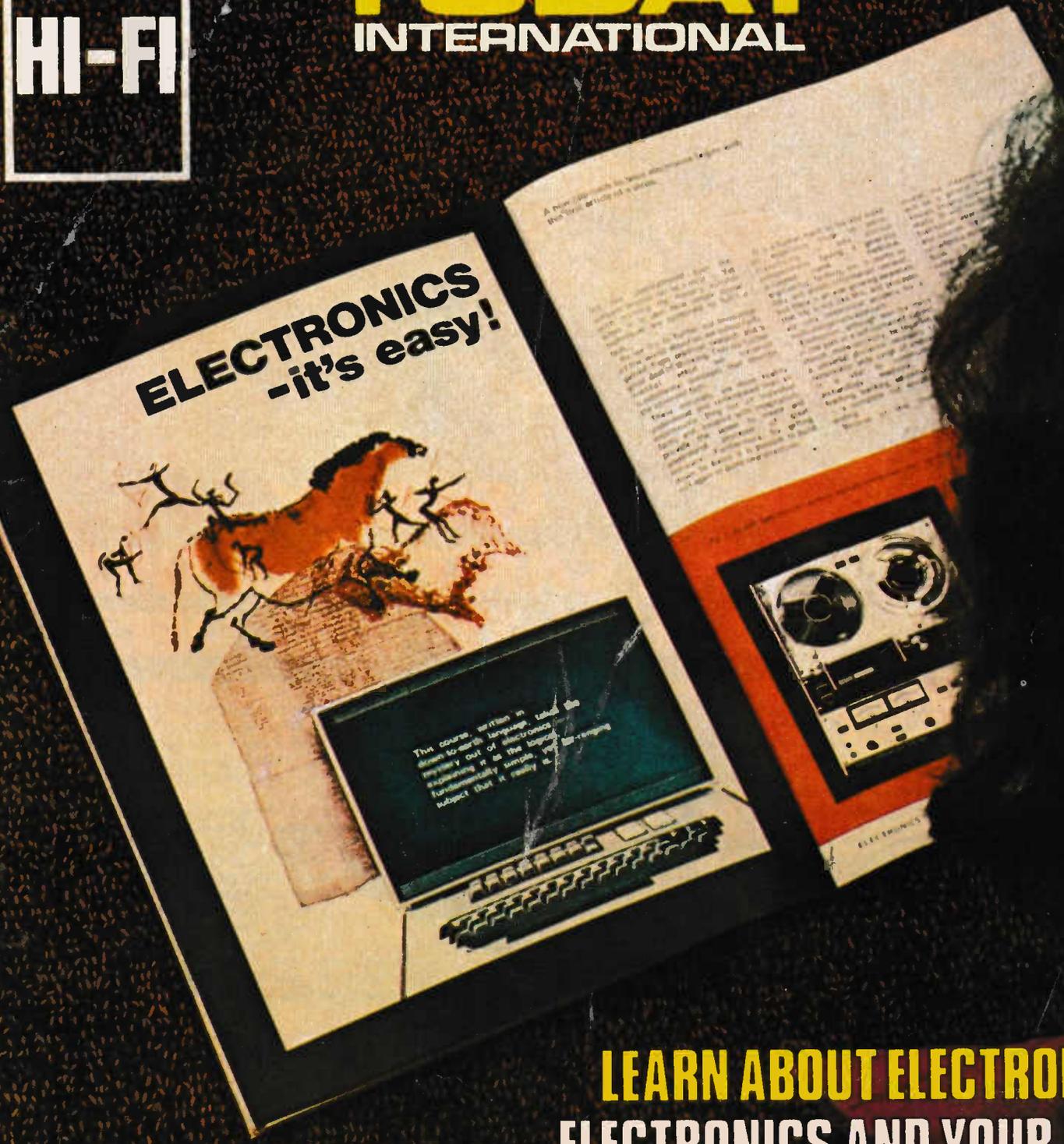


electronics

TODAY

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HI-FI



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LEGALLY, WE CAN'T CALL THIS A REEL-TO-REEL DECK.

But reel-to-reel quality is what you'll enjoy from TEAC's new A-450 cassette deck.

We call it the "Challenger." And we challenge you to tell the difference between it and reel-to-reel.

We've perfected our new deck to the point of keeping wow and flutter below 0.07%.

We even improved what you can expect from the Dolby* Noise Reduction System.

Of course, we built the well-known Dolby into our A-450 to eliminate tape hiss and noise.

But we also put the system on the monitoring circuit. So you can copy Dolby cassette tapes and record FM Dolby broadcasts with de-coded monitoring.

Our best cassette deck deserves our best heads. This is why you get wear-free High Density Ferrite Heads.



And to assure you of the smoothest possible tape travel, we designed a new tape drive mechanism.

Our A-450 is the only cassette deck we know of that even allows for full mic-line mixing capabilities.

Reel-to-reel supremacy has been challenged by the A-450.

Yet over the years, TEAC has continually developed a quality line of cassette decks.

Both our A-350 and A-250 feature the Dolby System. Because even on these decks, we knew that you should hear tapes only one way. Perfectly. They also feature those sophisticated Ferrite Heads.

The A-350 and A-250 are great. But our challenger is the A-450.

Remember, It's a cassette. But if you didn't see it, you'd swear you were listening to a reel-to-reel deck.

TEAC
The sound of perfection

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electronics TODAY INTERNATIONAL

NOVEMBER 1973

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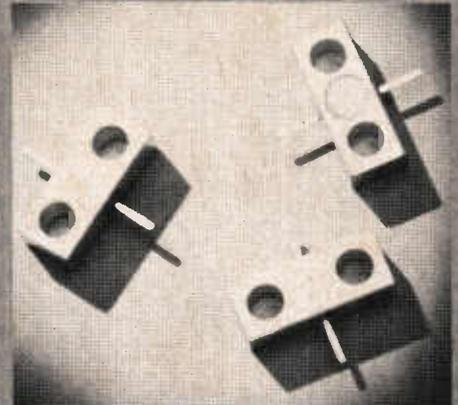
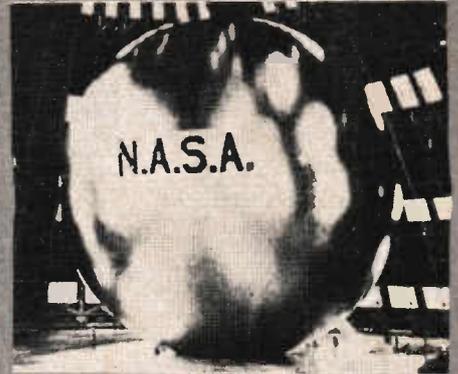
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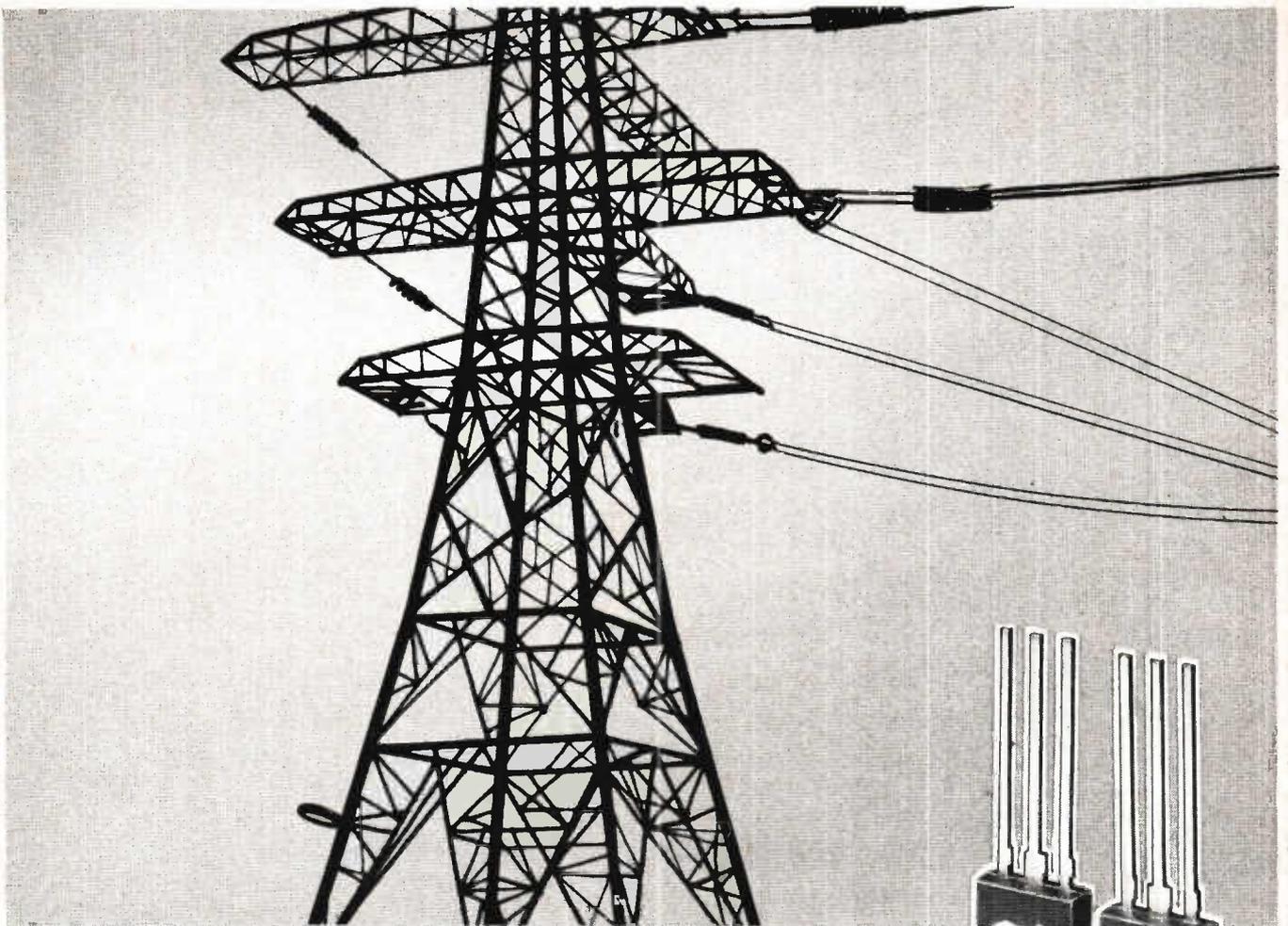
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Published by MODERN MAGAZINES (HOLDINGS) LIMITED, 15 Boundary Street, Rushcutters Bay 2011. Phone: 33 4282. Cables: MODMAGS SYDNEY. Managing Director: Jules Feldman. Advertising Director: Max Press.

INTERSTATE advertising — Melbourne: Clarrie Levy, Suite 23, 553 St. Kilda Rd. (51-9836). Adelaide: Ad Media Group of South Australia, 12-20 O'Connell Street, North Adelaide S.A. 5006. (67-1129). Brisbane: David Wood, Anday Agency, 11-14 Buchanan St., West End (44-3485) OVERSEAS — United Kingdom: A.C.P., 107 Fleet St., London, EC4. U.S.A.:

A.C.P., Room 401, 1501 Broadway New York. Printed in 1973 by Compress Printing Ltd., 65 O'Riordan St., Alexandria N.S.W. Distributors: Australian Consolidated Press. (*Recommended and maximum price only.) COPY RIGHT.



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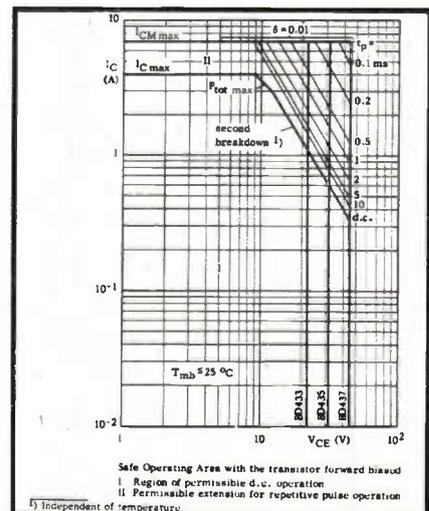
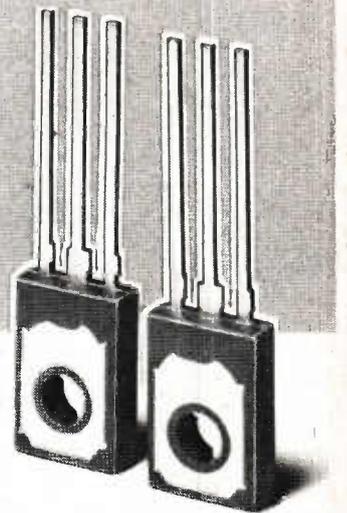
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BD135	BD136	45	1.5	1.0	8*	>25	0.5
BD137	BD138	60	1.5	1.0	8*	>25	0.5
BD139	BD140	80	1.5	1.0	8*	>25	0.5
BD233	BD234	45	6	2	25	>25	1.0
BD235	BD236	60	6	2	25	>25	1.0
BD237	BD238	80	6	2	25	>25	1.0
BD433	BD434	22	7	4	36	>50	2.0
BD435	BD436	32	7	4	36	>50	2.0
BD437	BD438	45	7	4	36	>40	2.0

* up to T_{mb} = 70°C

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Electronics Today International
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15 Boundary Street,
Rushcutters Bay 2011
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FRENCH EDITION

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THE MATERIALS CRUNCH

WANDER down to the local discount house and try to buy a refrigerator, lounge or dining-room suite. Chances are you will be told that delivery may be anything up to six months.

In the field of electronics the humble resistor and capacitor are difficult to obtain, whilst integrated circuits for consumer appliances are a disaster area, with quoted deliveries up to 60 weeks!

Most of the current spate of shortages are due to demand outstripping manufacturing capability — but an alarming, and growing, proportion are caused by world-wide shortages of raw materials.

The latest to join the shortage list is PVC, a material very widely used in our society to manufacture all kinds of plastic products. As PVC is a synthetic material based on crude petroleum, the world-wide energy crisis — not to mention the Middle East war — can only worsen the situation.

The PVC shortage is currently of great concern to the audio industry, as it is used in the manufacture of records and tapes. Already many overseas companies have been forced to curtail the release of new albums, and some smaller companies may even be forced out of business.

Thus records and tapes are bound to go up in price; and, worse still, they may in future be difficult to obtain — no matter what the price.

You may think this is bad enough but just think where plastic is used these days — insulation of hook-up wire, car parts and upholstery, containers and food wrapping — the list is endless.

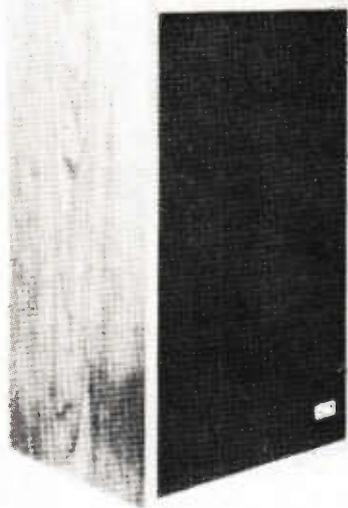
If the shortage worsens, it is bound to have a profound impact on our current way of life.

Brian Chapman

eti

JVC NIVICO

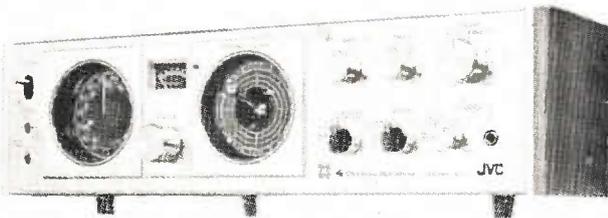
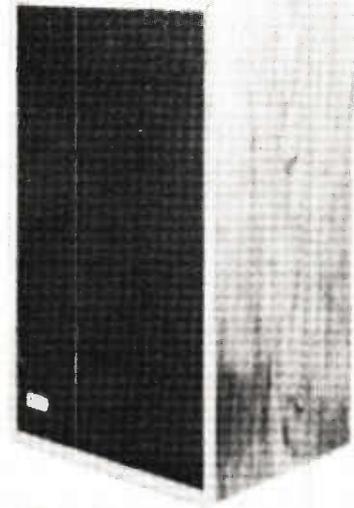
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AVAILABLE AT SELSOUND HI-FI
THE SYSTEM BELOW FOR **\$450-00**



**JVC 2-Way 2-Speaker
Acoustic Suspension
Speaker System**

SPECIFICATIONS:

Speaker Woofer — 8" free-edge.
Tweeter — 2" Cone.
Power Handling capacity — 40W
peak 20W rms.
Efficiency — 99dB/W (50cm on
axis).
Minimum required power — 8Wrms
per channel.
Impedance — 8Ω nominal.
Crossover frequency — 4,000Hz.



**JVC 4 Channel receiver — This is what you were
looking for with AM FM tuner sections.**

SPECIFICATIONS:

Continuous power — 40W at 8Ω (4CH driven)
Power bandwidth — 20 — 30,000 Hz
Frequency response — 20 — 25,000 Hz
Distortion — 1% at rated power.



SPECIFICATIONS:

Type — Belt-drive stereo record player
Drive motor — 4-pole synchronous motor
Turntable — 12" aluminium die-cast
Automatic mechanism — Auto-up and stop system
Signal-to-noise ratio — More than 50dB (100 or
120 Hz)
Wow and flutter — Less than 0.1% (WRMS)
Tone arm — TH-type universal arm
Cartridge — Moving magnet type
Frequency response — 10 to 25,000 Hz
Channel separation — More than 25dB (1kHz)

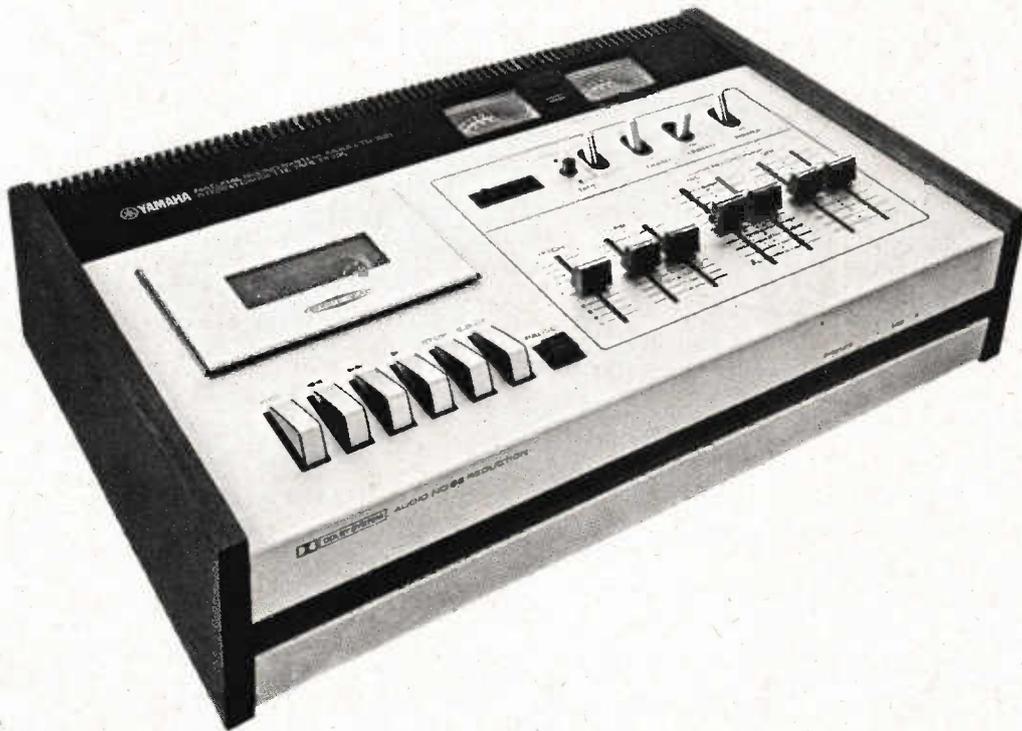
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YAMAHA TB700 CASSETTE



"The Yamaha TB700 is an excellent cassette player, and in keeping with only a small number of other machines, can lay claim to that very much abused term 'High Fidelity Cassette Player'. It is a 'state-of-the-art' product providing a performance equal to the best we have heard" — Electronics Today International, September, 1973 issue. The Yamaha TB700 is a most versatile stereo component that will perform to the grand specifications of many expensive open-reel decks. In every respect the TB700 is a quality component, bringing the technology of the cassette deck to a new peak. Its many features include, Dolby noise reduction system — H.P.F. Record/Play Head — Three position tape selector — Input selector — Line input/Mic mixing — Limiter — Pitch control Auto stop mechanism — High recording bias frequency — DC stereo motor — Thin film IC's — stabilized power supply — OTL head amplifier — Pause switch — expanded VU meters, to name just a few.

For the complete Yamaha TB700 story and the best price contact:

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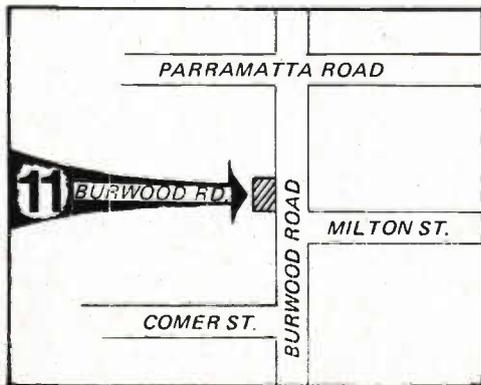
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SAVE \$\$\$...



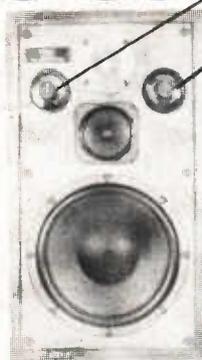
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SPECIFICATIONS Type — 3 way 3 speaker system, Woofer: 12", Squawker: 5", Tweeter: 1" dome type, **CROSSOVER** Frequencies 600 Hz, 6,000 Hz (12dB/Oct), Frequency Response 30 — 20,000 Hz, Impedance 8 ohms, Power Handling Capacity 50 W, Level Controls Individual mid range and high range level control, Dimensions & Weight 660 c 380 x 310 mm, 19kg.

2 Teac LS380 Speakers

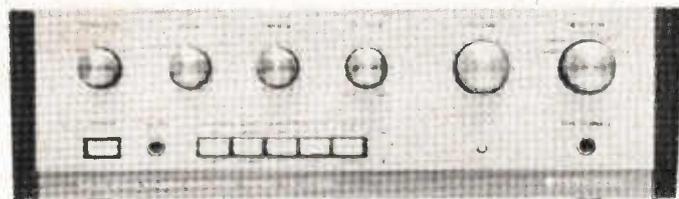
WITH

A Teac TS 130
turntable with
SHURE M55E Cartridge,
base & lid.



WITH

a KENWOOD KA 4002A
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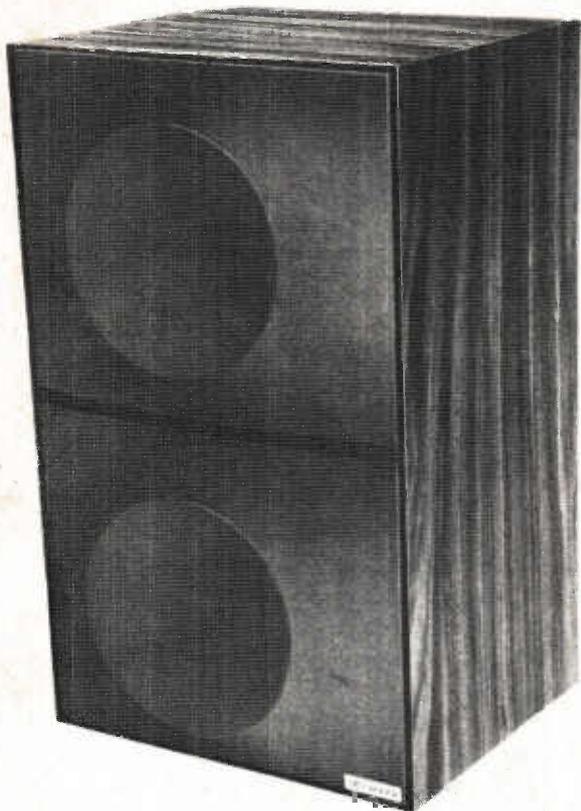
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5" Sealed Midrange.
2½" Super Tweeter.

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CROSSOVER FREQUENCIES 1500 Hz and 4000 Hz
MINIMUM POWER REQUIREMENT 10 watts RMS
MAXIMUM POWER HANDLING 60 watts RMS
NOMINAL IMPEDANCE 8 Ohms
COLORS AVAILABLE: RED, BLUE, BLACK, BROWN,
TIMBER WALNUT FINISH
SIZE: 24 3/8" H x 14½" W x 12" D

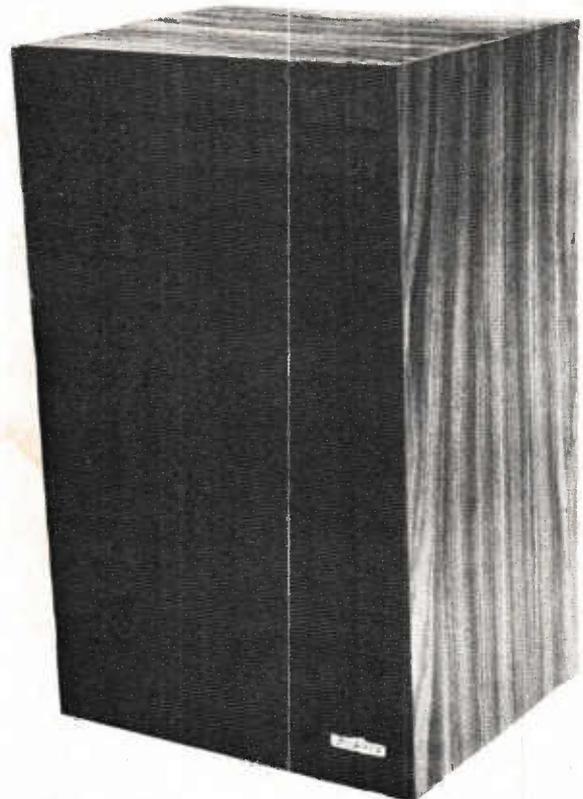
PRICE \$139 EACH

MODEL 150

DRIVERS 12" Air Suspension Woofer.
2½" Super Tweeter.

FREQUENCY RESPONSE 32 Hz to 20,000 Hz
CROSSOVER FREQUENCIES 2500 Hz
MINIMUM POWER REQUIREMENT 5 Watts RMS
MAXIMUM POWER HANDLING 40 Watts RMS
NOMINAL IMPEDANCE 8 Ohms
COLORS AVAILABLE: ORANGE, CHARCOAL
TIMBER WALNUT FINISH
SIZE: 24 3/8" H x 14½" W x 12" D

PRICE \$119 EACH



AVAILABLE FROM

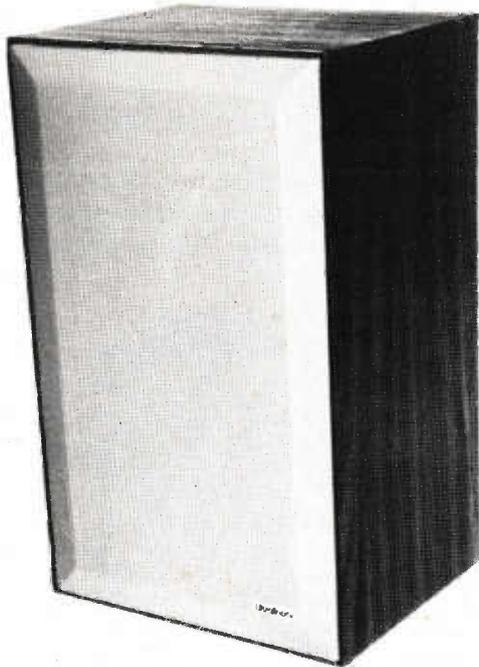
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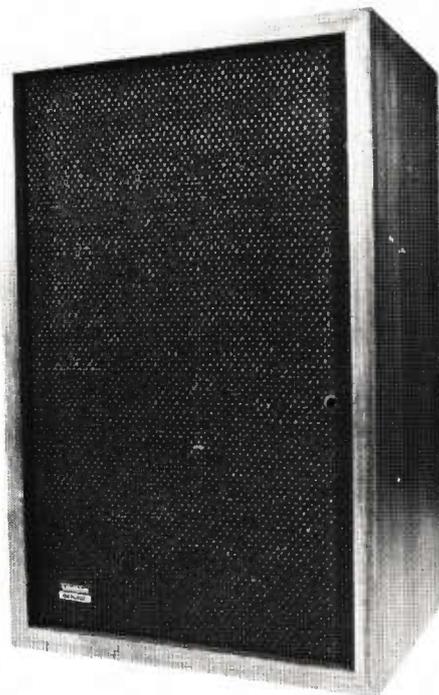
DRIVERS 12" Twin Cone Woofer.
2½" Super Tweeter.
FREQUENCY RESPONSE 37 Hz to 20,000 Hz.
CROSSOVER FREQUENCIES 2500 Hz
MINIMUM POWER REQUIREMENT 5 Watts RMS
MAXIMUM POWER HANDLING 30 Watts RMS
NOMINAL IMPEDANCE 8 Ohms
COLORS AVAILABLE: RED, BLUE, BLACK, BROWN.
TIMBER WALNUT FINISH
SIZE 24 3/8" H x 14½" W x 12" D

PRICE \$94 EACH

LINEAR SOUND 82

* 1 year parts and labour warranty
* As reviewed in Aust. Hi-Fi Speaker Guide Vol II
DRIVERS 8" Acoustic Suspension Woofer
1½" Pressure Dome Tweeter
FREQUENCY RESPONSE 37 Hz 20,000 Hz
CROSSOVER FREQUENCIES 2300 Hz
MINIMUM POWER REQUIREMENT 3 Watts RMS
MAXIMUM POWER HANDLING 25 Watts RMS
NOMINAL IMPEDANCE 8 Ohms
COLORS AVAILABLE: BROWN
TIMBER WALNUT FINISH
SIZE 21½" H x 13" W x 9¾" D

PRICE \$69 EACH



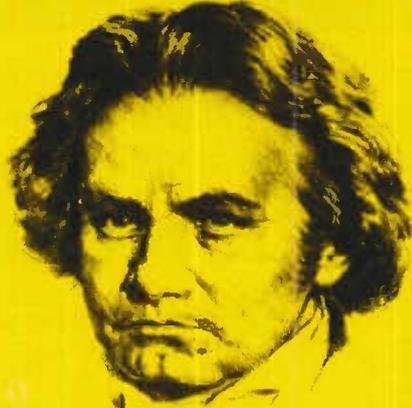
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(he would have approved)



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How many ways can you make a speaker system new?

To build the new R series speaker systems, Pioneer threw out the old ways of doing things. And created a unique superiority in sound reproduction.

The story behind the grille of these colorful systems says everything.

The R series' drivers are flush mounted, rather than recessed. This adds vitality to the midrange tones and wider dispersion.

We used exclusive free-beating cones for robust bass, clear mids and highs, improved damping, and minimal distortion. That's new, too.

The center pole design is uniquely concave, and covered with a pure copper cap. This reduces the voice coil's inductance, decreases inter-modulation distortion, and improves bass and midrange transient responses.

The horn tweeters are also newly designed. They're made from expensive die-cut aluminum. They lead to high transient response and low distortion.

Crossovers are improved, too. We've combined both inductances and capacitances for minimum inter-modulation distortion and improved linear response.

Even the enclosures are something else. Acoustically padded, for one thing. Two-piece, two-color, for another. Stained in hand-finished

walnut.

The Pioneer R series speakers are not just an improvement on an old speaker. They're a whole new speaker achievement.

You've got to hear them once to know you'll want to live with them forever.

At your Pioneer dealer today.

Pioneer Electronic Corporation
15-5, 4-chome, Ohmori-Nishi, Ohta-ku,
Tokyo, 143 Japan

	Speakers	Maximum Input Power	Crossovers	Dimensions
CS-R700	12" woofer, midrange horn, multigell horn super tweeter	75 watts	750 Hz, 14,000 Hz	15" x 26" x 13 1/2"
CS-R500	10" woofer, 8" midrange horn tweeter	60 watts	800 Hz, 5,200 Hz	13 3/4" x 24" x 12 1/4"
CS-R300	10" woofer, horn tweeter	40 watts	8,300 Hz	13" x 22 1/2" x 11"

 PIONEER[®]

CS-R700



CS-R700

CS-R300



CS-R500





LUX

ULTIMATE FIDELITY



What do we need to say about Lux that hasn't already been said by these highly skilled, long-experienced reviewers?

SQ 507X (above) Britain's "HI FI FOR PLEASURE" Magazine said: "One of the few amplifiers I have tested which unhesitatingly met and frequently exceeded its exhaustive specifications in all parameters" 50/50 watts RMS, distortion less than 0.04%.

SQ 700X 27 transistors, 2 silicone varistors, 4 silicone diodes. "HI FI FOR PLEASURE" said: "Various oscilloscope traces all add to proof of good performance in respect of wide frequency response, low distortion and stability etc. I estimate the 700X to be a top performance amplifier." 20/20 watts RMS, 0.1% distortion.

SQ 505X Electronics Australia said: "At onset of clipping, we recorded 50 watts per channel, across an 8 ohm load. Power bandwidth (0.04% -3dB) is 5Hz to 50kHz. A listening test, using familiar speakers and source material, proved what superb unit this is. "30/30 watts, 0.04% distortion.

SQ 202 The professional amp! 80 watts channel RMS/8 ohm, 100 watts channel RMS/4 ohm, below 0.4% distortion. 10-60,000 Hz -1dB. S/N phono 66dB unweighted, 81dB weighted. Direct coupled, fully complementary/switched hi-lo filters. 12 dB/oct.

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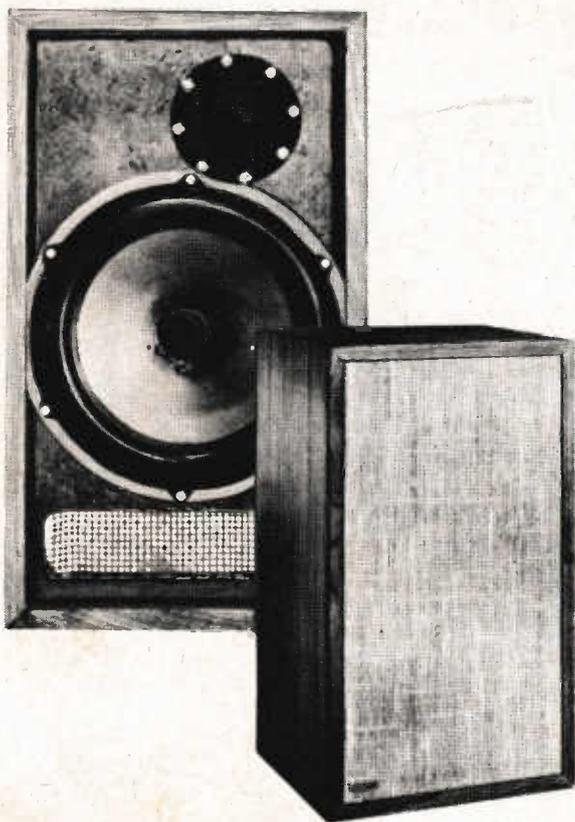
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INTERNATIONAL DYNAMICS
(AGENCIES) PTY. LTD.,
P.O. BOX 205, Cheltenham, Victoria. 3192.

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

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



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

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

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

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

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

See and hear two additional Dynaco models, the A10 and A35 with markedly similar sonics and closely matched characteristics at your Dynaco dealer now. Together with the A25, these models represent the finest value available today.

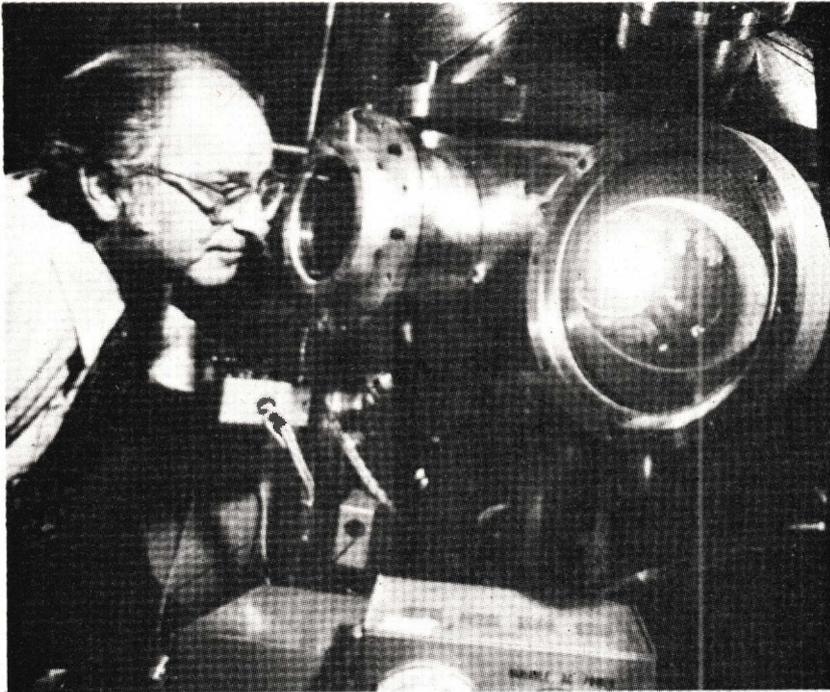
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NEWS digest

LASER FUSION RESEARCH



A project begun last year to explore the potential of high-power lasers to produce controlled thermonuclear fusion is well under way.

The project is being carried out at the University of Rochester under joint sponsorship of that university, General Electric, Esso Research and Engineering Co., and Northeast Utilities. The New York State Atomic & Space Development Authority and the Empire State Electric Energy Research Corp. also are supporting the project with grants.

Here, Dr. Leonard M. Goldman, a physicist on loan to the project from GE's research and development centre in Schenectady, adjusts instrumentation on the target chamber within which fuel pellets of deuterium or lithium deuteride will be heated and vaporized by bursts of light from a high-power laser system.

An objective of the study is to gain information and data that will enable prediction of how large the net yields of energy and neutrons could become in a practical system.

SIBERIAN 'METEORITE' A BLACK HOLE?

Was the Siberian 'meteorite', that levelled an area of forest of over several hundred square kilometres (in 1908) in fact a black hole?

Probably so, according to a paper

published in *Nature* (vol 245, p. 88) last month.

Written by Drs A. A. Jackson and M. Ryan of the University of Texas, (centre for Radioactivity Theory - University of Texas, Austin, Texas 78712, USA) the paper explains that the devastation could well have been caused by a black hole only a few

Angstroms in diameter, but possessing a mass similar to that of an asteroid (10^{20} grams).

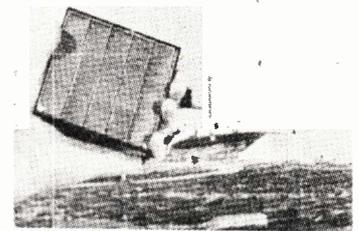
If subsequently proven correct, this explanation clears up a mystery that has puzzled scientists for many years, for the damage was so great that energy equivalent to a 20 Megaton atomic explosion must have been released — yet there was no crater, and no meteoric remains have ever been found.

Nevertheless eyewitnesses reported seeing a clearly visible fiery trail.

Jackson and Ryans' belief is that the black hole approached the earth at a speed just above escape velocity, causing a shock wave that produced temperatures of some 10^5 K. This caused ultraviolet radiation, and thus a plasma column blue in colour (this is confirmed by the eyewitness accounts that described the trail as being similar to a bright blue tube).

The black hole then, say Jackson and Ryan, passed right through the earth, emerging in the North Atlantic somewhere between 40 and 50°N, and 30 to 40°W.

SUN BATTERY PROVIDES POWER

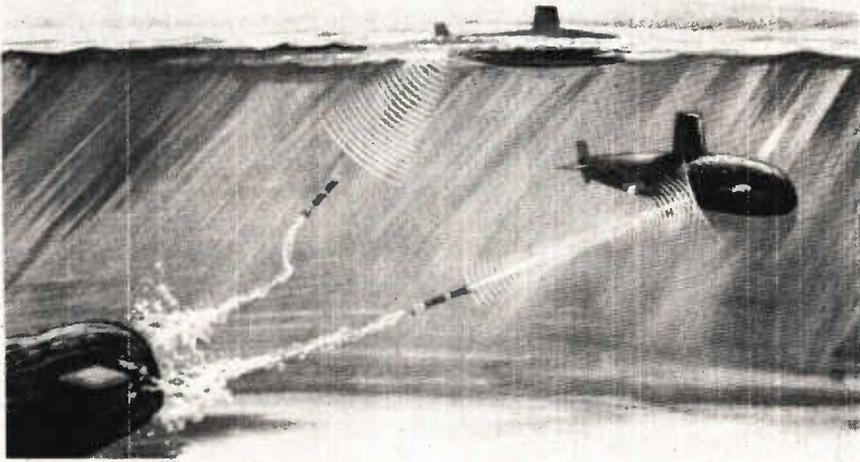


Power for remote marine lights, buoys and other navigational aids could be provided by solar battery units being developed by Britain's International Research & Development Corporation (Fossway, Newcastle on Tyne, UK). They could also be used for portable flashing beacons, portable power supplies, water pumping, irrigation control and educational television and domestic lighting in developing countries.

The module shown measures about 12cm square and gives an output of 300 mA at 2 V in full sunlight. It has been designed to take advantage of the low manufacturing costs possible with CdS solar cell technology.

IRD has been working on thin film solar cells for space applications since 1965 but more recently has adapted the technology to other fields. A paper on the future potential of CdS solar cells for both space and terrestrial applications was given by R.J. Mytton of IRD at a recent international congress in Paris on 'The Sun in the Service of Mankind'.

NEW TORPEDO



Acceptance trials are currently being carried out by the RN to evaluate a new type of torpedo developed by Marconi Space and Defence Systems Ltd.

The new torpedo is driven electrically by contra-rotating propellers and is guided during the initial stages of its 'run' via a trailing wire linked to the firing submarine's control computer.

Once the torpedo is within 'sight' of its target an ultra-sensitive acoustic homing head takes over the task of guidance and at the same time updates the submarine's computer memory bank.

The torpedo's position with respect to the target is established by the

torpedo's steering computer, from acoustic signals detected by the transducer array. This computer controls the torpedo's course speed, and pitch attitude during the attack phase, and information is relayed to the submarine. As the attack develops, the torpedo's homing computer progressively increases the rate at which the target is interrogated, and reduces the sensitivity of its sonar system to ensure that accurate steering commands are generated as the range decreases. Steering logic ensures high terminal accuracy on a manoeuvring target.

SONY QUIT CALCULATOR MARKET

Sony has decided to cease production of its SOBAX electronic desk-top calculator, and to fully withdraw from the calculator market by July, 1974. The firm has marketed the calculator since 1964, but has found that the product wasn't returning sufficient profits.

Production in the electronic calculator market has declined since 1970, with average unit prices dropping sharply from \$597 in 1967 to about \$70 in 1973. Total calculator deliveries for Sony amounted to approximately 200 000 units with 1972 sales of \$6.49 million, only one percent of their total sales.

The Atsugi plant that produced the calculators will be converted into use for video and audio equipment. Sony plans to sell remaining inventories as they have been sold previously, with the service network taking care of all after-service work, and repair parts will be made available for the next seven years.

ELECTRONIC MONITOR IN 1974 TOYOTA CARS

An electronic panel that monitors and warns drivers of defective automobile parts has been installed in Toyota's 1974 model Corona automobiles.

Called OK Monitor, the computerized device monitors 11 checkpoints, including brake lining, engine oil and headlights, and blinks a warning to the driver should any defects or trouble develop.

The system consists of a sensor for detecting malfunctions, a "computer" that processes the information, a primary warning lamp that indicates the presence of trouble and a secondary warning lamp which pin-points the trouble.

The monitor panel on the ceiling of the car, lists 11 checkpoints, including brake, booster vacuum, brake fluid, engine oil, radiator coolant, battery electrolyte, windshield washer solution, headlights, tail lights, parking lamps and license plate lamps.

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\$299.99 Rambler 80 Watt I.C. Amp. Garrard Turntable with Mag. Cart. Realistic Midi 8" 2-way Speakers.

\$399.99 Expo 80 Watt Amp with S.E.A. System and inbuilt 4 channel matrix decoder Garrard SL72B Turntable with Mag. Cart. Realistic MAXI 10" 3-way Speakers.

\$399.99 As above but with Nivico 60 Watt Amp.

\$459.99 As above but with Pioneer 100 Watt Amp.

\$599.99 Nivico 550 4 Channel Amp. Garrard Syncrolab Turntable with Mag. Cart. 4 Realistic Midi 8" 2-way Speakers.

\$659.99 Leak Delta 70 Amp. Garrard Zero 100 Turntable with Shure M75 Cart. Realistic Mini Ultimate 12" 4 way speakers.

