40
				TAA840	\$3.20

Once again, we offer these devices at Australia's best prices.

All available by return Post. (20c)

## SPEAKERS

MAGNAVOX 8.30 8 or 15 ohm	\$17.00
MAGNAVOX 3TC 8 or 15 ohm	\$3.75
PHILIPS TWEETER SPECIAL:	\$20.50 per pair.
Postage on above Speakers: \$1.00.	

## KIT-SETS AUST

MAIL ORDER DEPT: P.O. Box 176 Dee Why. 2099.  
SYDNEY SALES DEPT: 230 Sussex St. Phone 29-1005

NORTHSIDE SALES DEPT: 2/21 Oaks Ave. Dee Why. Phone 982-5571.

BRISBANE SALES DEPT: 293 St. Pauls Terrace, Fortitude Valley. Phone 52-8391.

Canberra Distributor: Electro Pak. 5 Garama Arcade.

# BOOK REVIEWS

REVIEWER: Brian Chapman

## NEWNES RADIO ENGINEER'S POCKET BOOK

14th Edition

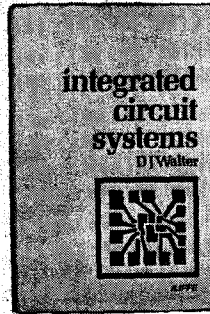
NEWNES RADIO ENGINEERS POCKET BOOK. Revised by H.W. Moorshead. Published 1972 by Butterworth and Co. Hard covers, 188 pages 4 1/4" x 3". Review copy supplied by Butterworths. Australian price \$4.25.

This little pocket-book is a valuable compendium of radio facts, figures and formulae, which are indispensable to the designer, student or electronic hobbyist.

The new edition has been completely revised, a lot of obsolete information deleted, and much new material added.

Everything necessary is included, from wire tables to mathematical tables, television radio and time standards, network theorems etc. etc.

If you are forever trying to find the right tapping drill, what gauge wire to use, or, what was that transformation theorem? - this little book is for you. - B.C.



INTEGRATED CIRCUIT SYSTEMS by D.J. Walter. Published by Hiffe Books London 1971. Hard covers, 228 pages 8 1/2" x 5 1/2". Review copy supplied by Butterworths (Australia) Pty. Ltd. Australian price \$11.70.

No one in electronics can now be unaware of the impact of integrated circuitry on modern technology. Indeed, IC useage in professional equipment is probably rivalling, on a component count basis, that of discrete transistors.

This book is aimed at the practising engineer and students in the last years of degree or diploma courses. It is assumed that the reader has a knowledge of transistor circuitry, Boolean algebra and binary counting. The level of the book is adequate to achieve understanding of simple digital systems such as desk calculators and digital voltmeters.

The first chapter deals with basic forms of integrated circuits and then deals with factors affecting reliability, and the calculation of system reliability. This chapter gives a clear and concise treatment of a subject which is too often neglected in most textbooks.

Manufacturing processes are then discussed, epitaxial and thin and thick film included. The discussion includes brief details and formulae for component design within the various methods and I found it very interesting reading. This contrasts with the more pretentious texts which invariably make this subject very dull.

Chapter 3 describes the various basic logic gates and uses these as a basis for expounding the manipulative rules of Boolean algebra. This is followed by a chapter on flip-flops, counters and registers, and then another on arithmetic, error-correction and codes.

The last three chapters deal with MOS logic systems, IC operational amplifiers and D to A, A to D converters in that order. In all, the book is clearly written and conveys the information in a manner which makes for interesting reading. I would like to see an expanded version of this text covering much greater territory, as it is, it needs supplementing with other texts to provide a well rounded education in integrated circuit technology. But it is thoroughly recommended. - B.C.

Woody Herman chose AR-2ax speaker systems for his listening at home. The sound of live music, be it rock or big band, is reproduced accurately on AR equipment.



The accuracy with which AR speaker systems reproduce music serves as a valuable tool for many notable musicians. Among the most notable is Woody Herman, whose big bands have long enjoyed great success. His secret seems to be an ability to stay in tune with the evolution of musical styles, as is documented by the Herd's latest recordings. In spite of a schedule of more than 200 concerts every year, Mr. Herman can sometimes relax in the seclusion of his Hollywood home. Here, he listens to a high fidelity system consisting of an AR receiver, AR turntable with Shure V-15 type II cartridge, and a pair of AR-2ax speaker systems.

The low frequency speaker cone of the AR-2ax uses a newly developed material and process of manufacture which makes its absorption of high frequencies very high, suppressing a form of colouration frequently found in conventional cones its size. The circular suspension ring around the cone is also of a new material, silent and highly stable. The voice coil is a new high temperature design, triple insulated and wound on a former of Du Pont Nomex. The mid range speaker is a small, high dispersion cone type.

The high frequency unit is the same miniature hemispherical device as is used in the AR5 and AR3a and is the best high frequency speaker we know how to make.

The workmanship and performance in normal use of AR products are guaranteed from the date of purchase; 5 years for speaker systems, 3 years for turntables, 2 years for electronics. These guarantees cover parts, repair labour and freight costs to and from the factory or nearest authorised service station. New packaging if needed is also free.

The AR catalogue and complete technical data on any AR product are available free upon request.

**AR-2ax recommended retail price \$285**



**Acoustic Research Inc.**  
Massachusetts, U.S.A.

All AR audio equipment is on demonstration at the AR Music Room in the Sydney showrooms of the Australian Distributors.

Australian Distributors

**W. C. Wedderspoon Pty. Ltd.**

193 Clarence Street, Sydney. 29-6681

AR sound equipment may be purchased from the following Australian Dealers:

N.S.W.: Magnetic Sound, Sydney. 29-3371. Sydney Hi-Fi, Sydney. 29-1082. VIC.: Brasch's, Melbourne; Douglas Trading, Melbourne. 63-9321. S.A.: Sound Spectrum, Adelaide. 23-2181. A.C.T.: Homecrafts, Canberra. 47-9624. W.A.: Leslie Leonard, Perth. 21-5067. Alberts T.V. & Hi-Fi Centre, Perth. 21-5004. QLD.: Brisbane Agencies, Brisbane. 2-6931.



# We're in step with the "one small step"...\*

...the giant step made by Armstrong as he became the **first man on the moon** ... 3 years ago.

Sophisticated electronics made this possible...and that's where Jacoby Mitchell is right in step **today** ... first in every facet of **new development in electronics**.

Our association with electronics started 37 years ago.

Since then we have continually widened our horizons until today we market a complete spectrum of instruments...from simple multimeters to complex RF analysis equipment...from internationally respected principals.

Constant contact with these principals, and the expertise of our own staff, enables us to instal and

service every item to the client's complete satisfaction.

You'll find Jacoby Mitchell good people to do business with...and to keep in step with your instrument needs.

*\*\*\*That's one small step for a man,  
one giant leap for mankind\*\**  
— Neil Armstrong July 20, 1969

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# ELECTRONIC COMPONENTS, TESTS & MEASURING EQUIPMENT EXHIBITION



*Our lead picture shows North Atlantic Industries Model 213 solid state phase angle voltmeter. The instrument measures in-phase voltage, quadrature voltage, and phase angle, relative to an arbitrary reference voltage; uses a built-in filter to measure the harmonic-free "fundamental" component of input voltages; and bypasses the filter to measure "total" input voltage (as with an ordinary ac voltmeter). The meter may also be used as a phase-sensitive null detector with a two micro-volt resolution. The manufacturers are represented in Australia by Ronald Payne Pty. Ltd.*

**T**WENTY-THREE Australian agencies will represent 78 U.S. Principals at the Electronic Components, Test & Measuring Equipment Exhibition to be held at the United States Trade Center, 37 Pitt Street, Sydney from November 6th through November 10th.

Equipment on display will have a variety of uses ranging from polar cap exploration, medicine and underwater research, to more conventional laboratory and plant applications.

Almost a score of the instruments on display will be new to the market in Australia while a number will be making their world debut.

About half of the Trade Center's 4,000 sq. ft. of exhibition space will be given over to electronic components and the other half will be devoted to test and measuring equipment.

As the Exhibition is a 'trade only' presentation, admittance is by ticket/invitation. Admission tickets are free and may be obtained by contacting the U.S. Trade Centre directly.

Their address is: The Director, U.S. Trade Centre, P.O. Box R307, Royal Exchange, N.S.W. 2000.

In conjunction with the exhibition, a seminar will be held at the Australia Square Auditorium on Tuesday November 7 and Wednesday November 8.

The first day will be devoted to Components while the second day will be taken up with Test and Measuring equipment.