These combinations may be altered to suit your requirements.. Available at Cost Less stores refer page 149

QUACK DOCTORS

The United States Navy is buying electric systems capable of overcoming the potentially deadly 'Donald Duck' effect that oxy-helium has on deep-sea divers' speech. The systems, worth, with spares, a total of A\$45 000, were developed for the Royal Navy by Marconi Space and Defence Systems Limited, (Chelmsford, Essex, UK) from Admiralty Research Laboratories designs.

The 'Donald Duck' effect results from divers having to breathe an oxy-helium mixture in depths of greater than 200 metres, where air cannot be used safely. The mixture, being much less dense than air, produces changes in the speed of sound, and therefore in the pitch of a speaker's voice. This rises to an extent where it becomes completely unintelligible to the listener. In emergency situations, the lack of effective communications can mean life or death to the diver.

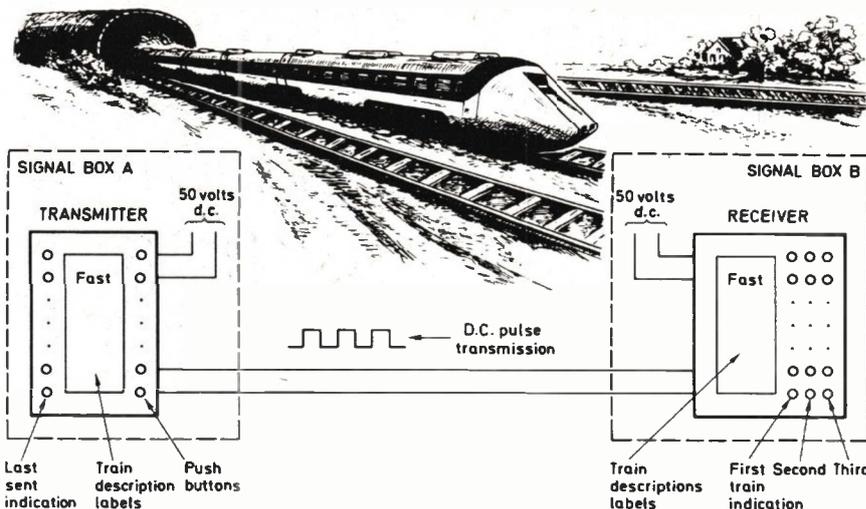
The Marconi system, designated the Type 023, was developed from ARL designs started in late 1968. It has already seen service in the Admiralty Experimental Diving Unit and the Royal Naval Physiological Laboratory, and is currently being evaluated, with favourable results, in a series of medical research dives of up to 300 metres by the Smithsonian Institute in the USA. It operates on a 'Time stretching' principle, where each sound is digitally analyzed, and the significant portion, typically about one third, is reconstructed at a slower rate, while the rest is rejected. This has the effect of lowering the frequency to about a third of its transmitted value, and thus creating full intelligibility.

LASER COMMUNICATION CLOSER

Varian Associated (Palo Alto, California, USA) have developed an advanced photomultiplier that can detect and separate light pulses less than one thousand millionth of a second apart.

This development will be of great value in high speed laser communication systems, analytical instruments, astronomical mapping and many other similar applications that have been impeded by the lack of fine sensitivity in previous photomultiplier tubes.

DESCRIBING A TRAIN



An essential feature of railway operation is a method of transmitting data about trains position etc from one signal station to another.

This type of equipment, known generically as train describers, is traditionally electromechanical, and many of the systems used date back to the early 1930's.

A new type of train describer, operating electronically, has now been developed by AP Electronics (UK).

Operation of the transmitter and the receiver is extremely simple. Both transmitters and receivers may have either 12, 24 or 36 channels, while the receivers may comprise from three to nine stores with descriptions in the first three only being displayed.

A major attraction is that the equipment is housed in one block shelf instrument, with the transmitter and receiver each measuring 400 x 270 x 400mm for a typical 12-channel system, and thus is easy and quick to install. Operations, as with the electromechanical train describers, is from a 50 volt dc source. Power consumption is as low as 50

watts.

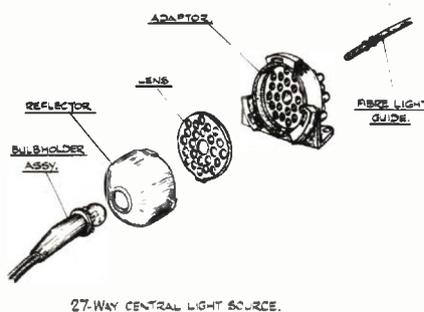
The equipment is extremely light, weighing only 4kg.

Only four wires need be connected to either the transmitter or receiver — a pair for the power unit and a pair for the lines. The electronic describers are very reliable in operation and intensive operational tests have shown the equipment to be completely dependable. Immunity to external interference signals is extremely good.

Red light-emitting diodes (LEDs) are used for the last sent display on the transmitter and for the description received displays on the receiver. The electronic describer incorporates TTL microelectronic circuits on printed-circuit boards while reed relays are used for the line buffer circuits. The reed relays enable the new electronic train describer to work in conjunction with an existing electromechanical describer.

Australian agents are Foss Electric (Aust) Pty Ltd, 96 Penshurst St., Willoughby, NSW.

LATEST JAGUAR XJ6 USES FIBRE OPTICS



In their latest model XJ6, Jaguar have used fibre optic light guides to illuminate the labelling of fascia panel controls governing the operation of the air conditioning unit, the ignition switch and the lighting switch. Just one centrally located bulb is used to supply the light energy for all these points.

A considerable amount of development work has been carried out by the Lucas Electrical Company Ltd., Burnley (UK), over past years, on the uses of fibre optics in automotive application.

Emphasis is presently placed on the development of switch gear illumination, in view of present safety concern in motor vehicles. The

advantages of switch control gear illumination is self evident.

To meet the need for a single bulb light source with multi-way fibre light guide outputs for the illumination of a number of remote devices, Lucas have developed units with up to 27 outlets.

However, most immediate production requirements are for a light source with seven outlets which can be converted to adapt 14 outlets. The unit assembly consists of an aluminized reflector which accepts a bulb holder assembly in a manner that the bulb filament corresponds with the focal point of the reflector. On the opposite end three equally spaced lugs provide part of the locking element which corresponds with three latched on the body. To lock reflector and body, the reflector is twisted about 20° clockwise after locating reflector lugs in the body latching aperture. A heat filter/lens unit is clipped into the body. The lens focuses the light onto the polished fibre light guides ends which are clipped into circular retention elements on the opposite end of lens entry.

Fibre optics light guide cables comprise about 600 light conducting fibres of single fibre diameter measuring approximately 40 μm enclosed in a polyvinylchloride (P.V.C.) sheath.

MEMOREX TO MAKE SONY VIDEO CASSETTES

The US Memorex organisation has been licenced by Sony to manufacture and market video tape cassettes in Sony's 3/4" U-Matic format.

Memorex currently produces chromium dioxide video tape for use in the U-Matic cassettes — under the trade name 'Chromex'.

HUGE FUEL CELLS

The USA's Pratt and Whitney organization have accepted a US\$5 million research project to develop a fuel cell capable of developing a continuous 26 000 kW — enough to provide power for a town of at least 20 000 people.

It is hoped that the fuel cell will be developed to demonstration stage by 1976 and be ready for commercial usage by the early 1980's.

HEWLETT-PACKARD TO MARKET LOW-PRICE 'SCOPES

The Colorado division of Hewlett-Packard are reliably reported to be actively planning to market a new range of 'low-price' oscilloscopes to compete with those from Tektronix, Philips etc.

It is believed that the range will include single and dual channel oscilloscopes (of 15 MHz capability) priced at US\$500 or so.

AUTOMATIC ELECTRONIC CONVERSION



The metric conversion calculator chip — described in Electronics Today International last month — is to be incorporated in a calculator shortly to be marketed by Summit International (Salt Lake City, USA).

Doubling as a five-function calculator, the unit will sell for around US\$160.

Each number on the keyboard has beneath it an abbreviation signifying a particular metric conversion. For example the 0 key doubles also for inches to centimetres, the 8 key also doubles for gallons to litres.

A change key selects whichever key function is required.

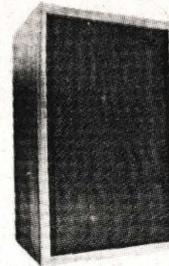
To use the calculator as a conversion device, the user firstly enters the relevant data (e.g. 45.7 gallons) and then presses the change key plus the 'gallons to litres' key. The readout then indicates the metric equivalent of the number quantity entered. A reverse key is also provided to reverse the action of the unit.

NATIONAL SEMICONDUCTOR MARKET \$39 CALCULATOR

In the USA, National Semiconductor are actively marketing their own six-digit fixed point calculator at a retail price of US\$39.

The calculators are being handled through NS Electronics, a newly formed subsidiary of National Semiconductor.

It is reported that the distributor price is a mere US\$28.50, thus allowing a close-to 40% mark-up for the retail trade. Despite this already low price it is believed that NS have plans to reduce the cost price even further to enable retailers to sell the calculators for around US\$29.



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— reproduced from publicity material associated with the book.

TDK TO MAKE TAPE IN USA

Japan's TDK Electronics Co. has recently completed construction of a \$1 million cassette tape manufacturing plant in Irvine California (USA).

Output of the plant is scheduled as 500 000 cassettes a month — initially. This figure will be raised to one million cassettes monthly in the near future.

AN ELECTRONIC VENTURE IN ELECTRONIC SPEECH RECOGNITION

EMI Limited, London, and Threshold Technology Incorporated, (Cinnaminson, N.J. US), have announced the signing of a letter of intent which will shortly lead to the formation of a joint venture company in Britain to market over much of the world, electronic systems for recognising spoken words and converting them into signals for controlling machines or instructing computers.

The joint venture, in which EMI will own 60% of the equity, will be established at Hayes, Middlesex.

It will exploit the related capabilities of both EMI and Threshold in advanced electronic speech recognition systems and automatic pattern recognition, and will immediately begin to develop sales of the threshold range of electronic voice recognition systems throughout the UK, Europe, Africa and various other areas of the world.

Threshold has taken the lead in the development and manufacture of voice data input systems, which identify spoken words and convert them into digital signals for transmission to computers or for controlling machine operations.

Another major area of Threshold's expertise is in the security field. It is currently testing a Threshold-developed system which can identify a speaker's voice and compare it with voice patterns in a memory bank of

"authorized" voices.

Threshold's speaker-verification systems have potential as a means, for example, of validating bank cash cards, by comparing a voice-pattern pre-recorded on the card, with the actual voice of the individual presenting the card. These systems promise to be an important method of preventing fraud, and several major British companies have already expressed interest in the concept.

In addition, such systems can be used for validating the authenticity of individuals seeking to enter restricted areas, such as research laboratories, and similar locations.

One of the most significant advantages of voice data input systems used to control machines and to feed data to computers, is that voice input often eliminates a prohibitive volume of intermediate paperwork.

The capability of Threshold is complemented by that of EMI, which has gained a leading position in the areas of automatic pattern recognition, magnetic recording technology (notably in relation to the development of special magnetic coatings for security applications) and in various aspects of advanced audio engineering.

Threshold was established in 1970 by a small team of engineers which had been concentrating for several years on the development of speech recognition systems. It has been engaged on a number of research projects for the US government and in the installation of voice data entry systems for a number of industrial applications.

ESSENTIAL BOOKS

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES. Includes many thousands of British, USA and Japanese transistors. 78 pages. A\$1 including postage.

HOW TO MAKE WALKIE-TALKIES FOR LICENSED OPERATION. A\$1 including postage.

HANDBOOK OF RADIO, TV AND INDUSTRIAL TUBE & VALVE EQUIVALENTS. Includes many thousands of British, USA, European, Japanese and CV types of Radio, TV and industrial valves & tubes. A\$1 including postage.

PRINCIPLES OF ELECTRICITY AND MAGNETISM. Ideal for anyone wishing to improve their knowledge of this important subject. A complete course in this subject for the student, technician or engineer. Suitable for those studying electronics. Authors Page & Adams. As recommended to technical colleges & universities. 532 pages. Fully illustrated. A\$6 including postage.

CONSTRUCTORS MANUAL OF ELECTRONIC CIRCUITS FOR THE HOME. ELECTRONIC NOVELTIES FOR THE MOTORIST. PRACTICAL TRANSISTOR NOVELTY CIRCUITS. The above 3 new books sent for A\$4 including postage.

MOBILE RADIO TELEPHONE EQUIPMENT HANDBOOK. Gives circuits, data and illustrations plus some valuable modifications for popular commercial radiotelephone equipments. A\$8 including postage.

HOW TO MAKE 2 & 4 METRE CONVERTORS FOR AMATEUR USE. A\$2 including postage.

THE THEORY OF GUIDED ELECTROMAGNETIC WAVES. R. Waldron. The most comprehensive book ever written about Wave-Guides, Transmission Lines, Cavity Resonators, Micro-Waves etc. Contains important mathematical formulae and data. 500 pages. Marconi Series. Usually A\$22. Special offer A\$14 post free.

THE SCATTERING AND DIFFRACTION OF WAVES. A goldmine of information for the experimenter, amateur and scientist. Published by Oxford University Press. A\$4 including postage.

THE GOVERNMENT SURPLUS WIRELESS EQUIPMENT HANDBOOK. Gives circuits, data and illustrations plus valuable information for British/USA receivers, transmitters, trans/receivers. With modifications to sets and test equipment. A\$7 including postage.

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BATTERIES MAY BEAT BLACKOUTS

Improved sodium-sulfur batteries are the goal of a development project jointly funded by General Electric and Edison Electric Institute. A major problem is overcoming corrosion of the beta-alumina separators by liquid sulfur and sodium. The batteries operate at temperatures of 300° to 350°C. GE vice president Arthur M. Bueche says that the batteries offer an efficient means of avoiding future blackouts by storing off-peak electrical power. They also may be useful to power vehicles.

Meanwhile, a long life storage battery using molten lithium metal sulfide electrodes has been developed by Rockwell International. A demonstration cell has been charged and discharged 225 times with a near zero loss of capacity. Work is now being done on a practical-size battery that could be used in banks to store power generated during slack periods, which could be discharged during periods of peak power demands.

NEW STANDARD FOR RADIO INTERFERENCE LIMITS

A new Australian standard covering radio interference limits and measurements for television and radio receivers, has been published by the Standards Association. It is issued as Australian Standard 1053.

The standard prescribes limits for conducted and radiated interference to radio broadcasting services emanating from radio and television receivers. The limits are similar to those recommended by CISPR (International Special Committee on Radio Interference).

The method of measurement is technically identical with that recommended by CISPR and published by the International Electrotechnical Commission (IEC) in Publication 106 for 300 ohm input impedances using measuring equipment described in CISPR Publications 1 and 2.

The prescription of limits stringent enough to give full protection to all broadcast reception, including that in areas of low field strength, is impracticable. These limits are a compromise between higher receiver costs and desirable limits in order to protect broadcasting services in those areas most likely to be affected. It is appreciated that the standard will not provide adequate protection for other services under all circumstances but it is considered to offer the best protection possible at present.

Copies of AS 1053 may be obtained from the various offices of the Standards Association for \$2.40 each. (Postage extra).

CHINA TO USE PAL TV?

According to reports from Peking, China has started experimental colour TV broadcasting using the PAL system (shortly to be introduced also to Australia).

It is understood that Chinese TV experts have already visited West Germany to sign licencing agreements with Telfunken, holders of the PAL system patents.

China has TV broadcasting stations in all provinces excluding Tibet, however TV installations number only around 100 000 — for a total population approaching 800 million.

INDUSTRY WANTS RIGHT TO MARKET ADDITIONAL TELEPHONE APPLIANCES

Telecommunications firms want the right to sell to subscribers a range of equipment that can be connected to the public telephone network, just as other manufacturers sell appliances for connection to electricity, gas and water services.

At present five firms approved by the Australian Post Office are permitted to sell or lease private automatic branch exchanges (PABXs) to customers, and to install these in premises.

But less-sophisticated office switchboards (private manual branch exchanges, or PMBXs) are provided exclusively by the Post Office, which also monopolises telephone instruments and other apparatus for subscribers.

Most of the equipment itself is made by private enterprise for the Post Office, which does the marketing.

The Australian Telecommunications Development Association's recent submissions to the Commission of Inquiry into the Australian Post Office and the adequacy of its services included one seeking extension of the present PABX approved-contractors arrangement into other areas.

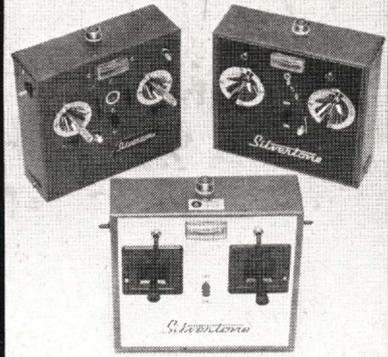
The association argued that it would be in the public interest for competing private-enterprise firms to be allowed to market PMBXs, intercommunication systems, alternatives to the present telephone instruments, data modems, and peripheral equipment for telephone and Telex services.

"Alternative" types of telephones referred chiefly to push-button phones, which now are not allowed to be connected to APO telephone lines.

The submission also sought installation and maintenance rights, including the provision of maintenance services for PABXs (now performed by the APO, which charges service fees).

The association also asked for the right to supply and install cable reticulation for all types of telecommunications devices, for which it

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M. S. COMPONENTS

The following Amendments apply to the 20 page catalogue published in the September issue of Electronics Today International.

- Page 3 "Star-pacs," — 1078 — should read BC 177 and BC 178
- Page 3 Audio Generator Model TE-22 D price should be \$48.00.
- Page 3 RF Signal Generator Model TE-20D price should be \$40.00
- Page 6 Connectors PR4 should be P44
- Page 8 Reed Switches Types XS4/2 and XS/10 under "Function" should read "N/O"
- Page 10 Transformers — The price of the X3A Jabel soldering iron transformer should be \$12.95.
- Page 34 Microphones — Cassette type D.M. 230 has now been discontinued.
- Page 35 Amplifiers — Expo Model KA-3300 is now Model E 15 x 4 (Improved version, same price).
- Page 36 Semiconductors — Silicon types PB40, PA40, PA60, all have a maximum current rating of 25 amps R.M.S.
- Page 37 Knobs — Types WT 1 and E/30 both are priced at 22c.
- Page 37 Multimeters, — Type 460ED should read Type 450ED.

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news digest

predicts increasing demand and diversity.

The association argued that the approved-contractor arrangement benefits the individual subscriber by giving him a choice: he selects the type of system he wants, at the price he wants to pay, and gets it without delay.

It said that competition generated the incentive for suppliers to ascertain just what subscribers needed, and to design and produce what they wanted as economically as possible.

The association said that after contractors took over the direct supply of PABXs from the APO in 1956 they eliminated a long waiting list.

Earlier in the commission's hearings the APO conceded that it had handed over PABX business because it lacked sufficient resources to overtake the demand, and acknowledged that it was well satisfied with the approved-contractors scheme.

The ATDA argued that extension of the approved-contractors arrangement to other products would ensure efficiency, best competitive price and earliest delivery, and would avoid the unnecessary use of public money in financing private facilities.

It might be claimed that choice made the APO's maintenance work more difficult, because of a multiplicity of equipment types to be serviced. But the association argued that the solution was to make the suppliers responsible for maintenance services, as in many other countries.

This also would benefit the subscriber, because he would take into account the cost and dependability of maintenance service in making his choice of PABX or other equipment.

In addition, servicing by the suppliers would conserve the APO's skilled manpower and free scarce capital funds for urgent needs, such as additional exchange equipment and other plant to reduce the present backlog of telephone applications.

It would be necessary for the APO to control technical standards to preserve the performance quality of the network, but this already worked successfully in the PABX field.

A similar practice existed in the United States, where private manufacturers must conform to technical standards laid down by the Federal Communications Commission.

The ATDA asked the Commission to consider the distribution of gas, electricity and water, and the provision of appliances.

"In each case the common reticulation network is controlled and operated by an authority, but the consumer has a choice of a range of appliances from competing manufacturers which can be bought and connected to the network — appliances which meet technical standards laid down by the relevant authority.

"Furthermore, in the provision of these services public funds, or the relevant authority's funds, are not in general used to finance the appliances for use by individual customers."

SIMPLER TV

Horizontal and vertical hold controls will no longer be required on TV receivers if a new technique developed by Toshiba proves successful.

In an experimental receiver, a ceramic resonator operating at 252 kHz is divided down to 15.75 kHz to provide stable horizontal synchronization.

Vertical synchronization is achieved by further division of the horizontal pulses.

The inherent stability of the resonator is so good, it is claimed that frequency drift is less than the pull-in range of the AFC circuit. ●

The Admedia group of South Australia have just been appointed as advertising representatives for Electronics Today International in that State. The company's address is:— Admedia Group of S.A., 12-20 O'Connell St., North Adelaide, S.A. 5006. Tel: 67-1129.



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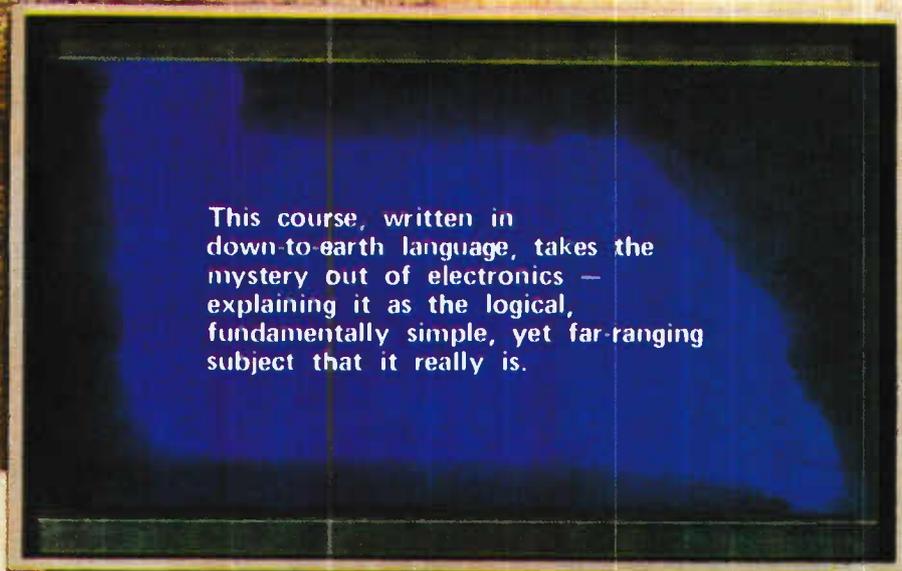
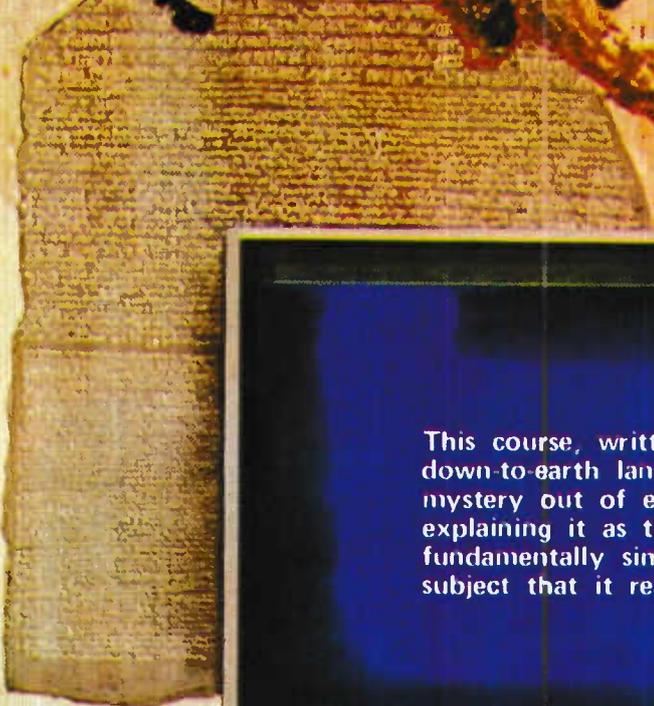
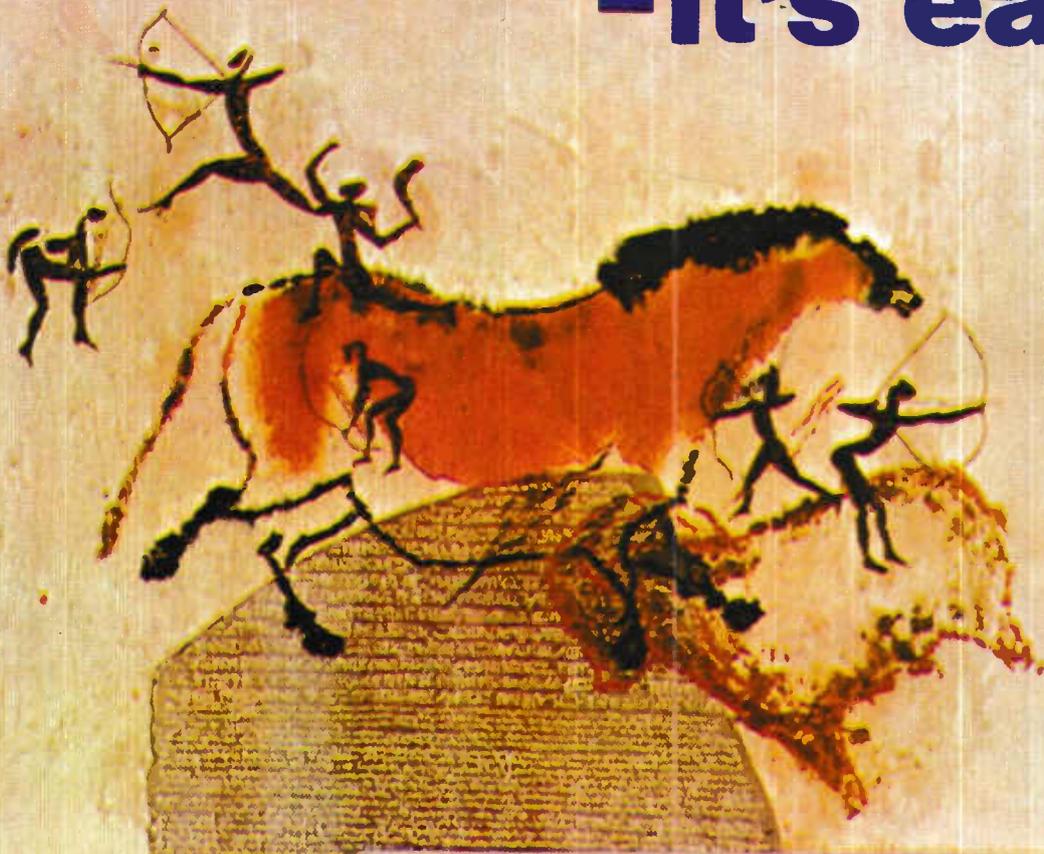
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ELECTRONICS **-it's easy!**



This course, written in down-to-earth language, takes the mystery out of electronics — explaining it as the logical, fundamentally simple, yet far-ranging subject that it really is.

A new approach to basic electronics begins with this first article of a series. /

TO the unenlightened even the simplest process can be a mystery. Yet with training the mystery vanishes when it is seen how simple logical techniques are combined to fulfil a task.

As we try to further our knowledge of the world about us, we collect facts gained from practical research and a great deal of thinking. Then by further mental effort we construct fundamental concepts that describe the observed facts.

These concepts, are more readily understood and remembered than an enormously long list of individual facts; and, coupled with imagination, provide the power to create and understand processes of great intricacy. Furthermore, by getting down to basics it is possible to build out again in quite new directions.

It is a human habit to try and make all experience black or white, classifying it into distinct compartments having a generally accepted name — medicine, engineering, farming, etc. It seems so tidy and assists information retrieval, but there is an ever-growing awareness that life is not like this, and processes are only understood properly by a multi-disciplinary approach.

Electronics, although seen by many in the past as a self-contained subject, should, more correctly, be regarded as a universal discipline necessary to a remarkably wide range of endeavour. It is vital to communications, archaeology, medicine, language teaching, banking, education, farming — a complete list would be never ending.

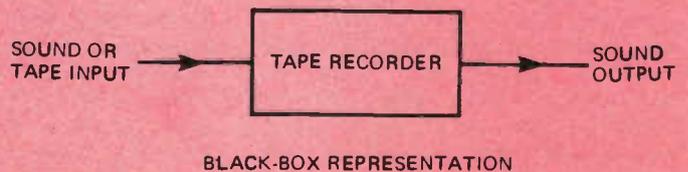
Because of this, throughout this

course, our treatment of electronics will be a general basic approach — known loosely nowadays as a systems study. It will contrast with the more traditional approach, given in books and courses, by placing more emphasis on where a concept fits, rather than on how a manufacturer makes components or how the fundamental particles involved behave.

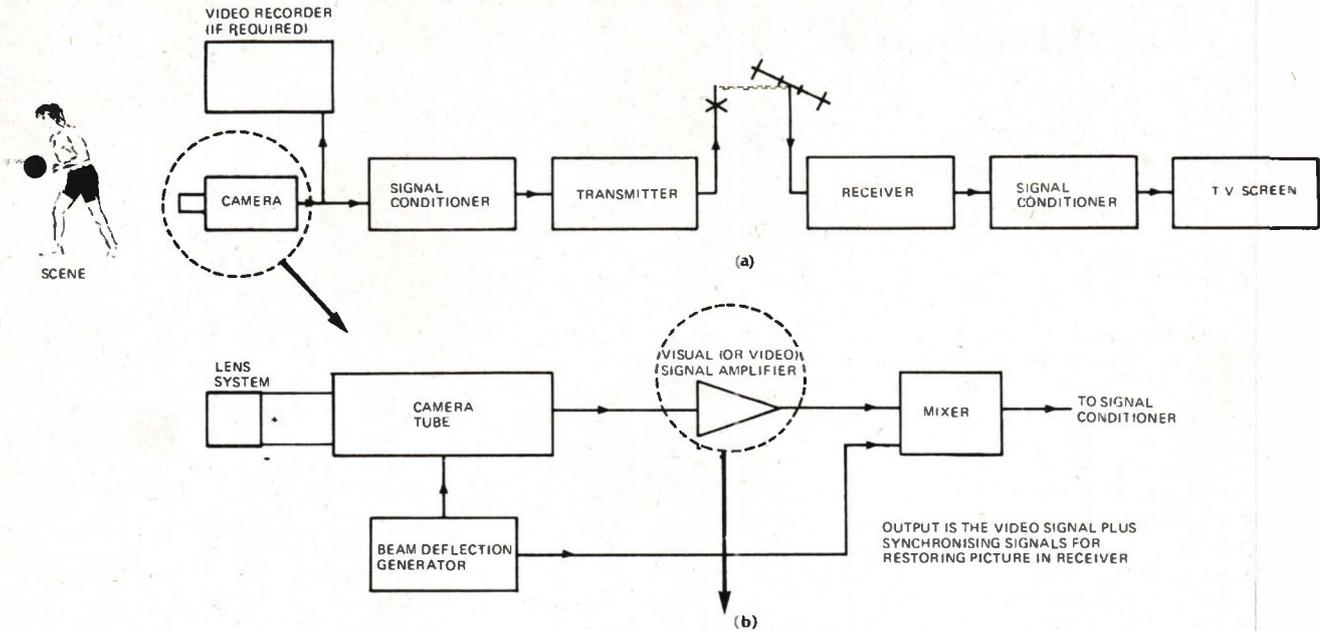
THE BLACK-BOX APPROACH

The physical world consists of numerous processes that interact with each other to form a reasonably well-balanced mammoth process. The nature of the individual processes vary enormously. In the natural world they involve such phenomena as biological behaviour and electro-chemical reactions. Man has added processes of his own that function optical and

Fig. 1. As both tape-recorders perform basically similar tasks, their 'black box' representation may be the same.

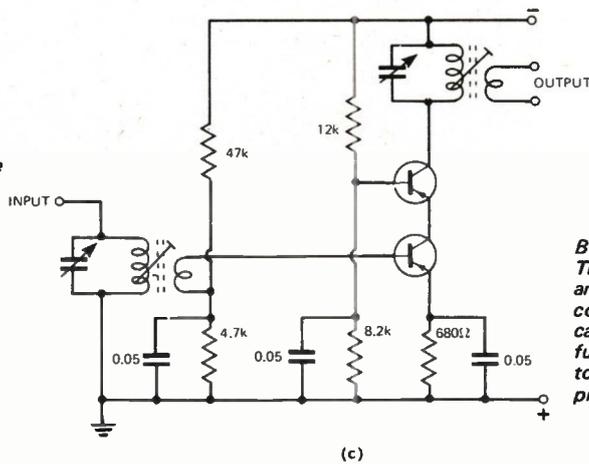


ELECTRONICS - it's easy!



TOP: Fig 2a). Complete TV transmitter and receiver — this 'black box' representation shows the rudiments of the system. Each individual 'box' may take one of many forms — yet the system as a whole can always be portrayed as shown here.

CENTRE: (Fig. 2b). Black box representation of the internal workings of the TV camera (shown ringed in drawing above). Here, an elementary knowledge of television techniques would be needed in order to understand the individual 'black boxes' into which the camera has now been broken down.



BELOW: (Fig. 2c). Final 'breakdown'. This drawing shows the components and their interconnections that collectively form the part of the TV camera in Fig 2b. (As will be explained further in this course, symbols are used to represent components — rather than pictures of the components themselves).

electronic hardware put together to create the machinery needed to make life easier.

To gain an understanding of the overall function of a system of any type, we need to break it down into recognisable basic blocks that each behave in a way that is comprehensible to us. This approach also enables one to realise what else the total system might do if the circumstances were a little different. Alternatively, it should tell how to modify a block or two to obtain a different behaviour.

Such blocks in electronics are commonly called "black boxes". The behaviour of a given kind of "black box" is always the same (by definition), but the internal mechanism used to achieve the given performance could be quite different (as shown in Fig. 1).

At a systems level of study it does not matter what is *inside* the box; its role is to provide characteristics of a certain kind. Understanding the behaviour of the system needs little

knowledge of the inside of such "black boxes". Similarly when designing a new system, it is first realised as a string of "black boxes" picked from one's catalogue of feasible concepts. (There is a catch, however, for technology is changing so rapidly that there is an ever-increasing and apparently never-ending supply of new functions coming into being. A compromise must, therefore, be drawn between being right up-to-date and actually getting on with building a working system).

When a system fails to operate, the faulty "black box" can be isolated for repair; this is achieved by applying carefully thought-out tests to the system to diagnose the fault, or in the case of small systems, by simply replacing "black boxes" one by one until the system works again. Designing and repairing "black boxes" needs a knowledge of more basic electronic design — we will be mainly concerned with this level in the early stages of the course.

At a stage more basic again, are scientists, research engineers and circuit designers who each have a specialized knowledge of the many individual facets of the basic components — it is they who invent and develop new devices.

To illustrate this hierarchy, consider the system used to transmit visual information to other places — television. In Fig. 2a a television system is depicted as a number of interconnected black boxes. The names in this form of portrayal (called a schematic) tell even the untrained the purpose of each box. The next stage of complexity is another schematic (still drawn as boxes, for we are not yet at the component level) that uses commonly available functions. The camera only, of Fig. 2a is drawn in Fig. 2b to illustrate this — the complete system diagram would need a great deal of space. If we wished actually to construct or fault-find the camera, we would need to know about the inside of each box,

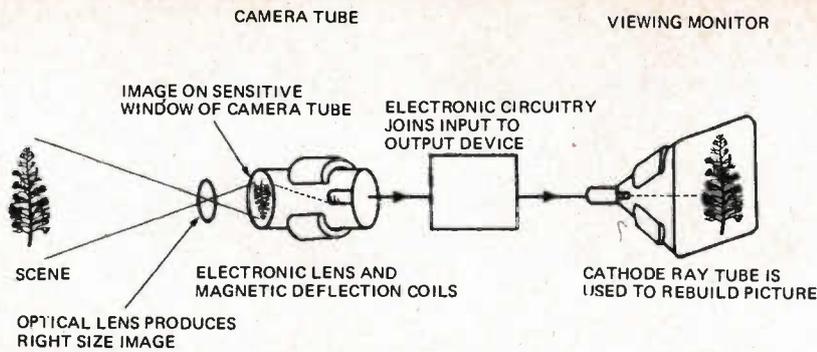


Fig. 3. Electronic circuits invariably need to be used in conjunction with 'bits' from other disciplines. Television, for example, utilises a number of mechanical and optical components — as our drawing shows.

and here we use circuit diagrams that show the actual connections made between components.

In electronic circuit diagrams, symbols are used to represent the various components — thus a battery is shown as $\text{---} \text{||} \text{---}$ regardless of its actual size or shape, a resistor is usually shown as $\text{---} \text{Z} \text{---}$, and a capacitor as $\text{---} \text{C} \text{---}$. Circuit diagrams are in fact a shorthand way of showing components and their interconnections.

The circuit shown in Fig 2c is that of the video signal amplifier (Fig. 2b). Given a circuit diagram and a little basic knowledge, it is relatively easy to assemble the circuit to form a more complicated black box.

Occasionally, especially when designing new circuits, it helps to have

more fundamental details of the operation, manufacturing process and material properties of components, but that stage is not entirely essential if the need is only to make designs already detailed by a designer, in application notes, or an electronic magazine. (A point to remember when studying schematics is that the supply of power necessary to operate the circuit is often omitted to simplify the drawing).

The systems approach to a problem is not restricted to use in electronics alone. It is just as useable in the study and design of mechanical and optical systems, as well as a host of non-physical processes. The electronic worker cannot avoid becoming involved with other disciplines — in the study of television for example, he

or she would need to know something of optical techniques, photography and acoustics (as shown in Fig. 3).

When systems are studied as boxes at the various levels described in this brief introductory article, a seemingly incomprehensible device (like that shown in Fig. 4) crumbles, slowly perhaps, but assuredly, to a stage where it is almost obvious — the mystery has vanished. With training and experience, that this course will provide, it will become possible to recognise the individual blocks in an intricate circuit diagram and thus realise its behaviour.

In electronics that which was regarded as a complex system component a decade or so ago, might now be merely a sub-system of another larger system. Twenty years ago it was a major project to design and build a stable amplifier for precision applications. (This is a device commonly used in many branches of electronics. Its function is to enlarge signals, and will be studied later). Today, they are of fingernail size, consume only a minute amount of power, perform equally as well as the best of yesteryear, yet sell at a price that enables them to be used with little regard for their cost. The earlier units used a thousand times more power, cost a hundred times as much, and were at least the size of a shoe box. The old and the new forms are contrasted in Fig. 5.

This trend towards the sale of complete inexpensive sub-systems as the most basic building block enables even the learner of today to build sophisticated devices speedily and at reasonable cost. It is because of this development that this particular course is different from most others on electronics.

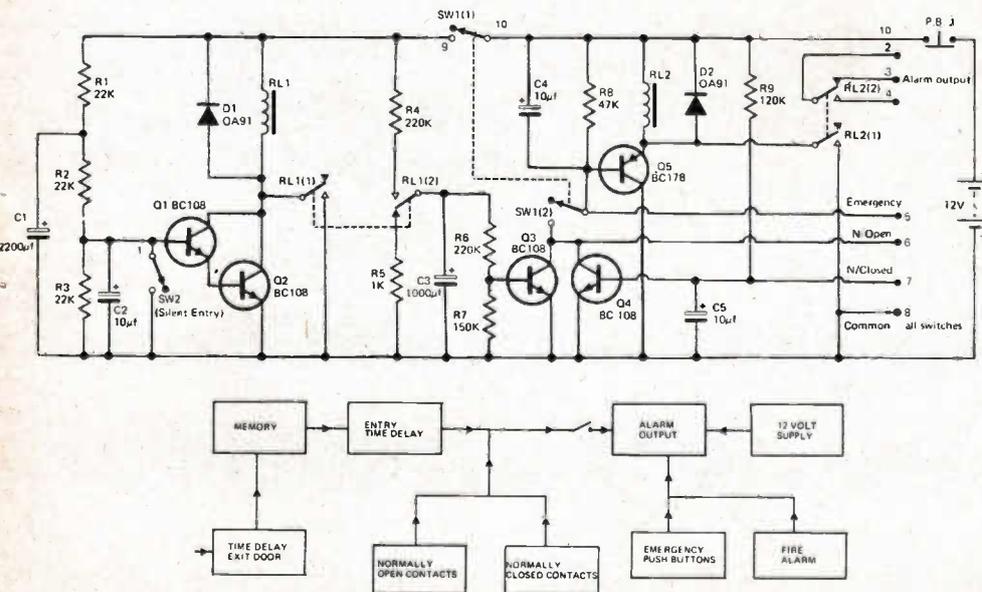
So much for the way in which we treat a system to gain an understanding of its operations. Let us now concentrate on the fundamental nature of black boxes.

Power flow in electronic black-boxes

For a system to operate, it usually must have an energy or power supply. The law of conservation of energy says there must be an energy balance (Fig. 6) — energy given out by a system as useful output, plus the energy losses of components, must equal the input energy from the supply.

Black boxes, therefore, have inputs and outputs of energy. For example, there might be an input of power to drive it and an input to operate the output. The relationship between the input and the output is called the transfer function of the box, for it expresses how the input is effectively transferred to the output. In boxes

Fig. 4. Complex devices may appear baffling — until broken down to show the actual functions: a/ Circuit diagram of a complex burglar alarm. b/ It's operation is much clearer as shown here.



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Fig. 5. Dramatically illustrating the rapidly changing nature of electronic techniques, the tiny module (below) has virtually identical performance as the massive unit shown above it. Both are high power audio amplifiers.

consuming small powers we refer to the input and output energies as signals. The input signal to a black box invariably controls the power flow to the output — like a tap controls water flow. There are a few electronic systems that derive their power from the input signal, but they are not common. The old-fashioned crystal radio set of our grandfather's day was an example of this. The energy used to drive the headphones was actually derived from the signal transmitted by

the broadcasting station, and no battery or other form of power supply was required.

Black boxes connected to the power supply will be constructed from two classes of component. They can either dissipate (or waste) the energy as losses (for example, the heating of a resistor) or they can store energy giving it back later. An example of this — explained in detail later in this course — is a coil of wire forming an inductor. This can store electrical

energy by virtue of a magnetic field. Another example is that of two close, but not touching, metal plates (known as a capacitor) that can store energy as an electric charge.

Resistors (often abbreviated when written, to R), inductors (L) and capacitors (C) are the basic elements of electronics. In practice, each has some degree of unwanted power-loss or storage and this may be important, as will be seen later. Basic resistors, inductors, or capacitors have a wire

Fig. 6. The total amount of energy flowing into any system will always be the same as the total amount of energy flowing out of that system.

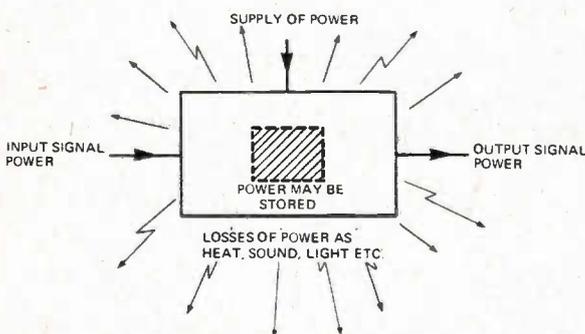


Fig. 7. Signals from many processes may not be in a form suitable for electronic processing. Transducers, are used to make the necessary transformations. Here, information from many different parts of this mammoth steel rolling mill is transduced into electrical form and displayed on this control desk.



ELECTRONICS -it's easy!

going into them, and another leading from them. (They are 'passive elements' in that they are unable to increase (amplify) the power level of input signals transferred to the output. They can be used to set the flow-rate of power but cannot produce a higher power at their output than that at their input.

THE AMPLIFIER

Another class of basic element, the amplifier, by contrast, has three terminals (at least) — input signal, power input and output signal, and with these an output signal can be made much larger than the input signal.

An amplifier does not increase power in a mysterious way. It merely acts as a device whereby a small input power can control a large output power by allowing it to flow (under control) from the power supply — just as a small hydraulic tap is operated to control the lift of a car-hoist in a service station. Such devices are known as 'active elements'. Individual passive elements are often combined to produce a passive circuit; these circuits can then be combined with active elements to form larger circuits.

THE NEED FOR TRANSDUCER BLACK BOXES

Some black boxes serve the purpose of interfacing an electronic system with the physical world, and vice versa. They change (or in electronic parlance, 'transduce') physical variables, such as sound, brightness and length into an electrical equivalent signal that is compatible with electronic techniques.

These are the 'sensors' of man-made systems, acting much as eyes, ears, etc do in other ways in humans.

The television camera, for example, changes visual images into electronic signals suitable for broadcasting. Once the electronic signals are processed, it will eventually be necessary to change them back to a non-electronic form (which may, for example, be the output of a record player).