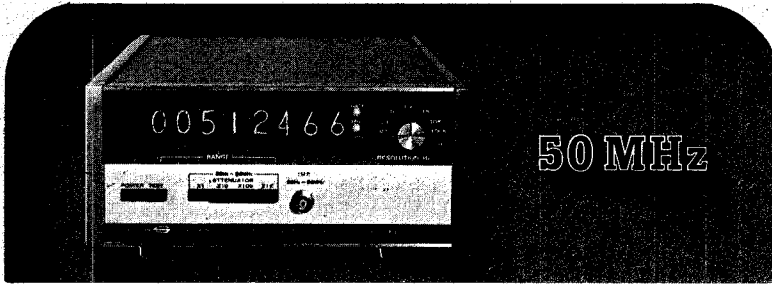
## **COMPONENTS SESSION — Tuesday November 7.**

Donald W. Marshall, General Electric Co. "Silicones for the Electronics Industry".

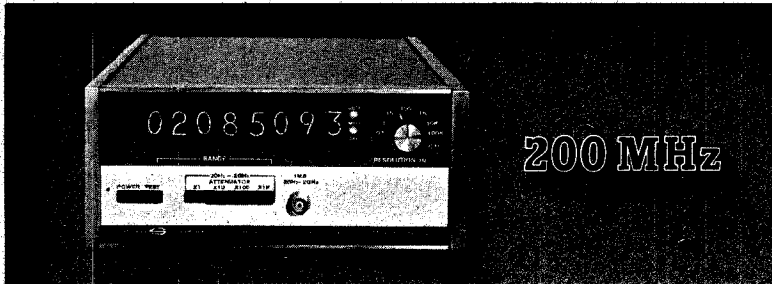
Walter F. Kalin, Solid State Scientific Inc. "The Growing Complementary MOS Logic Family." Edwin Schoell, National Electronics. "Tristate, MOS and LSI applied to Mini-computers and Calculators".

# Right for the times

## Systron-Donner's Unique 6050 Series



50 MHz



200 MHz



512 MHz



3 GHz

### Model 6050, 20 Hz to 50 MHz Frequency Counter

Lowest in cost at \$770, but offering the same high performance features as the higher frequency units. A new input amplifier design combines low sensitivity with high input impedance - 10 mV rms into 1 MΩ. Input signals may be attenuated by factors from 1 to 1000 in decade steps. Measurements can be read with the most desirable resolution, available in decade steps to as low as 0.1 Hz. Comes a future requirement for measuring frequencies up to 200 MHz, you simply insert a new PC card and the 6050 is upgraded to a 200 MHz frequency counter. Upgrading to ranges beyond 200 MHz is also available through any Systron-Donner Service Center.

### Model 6051, 20 Hz to 200 MHz Frequency Counter

Frequencies up to 200 MHz are counted directly by the 6051. The up-to-date front panel pushbutton controls reflect on the outside the new advances in componentry on the inside. Modular, expandable internal circuitry design makes it possible to add any option *after* initial purchase. The same counter can thus satisfy unforeseen application requirements.

### Model 6052, 20 Hz to 512 MHz Frequency Counter

This unit combines a 200 MHz direct counting range with an automatic prescaler to cover the entire frequency spectrum to 512 MHz. For communications work engineering labs, production testing, checkout and calibration applications, the 6052 is the most modern VHF-UHF counter available today.

### Model 6053, 20 Hz to 3 GHz Frequency Counter

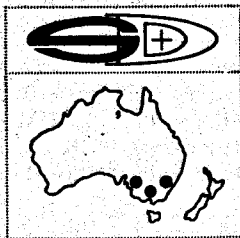
Using automatic computing transfer oscillator (ACTO®) techniques, the 6053 enables automatic measurements of continuous wave and amplitude modulated signals to 3 GHz. High readout resolution (0.1 Hz) makes this unit ideal for both systems and bench applications. All measurements are counter accurate ( $\pm 1$  count,  $\pm$  crystal stability) and the input frequency is automatically tracked.



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Choice of three models with manual, automatic, or convenient combination of both for measurements from 20 Hz to 18 GHz. Measure CW, FM or pulse modulated carriers down to 0.1  $\mu$  sec pulse width.

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CW with Amplitude Modulation	Fully Automatic	Fully Automatic or Manual	Manual
FM Modulated	No	Manual	Manual
Pulsed RF	No	Manual	Manual



### SCIENTIFIC DEVICES AUSTRALIA PTY. LTD.

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Cables: Devices Melbourne



followed by a review of "What's New in Semiconductors".

Speaker to be advised, Fairchild, Australia Pty. Ltd. "The State of the Art in Semiconductor Technology".

Bob Beard, National Semiconductors. "Evolution of High Reliability Moulded DIP".

#### TEST and MEASURING SESSION — Wednesday November 8.

Roland R. Stoker, Scientific Atlanta "Microwave Measurement".  
Gene Goodrich, Statham Instruments. "Thin-film Vacuum Deposited Strain Gauge Transducers".

Paul Williams, Tektronix. "Recent advances in Storage Tube Technology".

John Keen, Jacoby Mitchell. "Use of Correlators and Real Time Analysers.  
Rod Perry, Fairchild (Computer Division) "Computer Based Data Logger System".

Bookings for the Seminar are already being processed. Requests for further information and applications for attendance should be addressed to the Director, U.S. Trade Centre, 37 Pitt Street, Sydney, 2000.

A fee of \$30 is charged for both days while a \$15 fee is applicable where attendance is desired at only one session.

## EXHIBITORS

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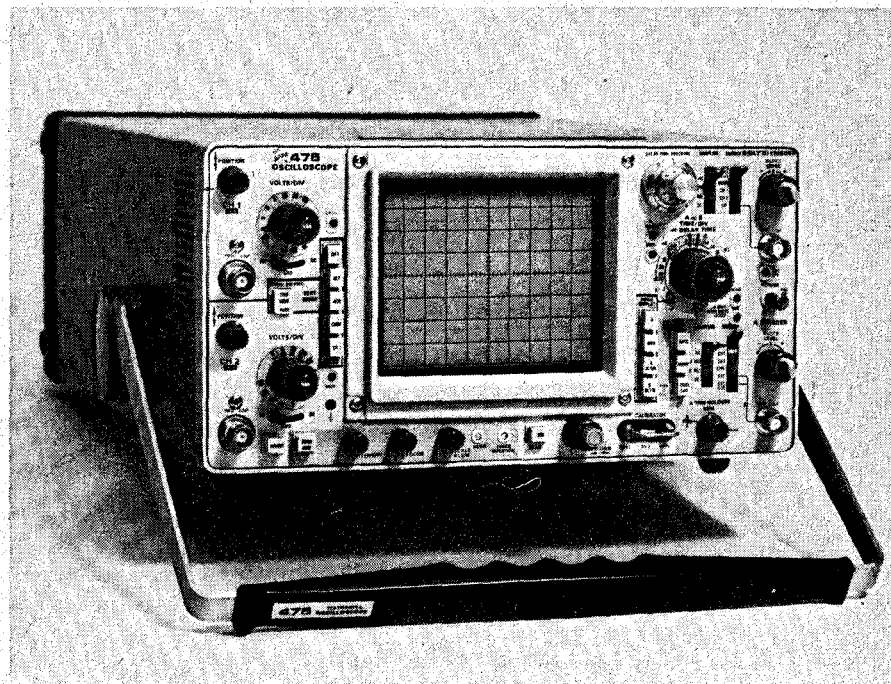
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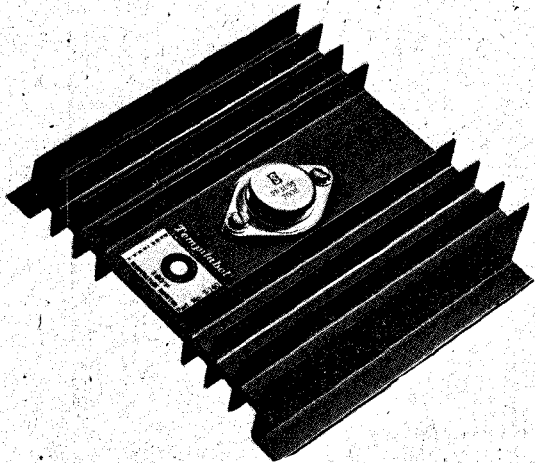
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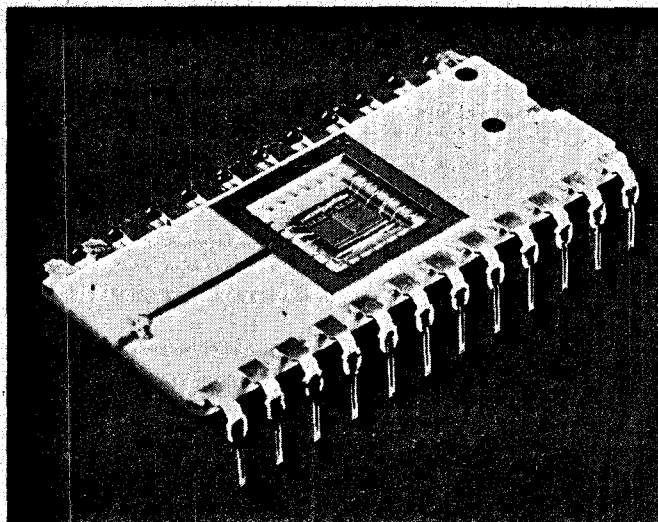
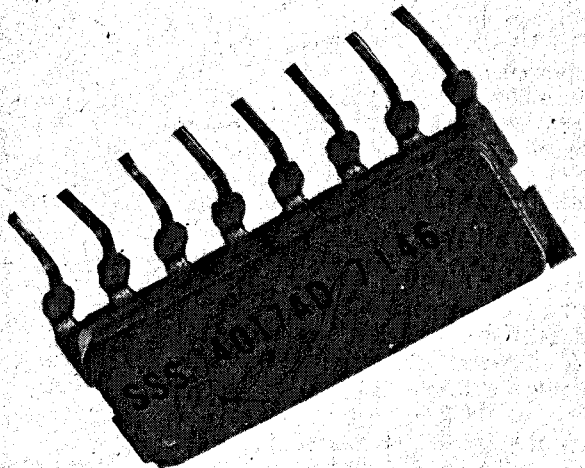
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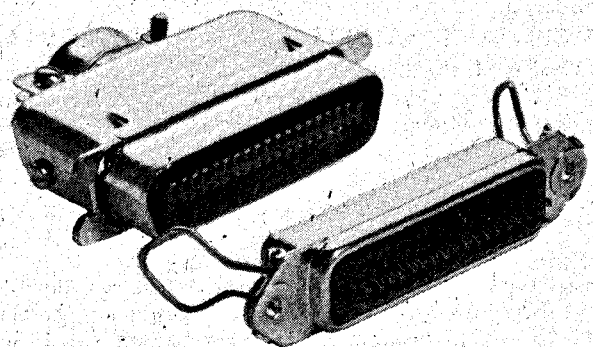