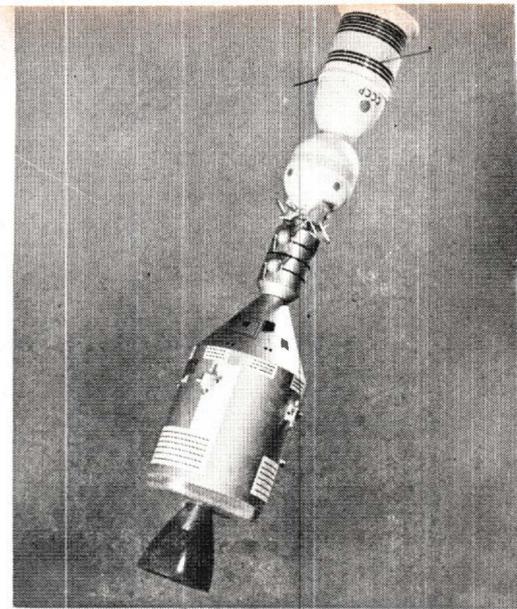
The loudspeaker is one such output transducer, for it converts electric currents to the motion of a diaphragm, thus producing sound pressure waves in the air that we recognise as music or speech.

Electronic systems then, are built up from passive elements (resistors, inductors and capacitors in the main) that can either store or lose energy,

and active elements (amplifiers) that enable energy flow to be regulated from a main supply. A proper understanding of these basic differences greatly assists comprehension of the operations of circuits that are encountered as we proceed.

As it is too early to start practical work, find out if you really understand the systems approach by sketching the black-box diagrams of common processes around you — they need not be electronic.

Examples worth trying are a motor-car, or bicycle system with a rider, the movie film process from scene to screen, automatic street lighting where the sun is used to switch the lamp off during the day, and traffic lights controlling vehicles at an intersection. Remember to identify where the power is coming from and going to, and which are the active and passive elements of each system. ●



Perhaps the most complex electric systems yet devised are those used in space — typifying such applications is this NASA model of the USSR's Soyuz and the US Apollo spacecrafts in simulated rendezvous and docking in Earth orbit.



Two transducers used in everyday life. The microphone (left) transduces sound energy into electrical energy, conversely the loudspeakers (below) transduces electrical energy back into sound.



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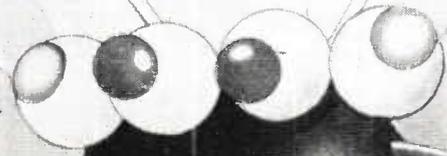
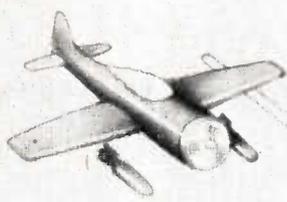
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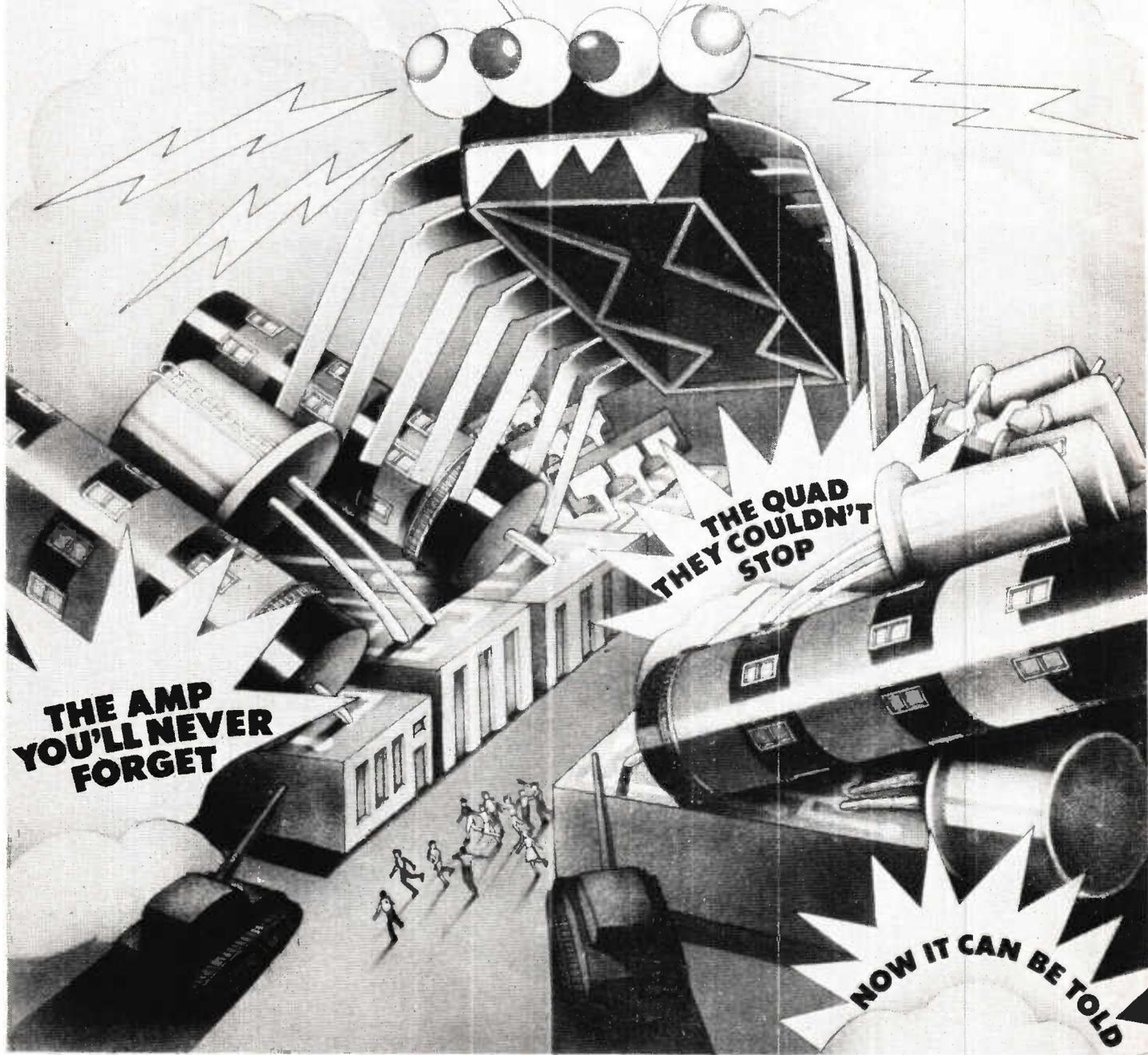
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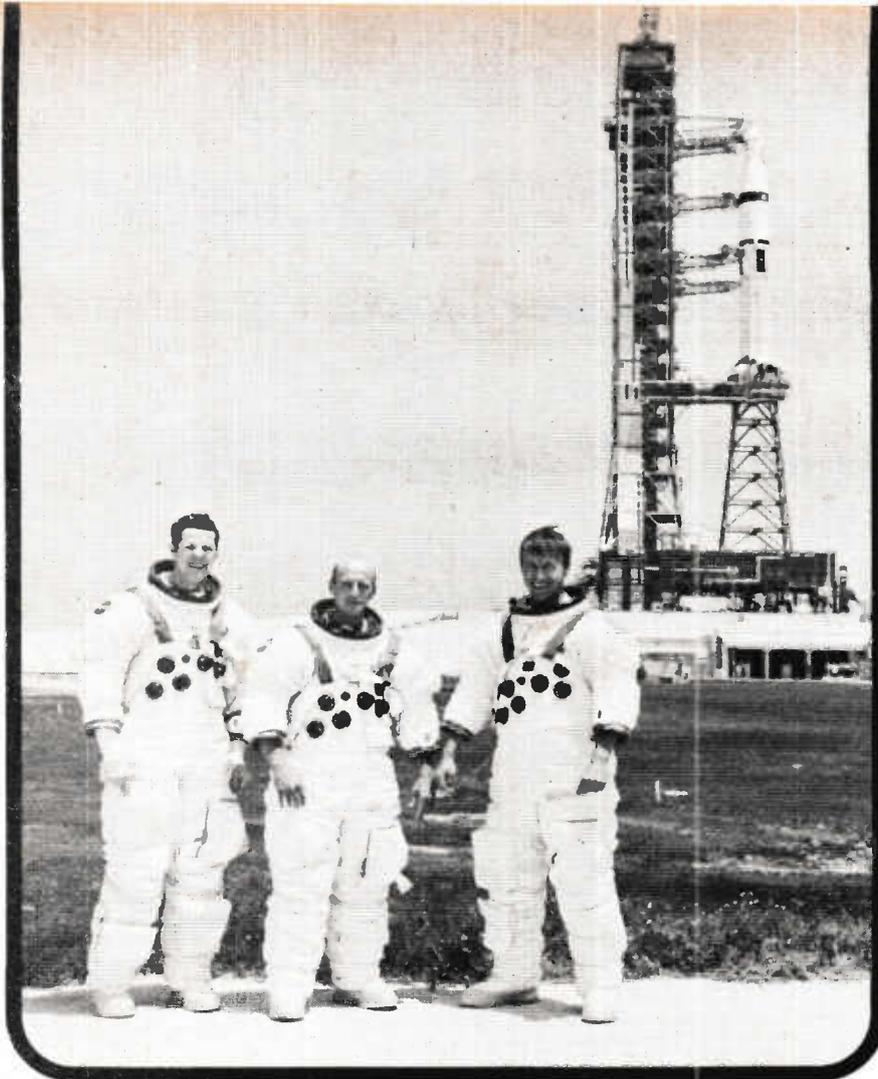
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Skylab 2 astronauts, from left to right, Dr. Joseph P. Kerwin, science pilot; Charles Conrad, Jr., mission commander; and Paul Weitz, pilot, pause in front of the Saturn IB space vehicle that launched them to Earth orbit from Complex 39B.

NASA - the first 15 years

A resume of past achievements and future plans of the American Space Agency.

FIFTEEN years ago, on the 29th of July 1958, President Eisenhower signed into law the National Aeronautics and Space Act of 1958. As a direct result of this legislation the National Aeronautics and Space Administration - NASA, was officially born two months later on October the first.

Prior to this time, research into rocket technology in the United States was fragmented among the military services and NASA's predecessor the National Advisory Committee for Aeronautics (NACA). This fragmentation and its resulting jealousies prevented any real progress being made.

Russia's Sputnik 1, launched Oct. 4,

1957, put 184 pounds of scientific instruments into orbit and seriously challenged the United States' reputation for technological superiority. Congratulatory messages had hardly stopped pouring in to the U.S.S.R. when the Soviets on Nov. 3 launched another Sputnik with six times the payload of the first one. This one also carried the first space passenger, a dog named Laika.

From the public and official concern arising from these events the United States realized that they needed a space program built on a foundation of well-formulated basic policy and planning, effectively organized, adequately funded, and given high priorities.

The outcome was a civilian space agency, the National Aeronautics and Space Administration, whose policy was "that activities in space should be devoted to peaceful purposes for the benefit of all mankind."

When NASA celebrated its 15th birthday on the first of October, the U.S. had orbiting the Earth every 90 minutes a 100-ton space station, Skylab. By contrast, the first US satellite, Explorer 1, launched Jan. 31, 1958, weighed just a little over 30 pounds. For all its small size, Explorer 1 was scientifically productive. It discovered the Van Allen Belts, areas of high energy particles that surround the Earth.

Skylab, manned by three crews of three astronauts each for periods of up to two months, is conducting solar astronomy, Earth resources, medical and other scientific and technical investigations.

It is hoped that the Skylab experiments in space will provide new knowledge for the improvement of life on Earth and that its investigations and experiments will help develop new methods of learning about the Earth's environment and resources, and provide new ways to evaluate programs directed at preserving or enhancing those resources throughout the world.

Following are summaries of the major space programs undertaken during NASA's first 15 years.

MANNED SPACE FLIGHT

In manned space flight the Russians were again first in the field. Yuri Gagarin, in his space ship Vostok, was the first man in space making an orbital flight in April 1961.

The United States' manned space flight program, Project Mercury, was established in October 1958 and in May 1961 Alan Shepard became the first American in space. He made a suborbital flight of 15 minutes, successfully landing in the Atlantic ocean 302 miles down range from Cape Canaveral.

On February 20, 1962, John Glenn became the first of four Mercury astronauts to be placed in Earth orbit thus accomplishing the major goal of the program.

Following Mercury, the Gemini Program extended manned spaceflight activities by the development of a two-man spacecraft designed for long duration flights. From March 1965 to November 1966, ten manned Earth-orbital Gemini flights were flown for missions of from 5 hours to 14 days.

In the late sixties and early seventies, the Apollo lunar landing program dominated the space program. In December 1968, with the flight Apollo 8, man first circled the Moon and returned safely to Earth. Starting with the flight of Apollo 11 and Neil Armstrong's first step on the lunar surface July 20, 1969, twelve astronauts were eventually to explore the Moon until December 1972 when the flight of Apollo 17 officially ended the program. But the five scientific stations established on the Moon continue to relay information to Earth, and it will take years to completely analyze the hundreds of pounds of lunar material returned to Earth.

Following 1973, the year of Skylab, the next major manned flight program will be the joint Apollo-Soyuz Test Project — the first manned international space effort. American astronauts, in an Apollo spacecraft, will rendezvous, dock, and visit an orbiting USSR Soyuz spacecraft. In turn, Soyuz crewmen will pass through the docking module and return the visit to Apollo. Target date for the launch is July 15, 1975.

Toward the end of this decade, the Space Shuttle will be ready for its major role in space. Needed to make space operations less complex and less costly, the reusable Space Shuttle is designed to carry out various missions in Earth orbit at a fraction of the cost that present day launch vehicles demand.

SPACE SCIENCES

Through the use of unmanned spacecraft, the exploration of space has provided man with a better understanding of his own planet and

an opportunity to see other planets, stars, and galaxies, unhindered by the Earth's obscuring atmosphere.

Earth-orbiting satellites have discovered and mapped in detail the highly complex magnetosphere surrounding Earth and the effect of solar radiation on Earth's ionosphere and atmosphere. Other spacecraft have looked far into space to study ultraviolet, infrared, X-ray and gamma-ray radiation to learn more about stars, galaxies and the little-understood pulsars, quasars and black holes.

Instrumented spacecraft have orbited Mars and have been sent toward Venus and Jupiter. The information from these probes will contribute to an understanding of those planets and why they are different from the planet Earth. Other far-ranging spacecraft mapped the Moon in detail and observed the Sun and the solar wind from widely separated points in the solar system.

In NASA's first 15 years, some 300 satellites have been sent into Earth orbit and interplanetary space. Milestones include:

- o Rangers, Surveyors and Lunar Orbiters: these unmanned spacecraft launched in the early 1960's paved the way for man's first landing on an alien planet, returning thousands of closeup pictures of the lunar surface and scientific data on its composition.

- o Mariner: A family of planetary probes designed to investigate Mars and Venus. Orbiting the Red Planet in 1971, Mariner 9 provided man with his first closeup look, returning more than 7,000 pictures and other important scientific information. The information obtained by Mariner 9 has provided valuable data for planning

the 1975 landing of Viking life-detection laboratory on the Martian surface.

- o Pioneer 10: Launched in 1972, Pioneer 10 will make the first reconnaissance of giant Jupiter in December, 1973, before becoming the first manmade object to escape the solar system. Pioneer 10 completed the first successful passage through the asteroid belt during its one-billion-kilometer (620-million-mile) journey. A second Jupiter probe, Pioneer 11, is scheduled to reach the planet in December 1974.

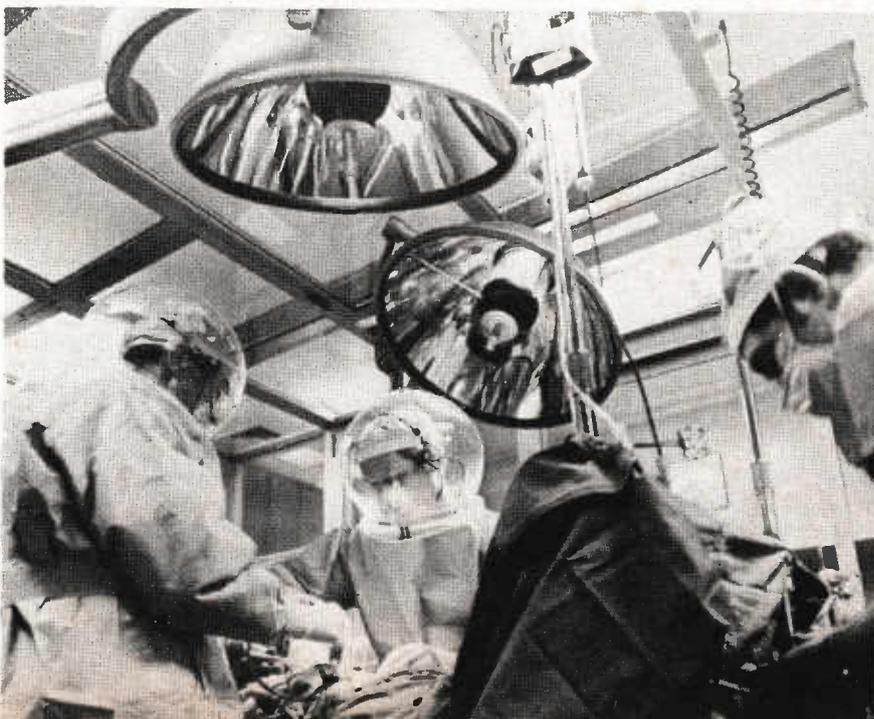
APPLICATIONS

In the area of direct benefits to mankind as a result of space activity, the groundwork was done in the early '60's with passive and active communications satellites and early meteorological spacecraft.

The Echo balloon satellites launched in 1960 and 1964, and seen by more people than any other man made objects in history, were some of the early stepping stones to the billion dollar global commercial communications satellite industry. They were followed by the Telstar, an active communications repeater, developed by American Telephone and Telegraph Corporation in 1962 and 1964, and NASA's Relay satellites in 1962 and 1964. With the launching of the synchronous orbit satellites, Syncoms 1 and 2 in 1963, it was apparent that the commercial capability required for the Communications Satellite Corporation, incorporated in 1962, was available.

NASA is now phasing out its conventional communications satellite research and development activity, leaving future endeavors to private

A surgery team at St. Luke's Hospital in Denver performs a hip-joint replacement in a new clean room facility which helps lessen the danger of infection to the patient. The surgery is being performed in a foldable clean room which can be stored when not in use. Air is forced in a gentle breeze from the rear of the room to the open front. Team members "upwind" of the patient wear astronaut-type helmets and garments which are impermeable to bacteria. Team members "downwind" of the patient are not required to wear the special gear, since the air around them is circulated away from the patient. Application of the clean room technique for surgery was developed by Martin Marietta Corporation's Denver division for the National Aeronautics and Space Administration and is being evaluated at St. Luke's.



NASA - the first 15 years

industry. The last and largest communications satellites developed by NASA, ATS-F, will be launched early next year to pioneer in even more advanced areas of communications technology. These satellites will be used for experimental broadcasts of instructional and educational television to remote regions, experiments dealing with such things as air and sea traffic control and satellite-to-satellite communications.

The first meteorological satellite, Tiros-1, was launched in 1960, followed by a rapid succession of similar spacecraft in following years. These resulted in the establishment in 1966 of the first operational meteorological satellite system. Weather satellites have observed every major storm or hurricane since the launching of the first T1ROS, and improvements in such spacecraft flow from research performed with NASA's Nimbus and Applications Technology Satellites.

In 1972, the first Earth Resources Technology Satellite, ERTS-1, was launched and continues to return information of great importance in managing the Earth's resources and observing its environment. More than three hundred investigators are using data from this spacecraft in experimental applications to these fields.

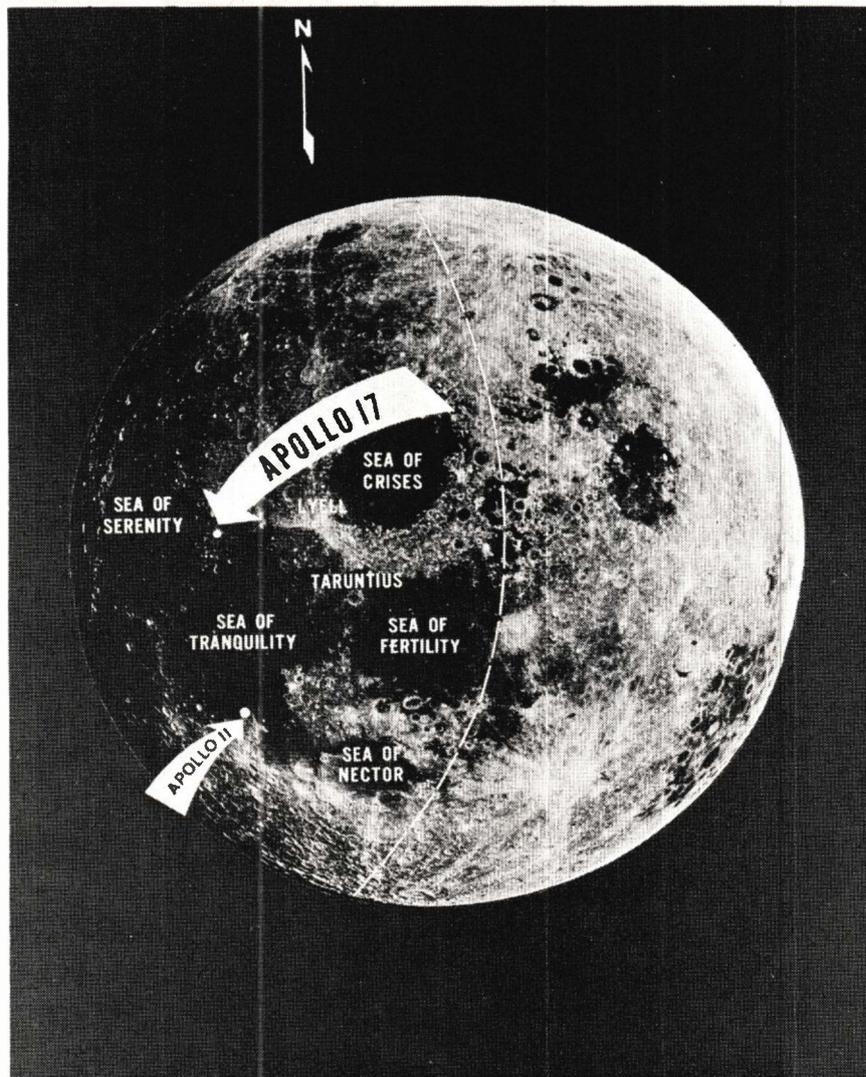
It is said that the ERTS project will help mankind solve some of the most pressing social and economic problems from one end of Earth to the other.

The photos and data on earth resources brought back by the Skylab astronauts from a battery of more sophisticated Earth observation equipment, onboard the orbiting workshop, will provide even more information in this area.

AERONAUTICS

The joint NASA/USAF/USN X-15 rocket powered airplane made its first flight in June 1959. The world's only manned aircraft capable of hypersonic flight, the X-15 flew to a peak altitude of 354,200 feet (67 plus miles) and a top speed of 4,520 miles per hour (Mach 6.7).

During the nearly 10 years of flight, the X-15 made major contributions to understanding the problems of manned flight both in the atmosphere and in space. It was used to study the effects of extreme conditions of hypersonic flight on skin friction and thermal expansion, it pioneered the use of ablative coatings, aided the efficient design of structures, and fulfilled its workhorse test-bed role



This photo, taken by the Apollo 11 crew on their way home from the moon, shows both the first landing site and the last — that of Apollo 17.

It was taken from a distance of 16,000 kilometres after the Apollo 11 crew had fired their engines on the back side of the moon to place them in a correct trajectory for earth return. To the right of the dotted line is the side of the moon which cannot be seen from earth. The darker left hand side is that which is normally visible.

encompassing approximately 40 wide-ranging experiments.

One of many NASA contributions during this period was the single-pivot variable-swept wing which allows efficient flight at both high and low speeds. This concept was first applied to the Air Force F-111 and has since been adopted for the F-14 fighter and the B-1 bomber.

The initial flight tests of the NASA-developed supercritical wing have successfully demonstrated that the new shaped airfoil does permit an F-8 aircraft to operate approximately 15 per cent more efficiently. These test results showed that the wing produces higher speed and greater range without increases in fuel consumption.

The US Air Force contractors are currently designing two Advanced Medium STOL Transport prototype aircraft employing supercritical wing

technology and also propulsive-lift concepts derived from NASA technology. The propulsive-lift concepts use engine exhaust air to provide additional lift to the aircraft, permitting low approach and takeoff speed, to facilitate short field operations. NASA's Quiet Propulsive-Lift Technology program promises to contribute significantly to reducing congestion and noise impact at existing civil airports and would enable use of smaller, more conveniently located, quiet-ports near city centres.

The experimental Quiet Engine Program, started in 1969, has demonstrated jet engine noise levels significantly below the US Federal Aviation Regulation requirements. Aircraft noise is currently constraining growth of civil aviation but the quiet engine technology development program aims at making aircraft

quieter and thus, more acceptable to the community environment.

TECHNOLOGY UTILIZATION

NASA's Technology Utilization Office has been assigned the task of making certain that any technology developed by the agency would be made readily available to any who want to use it for peaceful purposes. The office currently operates six Regional Dissemination Centres or technological data banks located around the US. By consulting any one of these computer-controlled data banks, a potential user has ready access to all of the other five in getting answers to his technical problems.

The dissemination centres contain more than one million individual publications deal with technology over a wide range of disciplines. These materials represent new developments and inventions resulting from more than \$45 billion worth of contracts with more than 400,000 separate companies during NASA's first 15 years. There is, in addition, a vast body of new technology developed by the space agency in its own government-operated laboratories and research centres.

Since 1970 more than 2,000 firms, ranging from small businesses employing less than 50 people to very large industrial complexes, have used the services of the Dissemination Centres annually.

The field of medicine has put more NASA-developed technology to use than any other discipline — mainly because of space age advances in miniaturization and sophisticated electronics circuitry. This is well illustrated by the following notable cases.

A compact, fully automatic gas analyzer is now on the commercial market. The gas analyzer measures the composition of air breathed in and exhaled from the lungs as an aid in monitoring pulmonary and cardiovascular activity in human patients. It affords prompt information on human respiratory and metabolic functions, previously unavailable or too time consuming to obtain.

In hospital intensive care units, the instrument can be used to monitor the breathing of acutely ill patients, signaling the need for changes in therapy more efficiently than previous methods. In surgeries, the anaesthesiologist can monitor the patient's progress, checking inhaled and exhaled concentrations of anaesthetic gas.

Ultra-clean laminar air-flow techniques developed by NASA for assembling spacecraft and their components are helping surgeons avoid infection in hospital surgeries. Ultra-fine filters purge dust and particles from the air during surgery, and the doctors and surgical team wear helmets resembling those worn by astronauts, plus specially treated surgical garments that bacteria cannot penetrate. The number of these special "clean room" surgeries has risen from less than 50 two years ago to more than 200 today.

Eye-operated switches, devices operated by breath controls, and ultra-sensitive pressure devices have been incorporated in a specially-equipped hospital room in a Huntsville, Alabama, hospital, designed to test various applications of NASA-developed technology in aiding

quadriplegics (patients with no use of their arms or legs).

A patient unable to use either his hands or feet may one day be able to control the total environment of his room using devices developed initially for the space program.

Immobile patients in the room are able to open and close doors and windows, control room temperature, change radio stations, dial a telephone, adjust the position of their beds, signal the nurse at a remote station, turn pages in a book and perform various other tasks necessary for their comfort and convenience.

Some of the other "spinoff" space benefits presently in daily use outside the aerospace field are:—

More and more nondestructive testing techniques developed by NASA are gaining widespread industrial use. A good example is a rapid-scan infrared tyre tester being used daily by a major US tyre manufacturer. The ultra-sensitive infrared optical device affords a nondestructive testing method for checking new designs in aircraft and automobile tyres.

The device produces a real-time cathode ray tube picture of the heat in tyres as they spin rapidly on the testing rig — up to 320 kilometres per hour in the case of automobile tyres and as fast as 640 kilometres an hour for aircraft tyres. The camera is capable of reading the heat from 600,000 points on a tyre every second, presenting an infrared "heat picture" of the tyre, in which flaws or hot areas appear as bright spots.

NASTRAN, a computer program designed by NASA to analyze the behavior of structures under stress, is now a design tool familiar to more than 1,000 American engineers outside the space agency. Hundreds of industrial firms, universities, laboratories and government agencies are using it to solve their structural engineering problems.

For example, front suspension and steering linkages in a line of American automobiles and light trucks are now being designed with NASTRAN assistance. NASTRAN analysis can also be applied in the construction of bridges, power plants, skyscrapers and airplanes.

Battery technology developed by the space agency is reaching the market daily in the form of better,



SHUTTLE WILL HAVE MANY USES

COMMUNICATIONS

MANUFACTURING
IN SPACE

EARTH
RESOURCES

NATIONAL SECURITY

SCIENCE

INTERNATIONAL

COMMERCIAL

NASA HQ MH72-3017
1-14-72

The man-operated space shuttle orbiter will deploy in Earth orbit all types of scientific and applications satellites weighing up to 29,500 kilograms (65,000 pounds) and thereby replace most of the expendable launch vehicles currently used.

NASA - the first 15 years

longer-lasting battery power sources. New successful lines of high-energy-output batteries appeared on the commercial market during 1972, providing sure, fast starts for portable power tools and sports equipment, thanks to battery technology originally developed by NASA.

These new products include both lead-acid and nickel-cadmium batteries, capable of being recharged 90 to 100 times faster than existing batteries. Compared with most commercial batteries requiring 14 to 16 hours for full recharge, the new batteries can be recharged in 15 to 20 minutes without damage to the cells. Some nickel-cadmium units can be recharged in as little as six minutes.

Another device benefitting average citizens daily is the "heat pipe" concept, developed jointly by NASA and the US Atomic Energy Commission:

A self-contained, fully automatic heat recovery and transport system, the heat pipe was first used in NASA spacecraft and in cooling nuclear reactors. This highly efficient equipment can transport heat at approximately 500 times the rate possible with the best solid

conductors, with minimal temperature loss.

The heat pipe has recently been applied domestically in recovering and recirculating heat from chimney flues, increasing the efficiency and economy of many types of home heating plants approximately 10 per cent. The firm developing this household application expects to market the device widely in the near future.

A heat pipe application now on the market and familiar to many housewives is a "cooking pin" for distributing heat evenly through meat during the roasting process. A heat pipe for lowering the lubricating oil temperatures in motorcycles is now being offered commercially.

INTERNATIONAL PROGRAMS

The first international cooperative satellite was launched in 1962. Called Ariel I, and developed jointly with the United Kingdom, it carried scientific ionospheric experiments.

In the following years NASA has conducted 18 cooperative satellite and probe joint projects with Canada, France, Germany, Italy, the United Kingdom and the ten-nation European Space Research Organisation (ESRO).

Since orbiting the first foreign experiment on Explorer 20 in 1964, NASA has flown 25 international experiments on its satellites and spacecraft. Since its early development of communications satellites, NASA has successfully orbited 12 such spacecraft which form the Intelsat system of global communications.

The first cooperative sounding rocket launch in 1961 was a joint effort with Italy. Since then, NASA has

participated in more than 790 such international sounding rocket projects.

From small beginnings NASA's international programs have — over these years — developed to the present stage when 94 countries and international organizations are cooperating with NASA in some form and NASA has entered into more than 500 agreements for international space projects.

Among other developments more than 350 foreign scientists have been involved in the analysis of lunar surface samples.

The European Space Research Organization has established a special project for the study and development of a Sortie Laboratory to operate as an integral part of the NASA Space Shuttle.

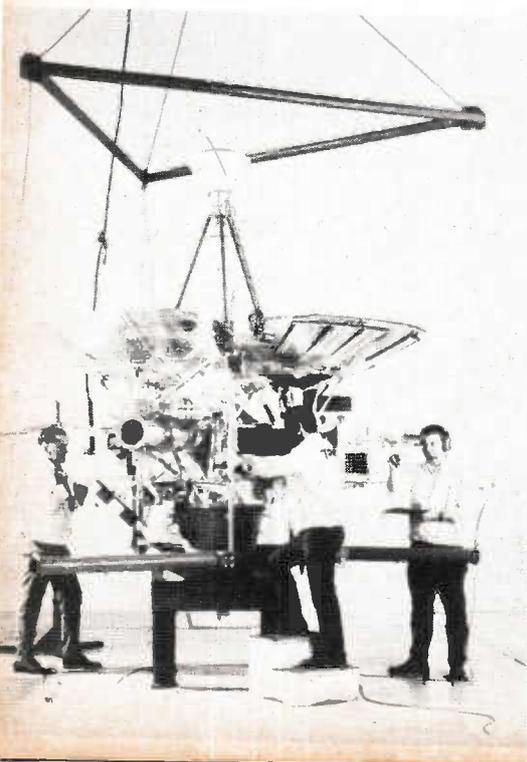
The Apollo-Soyuz Test Project, a joint US/USSR experimental mission to test compatible rendezvous and docking systems, is on schedule for a 1975 launching. Meanwhile, US/USSR working groups are exchanging results and defining coordinated joint projects in space science and applications.

In addition, tracking, communications, and data acquisition have been effected with the cooperation of 22 countries. And cooperative international aeronautics research is being conducted with four countries.

Promising cooperative ventures for the future include a satellite instructional television experiment with India and joint satellite projects with Canada, Federal Republic of Germany, Netherlands, Spain, and United Kingdom.

Technicians make final adjustments to Pioneer F spacecraft. Pioneer F, now on its way to Jupiter, is the first spacecraft designed to travel into the outer solar system and operate effectively there, possibly for as long as seven years and as far from the Sun as 2.4 billion kilometres (1.5 billion miles). Pioneer F's primary objective will be to take the first close-up look at Jupiter. It will return data on about 20 aspects of the big planet, its moons and environment.

The Space Shuttle will be a manned reusable space vehicle which will carry out various space missions in Earth orbit. It will consist of two stages. The first stage booster will be an unmanned liquid or solid-fueled rocket. The second stage orbiter will look like a delta-winged airplane and will be piloted by two men who will fly it back to Earth for an airplane-like landing.



ORBITER COMPARISON WITH EXISTING AIRCRAFT

	747	707	SHUTTLE ORBITER	DC-9
WINGSPAN	59.6 M (196 FT)	43.4 M (142 FT)	22.8 M (75 FT)	28.7 M (94.3 FT)
LENGTH	70.5 M (231 FT)	46.6 M (153 FT)	36.6 M (120 FT)	36.4 M (119.3 FT)
OPER. WT. EMPTY	165,920 KG (365,800 LBS)	61,236 KG (135,000 LBS)	63,400 KG (140,000 LBS)	26,000 KG (57,210 LBS)
LANDING SPEED	140 KNOTS	140 KNOTS	160 KNOTS	112 KNOTS

NASA HQ 8027-5191 REV. 1-26-72

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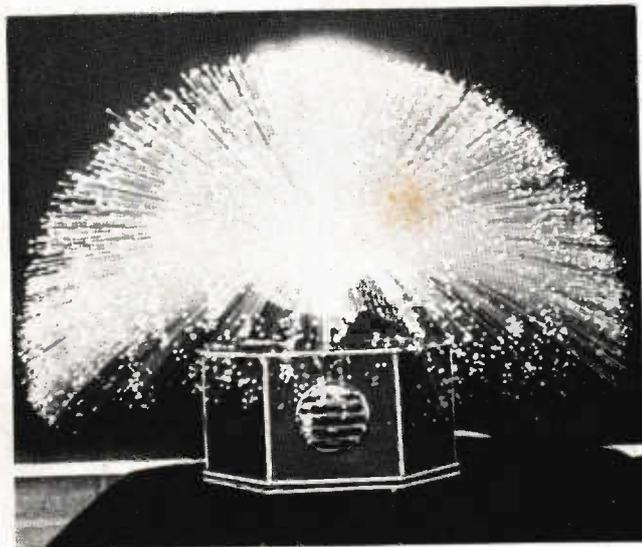
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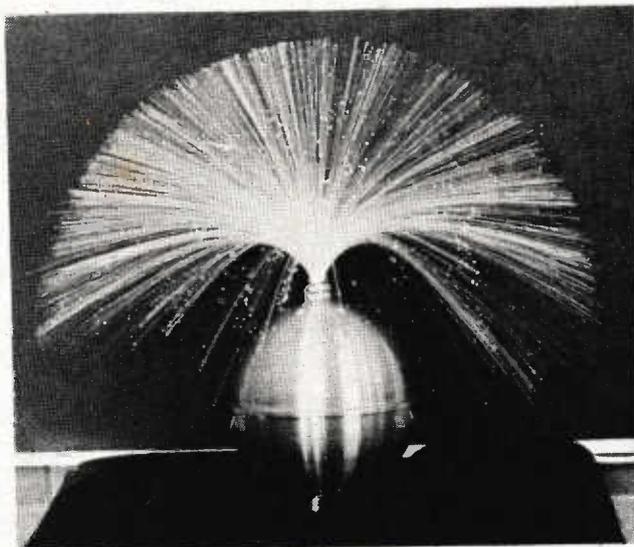
Suggested Retail \$75 for complete set.

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Distributors

NEW GUINEA Hagen Electrics Pty Ltd, P.O. Box 100 Mount Hagen New Guinea, Phone: 521 562.

NEW SOUTH WALES Remfrey Bros. 1/97 Cremorne Rd, Cremorne N.S.W. 2090. Phone: 90 6716.

VICTORIA Radio Parts Group, 562 Spencer St, West Melb. Vic. 3003. Phone: 30 1251.

Dorward Enterprises Pty. Ltd. 56 Levanswell Rd, Moorabbin Vic. 3189. Phone: 95 4633.

QUEENSLAND Ace Plastics (Aust) Pty Ltd, 29 Hayward St. Stafford, Queensland 4053. Phone: 56 3041

WEST AUSTRALIA Cox Distributors, 509 Charles St, North Perth Phone: 21 6510.

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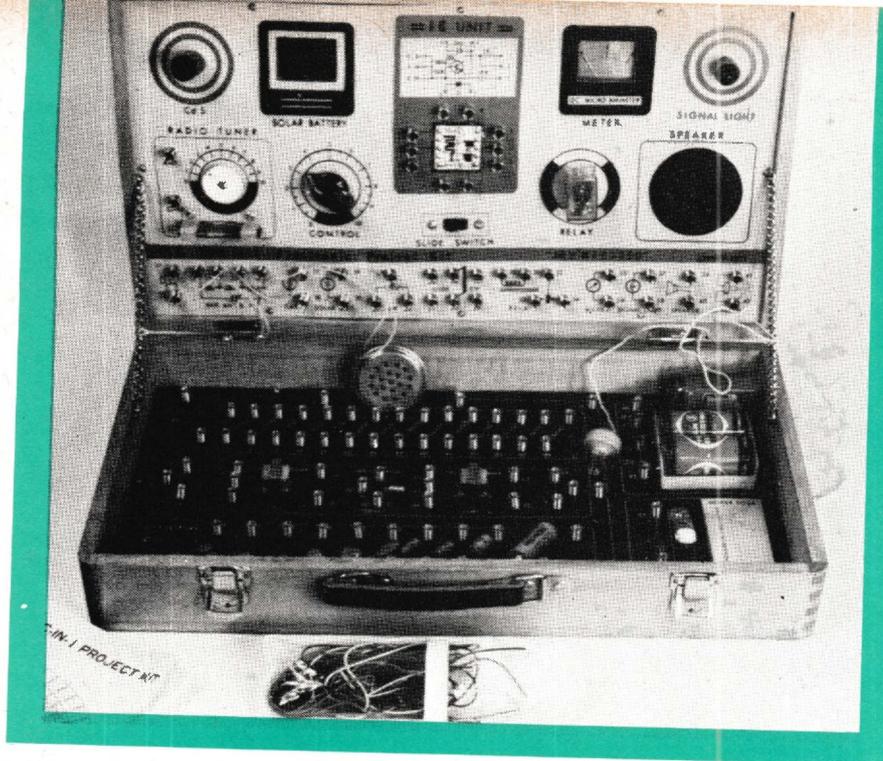


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An extensive experimenters kit (of the first type) is the Gakken IC 150-in-1 Project Kit. This Japanese product is offered in a handsome wooden case containing some 50 components, each being permanently mounted onto insulating panels. Each component has its terminals brought out to wire springs that are used to connect up a circuit by placing the bare end of hook-up wire into the coil — soldering is, thereby, avoided. A photograph of the kit, Fig. 1, shows the layout and detail of the assembly. Provided with the kit is a booklet explaining the function of the various components and how to use them. After a short preamble on the construction of high-gain radio aerials, the remainder of the contents are devoted to 150 circuits that can be assembled.

A schematic is given for each circuit, along with a brief explanation of what the circuit does. Experiment 83 is reproduced in Fig. 2 to show the format and depth of explanation. Note the wiring order given at the bottom. These numbers correspond to the numbers provided on the panel, and indicate which springs have to be joined with the ready-made wires provided.

Using the numbers method of wiring, anyone who can read can build a working circuit — a three-year-old boy (with help), and eight-year-old girl and a housewife tried it with success but the latter soon remarked "but this is not electronics — it's merely a game". In fact it becomes a case of how fast one can wire the numbers together. It is doubtful if the user will learn much by following this approach. However, assuming that interest in such a trivial pursuit fades it is reasonable to expect an intelligent person to soon be trying out self-generated ideas.

Sadly lacking in the book, however, is a statement of basic electronic principles — the concept of current flow; voltage and resistance with ohm's law; how an active device (the transistor) works, and indeed how each circuit actually operates. This deficiency would prevent an owner from experimenting. To get the best from the well-planned kit, it should be used in conjunction with an introductory course or text on electronics. It is a pity that designers did not extend the booklet a little further.

Turning now to specific points worth knowing, the first difficulty noted was that the vertical panel has terminals marked as though they are already connected to a microphone and a loudspeaker. This is not so — these two components being supplied unmounted. Apart from this, the panel connections could not be faulted.

ELECTRONIC PROJECT KIT IC 150 in 1

Recommended retail price — \$36. Available from most reputable kit-set suppliers.

IN THIS technological age many of us get the urge to build things, especially in the electronic line, for this has become one of the creative outlets of modern living.

But if you possess no prior experience in electronic fundamentals and practice, where do you start? Without doubt the best way is to follow an instructional course in a magazine (such as that commencing in this issue of ETI), or attend a course at technical school or university, or work from introductory books — these, however take time, and what many seek is a much simpler understanding.

Ready-made kits may provide the answer as an immediate introduction, for they provide the components and instructions for building interesting, working circuits within minutes. They will not promote the same basic understanding as do longer courses but will, at the least, introduce the user to the commonly used components and

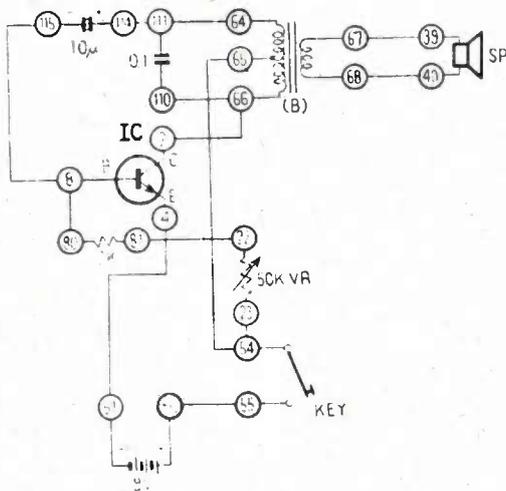
to the systems philosophy behind electronics.

Experimenters' electronic kits fall roughly into two types. The first provides for rapid assembly without basic understanding — these are suited for youngsters and casually interested persons and serve as a hobby — at a superficial level. (Rather like painting-by-number kits that teach no colour theory or art development). These amateur kits are usually sold through hobby shops and component suppliers with prices ranging from \$5 to \$40 depending upon the number of components included.

The second category — obtainable usually through trade houses only — are kits designed for teaching courses. The purpose of these is to impart basic knowledge of electronic principles, eventually leading to complex circuits and systems. These kits are expensive and would not have the same immediate fascination for the casual user.

"MACHINE GUN SOUND" GENERATOR

This generator creates the sound of a rattling machine gun. Adjustment of the volume control will vary the cycle of the sound created.



Wiring Order: 115-8-80, 81-22, 4-51, 23-54-65, 114-111-64, 110-66-2, 50-55, 67-39, 68-40. Connect a 9-volt battery to the clip leads. Depress the key for operation.

- Cadmium sulphide photocell
- Radio-tuner unit
- Potentiometer with knob and graduated scale.
- Imitation integrated circuit (transistor, 500 k, 50 k, 10 k, 5 kΩ resistors).
- Selenium solar cell
- 260 µA f.s.d. meter
- MES lampholder and 2.5 V coloured lamp
- 50 mm dia. speaker unit
- Conventional relay (spco)
- Slide switch (dpdt)
- 9 V battery holder
- 3 V battery holder
- Morse key
- Magnetic earpiece
- Carbon microphone insert
- Electrolytic capacitors 1000 µF, 100 µF, 3 µF
- Ceramic capacitors 0.1 µF, 0.05 µF, 0.01 µF, 0.061 µF, 150 pF
- Resistors 100 Ω, 200 Ω, 500 Ω, 1 kΩ, 2 kΩ, 5 kΩ, 10 kΩ, 20 kΩ, 50 kΩ, 100 kΩ, 250 kΩ, 500 kΩ, 1 MΩ.
- Transistor, output stage, transformers - 2
- 2SB56 (OC76) transistor
- Wooden case
- Project book
- Various length, bared-kit, hookup wires.