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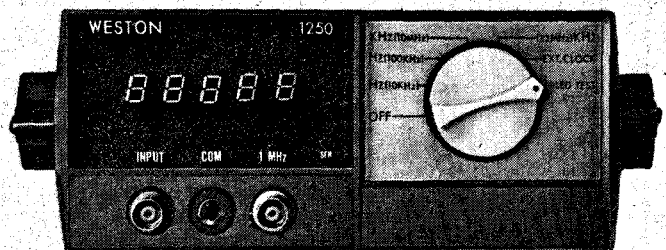
Vector Voltmeter model 2020 and 2021 sampling head, and model 904-AS2 noise generator.

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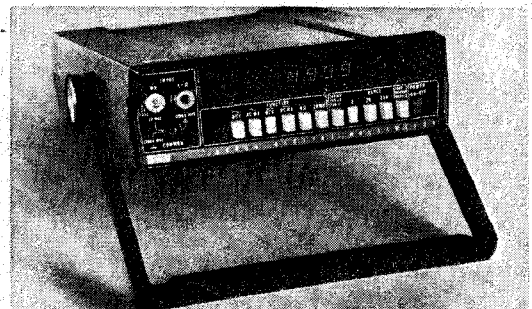
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3101. Displaying:

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**SANGAMO ELECTRIC COMPANY,** 1301 North  
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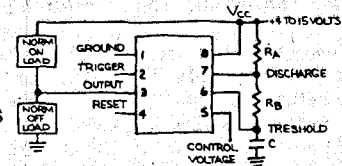
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# signetics

TECNICO ELECTRONICS



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# RECORDINGS... CLASSICAL

REVIEWERS: Tanya Buchdahl  
John Araneta, C.M. Wagstaff.

**MOZART:** Missa Brevis in C, K.257 ('Credo'); Mass in C, K.317 ('Coronation'). Helen Donath, Gillian Knight, Ryland Davies, Clifford Grant, Stafford Dean; John Alldis Choir, L.S.O./Colin Davis. Philips SAL 6500-234 (\$6.20).

Another to join the recent crop of quality choral performances — this one exudes enthusiasm from beginning to end, something which is absolutely necessary for Mozart's masses. The joyousness in them was counter to the customary idea of solemnity and proper reverence in liturgical music, to the point of profanity, but the simple faith in God shines through without question.

The 'Credo' Mass (so called because of the peculiar four-note cry "Credo!") is very early, but from the very first "eleison" is unquestionably Mozartean. Unlike much of his later choral work it is almost anti-coloratura, but it has a definite unity in themes which are short, blunt, but punch home the point. The 'Coronation' is a considerable development on this stage. To begin with, there is less awkwardness in fitting the words to the music, more thematic variety, more drama. An interesting comparison, particularly on this last point, is afforded by a Turn-about recording by the Vienna Pro Musica and Oratoria Choir conducted by Jascha Horenstein. In short, the Horenstein pays less attention to detail than the Davis (now that we are in a period of musical purism) but is perhaps a little tighter; conversely, the Davis has the great advantage of making the words distinct. It also managed the crossovers between the Osanna and Benedictus which can be outright clumsy. The soloists in the Davis are a little far from the microphones to have a chance, probably the only recording deficiency on the record, but the echo (presumably recorded in a church) at the end of each movement is magnificent — the Horenstein has unfortunately had all the sections spliced to such an extent that it sounds as if it had been recorded in a shoebox.

Helen Donath suffers by comparison with the wonderful Wilma Lipp. I am thinking in particular of the thunderous climax to the entry "Et in spiritum sanctum Dominum" which just doesn't come off (partly due also to distance from the microphone. But she sings the pseudo-aria 'Agnus Dei' with such loving care that I suspect she is more at home with Lieder than oratorio.

The nicest thing about this recording is its consideration for Mozartean colouring and balance which is often carried to excess in pussyfooting delicacy, though all but

abandoned in his (non-operatic) choral works. It may have something to do with the large number of Late Romantic editions in use; but it is good to see the Mozartean essence here. Thoroughly recommended. T.B.

1. **MOZART:** Symphonies Nos. 34 (Haffner) and 40; March K.408/2.
2. **HAYDN:** Symphonies Nos. 52 and 53 (L'Imperiale).
3. **BEETHOVEN:** Symphonies Nos. 1 and 2.
4. **J.C. BACH:** Six Symphonies Op.3. Academy of St. Martin-in-the-Fields/Neville Marriner. Philips Stereo, 1; 6500-162. 2; 6500-114. 3; 6500-113. 4; 6500-15.

In the set form in which these four records were originally issued as "The Rise of the Symphony", there was the disadvantage of possibly obtaining multiple copies of one or more of the works (not to mention the slightly odd choice of title for such a limited number of selections). Though still available in the set, it is a stroke of good common-sense to issue them separately.

The Academy's crisp and exact sound is ideal for all four composers who span the Classical period. It is heartening to see a recording of the insufficiently recorded works of 'the English Bach', and a little curious to hear the more common first two Beethoven symphonies played as they should be; that is, with a chamber rather than a full-size orchestra which also bears in mind that these works are not at the beginning of the Romantic style but still very much in the Classical tradition of Haydn and Mozart (the Academy uses First-or Urtext editions).

The sprightly happiness which makes the two middle-Haydn works such a success does not, unfortunately, work as well in the Mozart No.40, which stands in relation to No. 41 as Beethoven's 4th Piano Concerto stands in relation to the 5th, or as 4th Century Greek sculpture stands to Hellenism. Whereas the latter in each pair has qualities of the superartist, shown for instance in high drama and which earns it descriptions like 'Olympian' (note the nicknames "Jupiter" and "Emperor" for No.40 and the 5th, respectively), the former in each pair reaches the supreme balance of reason in its particular art form or style. There is a certain tendency to comfortableness, bordering sometimes on complacency, in this performance (but not in the "Haffner", which is quite exquisite and some of the best Mozart playing available) which cannot in any circumstances supplant the gentleness of reasoned experience.

Dwelling on the deficiencies of this one side should not however detract from the rest; the cover notes are better than most, the production is excellent, and the records are to be thoroughly recommended. — T.B.

**HANDEL — Oboe Concerti; Concerto grosso, Op.3/3; Sonata a 5 in B-flat.** Heinz Holliger (oboe), Kenneth Sillito (violin) English Chamber Orchestra, Raymond Leppard (cond.) PHILIPS SAL 6500 240.

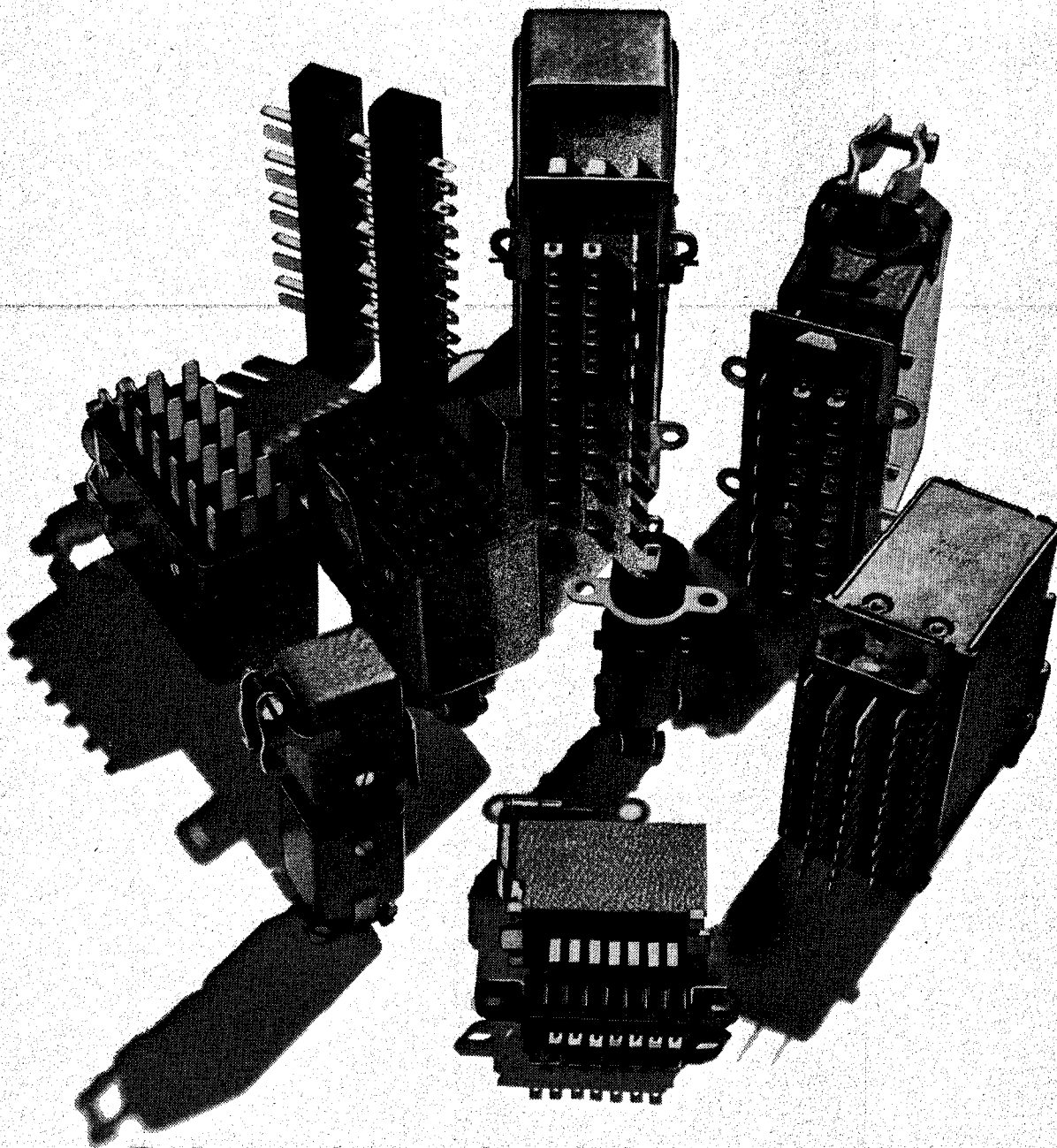
With at least three other fine recordings of the oboe concerti already available and more important Handel otherwise unavailable, I must consider this disc a rather useless bit of duplication. Holliger, not surprisingly, elicits very lovely sounds from his instrument. Unfortunately, the tempos and phrasing are strangely languorous, very slow, and definitely non-baroque. Grave is surely not just an adagio, yet Leppard's distinction between movements can hardly be called marked. Where are the accents, the dotted rhythms so characteristic of Handel's music? All in all, I do not find much consideration for proper performance practices here. Presumably, Leppard plays continuo but his harpsichord is rather faint sounding and in any case the playing lacks interesting invention and does not help to accentuate rhythms at all.

There are certainly other recordings of this music preferable to this one: the Goossens-Menuhin performance on HMV ASD-500, the ARCHIVE recording (SAPM 2533 079) using original instruments, and my own particular favorite, the Lord-Marriner performance on ARGO ZRG-5442. Compare the present recording with Marriner's if only to confirm how important dotted rhythms are for this music. The Concerto grosso here is also rhythmically slack and embellishments sound as if they were tacked onto the music for their own sake. Once again how much more preferable it is to hear Marriner's reading on ARGO ZRG-5400 with its sense of stylish elegance and strong grace.

The inclusion of the Sonata a 5 is interesting since it contains material from the second oboe concerto. Sillito's violin playing is very fine but his style and the general atmosphere of the playing is certainly more suited to Bruch than Handel, and that elaboration of the solo in the adagio is simply overblown and tasteless. Definitely alla Giazotto.

Recording is good with the exception of that faint sounding harpsichord but a more judicious spacing would have given us the G minor concerto complete on one side. J.A.A.





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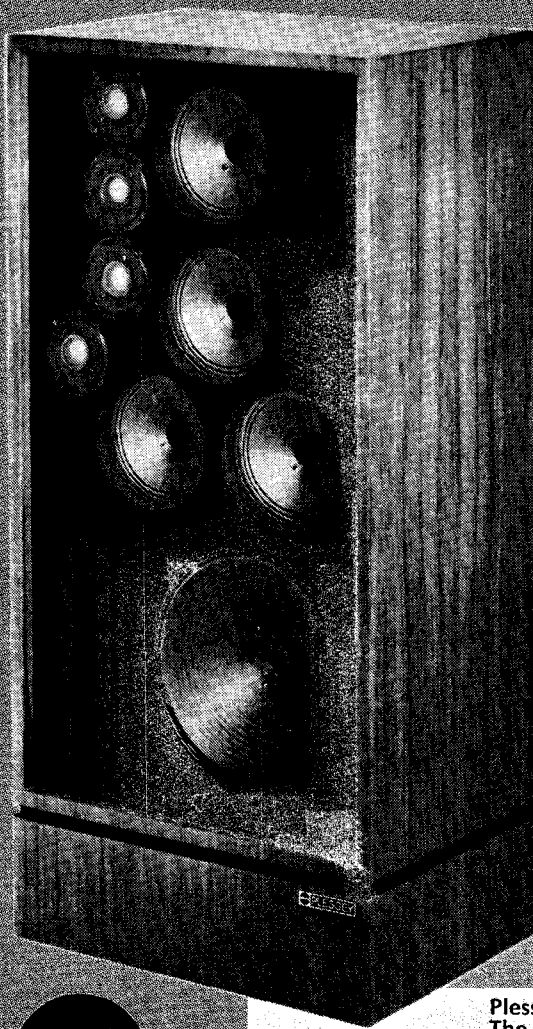
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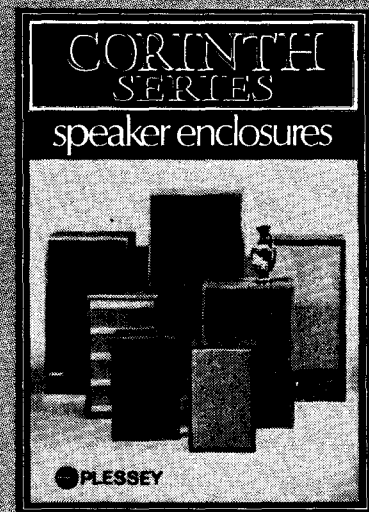
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# RECORDINGS... POP TRENDS

REVIEWER:  
Michael Delaney.



"Grateful Dead" - Grateful Dead. Kinney. Stereo. 2WS. 1935. "Quicksilver" - Quicksilver. E.M.I. Stereo. SW. 819. "Garcia" - Jerry Garcia. Kinney. Stereo. BS. 2582. "Powerglide" - New Riders Of The Purple Sage. C.B.S. Stereo. SBP. 234116.

Whatever energy-flux created the 'Frisco music scene of the mid sixties is still a question open wide for argument. Certainly two of the mainstays within that milieu were the Grateful Dead and Quicksilver Messenger Service. The other flash points in the Haight-Ashbury pentangle were Country Joe & The Fish, Jefferson Airplane and Big Brother & The Holding Company.

Here are four albums that come pretty close to paraphrasing the demise of that musical parlay. Each of the above bands with the exception of Country Joe still exist in one form or another and - excluding the Dead - all have lost their magnetism. They've said what they had to say and there's not much more for them to do. It's sad. At one stage they held such power as to virtually spearhead all that was special within American rock.