Several circuits were built, chosen randomly. They all worked well, showing that the kit has been carefully thought out. A few circuits, however, call for extra components not supplied with the kit. Extras needed are a bell, a burglar-alarm window grid, a push-button, test prods, a focussing lens, a permanent magnet motor, wire and insulators for aerials and sundry smaller items. Generally though, the lack of these does not make the kit useless. Batteries must also be supplied.

The quality of the components is generally quite good - a list of items is given in Fig. 3. The focal point of the layout is the imitation integrated circuit (see Fig. 4). It is not a true IC but has its capacitor and resistor made by thick-film deposition to simulate IC manufacturing technique at a size easily seen by eye. The diode and transistor are discrete components added to the "chip". (This helps replacement, of course). To be right up to date the manufacturers could well replace this unit with a real IC operational amplifier, the replacement cost now being quite reasonable and the "novice-proofness" of an IC being better than for a straight transistor.

The sensitivity of the micro-ammeter is not stated - a quick test established it to be 260µA full scale deflection (10µA is implied).

It is doubtful that the contacts on the relay would cope for long with the load currents implied in the experiments 131, 132, 134 (garage door opener, automatic car restarter, automatic headlight dimmer).

Several transmitter circuits are included and whilst there is a warning about the use of long aerials being contrary to broadcasting regulations, in Australia at least, an unlicensed operator using any of these transmitter circuits would be breaking the law.

Some circuits show "shocker" circuits being attached to living things - a rabbit and a fish - one can only hope that buyers of this kit will have sufficient compassion not to follow such instructions.

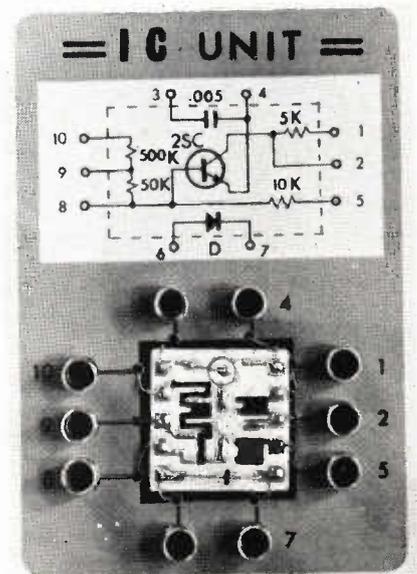
There is a small warning about the dangers of making connections to mains appliances. To make sure the warning is heeded, parents presenting such a kit to a son or daughter should stress the dangers of mains supplies.

The retail value of the components purchased separately adds up to nearly the retail cost of the complete kit so the purchase decision is prompted, firstly, by the fact that everything is ready to go at all times and, secondly, by the inclusion of the worthwhile project book that cannot be obtained separately.

It is a pity that there is not more educational content built in, but with

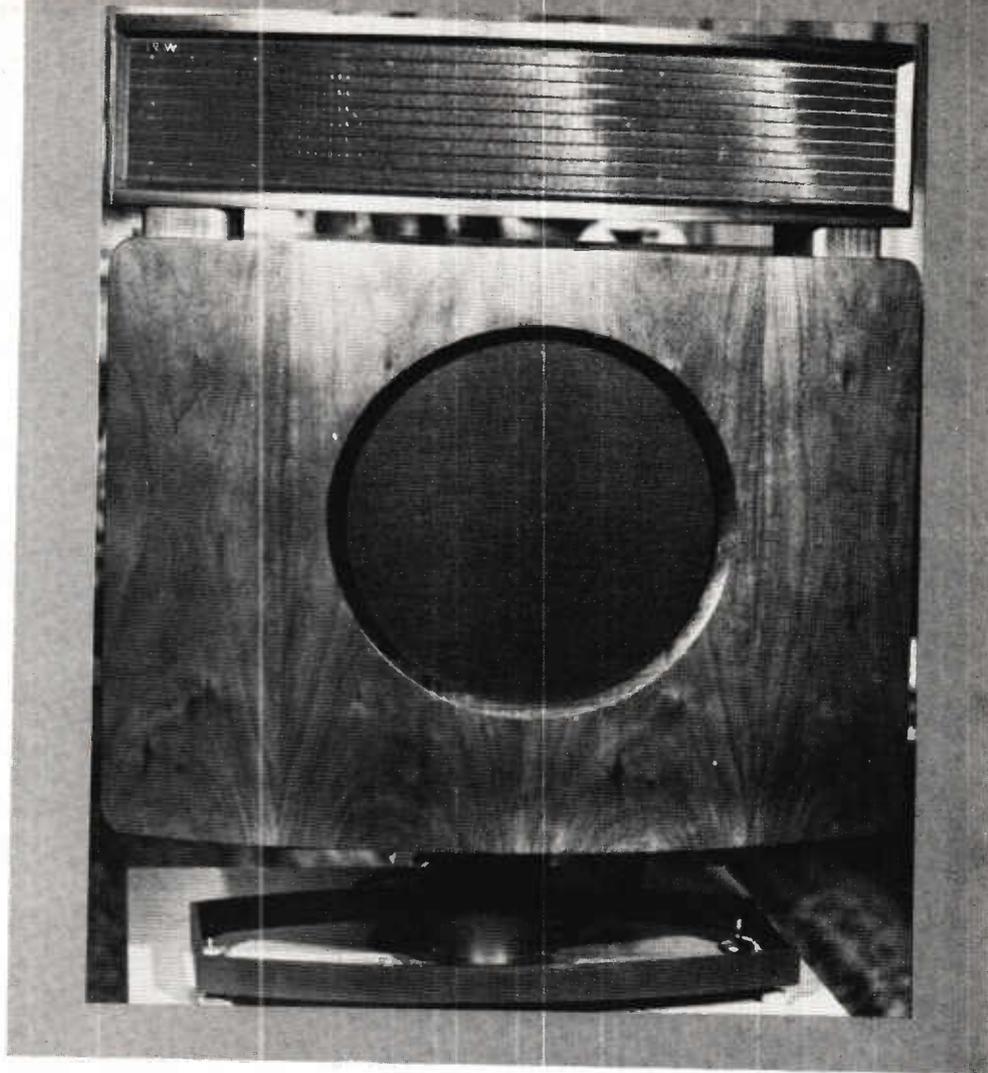
the combined use of an introductory book it should be possible to become proficient with basic electronics and systems.

Top marks must go to the box, layout and general design. Although built to a price, nowhere is there a sign of shoddiness in construction. The kits should stand the test of time and be a prized possession.



electronics
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INTERNATIONAL
product test

Recommended retail price \$985



BOWERS AND WILKINS DM 70 LOUDSPEAKERS

BOWERS and Wilkins have been producing speakers since the mid 1960s and in a short space of some seven years have captured a significant portion of both the European and international markets for top quality equipment.

It is this emphasis on top quality equipment that characterizes Bowers and Wilkins' products — for unlike many other manufacturers, who provide a range of speakers from cheap to expensive, Bowers and Wilkins cater solely for the 'purist' market.

The company has expanded rapidly

and in keeping with other world leaders in their field, have placed a very great emphasis on research and development. It is not surprising that 60% of their production is exported, and even then the demand grossly exceeds their ability to supply.

The Model 70's reviewed in this article are the second Bowers and Wilkins speakers that we have tested (the first were the company's type DM2 (Sept '72) — these had one of the best frequency responses of any speaker system we have ever tested in the range from 100 Hz to 20 kHz).

Whilst the DM2, and most previous systems produced by Bowers and Wilkins, have used electro-dynamic components, the series 70 uses an excellent eleven element wide dispersion electrostatic unit.

The series 70 system consists of a large bass enclosure, the front of which is curved, surmounted by an electrostatic tweeter assembly. Both units are mounted on a metal stand.

With an overall height of 820 mm, width of 680 mm and a total depth of 390 mm, the bass unit is physically large. It incorporates a 305 mm

diameter model DW 13/70 driver. This driver has a free air resonance of 28 Hz that increases to 45 Hz when mounted in the enclosure. An unusual feature of the DW 13/70 driver is a series of special rubber damping pads on the face of the heavy speaker cone to reduce cone break-up under high power drive conditions.

The designers have used a very long throw voice coil — together with a linear suspension system — to produce, as far as possible, true linear piston drive in the sealed enclosure.

The purpose of this is to reduce distortion at high power inputs, and in this respect the designers have been particularly successful.

The electrostatic unit is really the heart of the system, for it covers the frequency range 500 Hz through to 20 kHz. By using a series of individual electrostatic drive units arranged in a curve, the designers have avoided the high frequency beaming effect that is a fault of so many other electrostatic loudspeakers.

The power unit required to supply the polarising voltage for the electrostatic units, together with the cross-over networks, is located within the main bass enclosure. Access to these is provided from the rear.

MEASURED PERFORMANCE

Our first measurements were of the free field frequency response, on direct axis. The results showed that response was within ± 6 dB from 35 Hz to 15 kHz. We then moved the recording microphone through a 30° arc to check the polar response of the electrostatic units — and were pleasantly surprised to find that there was no effective change. In this respect the designers have achieved an outstanding result.

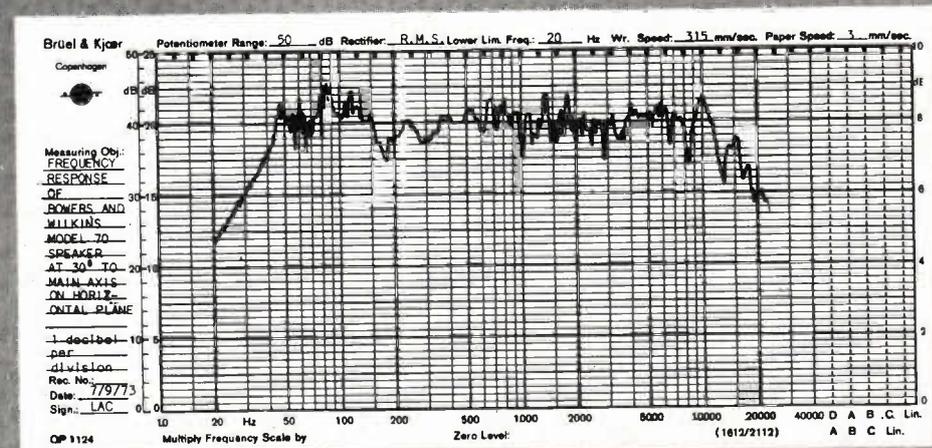
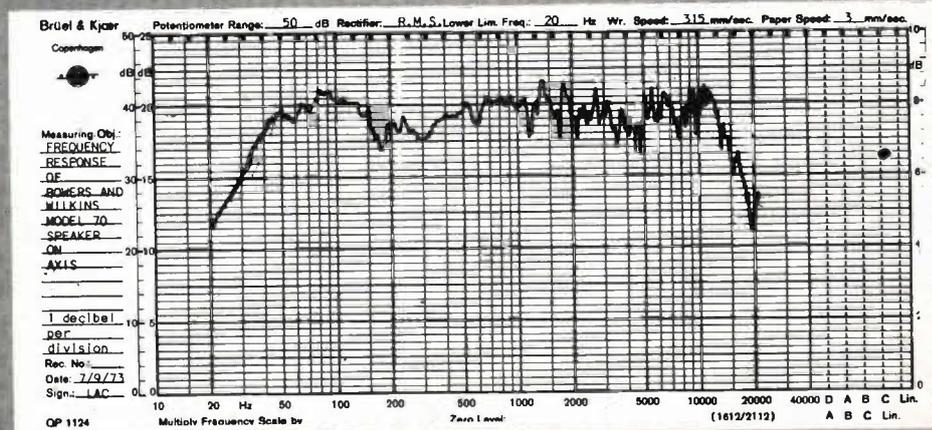
Having completed free-field measurements we next measured sound output power, with the speakers in our 340 cubic metre reverberant chamber, using white noise excitation and a 1/3rd octave filter test set. The results were highly commendable and, as can be seen from the relevant Bruel and Kjaer level recording (reproduced within this review) the sound output power level was commendably flat from 40 Hz to beyond 17 kHz. This is extremely good and equal to the best that we have measured.

Measured distortion was generally low, particularly from the bass unit. At 25 watts input, distortion at 100 Hz was only 2%; at 500 Hz it was 1%, and at 10 kHz it was 0.7%. However with 50 watts input, the distortion at 100 Hz had risen to 5% and was audible.

As our impedance curve shows, the impedance characteristics of this speaker are rather unusual. In fact above 10 kHz the impedance is so low

MEASURED PERFORMANCE OF BOWERS & WILKINS LOUDSPEAKER MODEL DM 70, S/N. 3286.

Frequency Response (on axis)	35 Hz to 15 kHz ± 6 dB														
(30° to axis)	35 Hz to 18 kHz ± 6 dB														
Total Harmonic Distortion (for 90 dB at 2 m on axis)	<table border="0"> <tr> <td>Frequency (Hz)</td> <td>Distortion (%)</td> </tr> <tr> <td>40</td> <td>4%</td> </tr> <tr> <td>63</td> <td>1.8%</td> </tr> <tr> <td>80</td> <td>1.2%</td> </tr> <tr> <td>125</td> <td>1%</td> </tr> <tr> <td>250</td> <td>0.8%</td> </tr> <tr> <td>500</td> <td>0.4%</td> </tr> </table>	Frequency (Hz)	Distortion (%)	40	4%	63	1.8%	80	1.2%	125	1%	250	0.8%	500	0.4%
Frequency (Hz)	Distortion (%)														
40	4%														
63	1.8%														
80	1.2%														
125	1%														
250	0.8%														
500	0.4%														
Sensitivity (for 90 dB at 2 m on axis)	15 watts														
Woofer Resonance	45 Hz														
Measured Impedance	(see curve)														
Dimensions	680 mm wide 390 mm deep 820 mm high.														





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that it rather disturbs us, for at these frequencies the speaker as 'seen' by the amplifier is virtually a short circuit.

Whilst it can be argued that, generally speaking, there is not a high level of content above 10 kHz, there is always the exception. If the manufacturers' recommendation — that a 30 watt (minimum) amplifier be used — then there should not by any problem, but, in our opinion if an *unsuitable* amplifier were to be used then there would be a strong possibility of damaging the output stages.

SUBJECTIVE IMPRESSIONS

Our next series of tests involved direct A-B comparisons, against a series of studio monitor loudspeakers, using high quality programme content.

The first record used was EMI's new four-channel 'Mandingo', (Q4TW0400). This record has every conceivable percussion instrument (and quite a few that are only barely conceivable — Ed!) — from cowbells to glockenspiels, maracas to jawbones.

On this type of material the top end performance of the DM 70's is superb. There are only two other speaker systems that we have tested that have a better top end performance and both of these are substantially more expensive.

Transient response, on both scales and pulse inputs was exemplary, and low frequency performance proved to be equal to any other speakers previously tested (or heard) costing less than \$1000 a pair.

Bowers and Wilkins have produced a

speaker system that is exemplary. The DM 70's point the way to the forthcoming trend in loudspeakers — namely a move away from wholly electro-dynamic systems of conventional albeit refined design — to hybrid transducers and to the quite revolutionary transducers currently under development both in Europe and the USA.

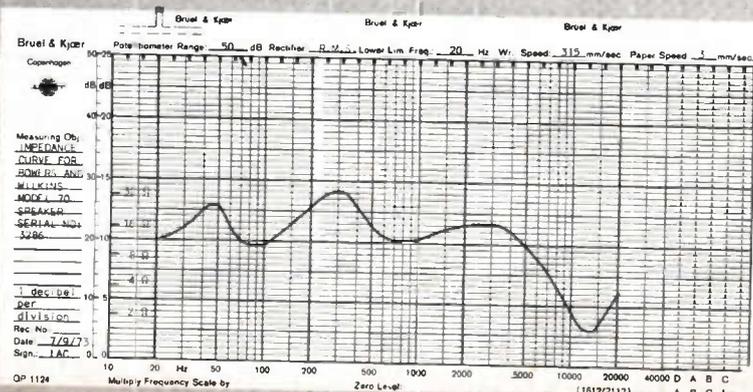
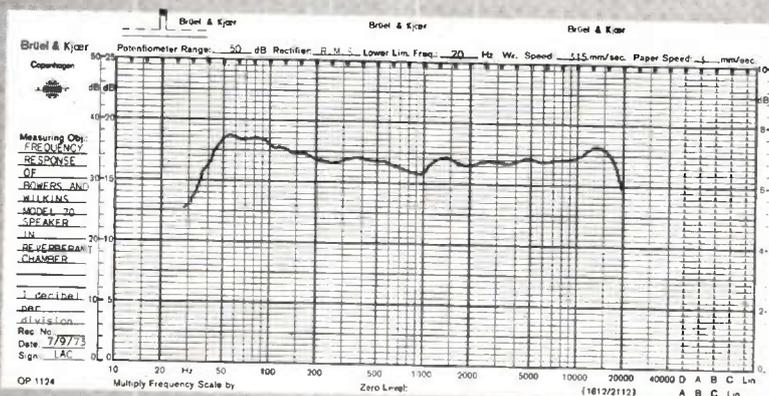
In keeping with their smaller brothers, the DM 2's, the DM 70's are truly worthy of the title 'Monitor Loudspeakers'.

This review of the Model 70 speakers is in line with the reviews carried out by some of the world's leading Hi-Fidelity authorities.

The B & W DM70 Monitors separate "the men from the boys" in regard to amplifiers. Any amplifier which is of poor quality or has parasitic oscillations above 10 kHz will immediately run into trouble, but any good quality amplifier of over 30 watts rms per channel will have little trouble driving B&W speakers satisfactorily. However, some amplifiers like capacitive loads better than others.

Your B & W dealer will know what amplifiers are best used with B & W speakers.

Malcolm Goldfinch
Convoy International
Pty Ltd.



Here's a superb stereo sound source you'll still be proud to own ten years from now.

And it will still be up to date. Of course, you do need to be discriminating, and realise where long term value lies in terms of precision engineering and its relationship to performance. We suggest you invest wisely in:—



THE NEW SWISS MADE THORENS MODEL TD 160 TRANSCRIPTION TURNTABLE.

Incorporating the radical new Thorens TP 16 tone arm — the arm overseas reviewers have enthused over — the Thorens TD 160 offers unrivalled engineering at a most attractive price. A 16-pole two-phase synchronous motor and belt drive combined with a dual chassis suspension system provide a wow and flutter figure of 0.06% according to DIN 45507, weighted. This is a remarkable figure in anybody's language.

The platter of the TD 160 is of non-magnetic zinc alloy, 12" in diameter and weighing 7 lbs. Two speeds are standard — 33 $\frac{1}{3}$ and 45 rpm. Stray magnetic flux has been minimised so that even the most sensitive cartridges may be used with the TD 160 without incurring problems with hum induction.

Bearing friction of the revolutionary Thorens TP 16 tone arm has been reduced to less than 20 milligrams in both planes measured at the stylus tip.

Your Bleakley Gray dealer will be pleased to demonstrate the all-new Thorens TD 160 transcription turntable. No doubt he'll also show you the superb Thorens TD 125 Mk. II electronic transcription turntable, a three-speed model which is undoubtedly the most sophisticated turntable manufactured in the world today. The TD 125 Mk. II has many superior features and naturally costs more than the TD 160. Both Swiss made Thorens turntables offer long term reliability and an extraordinary standard of performance.



SELECT AN ORTOFON STEREO CARTRIDGE.

From Denmark comes the new Ortofon M15 Super Stereo cartridge, recognised as the lowest distortion cartridge in the world. The magnet design of the M15 Super is quite unique. Signal currents are generated on the most linear portion of the magnetic transfer curve. There are no moving magnets, nor conventional magnetic gaps.

This Ortofon cartridge is available with an elliptical or conical diamond stylus. Both stylus are replaceable.

Frequency response of the M15 E Super is 20 Hz to 20 kHz, this figure varying only 1 dB up to 10 kHz. The same figure applies to the M15 Super with the conical stylus. Channel separation is 25 dB and recommended tracking force is 1 gram.

Ortofon's new extralinear magnetic circuit employed in the M15 Super Series reduces tracking and tracing distortion, frequency and phase distortion as well as harmonic and intermodulation distortion to the lowest level ever available in a magnetic stereo cartridge. The result is extraordinary fidelity and musical clarity.



USE WATTS EQUIPMENT TO KEEP YOUR RECORDS CLEAN.

Few music lovers realise the damage that airborne dust and dirt can do to a valuable record collection. Not only do these factors contribute greatly to reproduced noise and interference — the actual wear on the record can be considerable. Watts record maintenance equipment solves most of the problems. We recommend:

THE WATTS "MANUAL PARASTAT" Mk. IIA.

This is a dual-purpose record cleaner designed to maintain new records in new condition and to restore fidelity to older discs. Use immediately prior to playing.

THE WATTS "DISC PREENER".

Designed expressly for records which have not had previous anti-static treatment. The "Disc Preener" keeps new records like new.

THE WATTS "DUST BUG" (Illustrated.)

This effective device cleans the record, removing dust and static charges as the record actually plays. Surface noise can be reduced considerably with the "Dust Bug". This item should be used every time you play a record, for the sake of both records and stylus.

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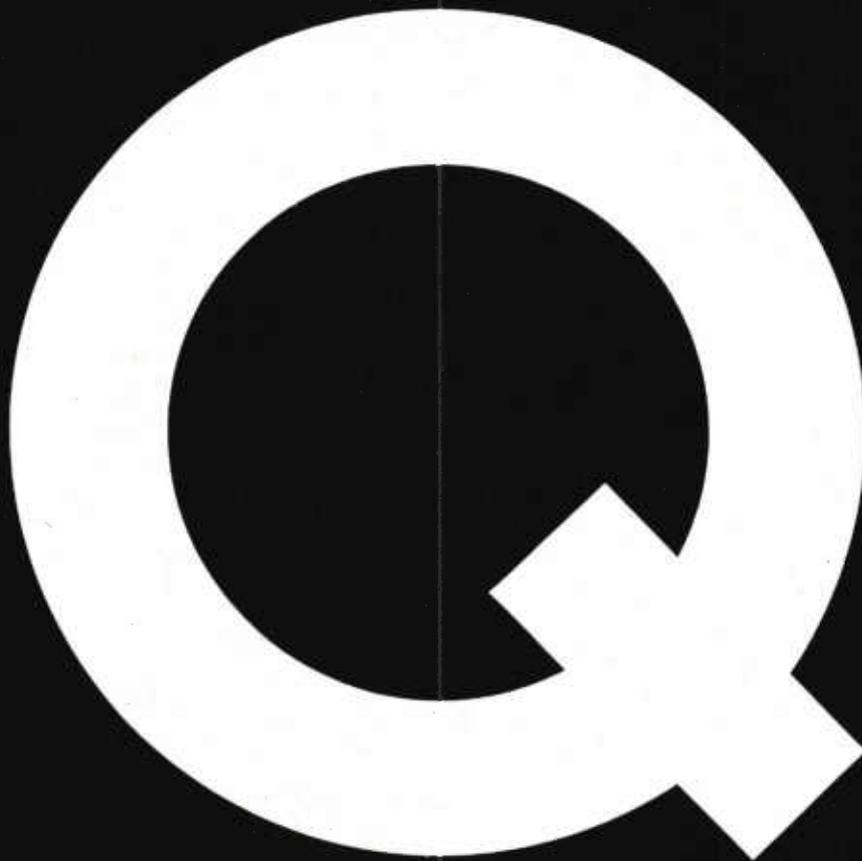
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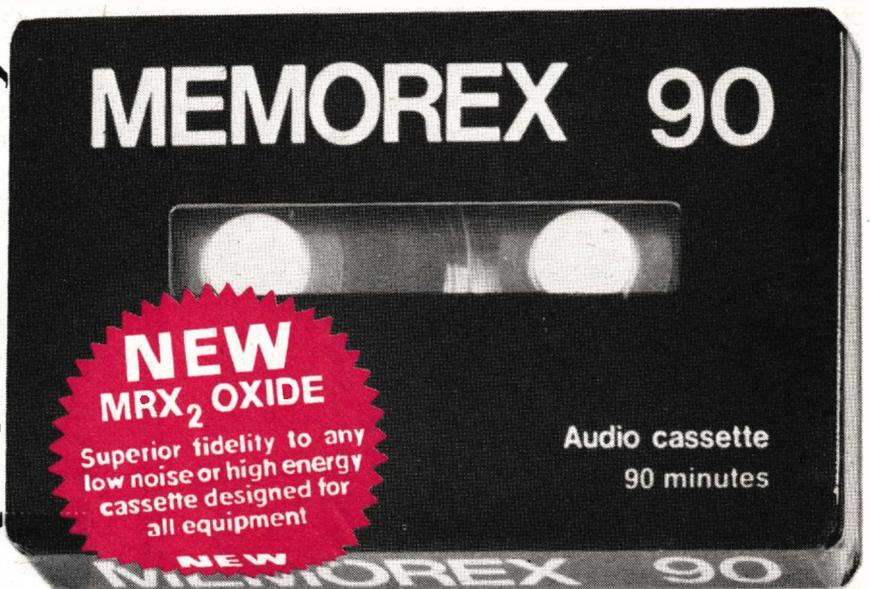
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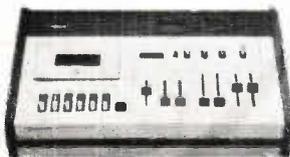
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1. total
2. systematized
3. parallel
4. functional
5. responsive
6. optical
7. synchronized
8. compatible
9. balanced

COLUMN 2

0. management
1. organizational
2. monitored
3. reciprocal
4. digital
5. logic
6. transitional
7. incremental
8. third-generation
9. policy

COLUMN 3

0. options
1. flexibility
2. capability
3. mobility
4. programming
5. concept
6. time-phase
7. projection
8. hardware
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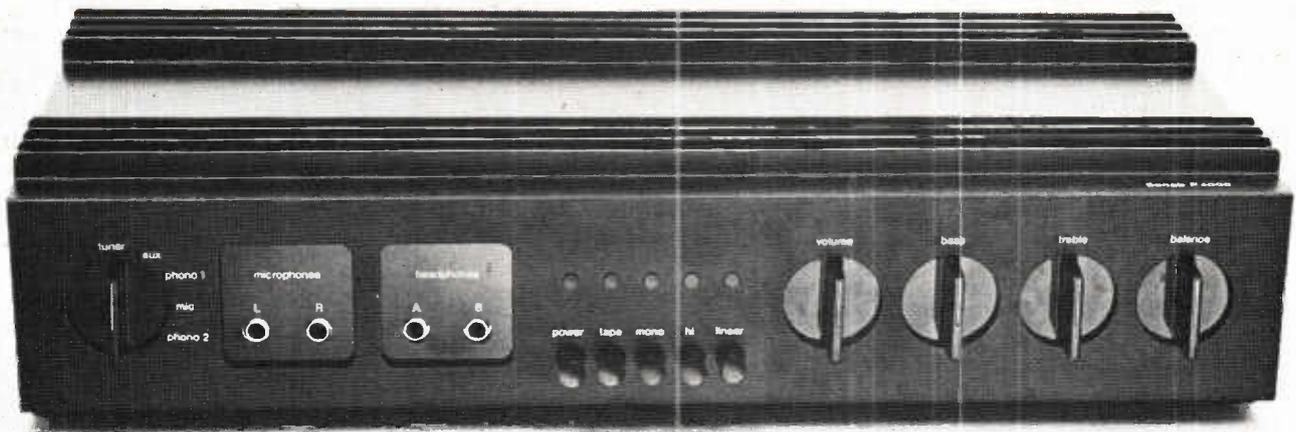
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See our Main Advertisement
page 116



SONAB P4000 AMPLIFIER



First-rate Swedish amplifier uses latest technology to provide excellent performance.

Recommended retail price \$385.00

WHILST the Swedish Sonab organisation are best known for their range of omni-directional speakers, the company also market amplifiers, headphones etc. that are comparable in quality to their speakers.

The Sonab type P4000 amplifier has a number of features that to some extent indicate a family relationship with Sonab speakers. The appearance for example is quite different from most present-day amplifiers. It is very 'avant-gard', with bold white control designations on a matt black front panel.

The cabinet too is quite unusual. It is of 1/4" extruded aluminium construction featuring a number of fins that at first sight can be mistaken for finned heat sinks. A closer

examination shows that they are nothing of the sort. In fact fully adequate heat sinks are provided internally, and the cabinet has ventilation slots at both top and bottom. The fins seem to be a styling feature intended to remove the visual impact of the ventilation holes.

Controls and facilities provided are, from left to right:— Function selector for, tuner, auxiliary input, phono 1, microphone, phono 2.

Two microphone jack inputs for standard tip and sleeve plugs, two headphone outputs for ring tip and sleeve plugs.

In the lower section of the fascia are five black push buttons, these are for:— Power on, tape monitor, mono-stereo high cut filter,

linear/loudness selector.

Above each of these controls is a clear green plastic bezel, illuminated from the rear, to indicate that the control function has been selected.

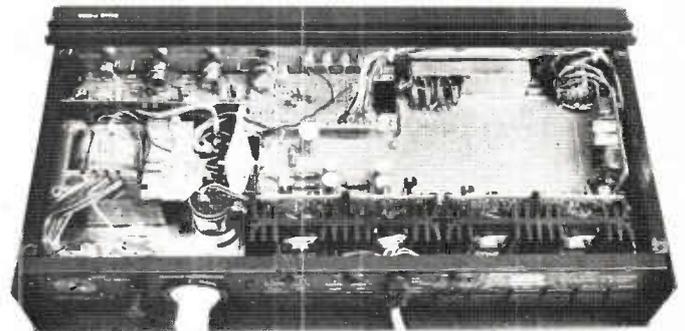
The four remaining controls, on the right hand side of the unit, are:—

Volume control, bass cut and boost, treble cut and boost, balance control.

The grouping of all controls is good. They fall immediately to hand after a few minutes — it is probable that an ergonomist has had some part in planning this amplifier.

The rear panel of the P4000 amplifier is, like the rest of the unit, slightly unusual.

All inputs are made via DIN sockets (although the unit reviewed was supplied with a double DIN to RCA



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adaptor to facilitate inter-connection with the more usual RCA type coaxial plugs — we understand however that this is not normally supplied).

Controls and inputs etc on the rear panel are, from left to right:—

Mains voltage selector — for 110, 130, 220 and 240 volts, or either 50 Hz or 60 Hz.

External, switched, power outlet complete with its own three amp fuse.

This outlet is of the European two-pin type, but fortunately the amplifier is supplied complete with a matching (white) plug.

Next in line are two pairs of DIN speaker sockets, each with separate ON-OFF switch for A and B speaker systems.

Above the mains lead in the centre are two separate fuses — one for each side of the stereo amplifier.

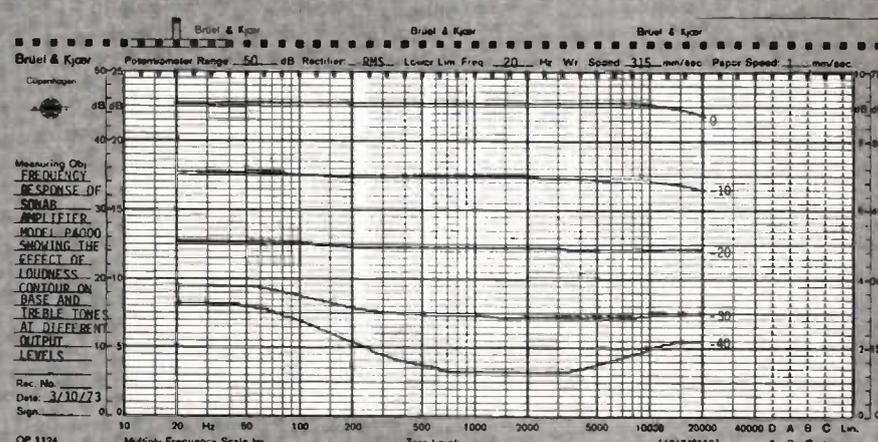
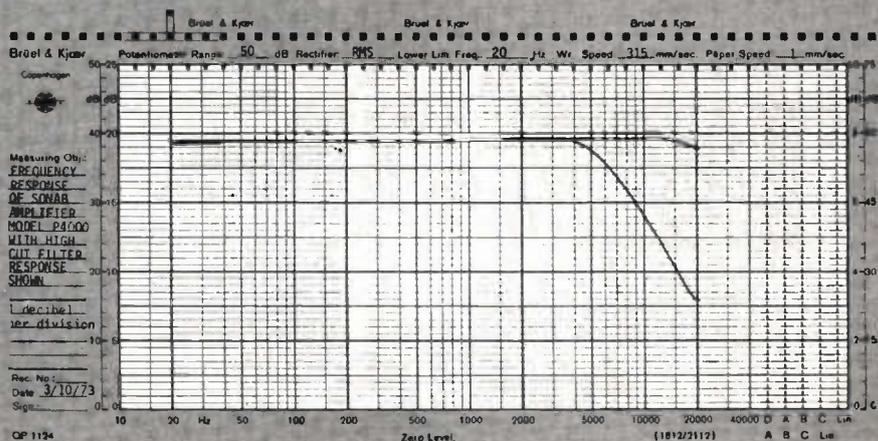
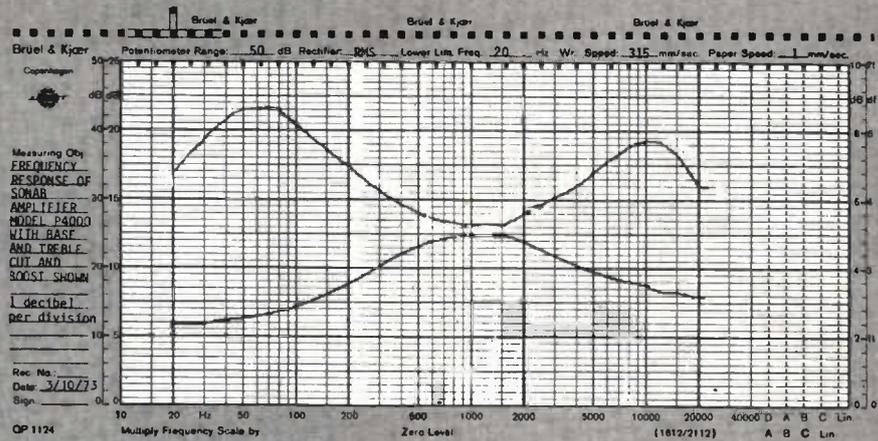
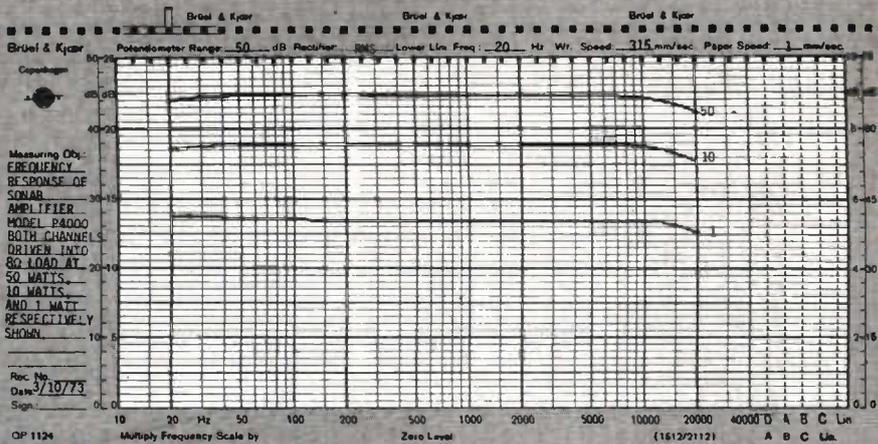
On the right of these is a DIN socket that enables an output to be taken from the inbuilt preamplifier — or to feed an external signal into the main amplifier. A switch is also provided to enable the preamplifier and main amplifier to be directly connected — as the great majority of units would in fact be.

Further DIN sockets are provided for tape, auxiliary input, tuner, phono 1 and phono 2.

Both phono and microphone inputs are 68 k impedance RIAA equalized. Sonab claim that this impedance provides a flatter response with most better-known cartridges. Whilst this may well be so, the small but measurable droop in the high frequency response of the amplifier partly negates any advantage otherwise obtainable from this technique.

The amplifier is well constructed and finished internally. Power amplifier stages are well designed, with large finned heat sinks, each incorporating special slots to support the integral printed circuit boards on which are mounted associated components. Each drive transistor has a section of black anodised aluminium attached, to further enhance thermal dissipation.

The bridge rectifier module is large



and conservatively rated, and the whole of the power supply is screened from the remainder of the unit by a steel enclosure.

Particularly noticeable are the printed circuit boards, which, with their well labelled circuit designations, quality of components and general finish, are quite outstanding.

The amplifier is supplied with a twenty page handbook, written in both Swedish and English. This handbook provides full installation details together with a quite invaluable section on room acoustics. This section is sensibly written and sets an example for other manufacturers to follow. A circuit diagram is adhered to the inside of the amplifier top plate.

MEASURED PERFORMANCE

Whilst Sonab claim that the P4000 is rated at 50 watts (continuous power) on a single channel basis — or 40 + 40 watts into eight ohms loads — our measurements showed this rating to be conservative. We found that the amplifier will produce 50 + 50 watts (continuous power) into eight ohms loads at 0.35% total harmonic distortion. This is significantly better than Sonab's claim.

Frequency response is slightly unusual in that, unlike most present day amplifiers, the output falls off below 20 Hz and above 20 kHz. Nevertheless this characteristic has particular merits at the low end in that it reduces the effects of turntable rumble. The small droop in response between 12 kHz and 20 kHz is of no importance.

It is pleasing to find an amplifier in which not only is the power output greater than claimed, but one in which *all* manufacturer's rating are adequately met — in fact many of the more important ones are exceeded. In particular, power bandwidth, total harmonic distortion and intermodulation distortion are equal to or exceed the manufacturer's specification, and channel separation and signal/noise ratio are substantially better.

In use, the amplifier is readily incorporated in a hi-fi system. It is basically a 'no vice' unit in that it can accept many different types of speaker with no harmful effects. To check this we connected electrostatic speakers, and also speakers of a lower impedance than Sonab recommend. But in all cases the unit performed faultlessly and added no significant colouration to the programme content — compared against our reference amplifiers.

The Sonab P4000 is a particularly good amplifier. The quality of manufacture and degree of care in provision of protection circuitry should provide long, trouble-free operation.

MEASURED PERFORMANCE OF SONAB P4000 AMPLIFIER SERIAL No. 002372

Power Output (at rated input)	50 + 50 watts ('rms') into 8 ohms.
Frequency Response at 1 watt output at 10 watts output at rated output	20 Hz — 15 kHz 25 Hz — 15 kHz — all $\pm 1/2$ dB 25 Hz — 15 kHz
Channel Separation (at rated output)	100 Hz — 47 dB 1 kHz — 45.5 dB
Hum and Noise (with respect to rated power output)	— 76 dB (unweighted) — 85 dBA (weighted)
Input Sensitivities (for rated power)	
Auxiliary	85 mV — > 100 k
Tape	87 mV > 100 k
Tuner	88 mV > 100 k
Phono 1	1.6 mV 68 k
Phono 2	1.6 mV 68 k
Power Amp.	500 mV 47 k
Mic.	1.8 mV 68 k
Total Harmonic Distortion (at 50 watts 'rms', both channels driven)	100 Hz — 0.35% 1 kHz — 0.33% 6.3 kHz — 0.33%
Intermodulation Distortion	0.2%
Tone Controls	
Bass	16.5 dB boost at 50 Hz 14.0 dB cut at 50 Hz
Treble	12.5 dB boost at 10 kHz 9.0 dB cut at 10 kHz
Loudness Control	15 dB boost at 50 Hz 12 dB boost at 10 kHz
Dimensions	475 mm wide x 250 mm x 110 mm high.
Weight	8.5 kg

THE MANUFACTURER OR HIS REPRESENTATIVE. COMMENTS —

Initial reaction to the review is of course that it is favourable and we are naturally delighted. However I do feel that when the review is in print it will appear a little short and lacking in detail. I think that the journalistic approach to the review is generally very basic — i.e. there are five knobs on the right hand side of the machine, one for volume etc. I would have liked to have seen some comment on the feel of the controls, the smoothness of the potentiometers, etc.

I will be interested to see whether curves and all test results will be printed, especially square wave response as I feel that this is rather exceptional.

Another point mentioned

nowhere is the Sonab five year guarantee which surely is a major point for consideration.

The headphones sockets appear to be of little interest — the fact that the two can be used simultaneously — with socket B plus speaker system B, speakers will be cut out. With headphone socket A and either speaker system operating, speakers will not cut out.

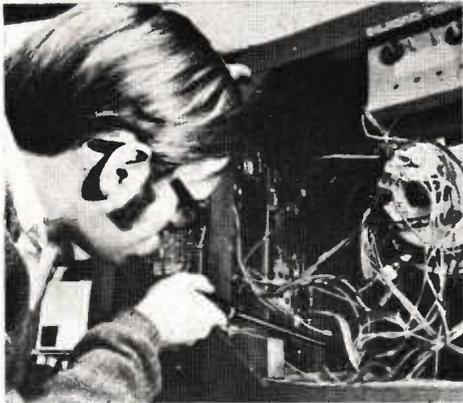
Apart from these points I am delighted to read that the P4000 falls well within manufacturers' specifications — in all I am delighted with the review.

Derek Pugh
Sonab of Sweden Ltd.
114 Walker St,
North Sydney.



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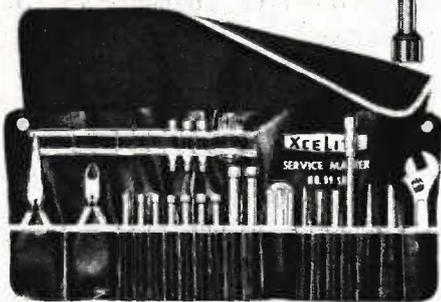
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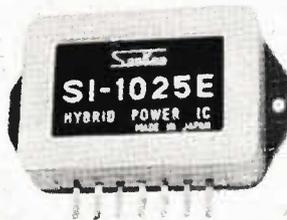
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Model S1-1010Y Sanken Audio Amplifiers are medium power hybrid amplifiers for Hi-Fi, stereo, musical instruments, public address systems and other audio applications. The amplifiers do not require a heat sink for operation at 25°C ambient or less. • Single-ended push-pull output. • Withstand a 5 second output short-circuit

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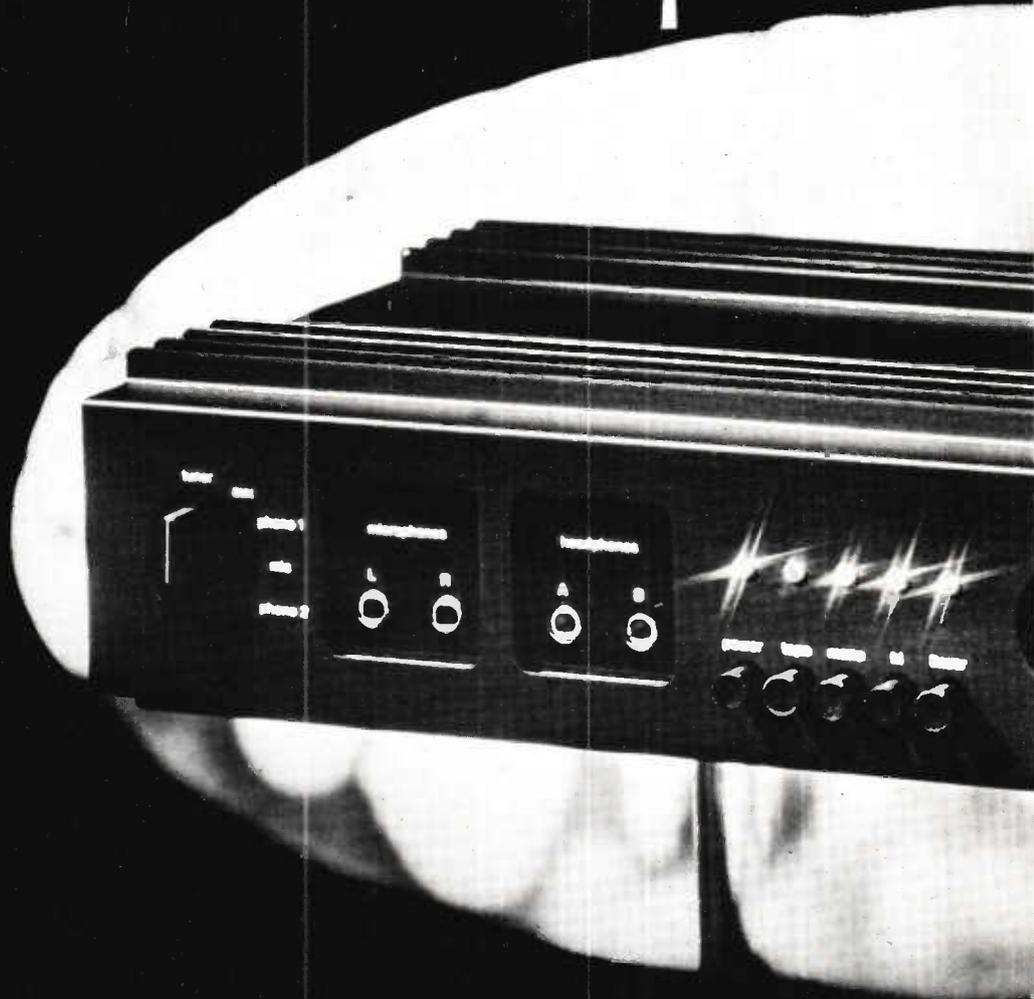
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In Sweden the new Sonab P4000 amplifier is considered good. Which is hardly surprising since it took thousands of design man-hours to develop.