Big Brother recorded one mighty album called "Cheap Thrills" back in '68. It made Joplin a superstar and she soon discarded them. She left to become a soloist and Big Brother is still struggling to live down her initial success brought on by songs like "Piece Of My Heart". Joplin gave them charisma. With each new year they just seem to fade further into obscurity unable to repeat that first record. Jefferson Airplane continues to stumble along through increasingly mediocre albums - its talent having migrated into Hot Tuna and the production of its own 'Grunt' record label. Country Joe is now a single act using occasional pick-me-up sidemen while the Fish - now Barry Melton & The Fish - have yet to establish themselves as anything beyond a memory.

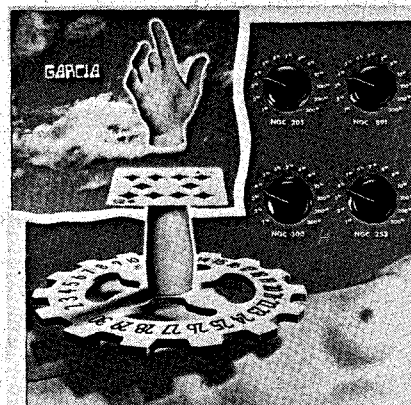
And Quicksilver Messenger Service. Around '68-'69 they were the only band

capable of rivalling the Dead. They were built on the brilliant musicianship of guitarist John Cipollina and - since his split - have reconstituted themselves as a technically excellent but musically trivial pop-rock group. Their latest album tagged "Quicksilver" comes as no surprise as they've been deteriorating as far back as 1970 with the release of "Shady Grove". Between '68-'69 they put out two wonderful albums - "Quicksilver Messenger Service" and "Happy Trails". Both featured Cipollina as probably the most adventurous musician in West Californian rock.

The music was essentially rock 'n' roll but it was played with a spirit that has somehow eluded them ever since. There was this long instrumental called "The Fool" and a couple of those psychedelic things that you used to hear about - songs like "Calvary" and "Cancer Moon". They weren't mish-mash studio effects but really innovative pieces of music capturing passion and juxtaposing images with a fire seldom heard outside their concerts at the Fillmore. And then you get the new album.

Quicksilver falls into the category of bands who've said all that was theirs to say. Dino Valente writes nice songs - gentle and melodic and altogether plain. The musicianship can't be criticized simply because it's excellent. But there isn't anything that leaps about with the spark once the sole reason behind their success. They're not exactly living on reputation - it's just that they've lost Cipollina's magic. It's a good album as far as albums go but - in the long run - it won't be remembered. And that probably sums up their fate.

And the Grateful Dead - with the departure of drummer Mickey Hart - have now returned to their personnel of half a decade ago. Their new album seems to represent a pause - a momentary halt before setting off in a new direction far from unprecedented with the Dead. Their first album introduced an eclectic band which combined elements of blues,



country-western, rock and the beginnings of an interest in drug-oriented psychedilia. Three succeeding albums moved deeper and deeper into free form - the most satisfying of which was "Aoxomoa" followed closely by the excellent "Anthem Of The Sun". Then they switched into a mode of relatively short, coherent, symmetrical songs as on "Workingman's Dead" and "American Beauty".

Throughout - except for the first album - their music was original with most of the credits stemming from Jerry Garcia.

And now - for some inexplicable reason - they've returned to the same mixture of influences as marked their first disc. Only half of the songs are written by the Dead: two new cuts by Garcia, one by guitarist Bob Weir and another by Bill Kreutzmann. The most impressive track is that by Kreutzmann called "The Other One" - a partial jam spilling over one complete side. In many ways it directly parallels "Anthem Of The Sun" except that it's not as good. It's all rather reminiscent of "Live Dead" - their first double album to be released in November.

The rest of the set tends to pale a bit alongside "The Other One" except for Garcia's "Wharf Rat" - an impressive blues cut. They do some fairly nice things with four old standards - "Big Boss Man" by Willie Dixon, the traditional "Goin' Down The Road Feelin' Blue", Noah Lewis' "Big Railroad Blues" and the classic "Not Fade Away". But it's all been done before and shouldn't have been by the Dead. They really don't serve any purpose.

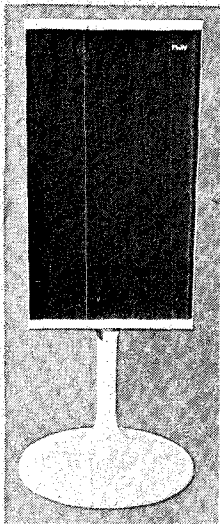
Dead versions of "Me And Bobbie McGee" and Chuck's "Johnny B. Goode" don't move very much - at least not the way they should. And besides, both belong so thoroughly to Janis and Berry that anything not startlingly different ends up a waste. And that's what happens here.

The performances on the album range from adequate to interesting: the sound is as good as can be expected of their live

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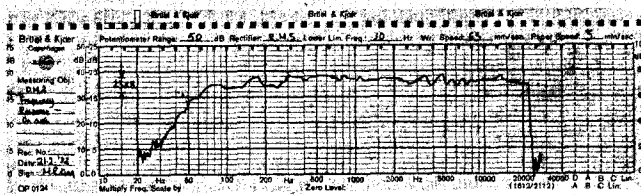
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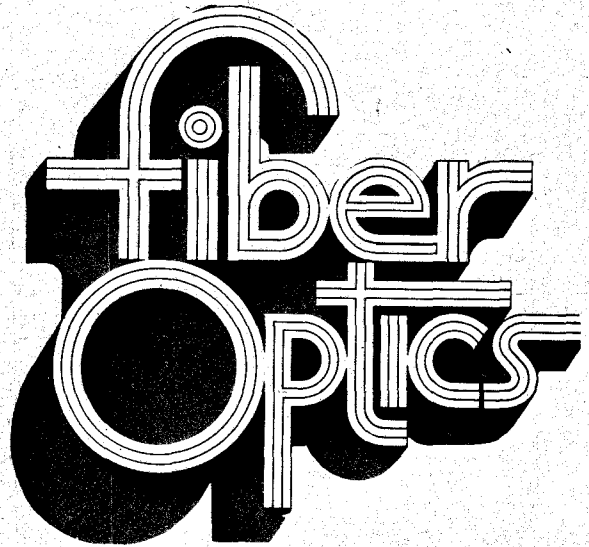
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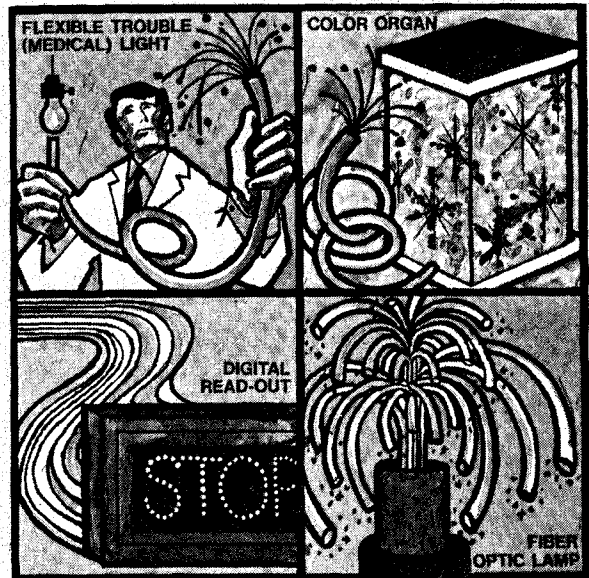
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# POP TRENDS

concerts. But it all sounds so lethargic almost as if they've lost their thread. Each song just seems to struggle on and then peter out — grind slowly to a halt. The wide variety in mood and material indicates a questioning on the part of the band — a possible search for a new direction. Garcia himself is thrusting in a couple of new directions not the least of which is his first solo album — a pleasantly pleasant disc that provides the missing link between his work with the Dead and his other outlet: New Riders Of The Purple Sage.

"Garcia" doesn't really attempt to do much as an album. He's often said that one of the major deciding factors behind its release was just so he could get some extra bread from the product-hungry Warners. But that's still a bit unfair. Garcia is a little too talent conscious to slip a dirty like that out into the market. And — after all — it's already done over 450,000 in America alone.

Basically the solo album takes up where the country-western "American Beauty" leaves off. It boogies neatly with some fine steel pickin' and — once every so often — lays back a solid blues the way the Dead used to do before "Anthem Of The Sun". "Sugaree" is a marvellous song and so is "Deal". Most of the tracks aren't much different to the things you'd expect to find on a Dead disc. And Garcia has always been their soul and inspiration no matter which way you look at it. Nothing gained — nothing lost.

New Riders Of The Purple Sage will probably surprise a lot of people because they're really a much better and more sophisticated band than the Dead. Garcia had a great deal to do with their inception — his influence is strongest in their approach forging an even keel between the music and its authenticity. They're most at ease with mid-tempo stuff much along the lines of their name-sakes — The Flying Burrito Brothers.

It's interesting. Right from the start they've been mothered by the Dead but their character owes most of its form to the Byrds circa "Sweetheart Of The Rodeo": their vocal strength is largely harmonic, their melody structure follows directly from bluegrass and not — as you would expect — from traditional American folk. New Riders will probably take up where the Burritos left off: boogeying their country and countrifying their boogie i.e. "I Don't Need No Doctor". I much prefer "Powerglide" to the Dead set. It's got more depth and vitality and the band doesn't sound tired.

The Dead had better pull their fingers out or else they're going to lose out to New Riders. And if it isn't New Riders it'll be the Eagles — an Asylum group formed by ex-Burrito Bernie Leadon and one time Poco member Randy Meisner. Have a listen to "The Grateful Dead" for old time's sake and then buy yourself a copy of "Powerglide" — the second disc from the Purple Sage. Things ain't what they used to be. — M.D.

**"LIVE IN CONCERT"** — James Gang. EMI. Stereo SPBA 3023. Stop — You're Gonna Need Me — Take A Look Around — Tend

**My Garden — Ashes, The Rain & I — Walk Away — Lost Woman.**

One of the secrets of the best rock 'n' roll is its tenderness. Beneath all the sweat and amplified passion there's a character distinctly romantic. More often than not it remains unassuming — modest; less than tough. James Gang are one of the few American groups who can play loud to the point of excess without becoming brutal. Their formula is a simple blend of Southern fried high energy a la MC5 and the more sensible West Coast ear towards acoustic folk-rock. This Cleveland trio has been able to retain an inherent sensitivity with regard to form whilst remaining an aggressive noise machine at heart. They know how to add dimension onto the physique which is the reason that their approach can cover so much ground unfettered by the volume they use to first establish the atmosphere. Their sound is direct and thoughtful — even delicate.

James Gang don't go in for superfluous technique probably due more to their rigid sense of discipline than a lack of theatre. Joe Walsh is responsible for this as it relates back to his time as a soloist circa 1965. Their music has a peculiar resilience that just can't be gauged in decibels. It's not crude like Grand Funk and it's not destructive like The Who. This band doesn't take unnecessary liberties with style nor does it go out of the way to be flash for the sake of cramming undue drama into the presentation. Their approach isn't extreme.

There's all kinds of funny little things strewn here and there on this 'live' album that continually strengthen interest. "Take A Look Around" offers a floating melody supported by an episodic arrangement — deft and emotional. It wanders across the record with an easy organ/guitar base that seems to make the song halt mid-stream while it soars and struts and plummets through the instrumental frame totally disassociated from the voice. "Tend My Garden" falls in with "Ashes, The Rain & I" as the most effective semi-acoustic work the band has ever recorded. I'm pleased to say that they've not lost any of their charm transposed as 'live' material — each has such a tensile mood that even the worst set of dynamics would've found it a task to inflict a noticeable amount of harm. "Stop" and "Walk Away" are heavily syncopated riff rocksters very much the typical James Gang scene — all spunk.

This album furnishes a chance to check out the priorities behind the group as a unit. More so than any of the three previous releases "Live In Concert" shows the true value of songwriter/guitarist Joe Walsh. "Lost Woman" is his grand showcase that features approx. 15 minutes of continual speed raving. It has a good deal of merit but even though he possesses sufficient restraint and expertise with his wall of amplifiers and arsenal of electronic doo-dads to make your average guitar slinger freak out with envy — he never fails to stick in a few bars of hackneyed doodlings both before and after his flashes of genuine inspiration and/or ingenuity. It's still not hard though to see why Peter Townshend admires him so much despite the narcissism. "You're Gonna Need Me" takes similar form to "Lost Woman" — pure and unexpurgated Walsh right from the word. All in all the album is exceptionally well done. Sound reproduction is the equal of any 'live' disc I've yet heard outside The Allmans at Fillmore East. M.D.



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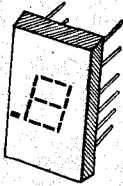
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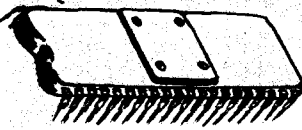
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### COUNTER DISPLAY KIT—CD-2

This kit provides a highly sophisticated display section module for clocks, counter or other numerical display needs.

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

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

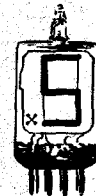
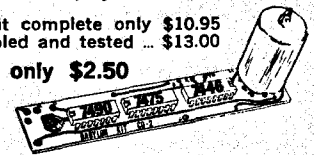
Kit includes a two sided (with plated through holes) fibreglass printed circuit board, three IC's, DR-2010 (with decimal point) display tube, and enough Molex socket pins for the IC's.

Circuit board is .8" wide and 4 1/2" long. A single 5 volt power source powers both the IC's and the display tube.

CD-2 kit complete only \$10.95

Assembled and tested ... \$13.00

**Board only \$2.50**

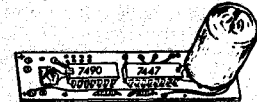


RCA DR2010 Numitron digital display tube. This incandescent five volt seven segment device provides a .6" high numeral which can be seen at a distance of 30 feet. The tube has a standard nine pin base (solderable) and a left-hand decimal point. **Each \$5.00 SPECIAL 5 for \$20**

### UNIVERSAL COUNTER DISPLAY KIT CD-3

This kit is similar to the CD-2 except for the following:

- Does not include the 7475 quad latch storage feature.
- Board is the same width but is 1" shorter.
- Five additional passive components are provided, which permit the user to program the count to any number from two to ten. Two kits may be interconnected to count to any number 2-99, three kits 2-999, etc.
- Complete instructions are provided to pre-set the modulus for your application.



CD-3 board only \$2.25

IC's 7490, 7447 2.75

RCA DR2010 tube 5.00

Complete kit includes all of the above plus 5 programming parts, instructions and Molex pins for IC's. **Only \$9.25**

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This Signetic No. 8223 IC operates at 5 volts and contains 32 x 8 bit wide ROM which can be field programmed.

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# Badly punched tape doesn't faze the Facit 4001 tape reader

Look at these tapes.

One of them has pitch inaccuracy of +25%, the other of -25%. According to ISO standards, tolerance should not exceed  $\pm 0.5$  over 50 characters. The majority of tape readers cannot cope with tolerances greater than this. But the Facit 4001 can.

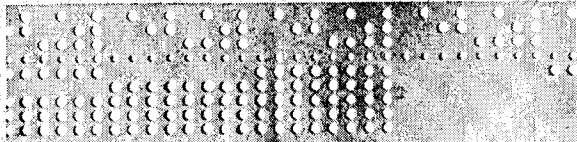
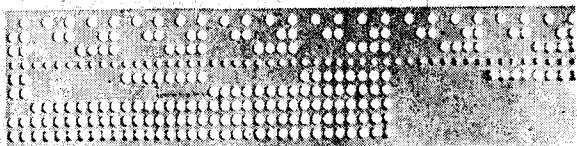
It reads practically every tape, no matter how badly punched it is. Correctly. At a speed of 1000 characters per second. Even completely transparent tapes. Owing to dielectric sensing and capstan tape feed.

If you choose the Facit 4001 you will also get a tape reader that only needs servicing once a year.

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# BOOKS

**COLOUR TELEVISION THEORY** — By Geoffrey H. Hutson **PAL System Principles and Receiver Circuitry** — \$10.80. CONTENTS: Light, Colour Signals, Basic PAL Codes, Transmitter, and Receiver Arrangements, Display Devices, Convergence, and Raster-shape Correction Circuitry, Chrominance Signals.

**DICTIONARY OF TELECOMMUNICATIONS** — R.A. Bones. \$7.50. — 208 pages. The wide range of definitions, including many reproduced from or based on, British Standards recommendations, is supplemented by appendices including units and abbreviations, wavelengths and frequency bands and signal reporting codes.

**PRINCIPLES OF PAL COLOUR TELEVISION AND RELATED SYSTEMS** — By: H.V. Sims, C. Eng., M.I.E.E., R.I.E.R.C. — \$3.80. CONTENTS: Development of Colour Television; The NTSC System; Phase Distortion; The PAL System; Some Inherent Deficiencies; PAL Decoders; The SECAM System; etc.

**110 SEMICONDUCTOR PROJECTS FOR THE HOME CONSTRUCTOR** — R.M. Marston — \$6.10. 124 pages, including 110 illustrations. This book introduces the reader to such outstandingly useful new devices as the field-effect transistor, unijunction transistors, silicon controlled-rectifiers, silicon planar transistors etc.

**PRACTICAL THINKING** — Edward DeBono — \$5.95 — 198 pages. This book looks at practical everyday thinking which allows us to use something effectively without knowing all the details. Thinking may seem to be too complex a process to be understood but the two basic steps are quite simple. Etc.