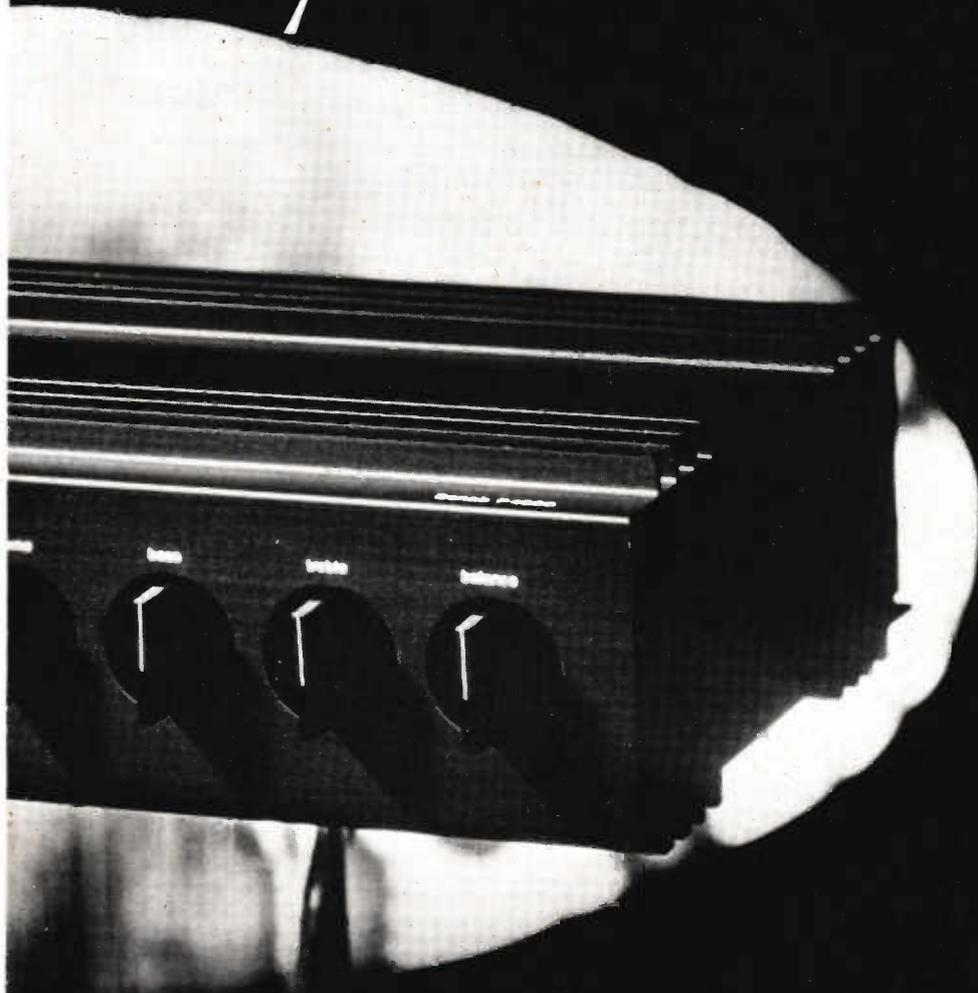
The man responsible was Clas Wanning — Stig Carlsson's greatest disciple. Clas Wanning is an honours graduate in Audio Electronics from the Institute of Technology of the University of Stockholm.

The P4000 is his brainchild.

So what makes it so good?

It has 50 watts per channel output, and an almost flat frequency response curve. So you never miss a note.

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It's good looking too. The chassis is made from extruded aluminium almost $\frac{1}{4}$ " thick. With all the inputs, outputs and knobs you need. And it's so strong not even a ton of bricks could harm it. In fact it's as durable inside as out.

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PART THREE

CREATIVE AUDIO

IN THE two articles that we have published so far in this series we have concentrated mainly on processing material that has already been committed to tape.

The introduction of a microphone considerably widens the creative scope of the existing complement. It is about microphones and their usage in the recording of music that this article is concerned. (The use of microphones for speech and sound effects will be covered in future articles.

Successful recording of musical instruments is governed by a number of interrelated factors. These are, in no particular order of importance:—

The means by which a musical instrument produces its tone.

The ambient nature of the recording room.

Various characteristics of the microphone (or microphones used).

Placement of the microphone(s) and instrument relative to one another and to the acoustics of the recording room.

PRODUCTION OF MUSICAL TONES

Every instrument has its own means of exciting a resonance and then passing these vibrations to the surrounding air. The excitation may be caused by blowing across an aperture in a cylindrical pipe (flute) or by blowing across a reed (clarinet). It may

result from scraping a tensioned string, thus causing a repetitive sequence whereby it distends and springs back at high audio frequencies (violin), or from striking the string percussively (piano). Or the vibrations may excite the air directly (drums), or semi-directly via some acoustical matching device — i.e. the sounding board of a piano or the bell of a trumpet.

Additionally to the 'tone' of an instrument there are also produced — in varying quantities — the actual 'operating sounds' of the instrument. Some of these sounds are vital to the instrument, for example the opening transients: should they be removed (by editing), the characteristic sound disappears. Opinion is divided about other operating sounds, such as finger noises when guitar chords are changed.

Finally there are irrelevant and redundant sounds that are often difficult to avoid — a squeaking bass drum pedal, the valve-operating noises of a trumpet, even perhaps the breathing of an asthmatic violinist!

These distracting sounds must be minimized in recording, either by tactful advice, alteration to the musical instrument (a squeaking bass drum pedal could be muffled by a blanket), or by well implemented microphone technique.

There is the further consideration when tackling redundant instrumental sounds that the tone of an instrument will differ over a markedly wide range, dependant on the position and proximity at which it is heard. Some guidance can be given although there is no single 'correct' position for placing a microphone — the recordist's personal aesthetic judgement is a major determining factor.

THE ENVIRONMENTAL AMBIENCE

The room acoustics can be regarded as the 'absolute acoustics' of the recording situation because the microphone is just as prone to give a subjective impression of the instrument/acoustics (related to its disposition within the room) as is the human ear. But, unlike the ear, it can make no allowances for poor positioning.

The two most likely situations to confront the recordist are those engendered by a domestic room or a large hall, concert or otherwise. It is feasible to carry out more drastic acoustic modifications in domestic rooms, so what follows primarily concerns these.

The policy adopted by the majority of small music recording studios is to provide a constant value of sound absorption or dissipation throughout

the audio spectrum, adding artificial reverberation to the recording as required. The reverberation time in a domestic room is usually short, but will inevitably be coloured by increased resonance at points in the audio spectrum where standing waves are occurring. The frequencies at which these standing waves are centred will be governed by the shape, 'geometricity' and size of the room. The simplest way to prevent or reduce standing waves is to arrange the furniture so as to break up the regular shape of the room.

The effects of large smooth reflecting expanses can be negated by draping with blankets, though this tends to dissipate the high frequencies to a rather greater extent than the low ones, leading to 'boominess'. One of the most successful and ubiquitous sound absorbers is the human body, and a well placed audience may prove the most adequate weapon for dealing with the large hall situation. Ultimately though, it will be the placement of the microphone between the artist and his reverberation that will determine the acceptability of a recording.

MICROPHONE CHARACTERISTICS

This section can be subdivided into the microphone's mode of operation, which determines its directional properties, and its impedance, which affects the length of cable that can be interposed between the microphone and its amplifying stage.

Microphones may be termed 'pressure operated', or 'pressure gradient operated'.

The pressure operated device consists of an air chamber with a thin diaphragm stretched across its front.

The movements of the diaphragm result from the instantaneous differences in pressure between that of the air trapped in the chamber and that adjacent to the 'open' side of the diaphragm. The magnitude of the diaphragm's travel is virtually independent of the frequency, or direction from which the pressure arises. Thus pressure operated microphones give a constant amplitude output for equidistant sound sources from any direction; they are said to have an omnidirectional pick-up pattern.

When both sides of the diaphragm are open to the atmosphere, sound

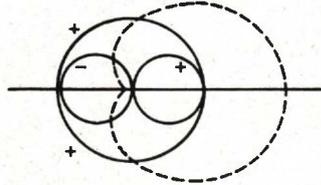


Fig. 2. Derivation of cardioid response (shown dotted) from phase differences between a pressure-operated and a pressure-gradient operated capsule when they are combined in one unit.

reaching the rear face has a slightly longer distance to travel than that reaching the front, hence a phase difference will exist between the two faces of the diaphragm. This is known as pressure gradient operation, as at each instant, the diaphragm is moving towards the region of lower pressure. The gradient, which controls the amplitude of diaphragm movement, is proportional to the extra path length (a constant) and also to frequency; the extra length assuming greater significance with high frequencies as

pressure will be maximal when there is a half-wavelength difference in path length, and zero where the path length difference is equal to the whole wavelength. The extra path length will be determined by the size, shape and thickness of the diaphragm, and size and disposition of the magnetic pole-pieces and microphone casing.

Sound waves emanating 'edge-on' to the diaphragm (i.e. at 90° to the microphone axis) strike both faces simultaneously, resulting in a null output from the microphone to sounds striking the microphone from this position. A graphical plot relating output to the direction of the sound source forms a 'figure-of-eight', the lobes of the '8' being perpendicular to the faces of the diaphragm.

The third major pick-up pattern is the heart-shaped cardioid. One of the easiest methods of generating this characteristic is to induce the sound, that would otherwise reach the back of the diaphragm directly, to follow a devious route so that it reaches the diaphragm in synchronisation with the same wave fronts reaching the front. As no pressure difference results, the microphone will be insensitive to sounds from its rear. Alternatively, an omnidirectional and figure-of-eight capsule may be carried in the same housing — the rear lobe of the figure eight being cancelled by the omnidirectional capsule which fills in the null areas at 90° to the figure eight axis.

It may be useful at this stage to briefly survey the actual electro-mechanical methods employed by the transducers as in most cases this affects the microphone technique employed.

MOVING COIL MICROPHONES

This can be likened to a loudspeaker with a small flat cone — a light coil is attached to the fine diaphragm and moves freely within the field of the permanent magnet surrounding it. The magnet/cone arrangement may be sealed to give pressure operation, or may have vents that, utilising phase-shift paths, produce a cardioid characteristic. Main benefits are small size, resistance to mechanical shock and relative immunity to condensation.

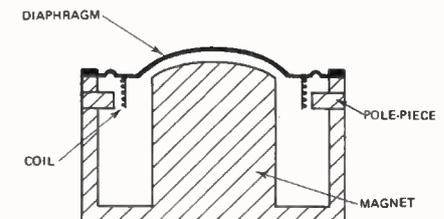
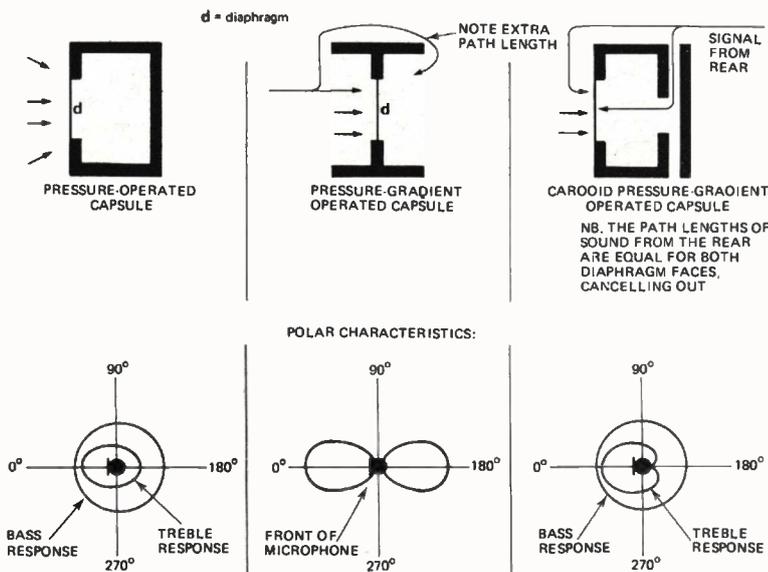


Fig. 3. Diagrammatic cross-section of moving coil microphone insert

Fig. 1. Microphone capsules (schematic) with related polar characteristics



CREATIVE AUDIO

RIBBON MICROPHONES

In this method, the ribbon acts as the microphone diaphragm. Corrugations increase its rigidity and provide a tension to control its low frequency resonance so that the resonance that does result can be damped out by the primary inductance of its matching transformer. The ribbon is suspended between polepieces of a powerful magnet with both its surfaces open to the atmosphere. The mode of operation is thus pressure gradient. Cardioid response can be generated by enclosing part of the rear of the ribbon but this does not always permit a wide flat response.

All ribbon microphones have integral matching transformers to transform the miniscule ribbon impedance to an impedance suitable for matching into an amplifier. Ribbon microphones, especially in 'close-miking' applications, have a progressive bass boost as the frequency drops. This accounts for the former "deep brown" radio announcer's voices during the period when ribbons were exclusively used for speech.

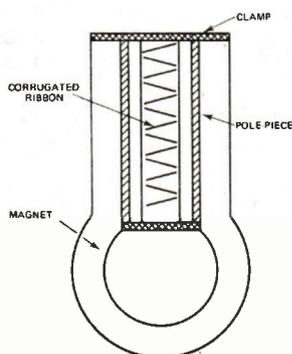


FIG. 4. RIBBON MICROPHONE INSERT (DIAGRAMMATIC)

CAPACITOR MICROPHONES

The studio standard for many years, these give a wide flat frequency response with a choice of polar patterns (using combinations of basic capsules or capsules with twin diaphragms). The capacitor capsule consists of a thin metal, or metal-flashed plastic diaphragm, spaced from a back-plate covered with damping holes. A constant voltage charge is applied between the diaphragm and the back-plate via a high resistance. The diaphragm, responding to air pressure variations in its vicinity, will move, varying the size of the air space, hence capacitive effects cause corresponding voltage variations to be present on the diaphragm. A preamplifier, contained within the microphone casing, and a

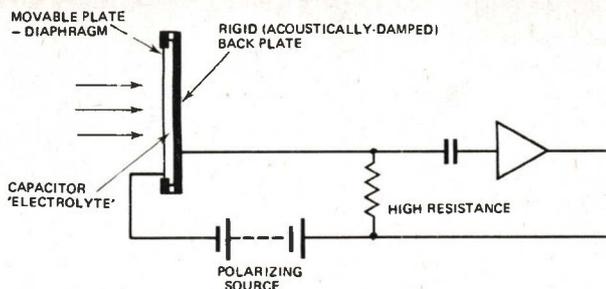


FIG. 5. CAPACITOR MICROPHONE SCHEMATIC

separate polarizing power unit or self-contained battery complete the basic system.

AKG have recently developed two microphones (C 12 and C24) with a central plate sandwiched between two independently polarized diaphragms. Varying one voltage, whilst keeping the other constant, enables the whole gamut of polar responses to be synthesized. This offers the useful facility of permitting the polar response to be remotely controlled.

ELECTRET

This comparatively new type of microphone is rapidly achieving importance especially in the amateur field, as its claimed performances approaches capacitor fidelity. The design is very similar to that of capacitor microphones, but no polarizing voltage is needed as a 'permanent' charge is impressed on the diaphragm. The electret microphone has considerable advantages of low price, size and convenience, but at present there is some uncertainty regarding lifespan. Some users claim this to be less than five years, many say much less than that, quoting a recent Australian pop festival where electret microphones lasted only 1½ days!

MICROPHONE POSITIONING

The two distinct philosophies of single-miking and close, or multi-miking, are very often integrated in recording sessions. On location, single-miking may be the only practicable solution, as when recording a brass band on the move. Single-miking offers the advantages of low financial outlay and easy manoevrability. If the desired musical balance cannot be achieved with musicians playing louder or softer, regrouping the ensemble may do the trick. The further the microphone is placed from the ensemble, the greater will be the "acoustic presence" on the recording.

MULTIMIKING

A multimike set-up only utilises the acoustics incidentally, reducing its effects as far as possible and synthesizing the ambience required on

the recording. This approach provides great flexibility in the recording, which is very useful when considering stereo or even quadraphonic work. A mixer is a pre-requisite, and so too are a number of good quality microphones so initial outlay may well be high.

The criterion of microphone placement need not be that which gives the 'most realistic' sound. When multimiking one may feed the sound from a single instrument into a number of mixer channels, with each channel set to treat the sound such that the composite output enhances the listener's interest.

A review of basic microphone positions with respect to various musical instruments is given below, although it is stressed that these are far from absolute, experiment being essential for best results. Once a microphone has roughly been placed, it is handy to monitor 'live' over headphones, adjusting the microphone whilst the musician plays.

Grand piano

The lid is raised and a cardioid microphone, close to the lid is pointed down towards the strings, in line with 'middle C', poked in from the back, i.e. the middle of the curved side of the piano.

Guitar (Spanish)

Most natural string effect is achieved with a cardioid pointed towards the sound hole from about one metre away, Miking too close gives a dull, throbby effect.

Guitar (Steel-string)

These give a more incisive sound than the Spanish variety, and can take a closer microphone although if the microphone is closer than 30cm it should be directed towards the sound hole at an oblique angle, to minimize bass boominess. When more microphones are available, directing an extra microphone a few centimetres from the front of the sound box, near the sound hole, will accentuate the fingering noises.

Viola and Violin

Vertical distance is required here —

one and a half metres or more above the sound box, and just in front keeps the clarity, at the same time losing the unwanted 'scratch and scrape' sounds. A small violin section may similarly be covered; a large section can be subdivided into a number of smaller groups, balancing each group as described, and using the mixer to 'recombine' the section. Violas are less prone to objectional operating effects than their higher pitched relatives, and hence can be miked slightly closer.

Cellos and Bases

In this case it is the scrape that provides the definition to the tone. A hard reflecting surface is preferable to a carpet for bringing out the 'body' of the sound. Laying a hardboard sheet under the instrument is very effective. Microphone position is a bit less than a metre in front and just below the bridge, bringing it to within half this distance if the instrument is to be plucked rather than bowed.

Clarinet, Flute, Oboe and Piccolo

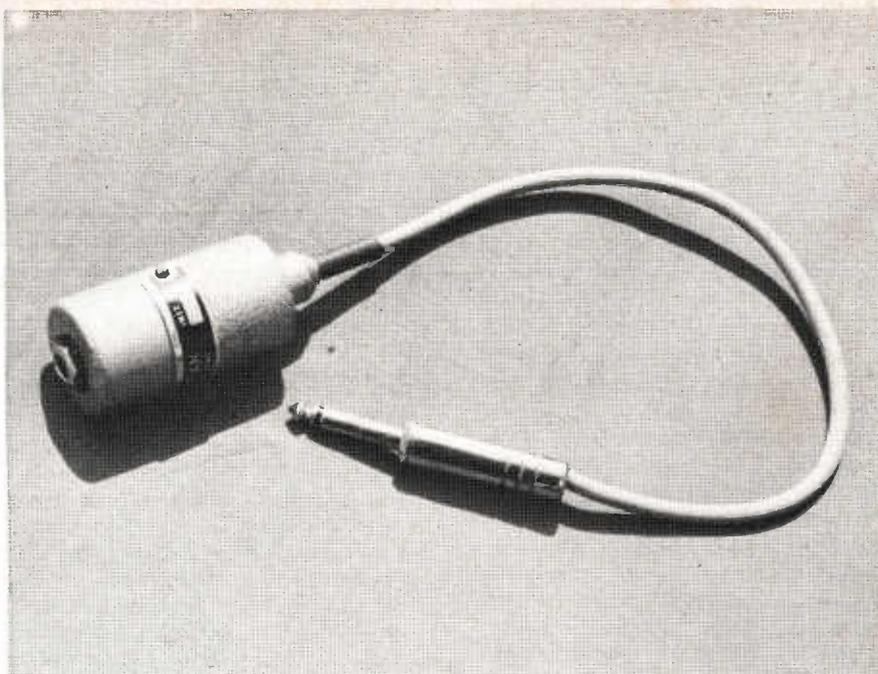
A difficult group to record as they produce wide variations in dynamics, not necessarily obvious to the ear. The operating noises, the huff-and-puff of the flautist and the clicking of keys, add to the difficulties. A minimum distance of a metre should be used when miking soloists, to lose the operating noise, but in the ensemble situation, 30cm or less may be used, directing the microphone to the centre of the instrument body. Wooden instruments tend to give less trouble generally, but when heavy peaking does occur, it is normally the upper musical registers that are affected.

French Horn and Cor Anglais

Ribbon microphones seem well suited to capture the rasp of all the brass section. Horns give out deceptively high pressure signals that can easily overload so miking should be a good two feet in front of, and directed at, the bell of the instrument. Polished wooden reflectors should be placed round the 'back' lobe of the figure eight to capture the chunky richness of the sound.

Flugel Horn, Sax, Trumpet and Tuba

The sax is miked close to get the breathiness, pointing the microphone down the bell. All the rest are also miked in line with the bell, the further away, the more stark will be the resulting sound. Reflectors, as in the previous section, may be used to strengthen the tone, but once again experimentation is the key.



Mumetal-shielded microphone matching transformer, made by Grampian.

Percussion

Timpani only give of their best in a lively acoustic; a cardioid should be placed a metre or so above them, directed slightly towards picking up the more elusive deep-toned timpani.

Hand percussion, bongoes and congas, must be closely miked, otherwise, in an ensemble situation, the delicate nuances of timbre will be lost.

The conventional drum-kit may be satisfactorily miked using anywhere between two and seven microphones. Unwanted drum rattling may be more noticeable with close-miking and it may require a combination of cushions, blankets and carpet tape to subdue the unwanted noises. The bass drum microphone must be capable of withstanding high pressure signals without sound break-up occurring; for this application a sturdy moving-coil unit is best, located on a cushion just below the centre of the skin, maybe even inside the drum with the front skin removed. Tom-toms can be miked near their rim, close to where the sticks strike. Cymbals do not need special miking as they happily spill over onto any of the other drum microphones.

Share drums can be miked similarly to tom-toms, but when few microphones are to be used a single top-kit microphone can be positioned level with the drummers head which, combined with a bass drum microphone, gives quite acceptable results.

Voice

A solo vocal microphone should be at least 15 cm away, in front of the performer and in line or just below the mouth. The soloist should be advised to lean slightly back on the fortissimo sections. A distance of up to a metre gives good results when a suitable room acoustic is available; it also prevents the stage-oriented performer trying to 'swallow' the microphone.

Choirs can be treated as a number of smaller sections, splitting them up into the various vocal ranges and grouping each in a semi-circle around a cardioid. Practically, a small number of groups is preferable, as there are less faders to balance.

An empirical rule which seems to work well with most instruments is to regulate the miking distance to between ½ and 1½ times the length of the instrument being miked.

STEREO

As in mono there are the same three possibilities: close multimiking, single (pair) miking, and a combination situation.

Classical music recording demands that the sound image corresponds closely with the concert hall positioning. One school of thought favours a 'crossed pair' of cardioids spaced well back and pointed towards the ensemble, the theory being that this would give the same subjective impression as would be received by a human listener located in the same position.

CREATIVE AUDIO

A multimike set-up would follow the foregoing guide, but after the signal has to an extent been processed in the equalization section of the mixer, it is then routed to the two output channels. The subjective position of each instrument in the sound panorama will be dependent on the relative loudness — there will be an orientation bias towards the speaker carrying any signal at greater volume.

The alternative to these two discrete techniques is to utilise an overall cross-pair and then pick out soloists or complete sections with spot microphones which are injected into the sound panorama in the correct position.

MONITORING

A critical part of the recording chain is the monitoring section, for non-linear operation here will be misleading to the recordist and will in all probability spoil any recordings made. Flat response should be combined with powerful amplification and good speakers that can handle power without distortion. The monitoring must be conducted out of earshot of the microphones for

obvious reasons. It should also be conducted at the greatest volume compatible with the equipment and environment. Monitoring at low levels will not show-up induced mains hum and similar small sounds.

MICROPHONE IMPEDANCE

The stated microphone impedance should match the impedance of the equipment it is feeding. The elementary rules to follow when long microphone cables are required, is that the lengthy section is at low impedance, 600 ohms or less. Hence if

a high impedance microphone is to feed a low impedance input, a step down transformer will be required adjacent to the microphone. If a long run is required between a high impedance microphone and a high impedance input then a step down transformer will be needed as before, with a step up transformer next to the input. ●

The next article in this series, to be published next month, will describe the techniques used in multi-track recording.



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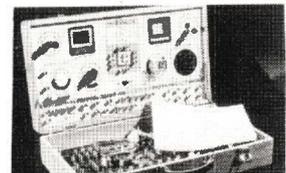
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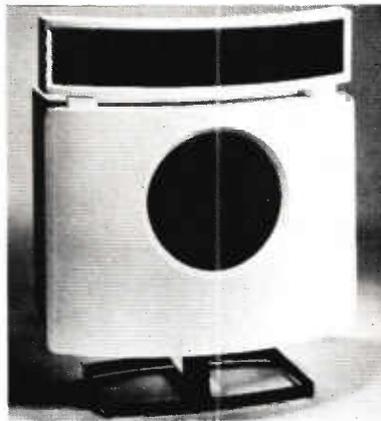
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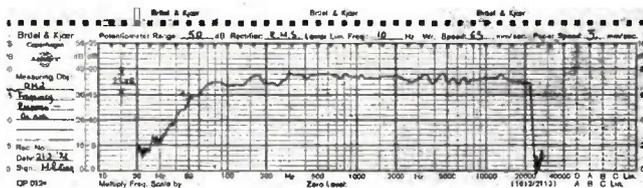


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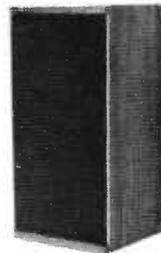


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The mighty atom DM4 Monitor

So small in size, but enormous in sound reproduction from high to low frequency. This is the speaker that has just astounded critics all over the world. They said this type of sound could not come from a speaker just over one cubic foot for those who do not have the room for DM2. Walnut.



B & W D5, Sound Value

A small speaker but a wonderful performance and at an extraordinarily keen price for those who want B & W quality on a budget. This speaker is a remarkable investment in quality sound. Only a little above the budget priced speaker but its fidelity and real timbre has to be heard. Walnut.

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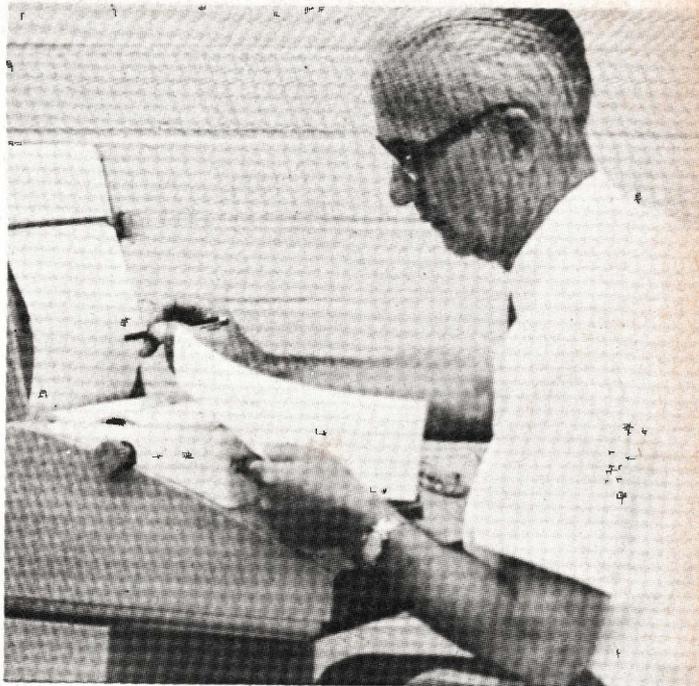
273 Hay Street East, Perth. W.A. 6000

THIS is a competition with a difference. All you need to compete is a logical mind and a little ingenuity.

Entrants are asked to suggest original uses for computer time-sharing, keeping in mind the practical feasibility of the project and the overall value it would have to the community.

No previous experience with computers is necessary to present a winning suggestion.

\$10,000 COMPUTER CONTEST



THE applications of Time Sharing are multitude, as pointed out in the two previous articles in this series. The first essential towards problem solving is a machine sufficient power. The second, is a program of instructions by which the computer is instructed in the steps necessary to solve the problem.

Programming is greatly simplified by the use of high level languages such as Basic and Fortran which may readily be learnt in a few days. However to relieve even this chore, a Time Sharing system will have available a library of programs designed for common tasks. All the user has to do is call up the program on his terminal by a reference number and feed in his data — the rest is entirely automatic.

To illustrate the wide variety of programs available, this article examines the common problems encountered in the business world and the application of Time Sharing to them.

A TOOL FOR THE MANAGER

Some of the more common areas of application in computing are in book-keeping, stock control and information processing in general. But there still remains a vast range of application where computers can be used to help the manager make a decision, or help him to exert more control over his business. Such applications are financial analysis, planning and forecasting, manufacturing and production control, and operation research. These are the areas in which Time Sharing is at its strongest.

The manager or businessman does not have time to become involved in the intricacies of programming; he needs a simple system which he can operate himself. Time-Sharing caters for this demand and in fact Honeywell's new Mark III system makes the task easier by making available a software package which writes a program for the user, thus providing greater simplicity in computing. This trend is placing the emphasis on the results and not on the computing, and adding strength to the concept of the computer as a 'management tool' and not just a paper eater.

Manufacturing organisations are continually under pressure to reduce costs and increase production and many very sophisticated manual systems have been developed to cope with this situation. As a result specialist advice is available on an incredible range of topics including Time and Motion Study, Quality Control, Production Scheduling, Inventory Control and Maintenance Scheduling to name but a few. In the same way that these techniques have increased productivity in the manufacturing industries, Time-Sharing has brought the ability to use them back into the hands of the man who knows the business best. There are many programs available to cover the needs of the manufacturing industry, they can control the flow of raw material through the manufacturing process, select numerical control (NC) tools to machine the parts, inventory both raw

Honeywell have advised that the PMG will not be a sponsor of the competition.

Of course winners of the competition will still require a PMG modem and line-connect time. These costs will be met by Honeywell. Thus the original prize offer remains unchanged.

material and machined parts, issue purchase orders, and produce numerous reports that help management decision making.

Users can acquire enormous capability from these programs — to absorb, compute, sort and classify the thousands of details found in any manufacturing situation, to relate them to each other so that effective and timely decisions can be made. This increased capability leads to a speed up of the production cycle by reducing non-productive delays.

Scheduling is one of the Production Manager's biggest headaches. There must be enough (but not too many) parts, people, equipment, and times allocated to every step of the production cycle. The bigger the products or number of different products, the tougher the problem. Time-Sharing allows initial scheduling, and instantaneous feedback in order to achieve the necessary degree of control.

The Time-Sharing terminal is also ideally suited to the production of numerical control tape. Numerical

\$10,000 COMPUTER CONTEST

TYPICAL LIBRARY PROGRAMS

PROGRAM	DESCRIPTION
TUTORIAL PROGRAMS:	
BASIC1***	INTRODUCTION TO CAPABILITIES OF BASIC 1
DEFINS***	ON-LINE LIBRARY FOR TIME-SHARING TERMS
LBASIS***	COMPLETE IN BASIC 1 PROGRAMMING
BUSINESS AND FINANCE:	
ANNUIS***	CALCULATES ANNUITIES, LOANS, MORTGAGES
DIGITS***	SUM-OF-THE DIGITS DEPRECIATION
DISRAS***	DISCOUNTED RATE OF RETURN
GROWTS***	CALCULATES GROWTH RATES
MORTGS***	INTEREST RATES AND MONTHLY PAYMENTS
SAVINS***	VALUE OF SAVINGS PLAN CALCULATED
TRUTHS***	TRUE INTEREST RATES FOR LOANS
LINEAR PROGRAMMING:	
LNRPRO***	MAXIMIZES OBJECTIVE FUNCTION USING TWO-PHASE METHOD
MATHEMATICS	
CODET\$***	EVALUATES REAL OR COMPLEX DETERMINANTS
ROOTS\$***	POLYNOMIAL ROOT SOLVER - BAIRSTOW METHOD
SIMEQA***	SOLUTION OF SIMULTANEOUS EQUATIONS
SOLTRI***	SOLVES FOR ALL PARTS OF A TRIANGLE
XPLOS\$***	PLOTS SINGLE-VALUED FUNCTIONS
ZEROES***	ZEROES, MAXIMUMS, MINIMUMS OF FUNCTIONS
STATISTICS:	
BICONS\$***	CONFIDENCE LIMITS FOR A PROPORTION USING BINOMIAL DISTRIBUTION
BINDIS\$***	CALCULATES BINOMIAL PROBABILITY DISTRIBUTIONS
CONBIS\$***	CONFIDENCE LIMITS ON PROPORTION USING NORMAL APPROXIMATION
CONLIS\$***	CONFIDENCE LIMITS ON RANDOM SAMPLE DATA, UNKNOWN POPULATION MEAN
DESTAS\$***	ANALYZES A SET OF OBSERVATIONS ON ONE VARIABLE
MNASDS\$***	MEAN AND STANDARD DEVIATION CALCULATION
ONEWSS\$***	ONE WAY ANALYSIS OF VARIANCE
PROTRS\$***	PROBABILITY TREE CALCULATIONS
PROVAS\$***	NORMAL AND STUDENT'S DISTRIBUTION CALC.
TWOWAS\$***	ONE AND TWO WAY ANALYSIS OF VARIANCE
UNISTS\$***	DESCRIPTION OF UNIVARIATE DATA (MEAN, ETC')

The above programs are a selection from the many hundreds available. The user merely purchases the program manual at nominal cost and may then use the program freely at any time simply by calling up the program name.

Control Languages are available for use in the production of tapes which will define the geometry of a part to be made on a N.C. Machine. The range of application extends to lathes, cutting and welding machines, wire wrapping machines, and many more.

Quality Control Managers and specialists face a multitude of daily inspections and tests that create a paperwork crunch. Acquiring data can be a long, costly task that slows production. Data analysis, can, likewise, be slow, overwhelming in proportions or not done at all due to lack of manpower, time, and funds. Time-Sharing programs help to develop expected machine tolerances, measure equipment reliability, prepare X-bar and R-bar charts, and can generally cope with a multitude of

statistical analyses in a fast and efficient way.

The problems of overstocking and understocking can be overcome on Time-Sharing, as determining an optimum inventory control policy and evaluating the many stocking alternatives can be done both quickly and inexpensively.

Many Industrial Engineering tasks are characterised by the mass of detail that must be collected, sorted, analyzed, compared, and studied in order to arrive at an accurate answer. Time, effort and errors can all be cut by performing these tasks on Time-Sharing.

Finally, the ability of Time-Sharing to help make decisions comes to light by the use of modelling and simulation of processes, where the user can find

out the answer to the question "what if?"

FINANCE

The ability to get results and cope with changing situations quickly is perhaps more important in the area of finance than any other area of business. Decisions have to be made based on the most up to date information, and alternative courses must be weighted against each other.

Every company has access to vast amounts of data past and present. The questions to be answered are:—

- What position are we in now?
- How does this compare with previous periods?
- How are we likely to fare in the future?
- How can we meet future demands?
- What past experience can we use to prepare us for the future?
- What happens if?
- Which parts of the business are getting out of control?
- What can we do about it?

In short businessmen should be interested in forecasting, 5 year-plans, report-writing, budget preparation, modelling, exception reporting, and decision making. This area is seen as being a major proportion of Time-Sharing business in coming years. Along with the more sophisticated techniques and technology available to computer users the trend towards simplicity has made these applications very feasible for the average company.

Forecasting helps to isolate the influences on a business. By analysing historic data it is possible to predict the future trend with some degree of certainty. By telling the computer which variables you think may contribute to known data, a relationship between these variables can be found and future data derived from that relationship. Cyclic or seasonal trends can be isolated, and more importance may be placed on more recent results.

As many financial executives can testify, preparing a five-year financial plan or forecast for a company is at best a difficult and time consuming task, involving a great deal of detailed clerical work. As assumptions are changed, the process of adding up detailed projections, applying cost factors, and drawing of totals may have to be repeated several times, each involving a tremendous volume of recalculations. Under these circumstances it is hardly surprising that changes in assumptions are discouraged whenever possible.

For truly effective forward planning

the financial executive should be able to change assumptions and to measure the effects of such changes on the company's profits and cash requirements. He should be able to test his projections under a variety of assumptions if he is to fulfill his responsibility for advising management about the financial opportunities and risks that the company is facing.

This demand is currently being met by Honeywell Time-Sharing's suite of financial planning and modelling programs. Users of these programs can gain tremendous insight into their businesses, and become fully aware of the many financial pitfalls.

REPORTS

The production of management reports is often regarded as a chore, and consists of rows and columns of figures which must add up correctly both horizontally and vertically. Percentages may need to be calculated and subtracted from subtotals, which must then be carried forward without loss of intelligibility and neatness. Because of these detailed calculations the preparation of a table is prone to errors which may not be discovered until too late (i.e. after the figures have been consolidated into a higher level report). However, this manual method does have the advantage of flexibility although it may be time consuming and prone to inconsistencies. Computers are being used to overcome the drudgery of producing tables and figures, in this way the accuracy of both calculation and tabulation is assured, although control of figures and layout is difficult on the typical computer.

Time-Sharing bridges the gap between these two alternatives. It retains the simplicity and flexibility of the manual method yet it allows the users the facility of using all the power and accuracy of a large computer. Honeywell's report writing program OLIVER is unique in this field in that it writes a program which produces a report. This computer written program can then be used for later runs using different data. The program is aimed to give the simplicity and economy of use demanded by today's businessmen.

FINANCIAL MODELLING

Financial modelling is subject in which there is growing interest. The concept is that the business may be represented by a series of relationships (e.g. sales x price = sales income) all interlocking to give a total picture of what happens in the company. The executive may then specify what his independent variables are and calculate the effect of these on his total business. For a truly representative

and useful model of the business environment these independent variables must have a random value, varying from time to time. Honeywell's PA300 program allows the executive to specify the range in which his independent variables lie and what form of random distribution the probable value will take.

Other areas of interest to the financial analyst, and some of the most commonly used programs on Time-Sharing deal with investment and revenue analysis. There is often a need to compare the relative merits of cash purchase, Lease, hire or hire purchase and determine the present value for each in order to arrive at a decision. Time-Sharing allows the user to sit down at his terminal, feed in his data and get these answers back immediately. Some other applications in this field are Discounted Cash Flow Analysis, Investment Analysis and Bond Analysis.

This range of financial analysis and planning programs allows the executive to take firm control of his company with real confidence.

INFORMATION RETRIEVAL

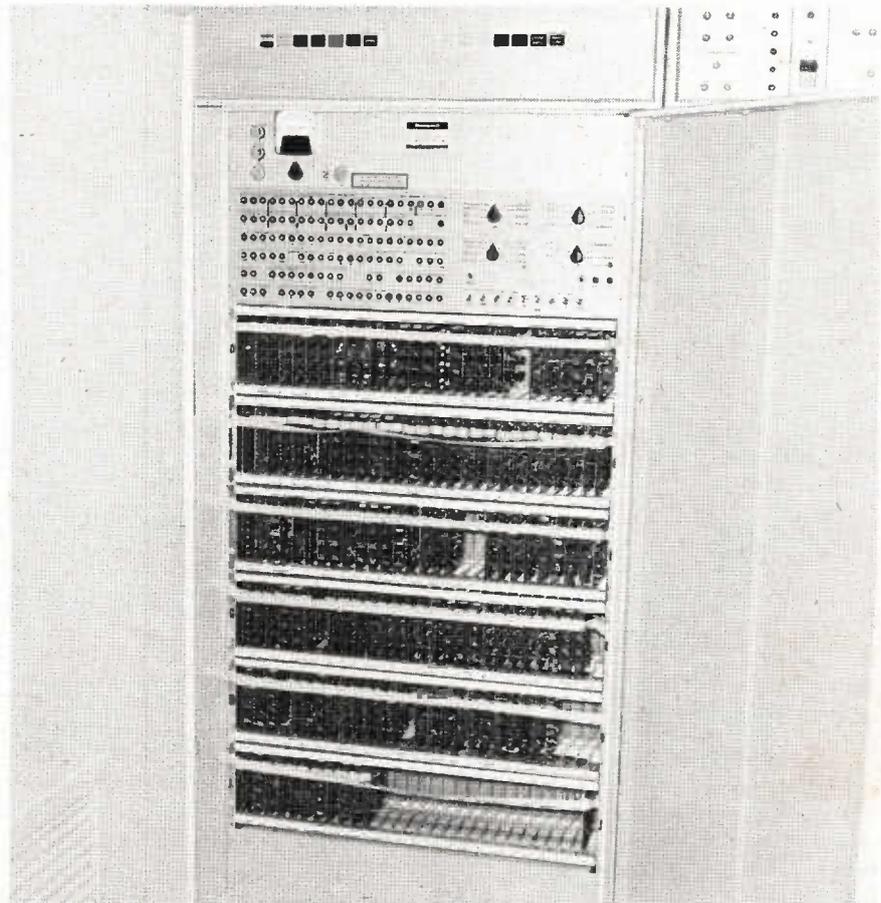
As mentioned before companies have access to vast quantities of data both

present and past. The ideal way to use this data is to select only that data which is relevant, and to be able to analyse the relationships between the important factors.

Information retrieval is essential to the fast and efficient running of a business, whether it is the Personnel Manager who wants to know which of the staff has an MBA, at least two years experience, is between 25 and 35 years old and speaks French, or the Sales Analyst who wants to know which of the customers have placed orders in excess of \$10,000 for Product B. Honeywell's program FLEXIMIS (Flexible Management Information System) fulfills this need by providing quick answers to information management questions. Its capability for retrieval and inquiry reporting makes it ideally suited for generating status, exception, and periodic reports.

It is of course very nice to have this sort of information at your fingertips, but it is often necessary to understand the meaning of the information. For this reason the businessman often requires some form of statistical analysis to be performed on his data. He may wish to create new dependant

(Continued on page 71)



One of the logic units of the Honeywell Time-Sharing computer showing the electronic complexity of the machine.

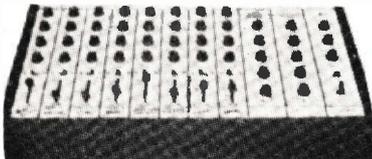
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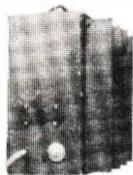
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Kit of parts less national semis \$153.00
p&p \$2
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\$19.10 20c p&p (including semis)
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including semis
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All coils prewound

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(as featured in *Electronics Today* Dec '72)

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second silent entry and
exit delay ● Fire warning
facility ● Battery opera-
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maintenance free. Com-
plete kit of parts.



ONLY \$23.00 plus \$1.00 p.p.
(does not include batteries)

\$10,000 COMPUTER CONTEST

WHAT THE WINNERS WILL RECEIVE

Each winner will receive the following:-

- * One STC time-sharing computer terminal installed, in the place of his choice, free of charge.
- * Up to \$1500 of G265 Time-Sharing computer time.
- * Free instruction in computer time-sharing.
- * Free telephone service throughout Australia whilst the computer terminal is connected to the main computer.

The following conditions are applicable to all winners.

- a) Only the Honeywell G265 systems may be used.
- b) There will normally be a time limit of three months duration — commencing from the date of terminal installation.
- c) The organizers are prepared to extend the time limit and dollar value of any prize if, in their absolute discretion, they consider that further computer

time would benefit the prize winning project, the project is of outstanding value, and that work so far completed on the project is sufficiently meritorious to warrant an extension.

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

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

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

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

These applications will be judged on the basis of:-

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

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

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

- 1/ Primary and Secondary Schools.
- 2/ Universities, Tertiary Educational Institutions, State and Commonwealth Departments and Instrumentalities.
- 3/ Industrial and Professional — this includes Private and Public Companies, Partnerships and employees of same — where the entry is either sponsored by, or in the name of a company or partnership, and/or where the nature of the entry is closely associated with the entrant's

occupation and sphere of business or professional activity.

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

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

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

Each entry must be accompanied by our official entry coupon — this is printed below, and will also be included in our November issue.

Entrants may submit any number of entries — providing that a separate entry form is included with each entry.

Final closing date for entries is December 12, 1973.

OFFICIAL ENTRY FORM

Honeywell/Electronics Today International
Time Sharing Computer Competition

Herewith my entry to your Time Sharing competition, I have read the contest rules and conditions and agree to abide by the decision of the judges.

SIGNED DATE.....
NAME (block letters)
ADDRESS
.....
EMPLOYMENT CATEGORY.....

A separate entry coupon must accompany each entry.
Closing date for this competition is December 12, 1973.
Send all entries to:-
Electronics Today International, 3rd Floor, 15 Boundary St, Rushcutters Bay, 2011, NSW.