**THE HI-FI AND TAPE RECORDER HANDBOOK** — Gordon J. King. — \$6.80. Hi-Fi fundamentals, Voltage Amplifiers, Feedback and Control Circuits, Power Amplifier, Faults in Valve Amplifiers, Transistor Amplifiers, Loudspeakers and Enclosures, Disc Recording, Pick-ups and Record Playing Equipment, etc.

**A.B.C.'s OF INFRARED** — O.F. Varnard — \$4.75. 144 pages. Numerous illustrations are included to clarify the explanations of the various instruments and methods. Many examples are given to illustrate novel and unfamiliar concepts, and questions for self-testing are provided at the end of each chapter.

**BEGINNERS GUIDE TO TRANSISTORS** — J.A. Reddihough — 160 pages. \$3.55. Describes what transistors are, how they work, the many types available and their many applications. This will be useful to the layman wishing to understand the fundamentals or the apprentice technician.

**A.B.C.'s OF INTEGRATED CIRCUITS** — R.P. Turner — 96 pages — \$4.25. This book is intended to serve as an elementary introduction to the IC, its construction behaviour, and uses. Theory and mathematics have been purposely kept at a minimum; instead, the approach is descriptive and practical, etc.

**BASIC ELECTRONICS OF NAVY PERSONNEL**. 9 1/2" x 6" 538 pp \$4.55. This covers every important aspect of applied electronics using no more advanced material than principles of applied electricity and elementary maths. This course is as valuable to hobbyists as to beginning students.

**SEMICONDUCTOR DEVICES AND CIRCUITS — ALLEY AND ATWOOD**. \$4.90. 490 pages. \$8.50. Semiconductors, Junction Diodes, Junction Transistors, Common-Emitter Amplifiers, Device with High Input Impedance, R.C. Coupled Amplifiers, Transformer-Coupled Amplifiers, Small-Signal Tuned Amplifiers, etc.

**DICTIONARY OF ELECTRONICS — HARLEY CARTER**. 410 pages, many illustrations. \$5.95. Contains concise but explanatory definitions from many branches of Electronics, including radio, television, communication, radar, electronics instrumentation and industrial electronics.

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# INPUT GATE

LETTERS  
FROM  
OUR READERS

## PHASE-LINEAR STILL!

Thank you for your informative article on the 700 watt Phase Linear amplifier — Electronics Today International, March 1972.

I am looking forward to your review of the new 'Dephon' electrostatic headphone amplifier with quasi-complementary Van de Graff generators in its output stage.

S.W.B. Sawbridgeworth, U.K.

*\*You would have to be joking — the 'Dephon' has long been superceded by the 'Diablaster' which uses nitromethane afterburners to provide bass and treble lift. We may run a review if we ever get to tie them down.*

## STATE OF THE ART

Congratulations on your new amateur radio column — 'The State of the Art'. It's a pleasant and interesting change from the interminable pages about who read whom on strength 3, in so many of your competitors.

T.D. Alice Springs.

## ERRORS

Several of your recent projects have contained errors which you have then corrected the following month. Every electronics magazine I have ever read seems to be the same — why on earth don't you all get your fingers out and get them right first time?

G.S. St. Ives, NSW.

*\*As you say this is a problem common to virtually all electronics publications.*

*It is a problem of which editorial staff are acutely aware and try very hard indeed to resolve.*

*It is caused by a number of factors — The major one is that it is inherent in the nature of publishing that editorial material must be handled by a number of people — typesetters, proofreaders, printers etc, who have no knowledge of electronics. Hence errors can creep in without the miscreant's recognition.*

*Naturally the final copy is checked over very carefully indeed by our editorial staff — usually by several different people — before printing.*

*Nevertheless errors do still slip through.*

*The problem will be familiar to anyone who has ever produced printed data or drawings.*

*But please don't think we are complacent about it. The Editor's comments whenever he discovers an error are far more violent than any our readers have made so far!*

*See also below:—*

From 'SCIENCES', the Journal of the New York Academy of Science, September-October 1972. It is a perfectly serious correction.

## Correction

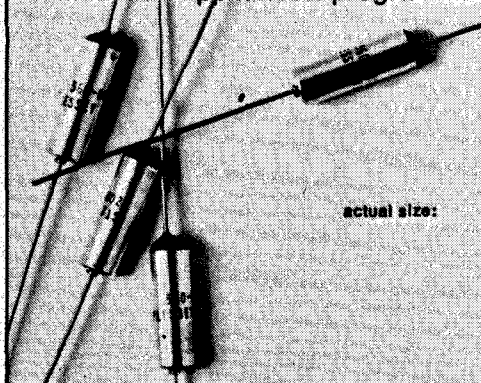
The object captioned the great icosidodecahedron ('The Great Inverted Retrosnub Icosidodecahedron,' July-August, p.17) is actually the great icosicosidodecahedron.

# PLESSEY E CELLS

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**Use-Time Measurement** end of life elapsed time and warranty indication/use accounting — office, automotive, industrial machines. **Repetitive Timing and Controls** repeat cycle timing — domestic and industrial appliances/programmed sequence timing/automatic controls.



Literature available on request.

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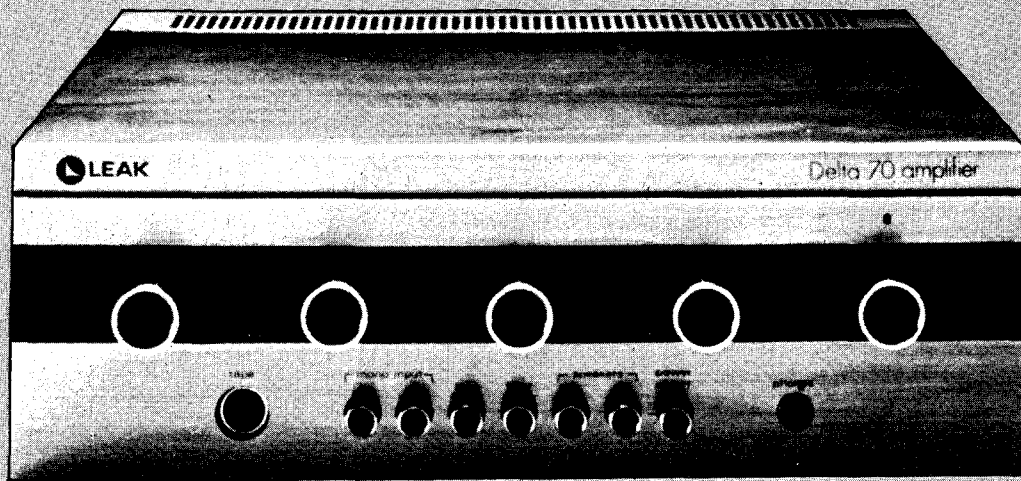
Plessey Ducon Pty. Limited,  
PO Box 2 Villawood, NSW, 2163.  
Tel. 72 0133





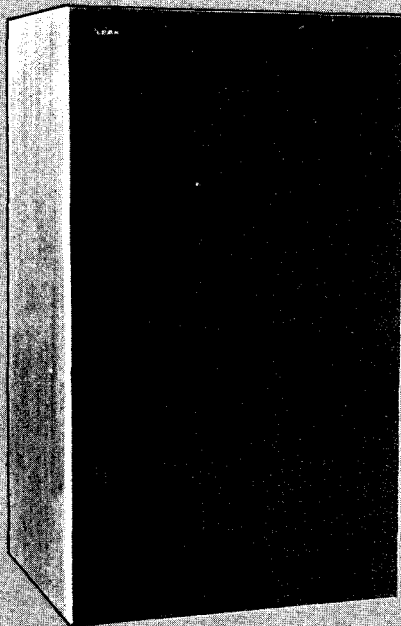
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The Delta 70 is full of latent power—up to 35 watts RMS per channel. Distortion is a mere 0.1% at 1KHz for all power outputs upto 25 watts RMS per channel. Power to spare for that second pair of speakers. Front panel is elegantly finished in solid extruded aluminium. Walnut and Teak finish cabinet. Headphone socket for quiet listening, and a DIN record/replay socket for a portable tape recorder. Also standard inputs at back of amplifier.