(Continued from page 69)

variables by transforming his data, and get some sort of 'feel' for the relationships before he goes through his statistical analysis. Honeywell's STATSYSTEM package allows users of Time-Sharing to manipulate and test the relationship of variables before continuing with a formal analysis. If the user is not satisfied with his results he may create further dependant variables and return to his analysis.

Among the extensive range of analyses and displays available to STATSYSTEM are Descriptive Statistics, Polynomial Curve-Fitting, Time-Series Forecasting, Analysis of Variance, T-Statistics, Chi Square Tests, Reliability Analysis, histograms, bargraphs, frequency tables and graphs of cumulative distributions. This ability to retrieve and analyse information in a few short moments using a Time-Sharing terminal, saves

many hours of research and calculations.

IN CONCLUSION

It can be seen that the computer fills an enormously important role in modern business, its ability to process, sort, and manipulate vast quantities of data and perform huge calculations in a very short time, is hard to believe. However, the complex technology of the computer makes it almost essential to have worked in that environment before one can use an in house computer. This is shown up by the role of the Systems Analyst who communicates between the person with the problem and the computer programmer. It is also true to say that the in-house computer is more commonly used for production of large quantities of information which are used for reference and not for problem solving.

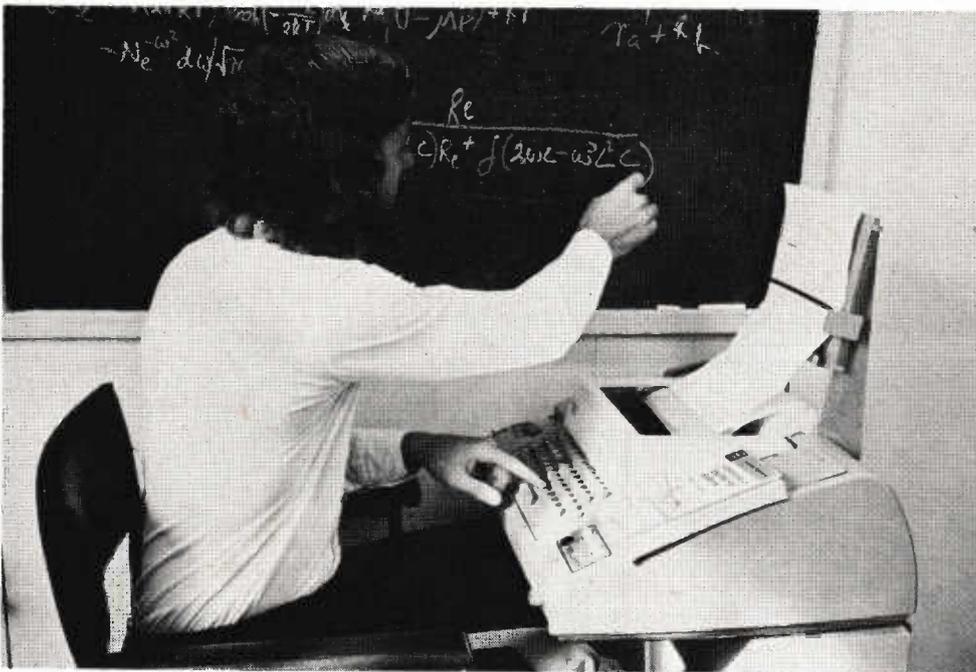
This leaves a gap where company

personnel need the ability to perform complex or time-consuming tasks and get *instant* response. This is the gap that Time-Sharing fills. At this moment Managing Directors, Middle Managers, Engineers and Technologists are using Time-Sharing to solve their problems.

From the foregoing it may be seen that it is not just the machine itself, but the software (computerese for the program library) which makes the Time-Sharing computer system so powerful.

Much development work is being undertaken to make communication with the computer even easier so that the man with a problem may solve it himself with a minimum of fuss.

That completes our series of articles on Time-Sharing and the organisers of the competition wish you all luck with your entries. ●



The solution of engineering problems with Time Sharing is as easy as two-finger typing.



EXTRA AND BACK ISSUES

The first articles in this contest were published in September and October 1973.

Back copies of these issues are still obtainable from our subscription department. Cost is 80 cents each including postage — or 70 cents if collected from our premises. The address is "Subscription Dept.", Electronics Today International, 15 Boundary St., Rushcutters Bay, 2011, NSW.

Further supplies of the *current* issue are obtainable from the same department — price is 50 cents if collected or 60 cents post free.

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Speakers created by Acoustic Research

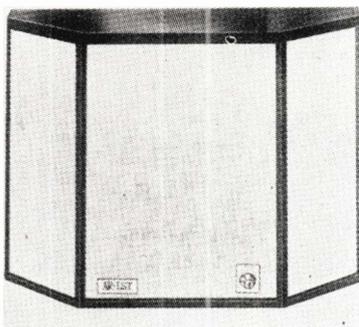
Inc. range from the modestly priced to highly complex engineering achievements. And the same care and expertise is carried throughout the range: when AR develops equipment of lower cost, it embodies only such compromises as will have least effect on the accuracy with which the music is reproduced.

AR 3A

Long considered the reference standard loudspeaker the AR 3A uses a 12" woofer and two hemispherical domes for mid and high range. "Stereo Review" said of it . . . "The best speaker frequency response we have ever measured using our present test setup . . . virtually perfect dispersion at all frequencies."

Highly detailed data available.

\$839 pair*



AR-LST

The "Laboratory Standard Transducer" was designed for professional applications. It offers the recording engineer a quantitative standard for the monitoring of recording and mix down operations. It is also used in scientific applications where the accuracy and repeatability of acoustical measurement is a prime requirement. It is also available for individuals who want such a precision instrument in their homes.

Highly detailed data available.

\$1795 pair*

AR 7

This speaker is very small (248 x 400 x 150 mm) and therefore particularly suitable for a channel use where space is at a premium. It uses a tweeter essentially the same as that used in the renowned AR 6. The smooth and well dispersed energy output of this speaker is well balanced by a newly designed woofer which offers a standard of low distortion bass exceeding that of speakers of much greater size and cost.

\$189 pair*

AR 2AX

The performance standard in the design of the AR 2AX was the same as that for the 3A: natural reproduction of music without exaggeration or artificiality of sound. But where quality in the case of the AR 3A has been limited only by the state of the art and our own engineering skill, for the 2AX price was also a consideration. "American Record Guide" said "1970 brings us a better than ever 2AX and I am nuts about it".

\$469 pair*

AR 6

In the three years or so that the AR 6 has been available it has already become the speaker that all others are compared to in its price range. It employs the very best technology in its cone woofer and tweeter that the state of the art permits and stands comparison with the most expensive AR systems. Also available in unfinished pine.

\$289 pair*

AR 5

The AR 5 is only different to the AR 3A inasmuch as it uses a 10" woofer and a slightly different crossover. As always the standard of accuracy is the comparison to live music. At AR the best repose curve for a speaker system, like that for a microphone or amplifier, is the one that most closely matches the input. The specifications of the AR 5 are obtained, as in all models, from production units, not prototypes.

\$599 pair*



GUARANTEE:

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.

AR 4XA

A new addition to the AR range and bringing you a third AR loudspeaker under \$300 a pair is the AR 4XA. A successor to the AR 4X the AR 4XA uses the same woofer and cabinet as its predecessor but utilises the AR 6 tweeter and a modified crossover. An audition of the AR 7, AR 4XA or AR 6 will show even the most critical listener that the differences are subtle yet obvious.

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AR Systems may be purchased from:

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PLAYMASTER 132 KIT SET



45W RMS per channel. Complete kit as per parts list includes Tuner, Push Button switching. 4 inputs. Reg. Power Supply with overload protector. Oiled Teak cabinet ready made. All parts new and guaranteed. See June/July '71 E.A. for all details.

Kit price: \$146.00 Reg. Post \$2.00

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4 CHANNEL AUDIO COLOUR UNIT



CREATE LIVING COLOUR THAT MOVES WITH THE MOOD OF YOUR MUSIC!

Designed to beat all others, this unit features:

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- Mono or stereo capability.
- Only 100 Mv drives for full display
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10-in-1 Project Kit: circuits included transistor radios, amplifiers, morse code oscillators etc \$8.50.

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INTERNATIONAL MUSIC SYNTHESIZERS

Constructional details of the voltage controlled oscillators and the keyboard controller are provided in this second article in the series.

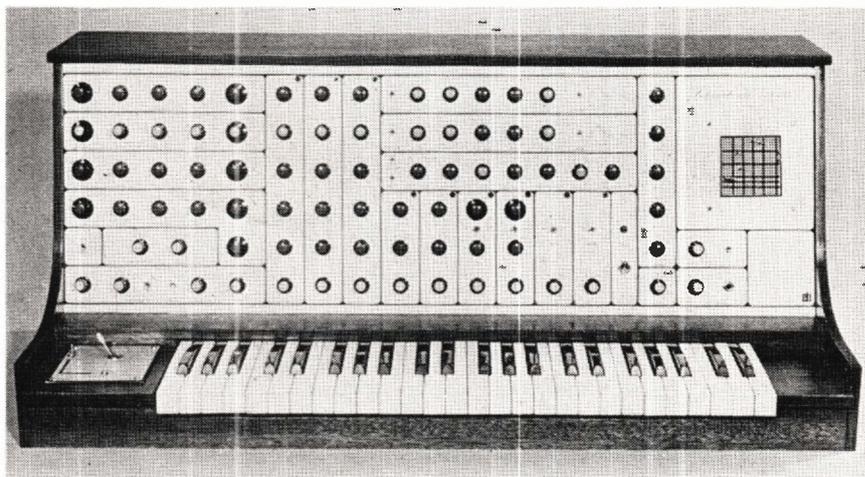
PART 2

IN THE first part of this series last month specifications were given for the 3600 and 4600 units and a brief description of module operation. This month we begin construction of the oscillator and keyboard-control modules. Full constructional details will take about 5 months to present, but with the power supply (next month) sounds can be generated immediately. Modules will be described in a logical sequence such that each month further capability will be added.

The description will concentrate on construction of the larger unit and although many of the modules may be used in the smaller version this will not be described until the end of the series.

For ease of construction and greater reliability and stability of the synthesizer, extensive use has been made of integrated circuits of both analog (operational amplifiers) and digital (CMOS). Hence this is not a recommended project for the beginner unless he has available the help of someone with experience.

Although the synthesizer can be built without the aid of test equipment, correct operation can only be assured



by the use of some equipment.

The most important instrument is most certainly an oscilloscope together with an organ tuner or digital frequency meter (an organ tuner project will be described soon) and an accurate dc voltmeter (preferably digital).

Components have been selected for use in the synthesizer on the basis of availability, price and performance. In most cases the components are second sourced, (that is, available from more than one manufacturer) however, due to the general worldwide component shortage, delays in obtaining some of the parts must be expected — so be patient with the suppliers — they can't help it.

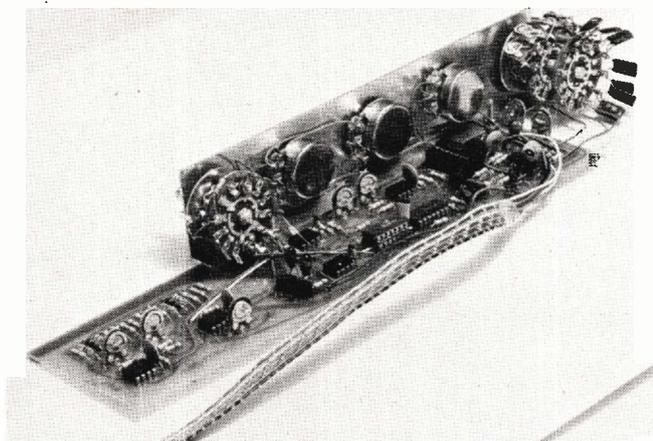
Since the publication of last month's article much interest has been shown

and we have had many telephone calls. From these it has become obvious that many people do not understand that this is a monophonic (one note at a time) instrument. That is, only one voltage at a time can be generated from the keyboard. Although a polyphonic instrument could be designed it would be considerably more complex and would virtually require a complete synthesizer for each note to be played simultaneously.

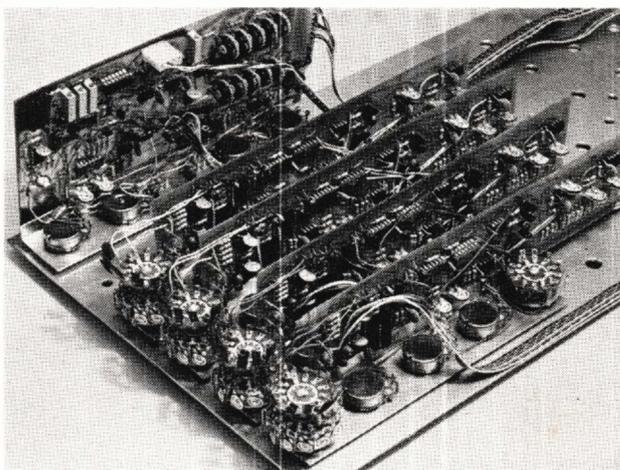
CONSTRUCTION General

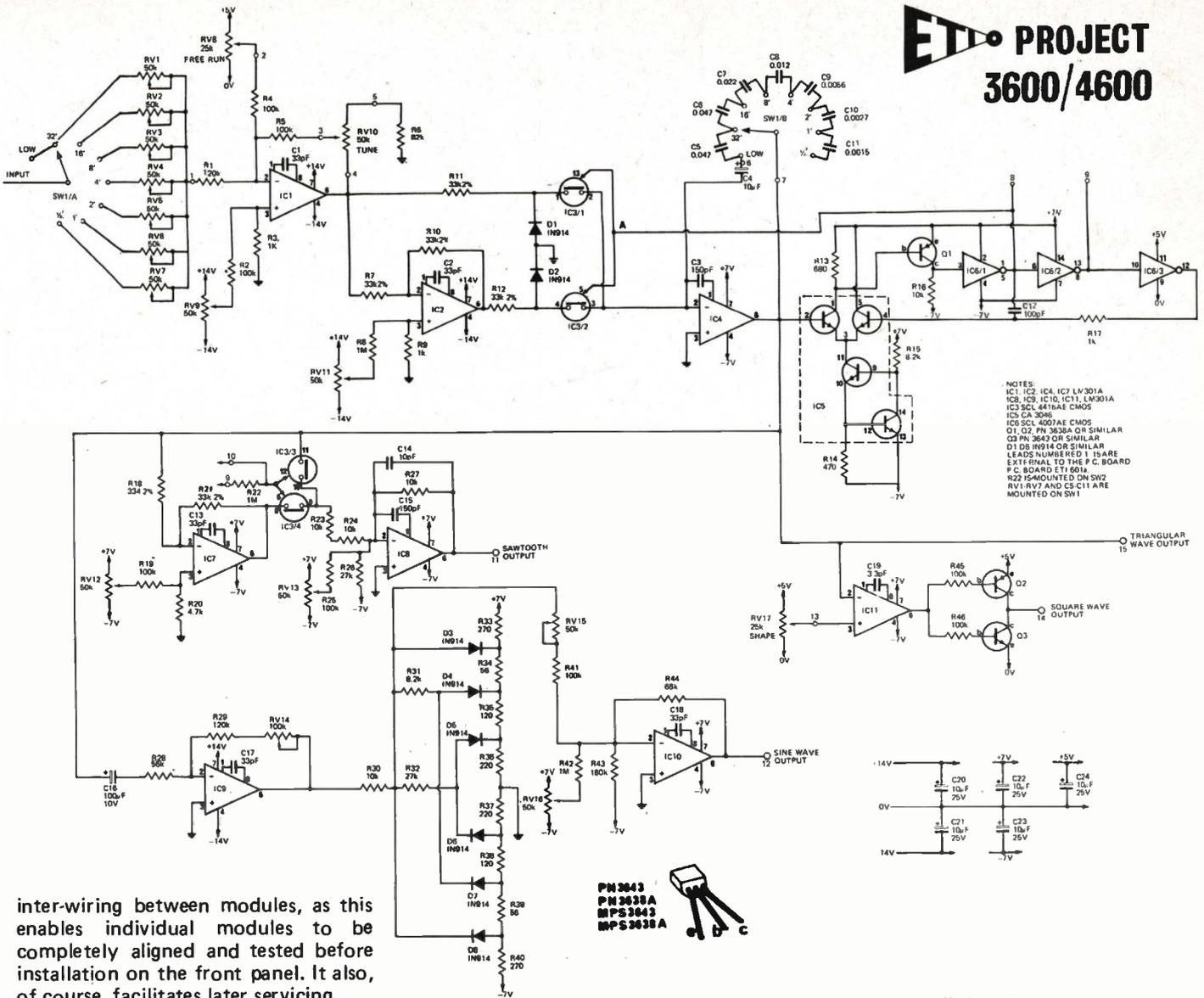
Each separate synthesizer module is constructed as an individual subassembly, and these subassemblies are mounted onto a common front panel. It is recommended that plugs and sockets are used for all

The voltage controlled oscillator, showing the assembly of board potentiometers and switches to the sub panel.



The four oscillators and the keyboard controller shown assembled to the front panel.





NOTES:
 IC1, IC2, IC4, IC7 LM301A
 IC8, IC9, IC10, IC11, LM301A
 IC3 SCL 4418AE CMOS
 IC5 CA 3096
 IC6 SCL 4007AE CMOS
 Q1, Q2, PN 3638A OR SIMILAR
 Q3 PN 3643 OR SIMILAR
 D1, D8, 1N914 OR SIMILAR
 LEADS NUMBERED 1 IS ARE
 EXT. RNAL TO THE P. C. BOARD
 P. C. BOARD ETI 501A
 R22 IS MOUNTED ON SW2
 RV1, RV7 AND CS-C11 ARE
 MOUNTED ON SW1

Fig. 1. The voltage-controlled oscillator.

inter-wiring between modules, as this enables individual modules to be completely aligned and tested before installation on the front panel. It also, of course, facilitates later servicing.

With circuitry as complex as that in the synthesizer it is normal to use double-sided PC board. However, since this doubles the price of the boards we have elected to use single sided board with wire links where necessary. These have been kept as short, and as straight, as possible.

Oscillators

Before mounting any components on the PC board install the links as shown in Fig. 2. Note that some of the links, due to the proximity of other components, must be insulated. Make sure when mounting the components that the orientation of ICS, transistors, capacitors and diodes is correct. It is recommended that IC sockets be used for IC3 and IC6. These ICs should not be fitted until ready for testing and should not be handled excessively. Leads leaving the PC board are numbered on the overlay and these numbers correspond to leads on the circuit diagram and Fig. 12.

The external potentiometers and switches are mounted on a small

aluminium bracket (Fig. 9) which also holds the PC board (see photo). The metal bracket is fitted to the PC board on the component side and not the copper side.

Except for the power supply which has 6 wires (+14V, +7V, +5V, 0V, -7V, -14V) only two other wires leave the board. These are the input and the output.

It is recommended that a plug and socket be used to connect the power supply from each module to the power supply board. Provision is made for this on the power supply board and the parts list contains the necessary part numbers.

Before switching on double check all soldering, component selection and orientation, and power supply connections.

Keyboard Controller

Construction of this module follows the same line as specified for the

oscillator. Provided the links are kept straight no insulated links need be used. It is recommended that IC sockets be used on IC3, IC4, IC5 and IC7 which are the CMOS devices.

It is recommended that a plug and socket be used to connect the keyboard to this module as it allows easy removal of the front panel. The layout of the PC board allows for the use of a plug and the part number of a suitable plug is given in the parts list.

ALIGNMENT Oscillator

This procedure will require the use of an oscilloscope and a digital frequency meter or organ tuner.

Procedure:

1. Connect all power rails to the power supply and, without any input connected to SW1, switch on.
2. Select the 8 foot range and turn free run control fully clockwise.

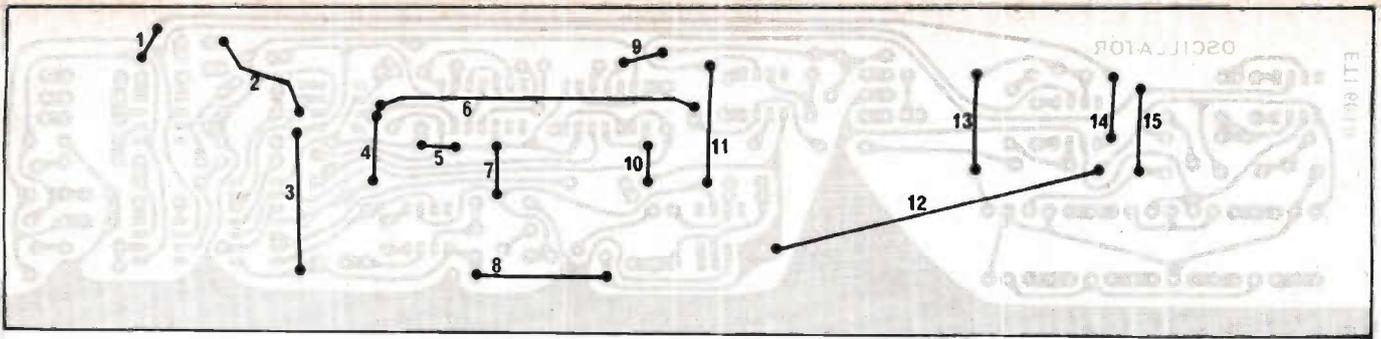


Fig. 2. Linking required on the oscillator board. This should be installed before components are fitted.

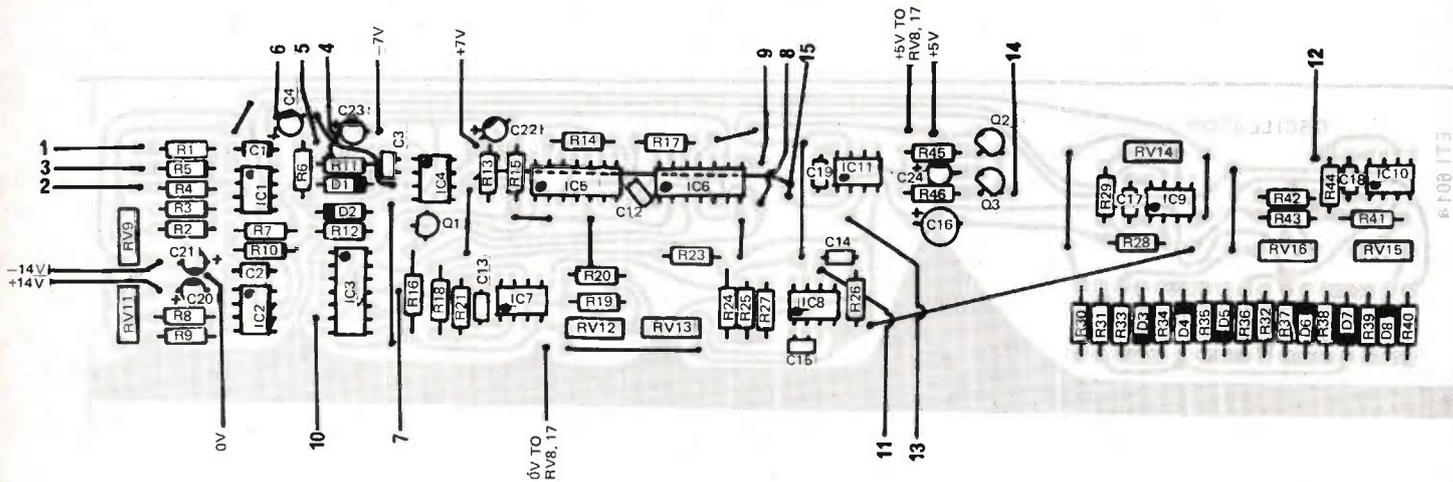


Fig. 3. Component overlay for the oscillator.

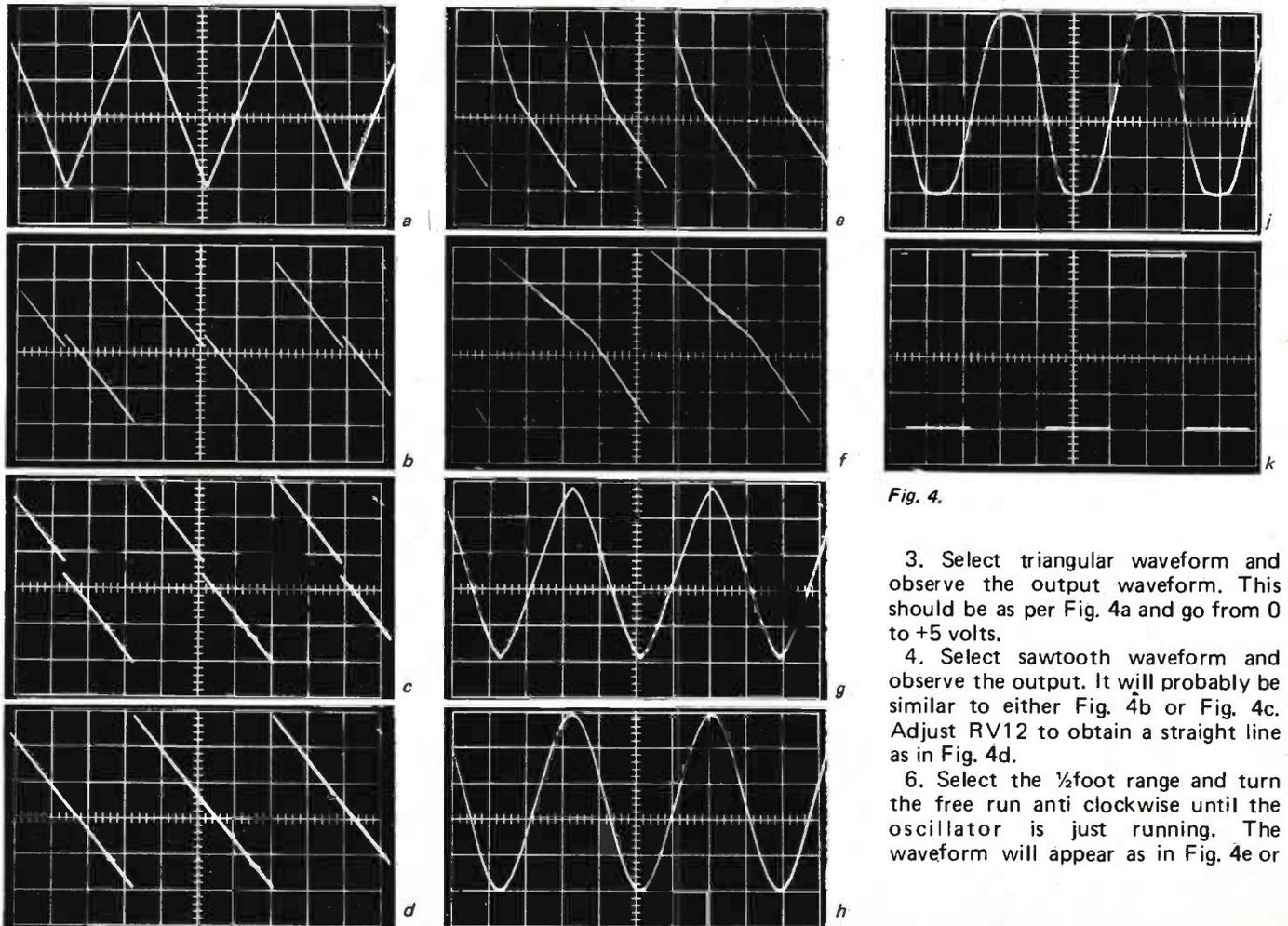


Fig. 4.

3. Select triangular waveform and observe the output waveform. This should be as per Fig. 4a and go from 0 to +5 volts.

4. Select sawtooth waveform and observe the output. It will probably be similar to either Fig. 4b or Fig. 4c. Adjust RV12 to obtain a straight line as in Fig. 4d.

6. Select the $\frac{1}{2}$ foot range and turn the free run anti clockwise until the oscillator is just running. The waveform will appear as in Fig. 4e or

PARTS LIST OSCILLATOR

R1,29	Resistor	120k ½ watt 5%
R2,4,5,19,25	"	" " "
41,45,46	"	100k " " "
R3,9,17	"	1k " " "
R6	"	82k " " "
R7,10,11,12,18,21	"	33k " " 2%
R8,22,42	"	1M " " 5%
R13	"	680 " " "
R14	"	.470 " " "
R15	"	8.2k " " "
R16,23,24,27,30	"	10k " " "
R20	"	4.7k " " "
R26,32	"	27k " " "
R28	"	56k " " "
R31	"	8.2k " " "
R33,40	"	270 " " "
R34,39	"	56 " " "
R35,38	"	120 " " "
R36,37	"	220 " " "
R43	"	180k " " "
R44	"	68k " " "
RV1,2,3,4,5,6,7	Potentiometer	50k trimpot type VTU (or similar)
9,11,12,13,15,16	"	" " " " "
RV8	"	25k log rotary
RV10	"	50k lin rotary
RV14	"	100k trimpot type VTU
RV17	"	25k lin rotary
C1,2,13,17,18	Capacitor	33pF ceramic
C3,15	"	150pF ceramic
C4,20,21,22	"	10µF 25V tag tantalum
23,24	"	" " " " "
C5,6	"	0.047µF polyester
C7	"	0.022µF polyester
C8	"	0.012µF polyester
C9	"	0.0056µF polyester
C10	"	0.0027µF polyester
C11	"	0.0015µF polyester
C12	"	100pF ceramic
C14	"	10pF ceramic
C16	"	100µF 10V PC mount electrolytic
C19	"	3.3pF ceramic
Q1,2	Transistor	PN3638A or similar
Q3	"	PN3643 " "
IC1,2,4,7,8	integrated circuit	LM301A minidip case
9,10,11	"	" " " " "
IC3	"	SCL4416AE CMOS*
IC5	"	CA3046
IC6	"	SCL4007AE CMOS*
*prefix and suffix varies with manufacturer.		
D1-D8	Diode	1N914 or similar
SW1	Rotary switch	2 pole 11 position (8 only used)
SW2	"	" " 2 pole 5 position

PC board ET1 601a, metal bracket, 5 knobs, 2 extra potentiometer nuts (to retain module), 2 of 1/8" x 3/8" long screws and nuts.

Recommended extras:
 2 off 14 pin IC sockets (for CMOS) Utilux type M1938-4 or similar
 1 off 8 way plug, Utilux type M2139/8
 8 contacts for above plug Utilux type 2138.

OSCILLATOR – HOW IT WORKS

The basic waveform generated by the oscillator is triangular. All other waveforms are generated by modification of this basic waveform.

The input voltage, normally between zero and +5 volts, is amplified in IC1. The tune control, RV10, controls the gain and can vary the output by a 2 to 1 ratio. With this control set at mid position, the output of IC1 is approximately equal to, but in antiphase with, the input voltage. That is, the stage has a gain of -1. Individual potentiometers on each switch position allow the ranges to be adjusted an exact number of octaves apart. Control RV9 adjusts the offset of IC7 and RV8 is the free run control. The output of IC1 is therefore normally in the range zero to -5 volts, but can range up to -12 volts if the modulated output from the keyboard is being used. (See keyboard controller).

The output of IC1 is inverted by IC2 to provide an identical voltage of opposite polarity, the offset of IC2 being adjusted by RV11.

Integrated circuit IC3 is a solid state, dual, double-throw switch. If the input at A is high (+7 volts) IC3/1 will be on and IC3/2 will be off, and vice versa if the input at A is low (-7 volts). The on resistance is between 200 and 500 ohms and the off resistance is of the order of 1012 ohms. Diodes D1 and D2 protect the input of the switch against the application of excessive voltage.

An integrator is constructed with IC4 and an integrating capacitor selected by SW1. If IC3/1 is on, the output of the integrator will be a linearly increasing voltage. Hence if IC3/1, 2 are switched alternately on and off,

the output of IC4 will be a triangular wave.

Transistor array IC5 when connected to Q1 and IC6 acts as Schmitt trigger; where IC6 is simply a CMOS inverter with IC6/1 and IC6/2 connected to +7 and -7 volts and IC6/3 connected to zero and +5 volts. The output of IC6/3 provides feedback to the comparator section of the Schmitt trigger, and being a 0 to +5 volt level, makes the Schmitt points 0 and +5 volts. The output of IC6/1 controls the CMOS switches IC3/1 and IC3/2 which hence derive a triangular wave from the integrator of 0 to +5 volt amplitude.

To generate a square wave of variable mark/space ratio, the triangular wave is simply compared to a dc level as set by the shape potentiometer (R17) by IC11, the output of which is buffered by Q2 and Q3 which ensure that the output has the correct levels of '0' and +5 volts.

The sawtooth waveform is generated by inverting the triangular waveform in IC7 and level shifting to produce a waveform 180° out of phase having 0 to -5 volts levels. The output of these two waveforms is selected in turn by CMOS switches IC3/3 and IC3/4. These switches are controlled by either IC6/1 or IC6/2 dependant on the position of SW2 (reverse or normal sawtooth). The correct amplitude and level of the sawtooth is maintained by IC8.

The sinewave output is generated by amplifying the triangular wave in IC9 to about 15 volts peak-to-peak, symmetrical about zero. This signal is then clipped by the diode-resistor matrix to approximate a sinewave. This is then level shifted and amplitude controlled by IC10.

Fig. 4f. Adjust RV11 to obtain a straight line as in Fig. 4d.

7. Adjust RV9 such that the oscillator is just running when "Freerun" is at zero.

8. Select 8 foot, maximum free run and sine-wave output. Adjust RV14 for best waveform as per Fig. 4h. Incorrect waveforms are shown in Fig. 4g and Fig. 4j.

9. Adjust RV15 such that the

waveform is 5 volts peak-to-peak.

10. Adjust RV16 such that the lowest edge of the waveform is at zero volts.

11. Check that all waveforms are selectable by SW2 and that the square wave output is correct as per Fig. 4k.

The calibration of each range is best performed in conjunction with the keyboard controller. With the keyboard controller connected, select

TABLE 1.

Adjust	RV1	RV2	RV3	RV4	RV5	RV6	RV7
Range	32'	16'	8'	4'	2'	1'	½'
Frequency	329.6	659.3	1318.5	2637	5274	10548	21096



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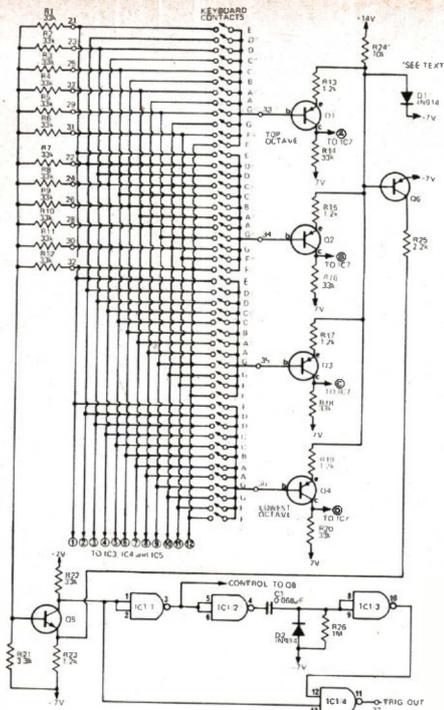


Fig. 5. Keyboard matrix and trigger generator components are mounted on keyboard controller board.

the top note of the keyboard, or if no keyboard is available, link pins 21 and 33 on the keyboard controller. Hold this connection closed to eliminate drift and set keyboard tune, oscillator tune and free run controls all to zero. Adjust potentiometers RV1-RV7 to obtain the frequencies appropriate to the range as per table 1.

That completes the oscillator alignment.

Keyboard Controller

The equipment required is an oscilloscope, organ tuner or digital frequency meter and an oscillator

(text continued on page 83)

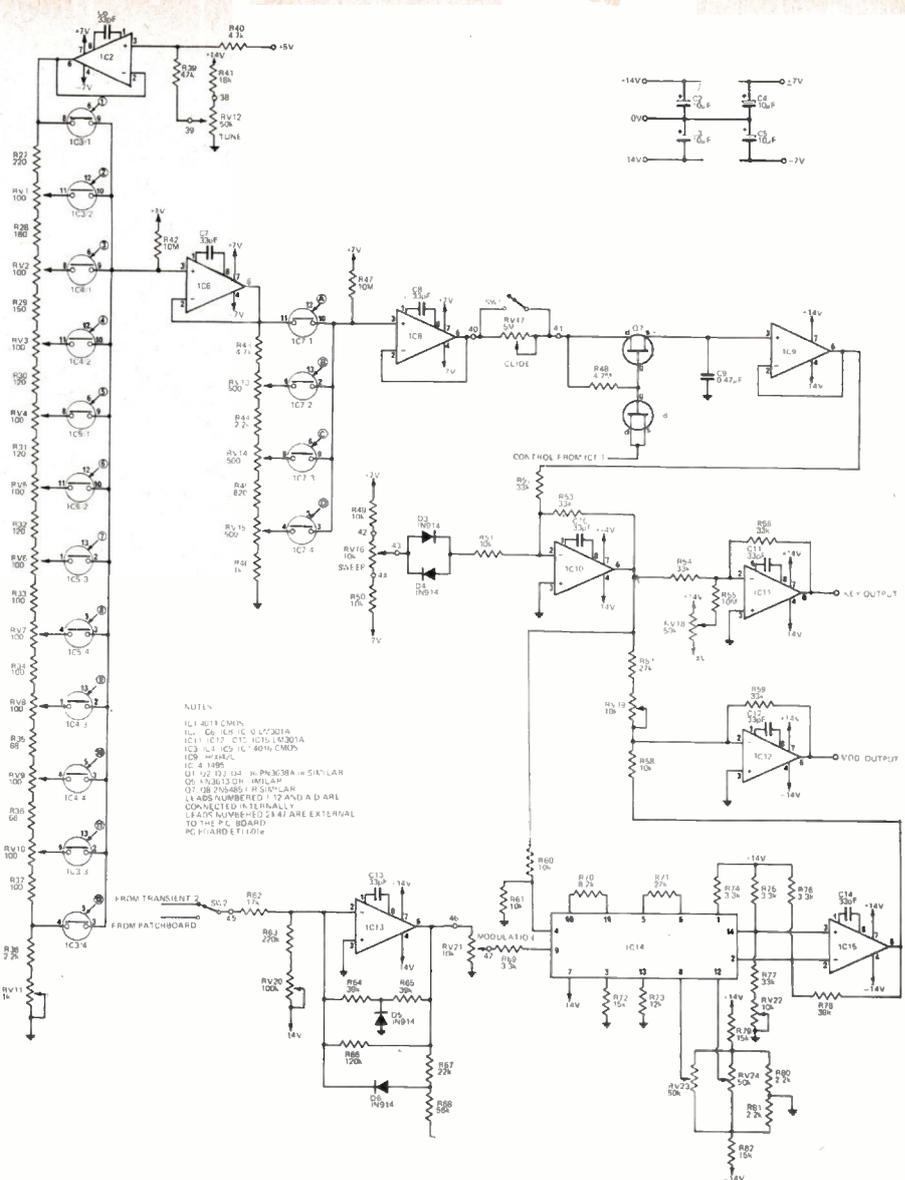
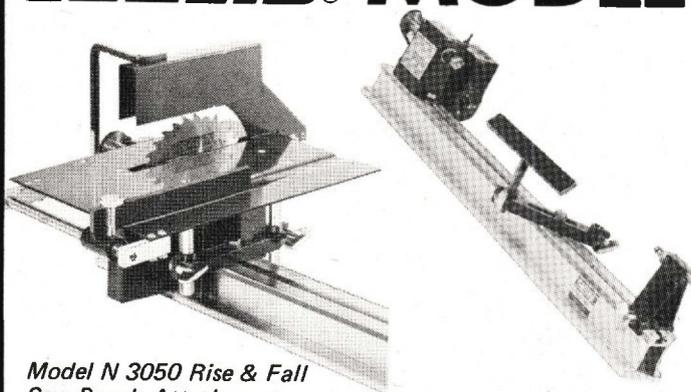


Fig. 6. Keyboard controller circuit.

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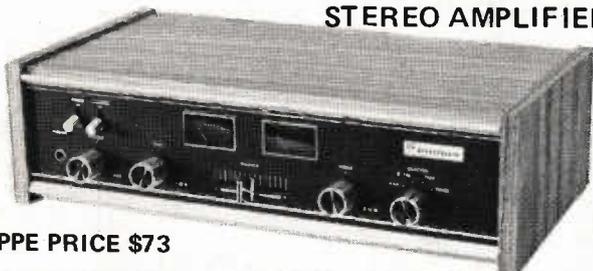
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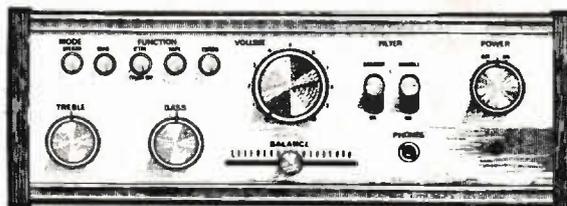


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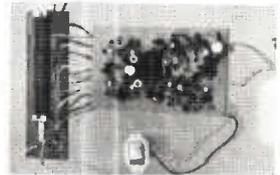
Designed specially for the VORTEX Stereo Cassette Deck (now only \$28.00) using three silicon low noise transistors in each channel. Features equalization for 1.7/8 IPS and perfect matching with low-impedance Alps heads on VORTEX deck. Output voltage 250mV. Complete Kit (Playback only) \$9.50 post 50c.

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This remarkable unit gives excellent noise reduction with tapes and eliminates most surface noise from records, yet is quite simple to build for yourself. Input voltage required is about 300mV while overall gain is unity. Operates from 12V D.C. Price (complete kit) \$19.00., post 50c.

ETI 113 THERMOCOUPLE METER



This new I.C. electronic thermometer enables 0 to 200°C temperature measurements to be made from up to seven separate points, virtually simultaneously. Operates from 240VAC, finished in grey hammertone case. Price (complete kit) \$59.00., post \$1.50

NEW CAR BURGLAR ALARM

A fairly simple burglar alarm for your car, house or office. Exit time delay allowed is about 45 secs., entry time delay about 5 secs., and "alarm on" time from 30 secs., to over 5 mins. It is designed to use a car horn as the warning device, giving a "beep . . . beep . . . beep" sound when set off. Refer EA Sept '73 for details. Price (complete kit) \$12.50., post 75c.

ETI 309 PROTECTED BATTERY CHARGER



A fool-proof electronically controlled battery charger with current and voltage regulation, auto taper charging, short circuit and reverse polarity protection and LED indication of operation.

Designed for 12V batteries but will also charge 6V batteries. Price: (complete kit) \$33.00 freight \$2.00

NATIONAL-SPERRY DIGITAL CLOCK KIT.

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



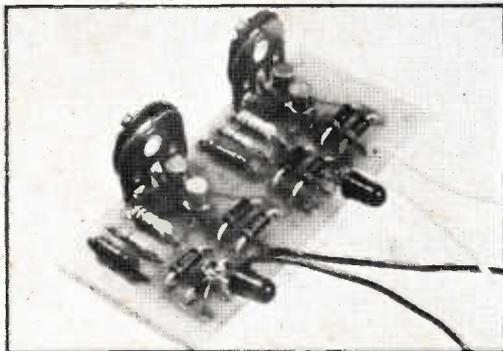
The National MM5314 I.C. Clock Chip contains all the requirements of a 4 or 6 digit clock in ONE SINGLE 24 Pin package. It is so easy to build even a child could do it. Also in the Kit are 13 transistors, 2 P.C. Boards, connectors and full instructions. All external components (resistors, capacitors)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

Kit. The addition of a seconds display (6 digit) is optional. Model SP-151 National-Sperry Kit ... \$39.50. Complete Digital Clock Kit (as in EA) incl. SP-151 Kit and all additional components required ... \$59.50.

Please note: The SP-151 special offer at \$28.75.. has now closed as this project was so popular that supplies of the special evaluation kits were soon exhausted. We can however, supply all components as used in the Kit for the price advertised of \$39.50., incl post.

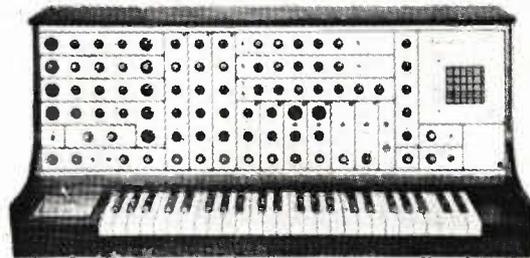
SAVE MONEY~BUILD IT YOURSELF!

ETI 417 OVER-LED INDICATOR

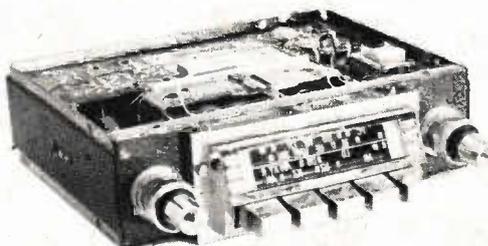


This simple but reliable monitor will tell you when your amplifier is "clipping" which causes distortion since the amplifier does not have enough reserve power to handle the peak music transients at the required volume. Price: (complete kit) \$6.50 post 50c.

ETI MUSIC SYNTHESIZERS



International 3600 and International 4600. We will be pleased to make available comprehensive price lists on both models as soon as parts lists are available. Components will be available separately, in module form and as a complete kit, offering substantial discounts for quantities of parts. It is also anticipated that a semi-conductor kit will be available for both projects.



CAR RADIO KIT

A new 10 transistor push-button car radio kit will be available later this month using a Philips UF415 pre-aligned and assembled tuner module. Reception is extremely good even in country districts due to RF amplifier and power output of 2 watts is more than ample. The push button or manual tuner makes for easy selection of stations and the overall appearance would complement the interior of any car. A speaker and car aerial are included. Price (complete kit) \$37.50., post \$1.50. (complete Kit) without aerial or speaker \$33.50., post \$1.50.

SPECIAL TRANSISTOR OFFER!

PAK 8 — 10 NPN Silicon Transistors, TO5 case. Suitable for audio or drivers. New and unmarked, similar to TT801 etc. Guaranteed quality. 10 for \$2.00., plus 15c post.
BONUS. Buy any 3 packs for only \$5 + 15c post.

PAK 45 — 10 NPN Silicon Transistors, TO92 case. Suitable for small signal applications, pre-amps, drivers, general purpose. New and unmarked, intended as BC107, BC108, BC109 series. Guaranteed quality and data sheet supplies. 10 for \$2.00, plus 15c post.

PAK 50 — 10 PNP Silicon transistors, TO92 case. Complements to PAK 45. Intended as BC177, BC178, BC179 series. Guaranteed quality and data sheet supplied. 10 for \$2.00 plus 15c post.

POTPAK ...

Consisting of the following range of potentiometers: 4 Tab-pots, 2 preset pots, 3 switchpots, 5 standard mono-pots, 2 ganged stereo pots and 4 concentric pots, a total of 20 potentiometers normally valued at \$6.00. Only now for \$2.00 plus 50c post.

FANTASTIPAK No. 1

A fantastic 5lb. Bargain Parcel of guaranteed NEW Electronic components. Included are Transistors, Electrolytic Capacitors, Resistors, Potentiometers, Rotary Switches, Magnetic Counter, Computer Boards, P.C. Boards, Transformers, Tag Strips, Lamp Holders, etc. We guarantee the value of this parcel to exceed \$30.00. **FIRST COME, FIRST SERVED, AS WE HAVE ONLY LIMITED QUANTITIES AVAILABLE.** Don't be astonished but we are only asking \$18.00 Post Free.

FANTASTIPAK No. 2

This Pak has been designed for the discriminating Hobbyist Building Valve equipment. Consisting of quantities of Valve Holders, Standard and Modern Valves, Electrolytics, Styrofoam, Mica and Ceramic Capacitors, Trimmers, Grommets, Toggle Switches, Circuit Breaker, Rectifiers, Chokes, Turret Units, Resistors, Relays, Tuning Condenser, Tagstrips, Plugs, Cable, plus assorted quantities of plugs, sockets, fuses, coils, etc. Worth at least \$20.00. Sure-fire value only \$10.00 plus \$1.00 post.

FANTASTIPAK No. 3

This interesting and varied Pak is ideal for the hobbyist building transistor circuits. Consisting of diodes, rectifiers, transistors, low voltage electrolytic and ceramic capacitors, trimmers, resistors, plugs and sockets, pots, switches, transformers (audio and IF) and many other useful parts for experimenters. First time ever offered! We guarantee this parcel is worth **DOUBLE** the asking price ... \$12.00 post 75c.

EX-COMPUTER PLUG-IN MODULES

Consisting of 2 x 12AU7 Valves, 18-way connector, hi-stab resistors, 2 mtg panels, and other useful parts — ideal for mounting experimental circuits etc. 3 modules for \$1.00. post 50c.

COMPACT RADIO TUNER

A limited quantity of these 3 transistor tuners is available at this low price. The tuner is designed for use in battery operated record players, but may be used for HI-FI applications or portable/mantel radios. Operates on 9V DC supply and is completely built except for dial-cord which is supplied separately. This offer may never be repeated — Price \$9.75. post 25c.



COMPACT 500mW AUDIO AMPLIFIER

A transformerless complementary transistor amp designed for record player or general purpose applications and ideal for use with the tuner above to build a complete radio/record player, requiring only a turntable, speaker and battery. Operates on 9V DC. Price \$3.50 post 25c.

DIGITAL ELAPSED TIME INDICATOR



Computer Grade (ex IBM) Precision Instrument. Size 4" x 3" x 2 1/2". Voltage 40-48V. A.C. 50 cycles, Watts 3.5 max. Reads up to 9999 hours and also calibrated into 10ths and 100ths of an hour. Single units \$5.00 ea. plus 25c post and Pkg. As above but with 200v to 48v Transformers \$8.00 plus \$1.00 post. Two indicators plus transformer \$13.00 post \$1.00.

3 WATT AUDIO AMP. TRANSISTOR PAK

A great new offer of 5 silicon transistors incl. AY6108/6109 audio output pair plus circuit diagram to build a high performance 3W amplifier with these specs. Operating voltage 12V — 18V DC at 150 mA max. Freq. response 50Hz to 50kHz. All five for just \$2.75 Post 10c..

'SUPERPAK' SPECIALS

PAK 3: Approx 100 assorted 1/2W resistors. Top quality. 100 for \$1.50 Plus 20c post.
PAK 32 — KNOBS — A selection of 25 high grade radio and instrument knobs, suit all types pots. Price \$2.00, post 25c.
PAK 33 — RECORDING TAPES — All on 3" or 3 1/4" Reels — Post Free. 5 x 150 ft. for \$2.00, 4 x 225 ft. for \$2.00, 4 x 300 ft. for \$2.50, 3 x 450 ft. for \$2.50, 2 x 600 ft. for \$2.00, 2 x 900 ft. for \$3.00.
PAK 34 — EX PMG 4 DIGIT. COUNTERS — Electro-mechanical non-resetting 12-24V DC Counter for lap timing, batch — counting etc., 2 for only \$1.00. post 50c.
PAK 36 — Latest tab-mounting plastic case transistors. Ratings 60V, 30W Motorola 2N4919 (PNP)/2N4922 (NPN) complementary types — ideal for switching/audio applications. Price \$2.00. pair. post 10c.
PAK 37 — HEAVY DUTY RELAYS — Contact ratings 5 to 10 Amp, coil ratings 15V to 60V DC — 2 for \$1.00. post 25c.
PAK 38 — TYPE 3000 (PMG) RELAYS — Range 12V to 100V., coil resistance 1000 Ohms to 5000 Ohms — 2 for \$1.50. post 25c.
PAK 39 — POLYESTER CAPACITORS — 400V DC rating — a selection of 100 preferred values — all useful, brand new and Australian made. Price \$3.50. post 50c.
PAK 40 — POLYESTER CAPACITORS — 630V DC rating — same types as those above. Price \$4.25. post 50c.
PAK 15: Approx 50 assorted rubber grommets. Price \$1.00 plus 20c. post.
PAK 24: Approx 100 assorted 1W resistors, A1 brand new, useful values, 100 for \$2.00 Post 20c.
PAK 26: Approx 100 new, first quality ceramic disc capacitors, all popular values. 100 for \$2.00 Post 20c.

ELECTRO — CAP PAKS

PAK 28: 25 miniature electrolytic capacitors, brand new, 3 volt to 12 volt; 25 useful values for just \$2.00 Post 20c.
PAK 30: 25 high grade, brand new, electrolytic capacitors, in range 10uF mfd to 500uF, from 12VW to 80VW. This special experimenters PAK includes the most common values in both pigtail and P.C. types. Price: \$3.50 post 20c.
PAK 31: 15 high grade, brand new, electrolytic capacitors in range 500uF to 3,300uF, from 12VW to 35VW. Ideal for power supplies etc. Unbeatable value at \$3.50 post 30c.

120 AMP SILICON RECTIFIERS

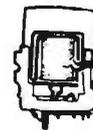


S.T.C. RS8 Series HIGH POWER SILICON RECTIFIERS

Suitable for outputs of 100 amperes (Direct forward current) at crest working voltages of between 50 & 700v. These rectifiers incorporate an alloyed silicon junction in a stud ended hermetically sealed case. Type RS801 80 PIV 120 amps. \$3.00 plus 75c post. RS812 120. PIV 120 amps. \$4.00 plus 75c post.

Type 108 Power Transistor in TO36 case. Mounted on large finned Heat-sink. Transistor is G.E. (PNP) similar to ADZ11. Max. 1c-15 amp. Nominal 10 amp. Vceo 37v Vcbo 40v Vcbo 20v. Frequency 90 kHz. \$2.50 ea. post free.

MINI-RELAYS



I.B.M. Silver Wire change-over Relays. Operating voltage 24v-48v. 4 pole 40c ea. 6 pole 50c ea. 12 pole 60c ea. 4 pole Latch 55c ea. Compact in size suits P.C. Board mounting. Post 20c.

COMPONENTS SPECIALS

12AT7 VALVES — brand new and boxed. 5 for \$2.00.
AC CAPACITORS — Block type paper capacitors 18uF/300V rating. Ex computer — all guaranteed. Price \$1.75. Post 50c each.
ELECTROLYTIC CAPACITORS — 5000mfd, 60/70V rating — brand new German made high quality. Price \$2.50. Post 30c each.
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CAPACITORS — 100pf, 20KV DUCON Type for Transmitters etc. Limited quantity available 2 for \$1.00. Post 10c.

DUPLEX LIGHT BEAM SWITCH UNIT

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

AUDIO OSCILLATOR MODULE



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

PARTS LIST KEYBOARD CONTROLLER

R1-R12	Resistor	33k 1/2 watt 5%
R14,16,18,20,22	"	"
59,77	"	"
R13,15,17,19,23	"	1.2k " "
R21,69,74,75,76	"	3.3k " "
R24,49,50,51,58	"	10k " "
60,61	"	"
R25,38,44,80,81	"	2.2k " "
R26	"	1M " "
R27	"	220 " "
R28	"	180 " "
R29	"	150 " "
R30,31,32	"	120 " "
R33,34,37	"	100 " "
R35,36	"	68 " "
R39,62	"	47k " "
R40,43	"	18k " "
R41	"	15k " "
R42,47,55	"	10M " "
R45	"	820 " "
R46	"	1k " "
R48	"	4.7M " "
R57,71	"	27k " "
R63	"	220k " "
R64,65,78	"	39k " "
R66	"	120k " "
R67	"	22k " "
R68	"	56k " "
R70	"	8.2k " "
R72,79,82	"	15k " "
R73	"	12k " "
R52,53,54,56	Resistor	33k 1/2 watt 2%
RV1-RV10	Potentiometer	100ohms PIHER type PT15ZH
RV11	"	1k ten turn cermet Morganite type 84 or similar
RV12	"	50k linear rotary
RV13,14,15	"	500ohm tenturn cermet Morganite type 84 or similar
RV16, 21	"	10k linear rotary
RV17	"	5M log rotary
RV18,23,24	"	50k trimpot type VTU or similar
RV19,22	"	10k trimpot type VTU or similar
RV20	"	100k trimpot type VTU or similar
C1	Capacitor	0.068µF polyester
C2,3,4,5	"	10µF 25 volt PC mount electrolytic or tog tantalum.
C6,7,8,10,11	"	33pF ceramic
12,13,14	"	"
C9	"	0.47µF polyester
O1,2,3,4,6	Transistor	PN3638A or similar
Q5	"	PN3643 or similar
Q7,8	"	2N5459 or similar
IC1	Integrated Circuit	SCL4011AE CMOS* LM301A mindip
IC2,6,8,10,11	"	"
12,13,15	"	"
IC3,4,5,7	"	SCL4016AE CMOS*
IC9	"	LH0042C TQJ5 cans
IC14	"	1495 or µA795
*prefix and suffix varies with manufacturer		
O1 to O6	Diode	1N914 or similar
SW1	Switch	Single pole toggle switch
SW2	"	Single pole double throw toggle switch

PC board ET1601a, metal bracket, 5 off 14 pin sockets for CMOS, 4 knobs, 2 extra pot nuts, 2 off 1/8" x 3/8" long screws and nuts.

(Continued from page 78)

module type ET1 601a.

Procedure:

1. Connect power supply, oscillator (to key output) and a keyboard if available.
2. Set keyboard tune and sweep controls to centre, glide to 'off', modulation to zero and oscillator free run to zero.
3. Switch on and press the top note of keyboard, or link pin 33 to pin 21 in the keyboard controller.

KEYBOARD CONTROLLER – HOW IT WORKS

A voltage representing the selected note on the keyboard is derived from a resistive divider chain. The keyboard is divided into 4 octaves each of 12 notes. The divider chain R27-R38 provides a voltage dependant only on the note itself regardless of the octave, that is, the same voltage represents all As etc. Integrated circuits IC3, 4 and 5 are CMOS switches which are 'ON' if the control input is greater than +5 volts and 'OFF' if the control input is at -7 volts. These switches are used to select the required voltage which is buffered by IC6 to prevent loading the divider.

To select the required octave a second divider chain, R43-R46, is used the output being selected by IC7 and buffered by IC8. Therefore, by selecting one switch of IC3, 4 or 5 and one switch of IC7, a total of 48 discrete voltages may be generated.

The four-octave keyboard is provided with single-make contacts. On one side of the contacts every twelfth one is joined, that is all the As, all the A# etc, so that twelve wires come out (see Fig. 5). On the other side of the contacts all 12 contacts of an octave are joined so that 4 wires come out. Thus we have a 12 by 4 matrix.

If a single note is selected, for example A on the second top octave, a connection will be made between pins 28 and 34. The current produced in R10 turns on Q2 causing point (B) to go high. Similarly point 8 will go high turning on IC5/4 and IC7/2. This selects a discrete voltage which represents the note A on the second highest octave. The process is similar for any other note on the keyboard.

When a single note is pressed the current in R1-R12 turns on Q5 causing its collector to go low. If two or more notes are pressed simultaneously the additional current through R24 forward biases Q6, turning it on. This lifts the emitter of Q5 turning it off. Thus Q5 collector is low only when one single note is pressed.

Contact bounce on the trigger output is prevented by IC1. Trigger output is held on for 50 msecs after the key is pressed. If contact bounce occurs within this period the timing recommences. The gate IC1/1 inverts the output of Q5 and controls Q7 and Q8.

In order to remember a particular note after the key has been released a FET INPUT OPERATIONAL AMPLIFIER, IC9, is used with capacitor C9 to hold the voltage applied to its input. Transistors Q7 and Q8 act as a switch to disconnect the output of IC8 from C9. If the control input is high,

the switch is on, and vice versa. Potentiometer RV17 acts as a glide control by placing resistance in series with C9.

To provide sweep control (that is a voltage which can vary the frequency up and down smoothly over a large range), a voltage is derived from RV16 and mixed with the output of IC9 in IC10. Two diodes are fitted back to back, and in series with R51, to provide a dead band which facilitates setting of the zero position. Since IC10 inverts the output of IC9, IC11 is used to reinvert to the required polarity, and RV18 is used to cancel all offset voltages due to the characteristics of the linear ICs.

A second output is provided (mod output) which is normally the same as the key output but which may be modulated up or down. The keyboard output voltage is not linear per note but exponential. Hence the voltage change required to shift up 1 octave will depend on where the start point is. Therefore we must multiply the voltage by a factor to obtain the correct shift. This is done in IC14 and IC15, which form a linear multiplier, where the output is the product of the inputs (pin 4 and pin 9 of IC14). Pin 9 comes from the modulation potentiometer and pin 4 is the keyboard voltage. The output of the multiplier is then added to the keyboard voltage in IC12. With zero volts into pin 9 the output of the multiplier will also be zero and hence the modulation output will be the same as the keyboard voltage. If there is a voltage at pin 9 the keyboard output will be shifted so many semitones irrespective of the keyboard voltage.

Integrated circuit IC13 and its associated components form a linear to exponential converter which is used to control the input of the multiplier. The use of an exponential converter provides a subjectively linear frequency change for a linear input voltage change. The accuracy required is not great but the stability required is. This is the reason for synthesizing an exponential instead of the more commonly used voltage current relationship of a transistor or diode method. With this system an input of 2.5 volts will give zero volts out due to the balancing current of R63-RV20.

The gain of IC13 is determined by R64, R65 and R66 when the input voltage is around 2.5 volts. At about 1.3 volts diode D6 becomes forward biased and the gain is reduced. At the other extreme, around 3.7 volts, D5 becomes forward biased increasing the gain. This results in a reasonable approximation of an exponential function.

4. Select 1/2 foot on the oscillator and check that it is running.

5. Turn the sweep control and check that it varies the output frequency. It will be found that there is a dead region in approximately the centre of rotation where the oscillator frequency does not change. Set the knob such that zero on the scale occurs in the centre of this band.

6. Release the key (or link) and short capacitor C9 to ground. Turn the sweep control to zero and then adjust RV18 until the oscillator is just running. This compensates for offsets in the ICs.

7. Remove the short on C9, select the 4 foot range and depress the top note again.

8. Adjust the output frequency by

use of the oscillator tune control to 2637 Hz. Calibration of the rest of the notes is then carried out in accordance with the order given in table 2.

9. Check that if a second note is pressed, whilst the first is still pressed, that the frequency does not change. If it does check if Q6 is turned on in the two note condition. If it is, increase R24 to 12k. If Q6 turns on with a single note pressed decrease R24 to 8.2k.

10. Release all keys, short C9 to ground, set modulation control to zero and free run control of the oscillator to obtain approximately 1 kHz.

11. Connect the output of the oscillator via or series 0.1 microfarad capacitor and piece of wire to pin 4 of IC14.

12. Observe the output at IC15 pin 6 and adjust RV24 to eliminate the 1 kHz from the output. Now inject the signal into pin 9 of IC14 and adjust RV23 to remove the 1 kHz.

13. Remove the signal input and adjust RV22 to provide zero volts output.

14. Remove the shorting link on C9.

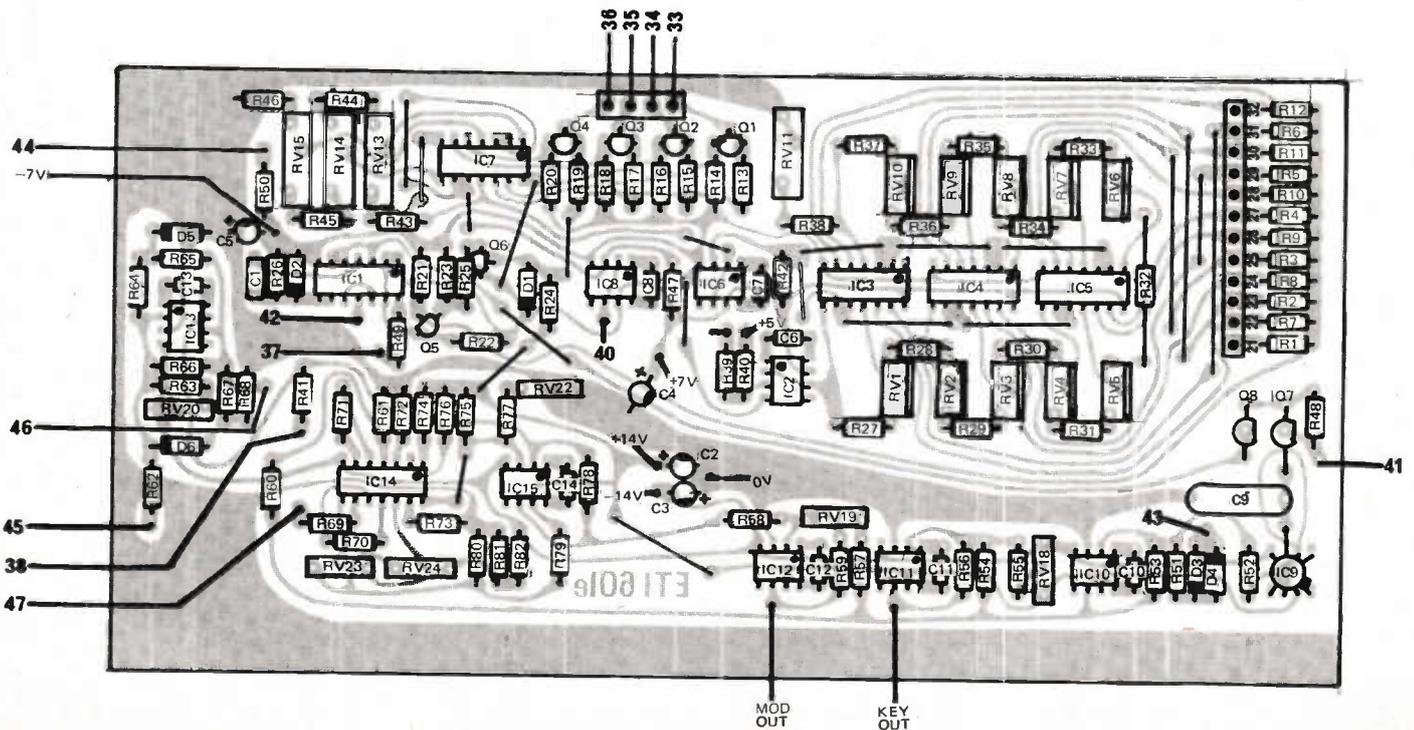
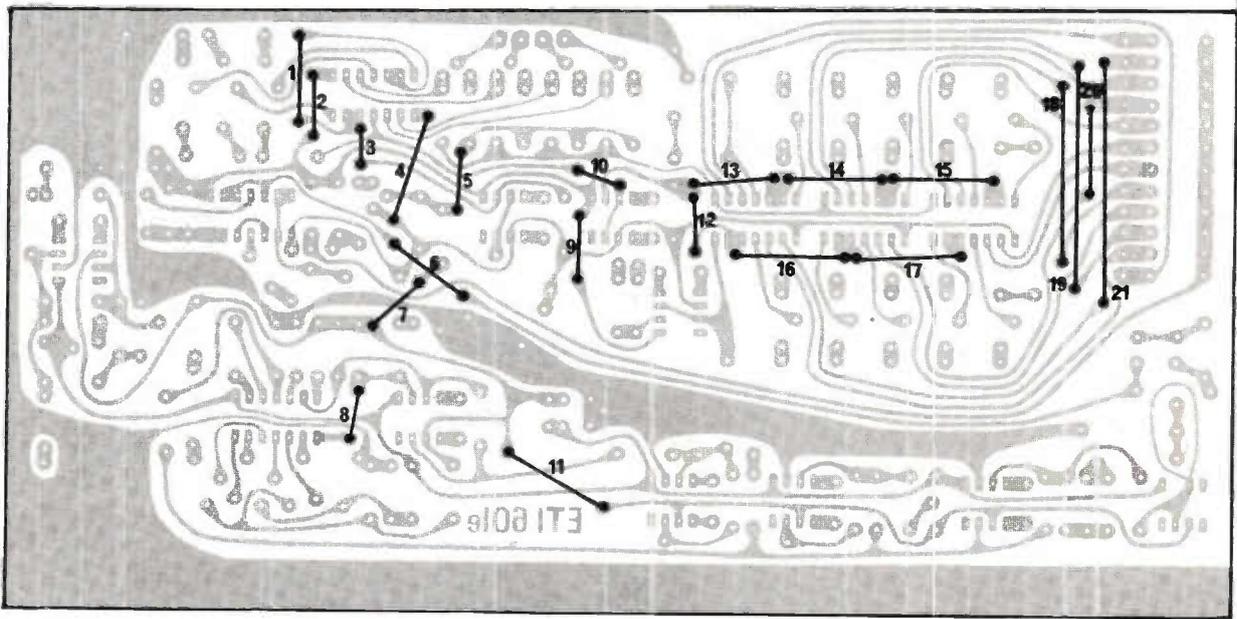
15. Take a wire from the key out to pin 45 and press the second top E (connect pin 21 to pin 34). This will provide 2.5 volts into the exponential

Fig. 7. Linking for keyboard controller. This should be installed before fitting components.

Fig. 8. Component overlay for keyboard controller.

TABLE 2
CALIBRATION ORDER

NOTE	OCTAVE	RANGE	FREQ (Hz)	ADJUST	NOTES
E	TOP	4'	2637	osc/tune	
F	TOP	4'	1396.9	RV11	
D#	TOP	4'	2489.7	RV1	RV1 - RV11 - may
D	TOP	4'	2349.3	RV2	be adjusted in
C#	TOP	4'	2217.5	RV3	any order as
C	TOP	4'	2093	RV4	there is no
B	TOP	4'	1975.5	RV5	interaction.
A#	TOP	4'	1865.7	RV6	
A	TOP	4'	1760	RV7	
G#	TOP	4'	1661.2	RV8	
G	TOP	4'	1568	RV9	
F#	TOP	4'	1480	RV10	
E	2nd TOP	4'	1318.5	RV13	RV13 - RV15 do
E	2nd Lowest	4'	659.3	RV14	not interact and
E	Lowest	4'	329.6	RV15	can be adjusted
					in any order.



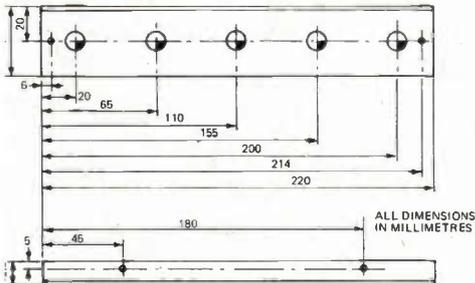
converter. Adjust RV20 to obtain zero volts at the output of IC13 pin 6.

16. Turn the free run control of the oscillator to zero and measure the frequency when the 'key out' is used as the voltage source. Now use the 'modulation out' as the signal and adjust RV19 for the same frequency.

This completes the adjustment of the keyboard controller. Next month details of the power supply and mixers 1 to 3 will be provided.

5 HOLES 9.6mm

4 HOLES 3.2mm



MATERIAL 18 GAUGE ALUMINIUM
OR 20 GAUGE PLATED STEEL

Fig. 9. Mounting bracket - oscillator.

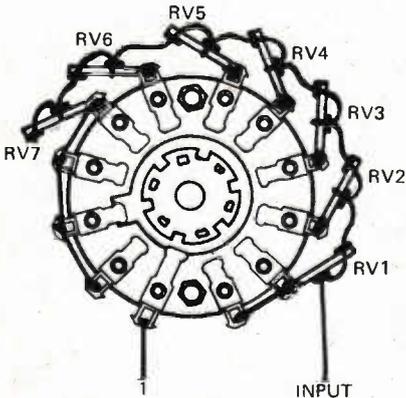


Fig. 10. Method of wiring up oscillator switch SW1 bottom wafer.

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C120 Library box (low noise)	..	\$2.65
C90 Library box (low noise)	...	\$2.10
C60 Library box (low noise)	...	\$1.59
G120 Library box Chromium Dioxide	.....	\$4.32
C90 Library box Chromium Dioxide	.....	\$3.68
C60 Library box Chromium Dioxide	.....	\$2.93

ADD 25c POSTING FEE

PLESSEY - ROLA SPEAKER

C6MR/8Ω/15Ω	.....	\$7.90
C60/8Ω/15Ω	.....	\$11.09
C80/8Ω/15Ω	.....	\$12.43
C100/8Ω/15Ω	.....	\$13.26
C3GX/8Ω/15Ω	.....	\$4.67
X30/8Ω/15Ω	.....	\$8.50
C6LX/8Ω/15Ω	.....	\$6.37
C60X/8Ω/15Ω	.....	\$12.62
C8MX deluxe/8Ω/15Ω	\$8.95
C80X/8Ω/15Ω	\$13.57
C100X/8Ω/15Ω	\$14.68

ADD 50c POSTING FEE

12U50/8Ω/15Ω	\$36.00
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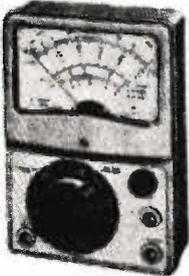
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Dick Smith Decision Maker (see E.A. June '73) As used by himself and good for a laugh. Ingenious circuit uses 3 transistors, 2 LEDs and diode switching. Handsome panel with jingle. Uses 9V transistor battery. Complete kit only \$8.75..

Musicolour (EA Dec '72) Watch the colour lights dance to the sound of music from your Hi-Fi etc. Drives reflector globes up to 1000W per channel. Attractive front panel etc Value at \$52.00 (P&P \$1.00).

Sperry Digital Clock Kit (E.A. Sept '73) Based on the Sperry Gas readout and National integrated circuit, this kit provides full 24 hour mains operation. All parts are included in the kit except the metalwork (we thought you'd prefer to make your own). Full kit \$49.00 Special Sperry/National offer of readout IC and transistors only \$28.75 (Both P&P 50c).

Headphone Adaptor (E.A. Aug '73) provides two sets of headphone outputs or speakers or both to be operated simultaneously. Separate left and right control from this very versatile unit. Full circuit details included etc. \$18.95.

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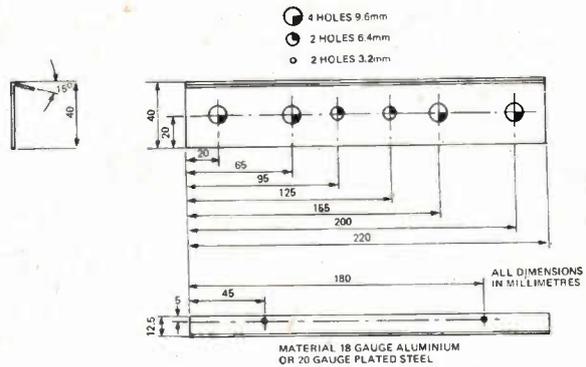


Fig. 11. Mounting bracket - keyboard controller.

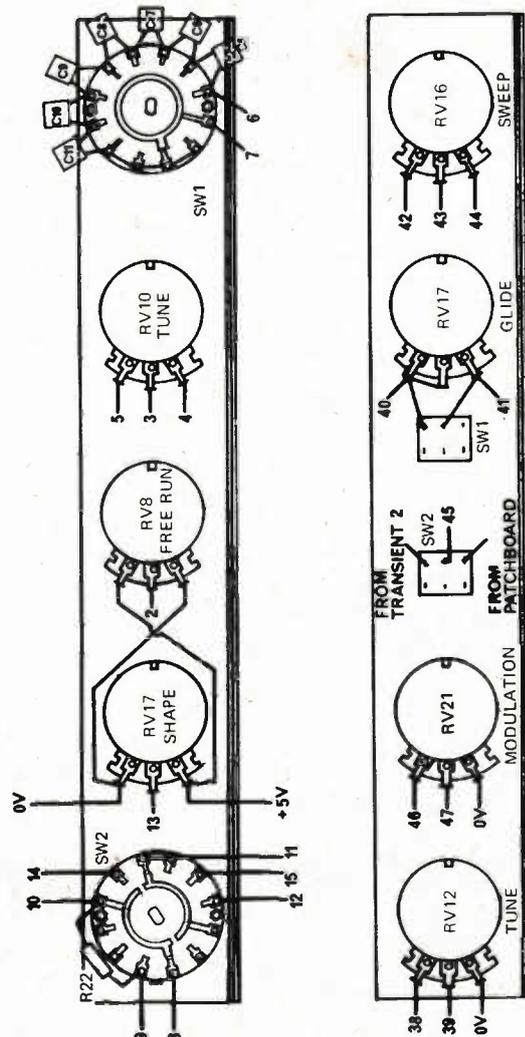


Fig. 12. Wiring to switches and potentiometers of oscillator - top wafer of SW1 only shown refer to Fig. 14.

Fig. 13. Wiring to switches and potentiometers of keyboard controller.

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



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



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Output: 4 mV at 5.5 cms/sec. recorded velocity
Tracking Force: .7 gram
Frequency Response: 10 Hz to 20 kHz ± 2 dB
Channel Separation: 30 dB from 50 Hz to 12kHz
Compliance: 35 x 10⁻⁶ cms/dyne
Elliptical Stylus Tip: Contact radius: .0003"; lateral radius: .0007"
IM Distortion: Less than 1/2% — 400 & 4000 Hz at 14.3 cms/sec. recorded velocity
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ADC 500XE ... \$27.00

ADC 500XE. Type: Induced Magnet; Output: 5 mV at 5.5 cms/sec. recorded velocity; Tracking Force: ¾ to 2 grams; Frequency Response: 10 Hz to 20 kHz ± 2 dB; Channel Separation: 20 dB from 50 Hz to 12 kHz; Compliance: 35 x 10⁻⁶ cms/dyne; Elliptical Stylus Tip Radii: Contact radius .0003"; Lateral radius .0007"; Vertical Tracking Angle: 15°.



OTHER MODELS: ADC 25 — \$110.00; ADC 26 — \$75.00; ADC XLM — \$70.00; ADC VLM — \$56.00

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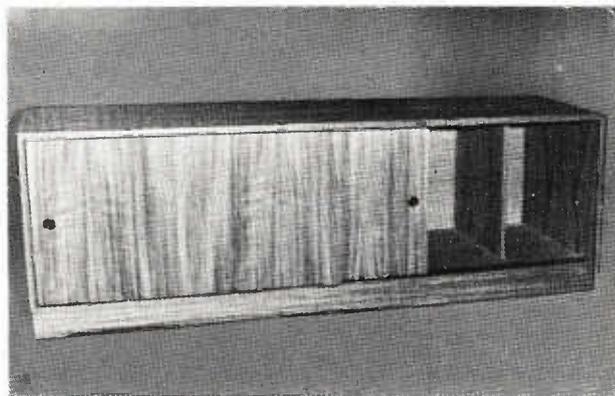
MODEL RS No. 1

A neat general purpose unit, designed to carry between 80 and 100 records, it measures 23½" x 14" (high) x 14½" (deep). Kit price is \$29.50 (teak or walnut veneer). Normally comes with base, but 4½" legs optional.



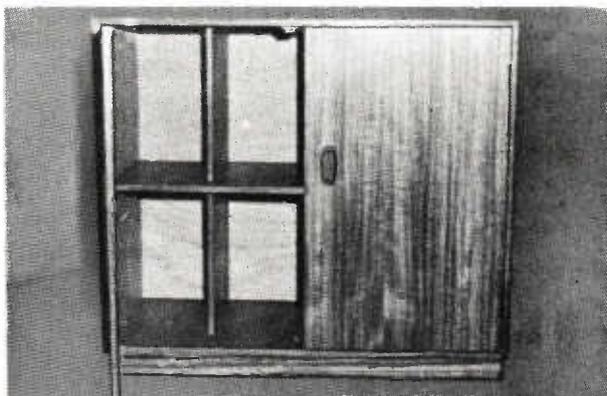
MODEL RS No. 2

A larger unit measuring 35½" x 14" (high) x 15½" (deep), the kit is priced at \$45.00 (teak or walnut veneer). Normally comes with base, but 4½" legs optional.



MODEL RS No. 3

This model measures 51¼" x 14" (high) x 15½" (deep) and is priced at \$49.50 (teak or walnut kits). Normally comes with base, but 4½" legs optional.



MODEL RS No. 4

This attractive model is aesthetically styled with full height opening doors and recessed handles cut from solid teak. With two record storage shelves, one on top of the other, and ample vertical dividers, the unit measures 35½" x 31½" (high) x 16" (deep). Kit price is \$65.00 (teak or walnut veneer).

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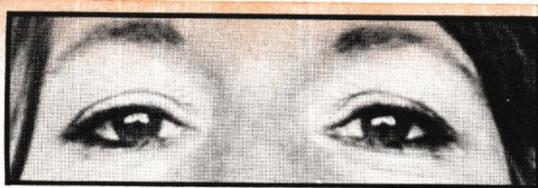
I enclose my money order/cheque for \$

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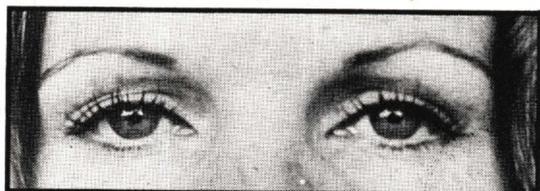
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ELECTRONICS AND YOUR EYES



Sophisticated electronic techniques in Optomology. This up-to-the-minute report, commissioned exclusively for Electronics Today International, by Terence Mendoza B.S.c. (Hons).

AN OPHTHALMIC optician (optometrist) is legally responsible for a range of functions in the interest of public health. Testing eyesight is only one aspect of this.

He must determine the integrity of the eyes and visual system by detecting the presence of any ocular ill-health in any individual who consults him. He is trained to recognise the ocular signs of *general systemic* disease; in the early stages this may *only* be evident in the eye, visible by skilled inspection within the vitreous-filled cavity behind the pupil using an ophthalmoscope (See Fig. 1). General diseases that may be manifest in the eye include diabetes, hypertension, anaemia and secondary growths from a primary cancerous site existing elsewhere in the body.

The more widely appreciated aspect of the work of the ophthalmic optician (optometrist) is his determination of appropriate optical corrections after which he decides the most beneficial manner in which the subsequent prescriptions should be dispensed. The possibilities include spectacles, contact lenses or telescopic aids.

Both pathological and refractive aspects of ophthalmic work increasingly use electronic methods, enabling the ophthalmic optician to undertake his tasks more effectively.

REFRACTION OF THE EYE

When considering the visual 'correction', the ophthalmic optician is concerned with the efficient formation of the (inverted) image on the retina. The eye's optical system consists of four transparent media which refract, (bend), the light incident on the front surface of the eye — called the 'cornea'.

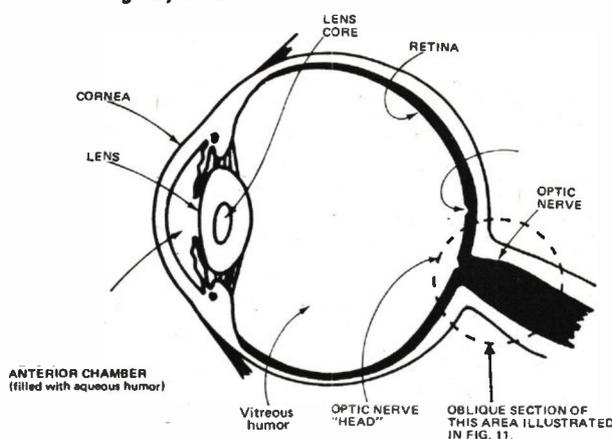
These four transparent media are the cornea itself, the aqueous and the vitreous humors and the focussing element of the eye, the crystalline lens which is interposed between aqueous and vitreous.

The lens has two separate refracting areas, the outer shell and the core. The gradients between the media dictate that the bulk of the eye's power is in the cornea. The lens, in its relaxed state, contributes only about one third of the 'refracting power' to the eye.

MYOPIA

Should the refracting power be too *strong* for the length of eye, a parallel beam of light from an object situated at 'infinity' will be focussed in front of the retina; by the time the rays reach the retina they will have crossed and diverged subjectively, a blurred image

Fig. 1. Horizontal Section through Eyeball.



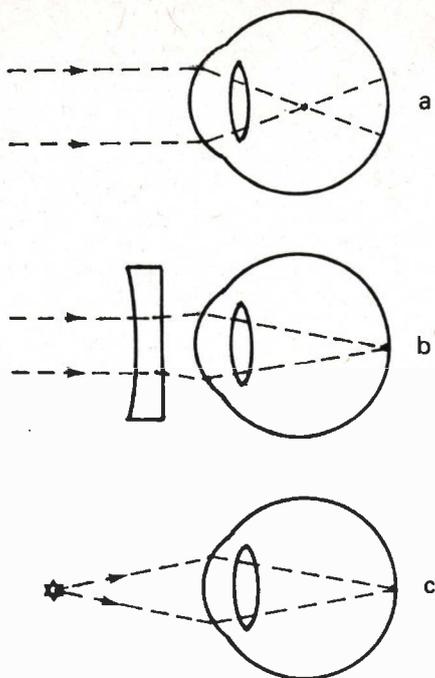


Fig. 2. (a) Parallel rays cross before reaching the retina. (b) Interposing a concave lens diverges the parallel rays before they enter the eye so they can be focussed on the retina. (c) Moving the 'object of regard' much closer, to the far part of distinct vision will also enable the rays to be focussed on the retina.

results. (See Fig 2.) In this case the angle at which the refracted rays converge has to be slightly reduced to eliminate the blur — this situation is fulfilled when either the object is brought very much nearer to the eye or when an external supplementary concave "spectacle" lens is interposed to diverge the parallel beam, neutralizing the state of the eye.

HYPERMETROPIA

The opposition condition, loosely termed long-sighted, requires a convex lens to focus the parallel beam onto the retina.

ASTIGMATISM

Astigmatism (from the Greek meaning 'without a point') is the condition whereby the rays from a parallel beam cannot be focussed onto the retina by a spherical convex or concave lens.

The usual reason for this very common condition is that the cornea, instead of possessing a near-spherical character, has a toroidal surface (like a portion of the surface of a tyre— with two distinct radii of curvature at right angles to one another — each curvature producing its own line focus. The two line foci may be refocussed onto the retina with the combination of a 'spherical' refracting element and a 'cylindrical' element (a spherical element will move both line foci an

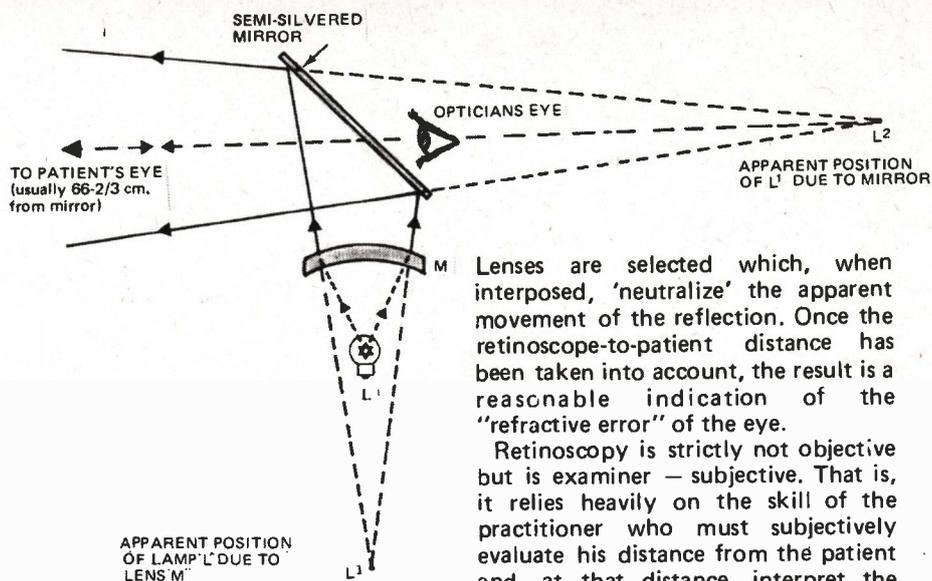


Fig. 3. Simple self-luminous Retinoscope using semi-silvered mirror.

equal distance — when one line is focussed on the retina the cylindrical element can selectively move the other line focus to the retina to once more achieve 'point focus' conditions).

HOW REFRACTION MEASUREMENTS ARE MADE

The 'refraction' that the optometrist carries out to determine the required spectacle lens correction uses a number of integrated methods, some requiring patient's judgment and response — ('subjective' testing), and others, (the 'objective' tests), relying on the practitioner's own judgment.

Supplementary tests are conducted to examine the ability of the two eyes to work together, to maintain a unified perceptual image when the eyes track a moving object; also how the eyes come to (physiological) rest when using apparatus which prevents active fusional movement.

The 'classical' objective test for determining the correcting lens required is *retinoscopy* — a light beam from a retinoscope is moved across the pupil of the patient. The beam, reflecting from the retina is viewed along the path of the incident beam (a mirror, either semi-silvered or with a central operative is used in the retinoscope to permit the illuminating/viewing axes to be coincident). (Fig. 3). The distance of the retinoscope from the patient is kept constant, enabling the optometrist to relate the speed of the incident beam scanning the eye, with that of the reflection from the back of the eye. This reflected beam emerges after going through the refracting influences of the various ocular media.

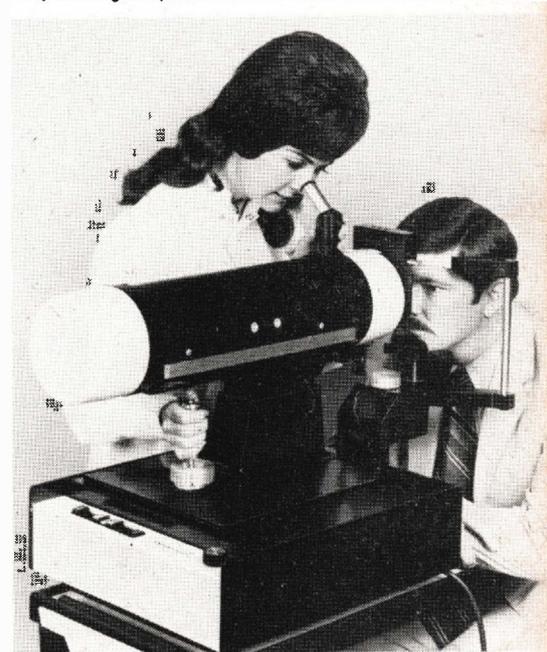
Lenses are selected which, when interposed, 'neutralize' the apparent movement of the reflection. Once the retinoscope-to-patient distance has been taken into account, the result is a reasonable indication of the "refractive error" of the eye.

Retinoscopy is strictly not objective but is examiner — subjective. That is, it relies heavily on the skill of the practitioner who must subjectively evaluate his distance from the patient and, at that distance, interpret the direction, speed and brightness of the moving reflection.