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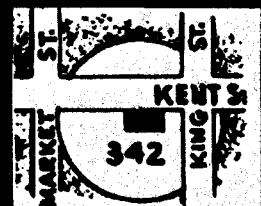
Dimensions—26" x 15" x 12".  
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**Rola**



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



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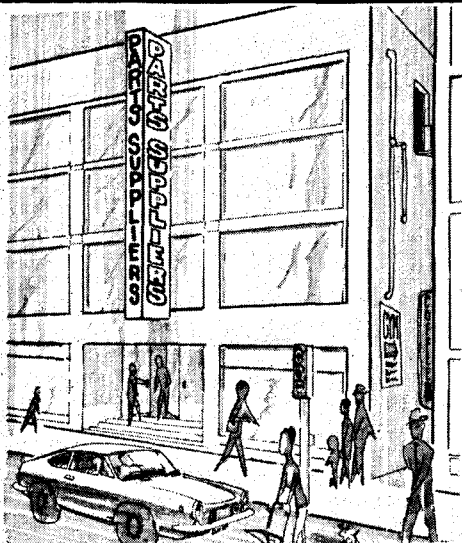
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AR48

# electronics TODAY

INTERNATIONAL



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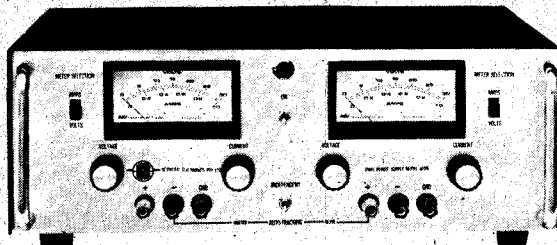


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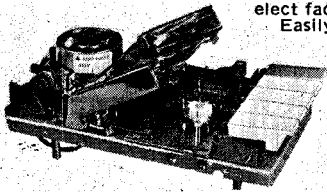
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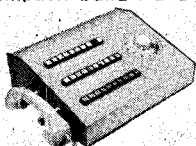
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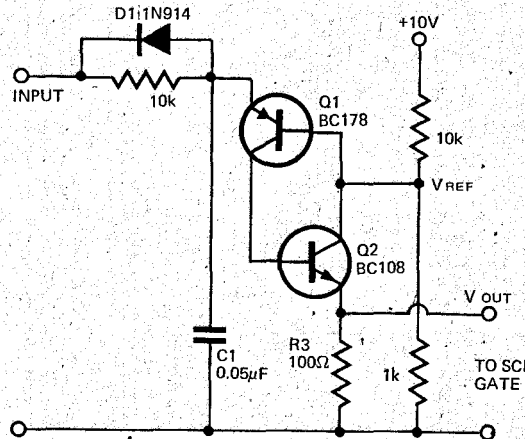


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**TECH-TIPS**

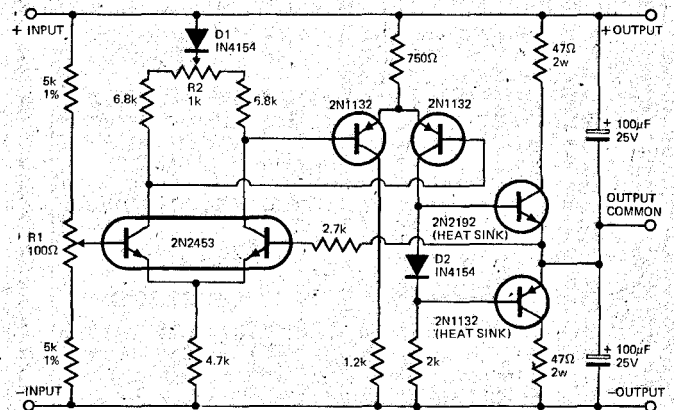
**NOISE REJECTING SCR TRIGGER**



When switching inductive loads, unreliable triggering is sometimes encountered due to feedback of switching transients.

The circuit shown overcomes this problem by using an integrator together with a voltage comparator to eliminate transients. Data pulses should be of 8 volt amplitude and 0.5 millisecond duration. Discrimination against noise pulses will depend on their energy content. For example a 70 volt 10 microsecond wide pulse will not cause triggering, but a 100 microsecond pulse must not exceed 20 volts amplitude.

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Operational amplifier circuitry requires double-ended power supplies. This simple circuit converts a conventional single ended supply to a double ended operation. Once adjusted, the positive and negative rails will track within a few millivolts without further adjustment.

The circuit will provide output voltages within the range five to 25 volts at output currents up to 100mn. The corresponding supply voltage range is 10 to 50 volts.

Potentiometer R1 is used to balance the output voltage (test by precision divider network) and potentiometer R2 is adjusted to provide best tracking.

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Wayne Communications & Electronics	79
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# MICRO-ADS

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**AUSTRALIAN Tape Record Society** offers tape library, "The Microphone" Journal, audio visuals, round robins, tapesondence, sales enquiries. PO Box 130, Hornsby, NSW 2077. Please enclose a stamped addressed envelope.

**WHOLESALE** and mail order: FETs, transistors, diodes, rectifiers, capacitors, TR radio parts, TR radio kits, etc. Fast delivery guaranteed. Write for free catalogues to: Radio Electronic Instrument Co, Chesterfield Mansion, 8th Fl, Flat 3, Causeway Bay, Hong Kong.

**"AMATEUR Electro-Plater's Guide"**: Elementary level, practical booklet describes home electro-plating with copper, nickel, silver, gold, rhodium, aluminium anodising. \$1.00 (includes postage) from PATRICIAN TRADE SERVICES, P.O. Box 114, Stafford. Q. 4053.

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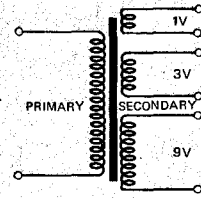
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# TECH-TIPS



OUTPUT VOLTS	1-VOLT WINDING	3-VOLT WINDING	9-VOLT WINDING
1	+	0	0
2	-	+	0
3	0	+	0
4	+	+	0
5	-	-	+
6	0	-	+
7	+	-	+
8	-	0	+
9	0	0	+
10	+	0	+
11	-	+	+
12	0	+	+
13	+	+	+

## UNIVERSAL TRANSFORMER

Here is a useful method of obtaining a variety of output voltages from a single transformer. This method is useful for experimenter's bench mock-ups. To use, connect the windings in series with the phase relationship shown in the table. For example, to produce 5 volts, connect the 1 and 3 volt windings in series and in antiphase to the 9 volt winding.

The system has a drawback in that regulation suffers. Winding impedances always add - regardless of the phase of windings. The procedure may be extended further if required. A 27 volt winding will provide all voltages from 1 to 40 in steps of 1 volt.

## TECH TIPPING

We are sure that many experimenters have original circuit ideas which would be of interest to other readers. Electronics Today International will pay \$3 for each original item selected for inclusion in Tech Tips.

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# Make music— not noise

You may not realise it, but until now, even the best tape decks allowed a degree of noise during recording and playback. This may have been all right for conventional tapes, since they were far from perfect. But with the recent introduction of the low noise/high output tapes, it's no longer permissible. Which brings us to a new generation of decks by TEAC. And TEAC calls them Superior Sound/Low Noise decks: decks designed to get the most out of the low noise tapes as well as the conventional types.

Five of these new generation decks are described here. If you'd like to know more, write to us and we'll send you further information (catalogue, dealer list and price list) on the unit(s) that interests you.

# TEAC

A Sound Idea

Australian Distributors: Australian Musical Industries Pty. Ltd., 155 Gladstone St., South Melbourne Vic., 3205. Ph: 69 7281



**Bi-directional record and playback tape deck Model A-4070**

- 4 Ferrite heads (6 head function)
- Reel size 7"
- Tape speed 3 $\frac{3}{4}$  ips and 7 $\frac{1}{2}$  ips
- Triple motor mechanism
- Wow and flutter .06% at 7 $\frac{1}{2}$  ips
- F/R 25 to 24,000 Hz at 7 $\frac{1}{2}$  ips
- S/N ratio 58dB



**Stereo Tape Deck Model A-3300**

- Reel size 7"
- Tape speed 3 $\frac{3}{4}$  ips and 7 $\frac{1}{2}$  ips
- Triple motor mechanism
- Wow and flutter .06% at 7 $\frac{1}{2}$  ips
- F/R 25 to 24,000 Hz
- S/N Ratio 55dB



**Stereo Tape Deck Model A-1230**

- 3 heads-4-head function
- Reel size 7"
- Tape speed 3 $\frac{3}{4}$  ips and 7 $\frac{1}{2}$  ips
- Triple motor mechanism
- Wow and flutter .08% at 7 $\frac{1}{2}$  ips
- F/R 30 to 22,000 Hz at 7 $\frac{1}{2}$  ips
- S/N Ratio 55dB



**Automatic Reverse Stereo Tape Deck Model A-1250**

- 3 heads-4-head function
- Reel size 7"
- Tape Speed 3 $\frac{3}{4}$  ips and 7 $\frac{1}{2}$  ips
- Triple motor mechanism
- Wow and flutter .08% at 7 $\frac{1}{2}$  ips
- F/R 30 to 22,000 Hz at 7 $\frac{1}{2}$  ips
- S/N Ratio 55dB



**Combination Head Stereo Tape Deck Model A-1030**

- Reel size 7"
- Tape speed 3 $\frac{3}{4}$  ips and 7 $\frac{1}{2}$  ips
- One motor mechanism
- Wow and flutter .08% at 7 $\frac{1}{2}$  ips
- F/R 30 to 22,000 Hz at 7 $\frac{1}{2}$  ips
- S/N Ratio 55dB
- Auto. Shut-off

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