THE OPHTHALMETRON

An exciting new instrument, designed by Dr Aran Safir (Mount Sinai School of Medicine, New York) in 1970 has proved itself capable of carrying out a truly objective refraction. The Ophthalmetron, utilising photo-electric, optical, electronic and graphical elements is marketed by the American company of BAUSCH and LOMB. (See Fig. 4). Safir takes pains to stress that the instrument does not completely determine the lenses required. "The practitioner's experience and judgment remain, as always, crucial factors in determining whether or not the

Fig. 4. Lining up the measuring system of the Ophthalmetron prior to carrying out a recording of the refractive error of the subject's right eye.



ELECTRONICS AND YOUR EYES

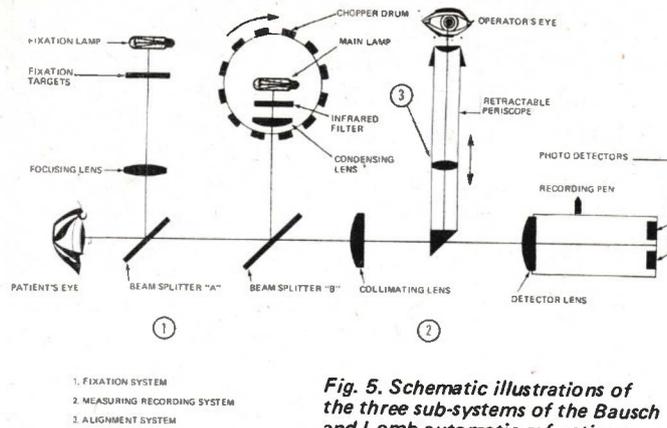


Fig. 5. Schematic illustrations of the three sub-systems of the Bausch and Lomb automatic refractometer - the "Ophthalmometron".

patient is made visually functional and comfortable."

The Ophthalmometron has three overlapping systems (see Fig. 5); first there is the fixation system - the patient is directed to observe a target presented to his eye. When he 'fixates' it steadily, his eye will line up with the optic axis of the measuring instrument.

The fixation system consists of a light source, fixation target (a transparency of a rocket at blast-off - very impressive!), a focussing lens and a semi-silvered mirror (beam-splitter) which permits the reflected target-image to reach the eye simultaneously with the directly transmitted "measuring beam."

The second system is the measuring-recording system. An ingenious light-source assembly gives a scanning light beam. It consists of a lamp, a new-infra red transmitting filter, a condensing lens and a chopper drum. The chopper drum is divided by many equally-spaced slots and in operation rotates around the light source to provide 720 slit/scans per second. The near infra-red light reflected from the retina is brought to a focus within the body of the instrument by a collimating lens. The position of this focal point represents the patient's far point i.e. the furthest 'distance' at which the patient can focus before objects appear blurred - it necessitates the crystalline lens to be

Fig. 6. Schematic illustration of Scan/photo-detector principle in the Ophthalmometron.

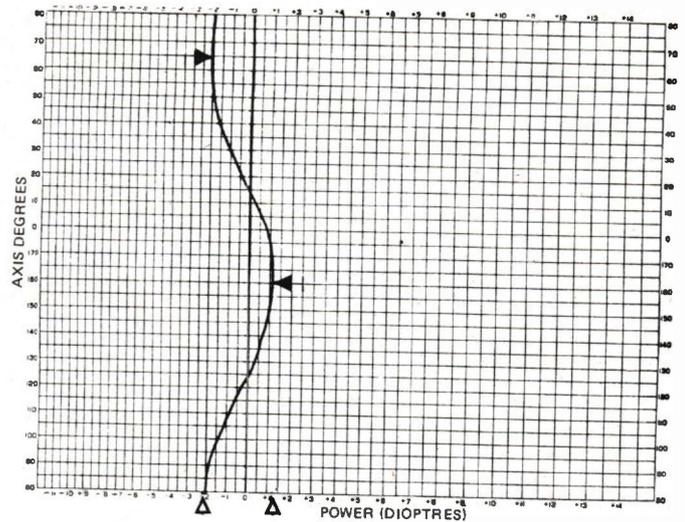
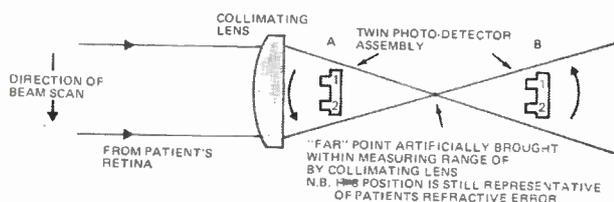


Fig. 7. Black arrowheads indicate most negative and most positive excursions occurring at 180° and 75°. Clear arrowheads point to dioptric value where the peaks are registered - -2.00 D and +1.12 D.

relaxed. A myope's far point is closer to his eye and a hypermetrope's is behind his head when the eye is completely relaxed.

If the photo-detector assembly is forward of the far point (See Fig. 6) the beam reflected from the retina, and the incident scanning beam travel in the same direction - in classical retinoscopy this is termed a 'with' movement. An integral servo-mechanism moves the detector apparatus back towards the far point. Should the detectors be situated behind the far point they sense the reflection travelling in the opposite direction to the illuminating beam - an 'against' movement; the assembly in this case is moved forward to the far point. At the far point, simultaneous illumination of the photo-detectors occurs and the recording pen begins to mark on a chart.

The measurement system (to the right of beam-splitter A in Fig. 5) is rotated through a 180° scan of the eye, recording the power in every meridian on a static chart wrapped around the pen cylindrical detector assembly.

The alignment of the recording

At position A, detector 1 is illuminated before 2 by collimated scan reflection from retina - detector assembly is moved back. At position B, detector 2 is illuminated before 1 - detector assembly is moved forward. At 'far' point both detectors are simultaneously illuminated - tracing commences by pen attached to detector assembly.

system with the eye's visual axis is critical, hence the attention that has been paid to this facet of the design. During the setting-up procedure the measuring light source is modified (the infra-red filter is removed and a pinhole aperture is introduced) and the operator views the reflection of this 'object' in the front of the patient's eye. The reflection is correctly centred, using a retractable periscope lowered into the axis of the measuring system and by moving the instrument by its XY joystick. The height is adjustable via the bezel ring at the base of the joystick.

Once aligned, the measuring/recording takes three seconds to produce the final read-out (See Fig. 7).

In use the Ophthalmometron produces results of an accuracy equivalent to that obtained by the skilled optometrist using streak retinoscopy, which is recognised as one of the most sophisticated 'objective' consulting-room techniques.

ELECTROPHYSIOLOGY

Various research programmes have been undertaken in recent years to try to develop an electrophysiological method for measuring refractive error objectively. Basically they consist of graphing the visually evoked cortical potentials (VELP) emanating from the visual cortex - the part of the brain at the back of the head which is concerned with seeing. The signals, picked up by electrodes painlessly placed on the scalp evidently bear a direct relationship to the clarity of perception of a target viewed by the "fovea" (the part of the retina where

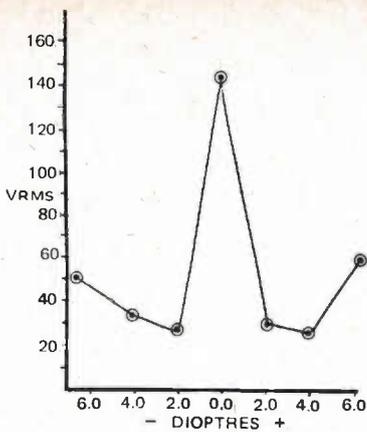


Fig. 8. Variation of V_{rms} (see text) with refractive error. The peak response coincides with the absence of any refractive error (after Arden, Barrada and Kelsey)

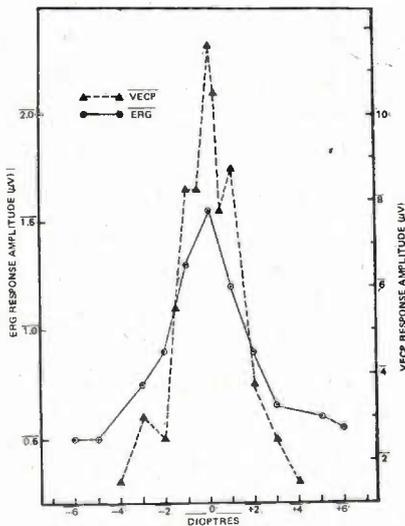


Fig. 8(a) Variation of the VECP and ERG with refractive error. Maximum response is obtained with the spherical power addition of zero dioptres (ie no refractive error) and falls off rapidly on either side (after Arden, Barrada and Kelsey).

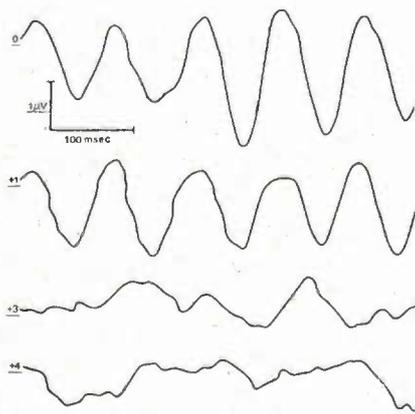


Fig. 8(b) Recordings of the VECP obtained upon light stimulation of the eye. Note how the amplitude of the response decreases as the retinal image is progressively blurred by the addition of 1, 3 and 4 dioptre lenses (after Arden, Barrada and Kelsey).

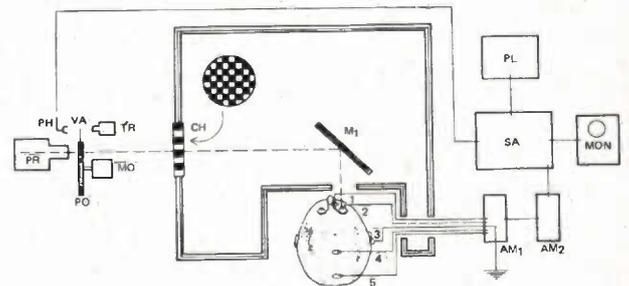
critical vision is carried out). (See Fig. 8).

When an eye fixates a dark/light border of a stimulus pattern a surface positive 'late wave' (180 - 375 msec) results in the VECP, the amplitude of which depends on the contact between the black and white areas of the pattern i.e. the less distinct are the borders, the smaller will be the amplitude of response. Blurred border margins, (defocussed either by the eye's crystalline lens or by an artificial

Fig. 9. Preparing to record an Electroretinogram; the subject wears a scleral contact lens containing one electrode, others being placed on forehead and ear. To the left of the picture an oscilloscope with a Polaroid camera attached provides a more detailed analysis of the ERG. The small unit in the centre is a high gain differential amplifier.



Fig. 9(a). Layout of apparatus for recording the electroretinogram and the visually evoked cortical potential. (Illustration after Millodot).



KEY: CH - circular crossed polaroid checkerboard stimulus target AM₁, AM₂ - series connected differential amplifiers giving amplification 10⁵ to 10⁶.

1. 'live' scleral contact lens electrode on eye
2. reference electrode on cheek
3. grounding electrode on ear
4. Scalp midline VECP electrodes
5. Scalp midline VECP electrodes

ERG Electrodes

SA - response-averaging computer. PH - photocell triggering sweep of SA via hole in vane (VA) attached to rotating polaroid (PO); light emitted from projector TR. MON - oscilloscope monitor. PL - X-Y chart recorder. PR - target illumination. MO - motor. M₁ - mirror.

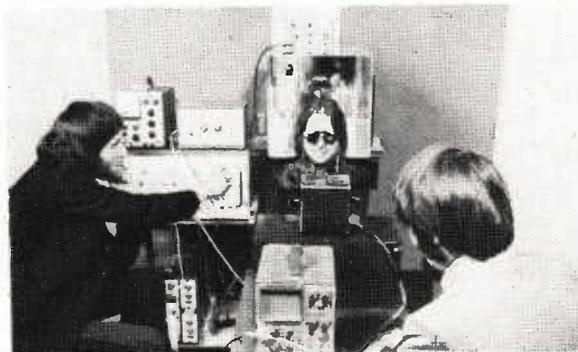


Fig. 9(b). Recording the change in VECP when viewing a flashing stimulus through various additional lenses. Subject is using her left eye (the right is covered). Metal shield prevents stray pick up. Xenon Strobe Stimulus is directly in front of subject. Bottom left is X-Y chart recorder and above it is the response averaging computer (being adjusted).

lens outside the eye) will give the same effect. If the process is considered in reverse and the VECP response is maximised using additional lenses, the visual performance of the eye will be found to have been improved; an objective lens correction will have been found. (See Fig. 8a and 8b).

The measurement is actually related

to the visual sensation and is registered by the patient's visual cortex. Hence there is virtually no discrepancy between the objective indication of the 'right' lens and the patient's subjective sensation of 'best vision'.

A checkerboard 'stimulus target' is used, constructed from crossed Poloroid strips; when lighted via a

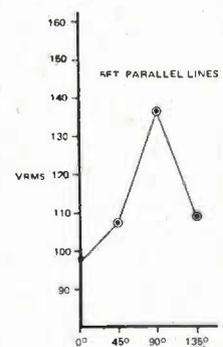


Fig. 9(c). V_{rms} and astigmatism. Peak response is obtained when astigmatism is minimal.

ELECTRONICS AND YOUR EYES

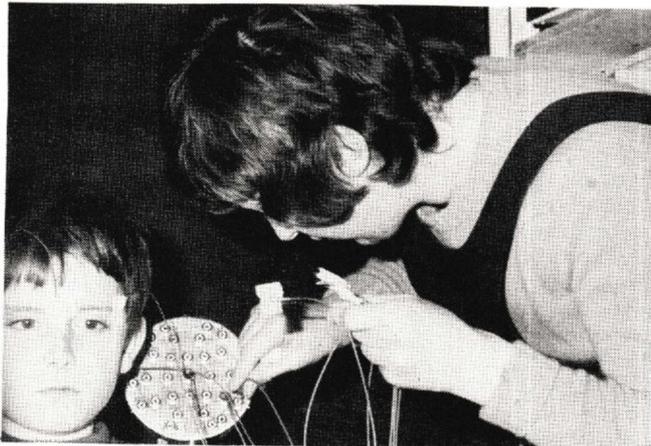


Fig. 10. Connecting electrodes prior to recording the electro-oculogram. (see text) Photo courtesy Dr. Bing, St Bartholomew's Hospital, London.

piece of rotating Polaroid, alternate squares sinusoidally lighten then darken — thus constant overall brightness is maintained in a continuously changing stimulus presentation.

The signals obtained from the electrodes on the midline of the skull, with a grounding electrode on the ear, are fed to a response-averaging computer and, after averaging, are printed out as a single trace on an XY recorder; this trace represents the VCEP.

The prime advantage of this method is that it detects abnormalities anywhere within the visual system; these could be in the eye or in the nerve fibres to the brain. Blindness due to injury to the nerve pathway will affect the VCEP trace but would not be indicated by instruments such as the retinoscope and the Ophthalmometron. Measurements of electrical potentials generated between the front and rear of the eyeball, termed the *electroretinogram* (ERG) also demonstrate a relationship between the size of the potential difference and visual clarity. In this case, one electrode is carried by a scleral contact lens worn on the eye and another is fixed on the cheek or ear (See Figs 9a, 9b, and 9c).

Most prescriptions have the astigmatic component which was mentioned earlier, therefore to determine the axis of the cylindrical element electrophysiologically, a grating stimulus can be used in the form of a series of parallel alternate light and dark bands. The orientation of the lines is rotated until maximal trace amplitude is achieved, indicating the axis where minimal astigmatism exists (See Fig. 9c).

THE ELECTRO-OCCULOGRAM

Finally, the group of techniques

includes the clinical possibilities of the electro-oculogram.

A resting or standing potential of the eye, maximal between the cornea and back of the eye, exists. Measuring some 6 mV, its cause is part retinal, and part due to the semi-permeable membranes within the eye, such as that which contains the lens. Its magnitude is greatest in the direction of the visual axis i.e. cornea to fovea. Electrodes placed either side of the eye will detect an increase in potential as the cornea approaches one electrode. If eye movements (of constant size and orientation) are repeated under different illumination conditions, changes in the relative resting potential can be noted. These can provide a useful diagnosis of the retinal function. Figure 10 illustrates a current piece of research being conducted at St. Bartholomew's Hospital, London. The form of the EOG is shown whilst being correlated with reading difficulty in school-children. In the picture, the electrodes are being connected to the rest of the apparatus via the circular plug-board behind the subject.

CURVATURE OF THE CORNEA

Contact lens fitting has also benefitted from electronic automation — albeit on a limited scale.

The cornea never follows a completely spherical curve. Central corneal curvatures can be indicated by a *keratometer* — an instrument that measures the angular size of an image reflected from the cornea of an object of known angular size. A direct reading of the corneal radius of curvature allows the choice to be made of 'trial' lens (of appropriate curvature) from a comprehensive set of contact lenses. The 'fit' of the lens curve to the corneal curve is determined by viewing the quantity

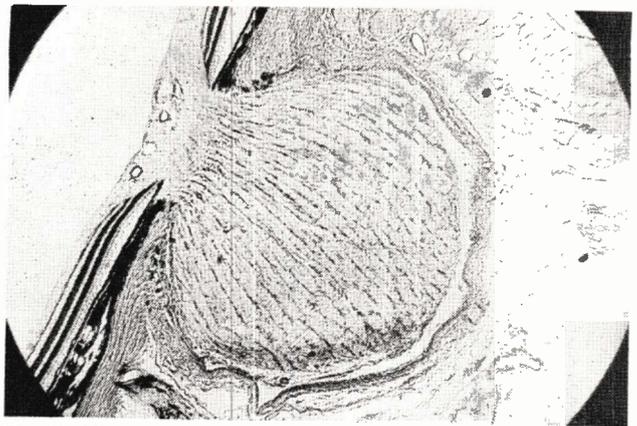


Fig. 11. Microscopic section of the optic nerve 'head' where undue intra-ocular pressure has most deleterious effect. The light area to the left is the vitreous and the large central circular area is the optic nerve which has been obliquely sectioned — the striped appearance is due to bundles of nerve fibres. In glaucoma the slight dip at the nerve head may be pushed right back to a goblet-shape, termed cupping.

and distribution of tears between the lens and the cornea — the tears rendered visible by a harmless dye (fluorescein 2%) which fluoresces when viewed under blue light.

Lenses of differing back surface curves are tried until the best 'fit' has been determined; this is often a compromise.

RECORDING KERATOSCOPIES

The skilled procedures described above have held their own, even with the advent of devices such as recording keratoscopes.

The principle of the recording keratoscope is basically similar to that of a keratometer in that the device produces a series of concentric ring reflections from the anterior corneal surface — this resulting pattern is photographed.

The rings of the 'object' bear a constant relationship to each other hence the reflected and photographed rings will also bear a (different) mathematical relationship to each other. From the photographed data it is possible to compute the curvature at an infinite number of points and plot the entire corneal topography. The photograph may be placed in a reader, the various measurements registered and recorded onto a teletype hooked up to a time-sharing computer. A readout of a number of lens specifications can be obtained in 30 seconds using this system but more accurate analyses naturally take longer. However to date most optometrists feel that there has been little apparent advantage over classical keratometry.

DISEASE AND THE EYE

The recognition of pathology involving the eye is a constant responsibility of the ophthalmic optician, because in most countries he

(continued on page 99)



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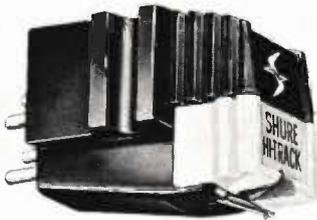
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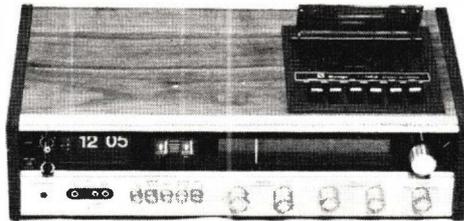
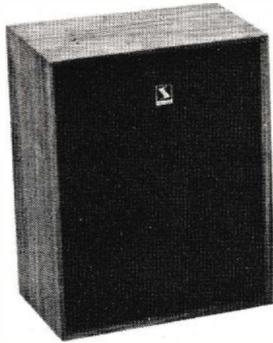
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ELECTRONICS AND YOUR EYES

(Continued from page 94)

is the "general practitioner" of eye-care.

A major concern to the ophthalmological and ophthalmic professions is the development of suitable instruments to detect that most insidious of visually-crippling maladies (glaucoma). This disease can be quite advanced before the affected individual has any awareness of his condition.

Fortunately present-day medicine can however prevent blindness from glaucoma if recognised and treated early; once detected the process can be halted but not reversed.

Although the causes of glaucoma are many and varied, one prime factor nearly always present is an increase in pressure exerted on the wall of the eye. This may be due to an adverse differential between the volume of fluid (mainly blood) entering to nourish the eye, and the volume of fluid leaving the eye. The pressure, although equally distributed, will have its greatest and most deleterious effect at the weakest portion of the globe — where the optic nerve fibres enter the eye at the nerve "head" (See Fig. 11). This is gradually and often imperceptibly pushed backwards affecting the entering nerve fibres and slowly destroying the sight. As the nerve fibre functions are affected, so also is their distribution, within the retina.

Characteristic patterns of visual loss, unnoticed, appear in the field of vision (until late in the disease when the peripheral losses start to encroach on the fovea).

There are three principal means of glaucoma detection — recognition of optic nerve head "cupping", disclosure of a pathological level of raised 'ocular tension' and detection of characteristic (visionless areas) in the visual field of the patient.

Visual field screening has been a slow, painstaking process, but in the

last few years a rapid and efficient piece of equipment, known as the Friedman-Bedwell Screener, has lightened the task for both practitioner and patient (See Fig 12).

Multiple stimuli of accurately calibrated brightness and size are exposed to the patient for set short periods. The patient is required to state how many stimuli he sees. The stimuli are positioned in the areas most likely to demonstrate pathological visual field defects. Previous devices of this type relied on flashes of blue light or the time-consuming use of a single stimulus. Great success has been achieved in screening the public by this new method.

TONOMETRY

The measurement of ocular tension is known as tonometry. It is closely allied to a technique known as *tonography*, in which there is a measure of the outflow of fluid from the eye in response to controlled pressure applied to the eye. In pathological states there is reduced outflow.

Two related, though distinct, principles are utilised in the measurement of tension — *indentation* and *applanation*. The corneal surface, suitably anaesthetised, is normally the site for the measurement as it affords a thin regular surface.

Indentation instruments utilise a flattened annular foot-plate. A plunger of known weight slides freely down the centre of the footplate, linked to a pointer indication via a gravity system. The more compressible the eye (i.e. the lower the tension), the further the plunger indents, when the footplate is rested on the cornea (See Fig. 13).

Applanation techniques rely on various methods of flattening the cornea — some, using a pre-calibrated scale, provide a direct reading of the force required to flatten a set area of

cornea. Others employ a standard weight and relate the measured area of corneal flattening to the ocular tension.

The Imbert-Fick law states that the intra-ocular tension is equal to the weight applied, divided by the area of cornea flattened. This theoretical relationship applies to a perfectly dry, flexible membrane but of course the cornea is wet and has a degree of rigidity.

In a typical situation an area of about three square millimetres of cornea is flattened and then the meniscus of tears which surrounds the flat area provide a certain amount of surface tension. This surface tension is enough to counteract the effects of the corneal rigidity so the Imber-Fick law will still hold good.

THE NON-CONTACT TONOMETER

All the methods discussed so far for the measurement of ocular tension have three drawbacks; they require a high degree of skill and care, the prior application of a local anaesthetic, and mechanical contact with the eye.

A recent instrument with electronic sub-systems developed by Dr. Bernard Grolman (1972) of the American Optical Company obviates the above considerations. Nevertheless it enables a complete measuring cycle to be carried out in three milliseconds with minimal discomfort to the patient.

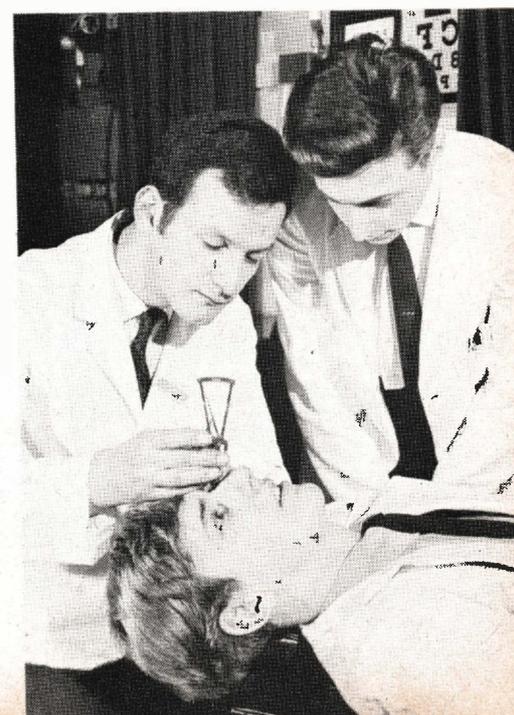
The applanating medium is an air-pulse and the *time* taken for the air impinging on the cornea to result in applanation is recorded; testing on both human and animal subjects has demonstrated that there is a direct linear relationship between ocular tension and the "time interval to applanation." The readout is generated in binary coded decimal form and is digitally displayed in "mm Hg" on a readout panel in front of the operator.

Precise instrument-to-cornea ▶



◀ Fig. 12. Friedman-Bedwell Visual Field Screener in use. Patient fixates central target through circular fluorescent tube which keeps lighting conditions consistent. Patterns, selected by a lever behind the white fascia, are flashed onto the black screen (in fact they are apertures illuminated by a xenon flash-tube).

▶ Fig. 13. Locating a Shiotz indentation tonometer on the eye to measure the ocular tension. The pointer is to one end of the scale as the plunger has not yet made contact with the cornea. Note the supine position of the "patient" necessary with gravity systems of this type.



ELECTRONICS AND YOUR EYES

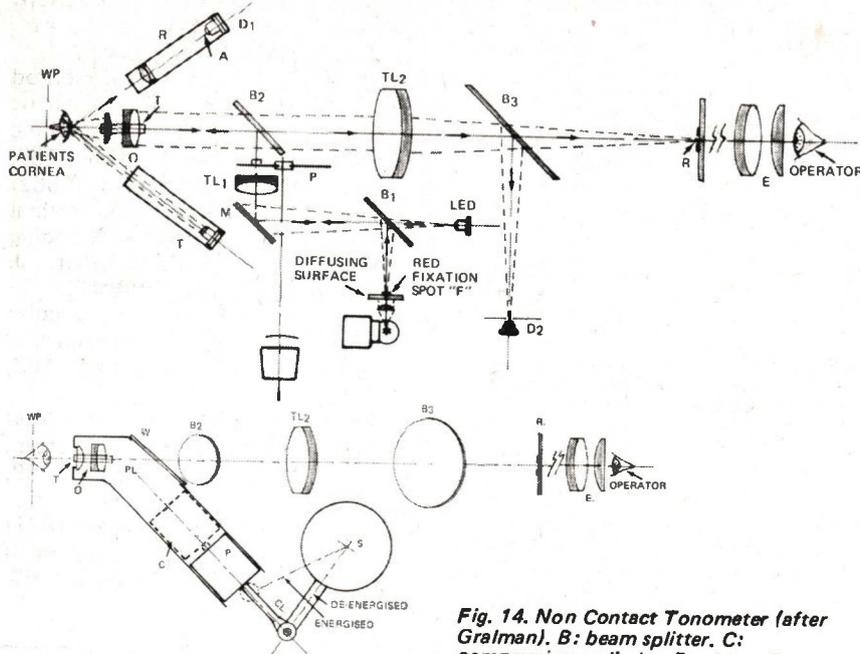


Fig. 14. Non Contact Tonometer (after Gralman). B: beam splitter. C: compression cylinder. P: piston. S: solenoid. O: objective broached by part (T).

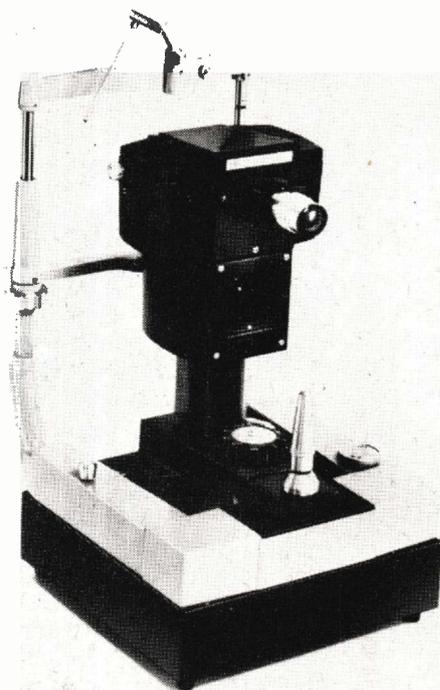
alignment is required, therefore a system similar to that of the Ophthalmetron is used.

A small target is reflected from the cornea and is monitored by the operator. A secondary automatic "fail-safe" alignment system is superimposed upon this primary visual one. A LED light source is reflected onto the cornea by a semi-silvered mirror, the image then being reflected by a second mirror onto a

photo-detector, after negotiating a small aperture (See Fig.14). When the visually — judged alignment satisfies the spatial tolerances bounded by the measuring system, the machine can be operated. Misalignment results in the reflected light not illuminating the detector behind the aperture and the machine becomes inoperable.

The long-focus microscope (See Fig. 14) used for visual alignment has a novel modification which forms the

Fig. 15. The non-contact tonometer viewed from the side of the operator. The Nixie panel is visible beneath the alignment telescope. In the foreground the joystick alignment handle can be discerned.



basis for the whole system — this is that its objective lens is broached by an axial duct; this ducted-lens forms one end of a cylinder with a compression piston, situated at an angle to the axis of the microscope — a window in the cylinder wall allows unobstructed light-path through the microscope.

When energised, an adjacent solenoid propels the piston down the cylinder and the positive pressure is ported through the lens duct. The resulting highly-repeatable force-time envelope (it takes 12msec to peak) impinges against a properly oriented cornea and sequentially causes first a gradual reduction of curvature, then appplanation, next a slight concavity and finally, (with the decay of the force-time envelope) progressive restoration of the cornea.

The status of the cornea is continuously monitored by a separate system consisting of a transmitter, to direct a collimated (parallel) beam to the centre of the cornea, and a telecentric receiver — this accepts only parallel rays symmetrically disposed relative to the transmitter (See Fig. 16). Only a small amount of light is received by the detector from an undisturbed cornea. Increasing numbers of rays are accepted and sensed with progressive corneal flattening, with a maximum occurring at the instant of appplanation.

This peak, when sensed, shuts off the current supply to the solenoid, ensuring that minimal applating force is directed at the cornea.

In the commercially-available instrument the time date output (i.e. time to first appplanation 'spike' from the telecentric receiver) is instantaneously converted to give the tension in mm Hg, a form which is more clinically useful.

DETECTION OF FLICKER

The ability of the eye to detect flicker is depressed in flaucoma, and in various other conditions including disseminated sclerosis, and diabetes.

The frequency at which a flickering source appears to become constant or at which the flicker is just perceptible is termed the critical fusion frequency of flicker (CFF). It varies with different parts of the retina and is highly dependent on such factors as the wavelength and waveform of stimulus used, and external considerations such as the ambient illumination.

Drasdo and Woodhall of the University of Aston in Birmingham (England) have devised a technique (See Figs 17a and 17b) for charting

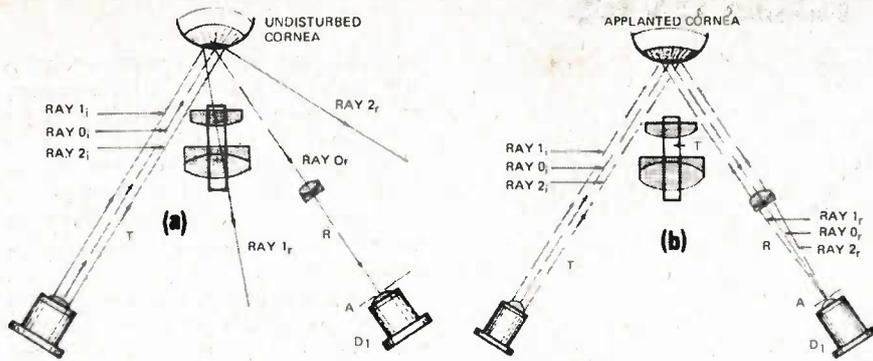


Fig. 16. Non-Contact Tonometer — Telecentric Corneal Status Monitoring (a) normal undisturbed cornea — few collimated rays from transmitter (T) are reflected by the cornea to be focussed on the detector D, behind the aperture A. (b) Applanated cornea resulting from air-pulse from tube (T); maximal signal is detected by the receiver due to the collimated transmitted beam.

the CFF for the 'visual field' by superimposing a modulated stimulus on a grey homogenous field.

A light emitting diode modulated with a 50% bright interval, is applied to the rear of a grey translucent screen fixated by the patient. Fine control of screen brightness is possible, and the ideal nature of the LED permits great scope by virtue of its small size and rapid response. The patient views one-second pulses of modulated light presented in various positions in his visual field — he is asked to indicate

whether or not the pulses appear to be modulated. Once the CFF field has been plotted, it can be compared with the 'norm' to confirm or negate any suspicion of pathology.

CONCLUSION

The sophisticated electronically-based techniques now being included in day-to-day practice, safeguard public eyesight and health, and will do so to an ever-increasing degree as the rapidly expanding electronic technology reveals yet further applications in this important field.

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The writer would like to thank the Department of Ophthalmic Optics and Visual Science of The City University, London and in particular to Professor R.J. Fletcher, Dr. J.E. Saunders and Mr. C. Bishop for helpful suggestions received in the preparation of this feature. The co-operation of the various ophthalmic equipment manufacturers and distributors is also gratefully acknowledged.

Fig. 17(a). Plotting critical fusion frequency of flicker using a flat screen perpendicular to patient's line of sight; patient fixates central red light.

Fig. 17(b). Plotting CFF using a LED externally applied to evenly illuminated hemispherical 'bowl'. Photos 18 and 18(b) courtesy N. Drasdo, University of Aston, Birmingham.



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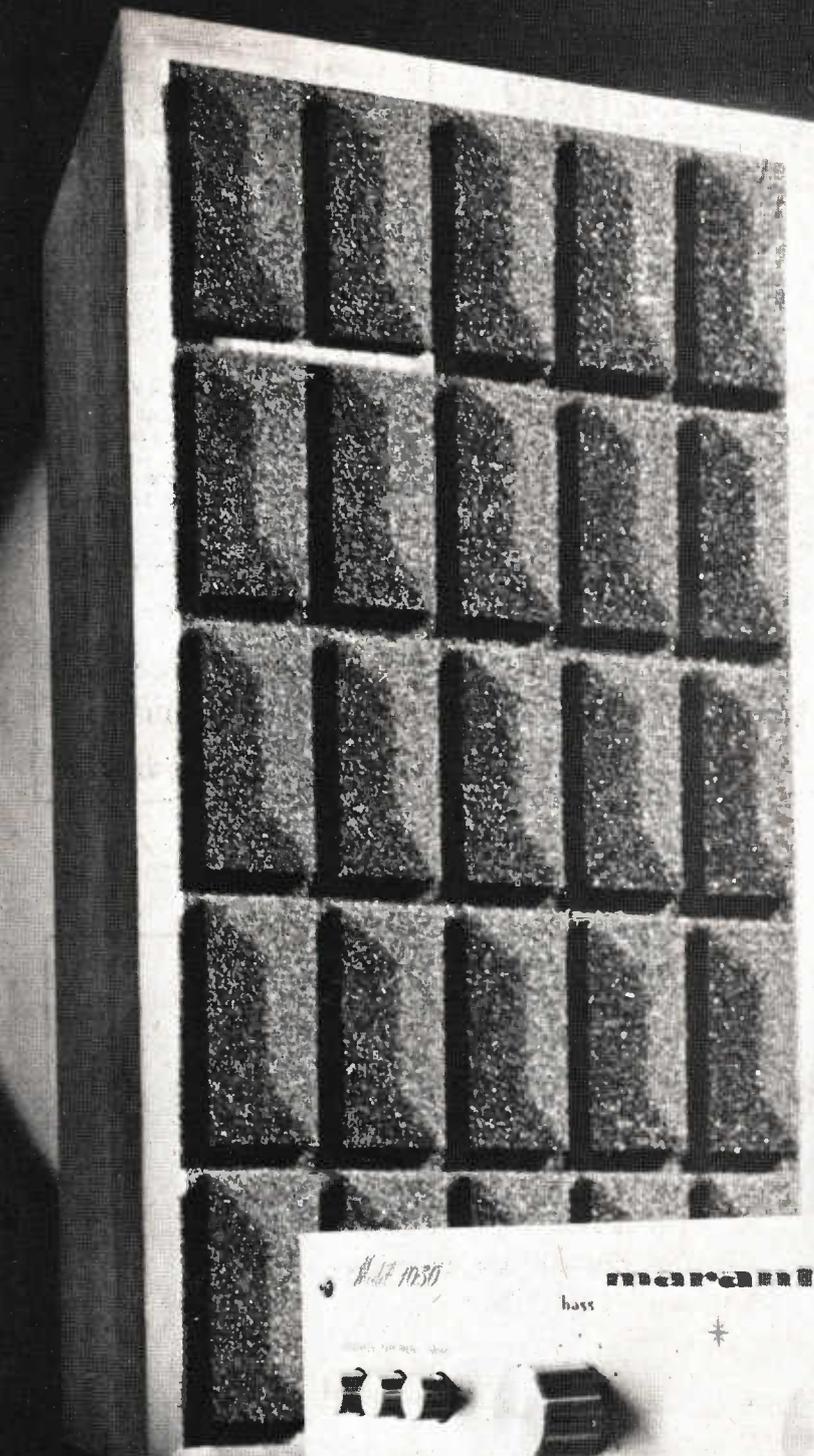
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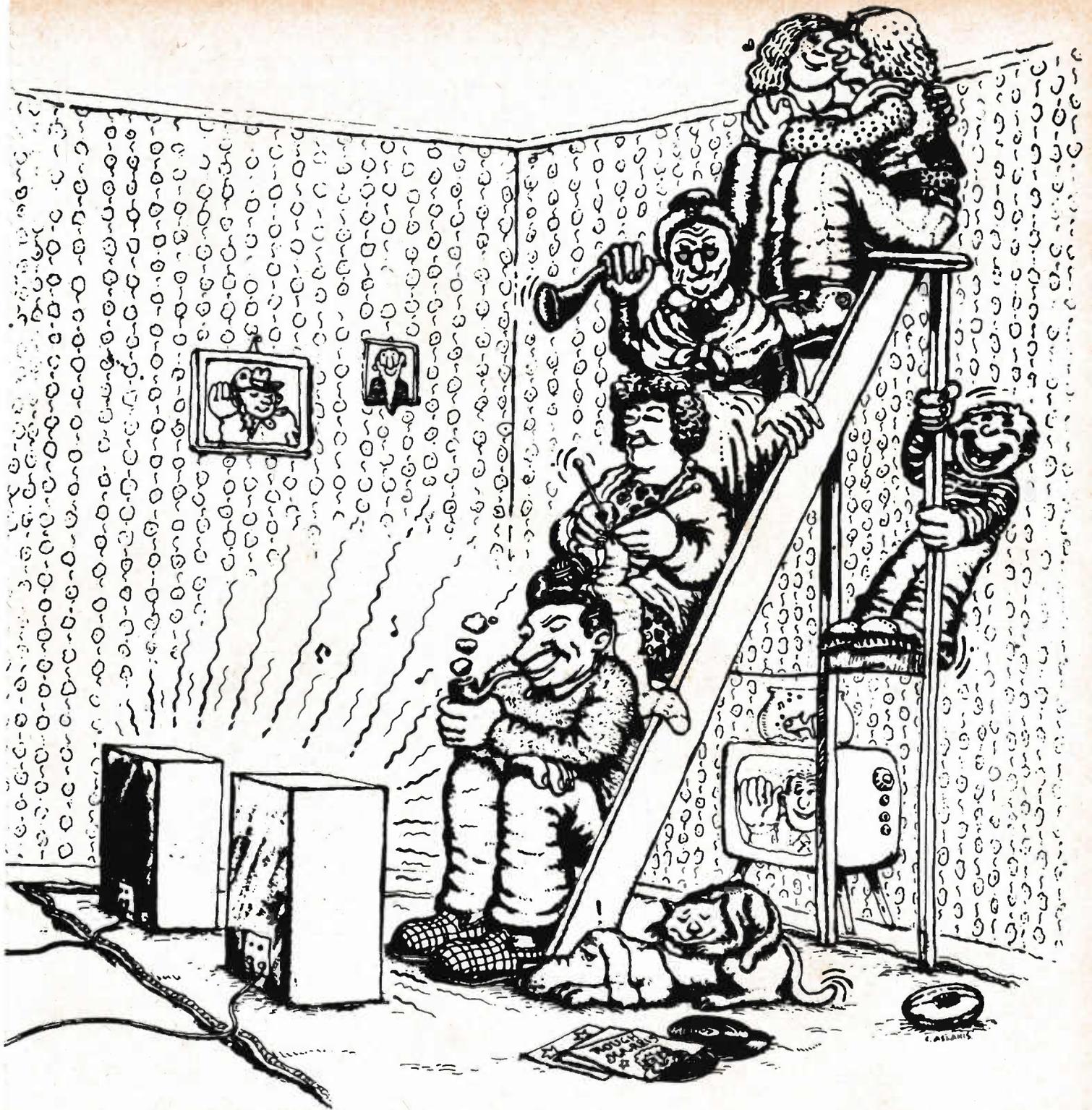
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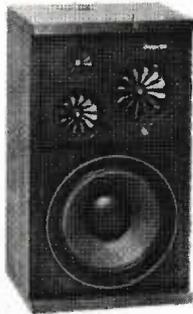
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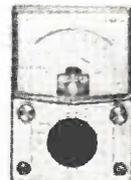
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PIN PHOTODIODES

Versatile solid-state photodetectors replace traditional photomultipliers in many applications.

TRADITIONALLY, the detection and demodulation of extremely low level optical signals has been performed with photomultiplier tubes. Because of this tradition, solid-state photodetectors are often overlooked even though they have a number of clear functional advantages and in some applications provide superior performance as well. Some of these advantages are summarized below.

1. Size and weight: PIN photodiodes are approximately three orders of magnitude smaller and lighter. This greatly simplifies and reduces the cost of mounting.

2. Power Supply: Multiplier phototubes require a supply of 1500 to 2000 volts, which must be precisely regulated and divided among the dynodes. By comparison, PIN photodiodes and associated amplifiers operate stably on less than 20 volts, and this voltage does not require precise regulation.

3. Cost: The cost, including that of the necessary amplifier, is lower for the PIN photodiode because of lower power supply requirements.

4. Spectral Response: Broad skirts of the PIN photodiode make it useful from the ultra-violet, through the visible, and well into the infrared region. This exceeds the range of any other device of comparable sensitivity.

5. Sensitivity: Noise equivalent power of the PIN photodiode is lower than that of any other type of photodetector. The signal levels are extremely low, however, and to achieve low level performance they require a high gain. Photomultiplier tubes have built-in gain and do not require additional low-noise amplification. Moreover, the high input-resistance needed for sensitive performance precludes fast response, whereas the response time of photomultiplier tubes may be in the nanosecond region even in the sensitive mode.

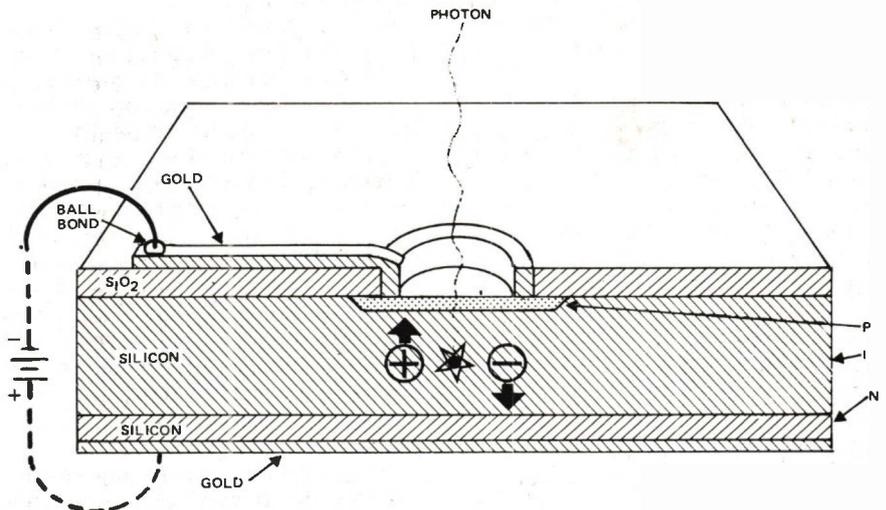


Fig. 1. PIN photodiode (cross-section)

6. Stability: The characteristics of noise, responsivity, and spectral response of the PIN photodiode are not dependent on time, temperature, or other environmental considerations. The same conditions may be hazardous to photomultiplier tubes.

7. Overloading: In the presence of excessive signal, of comparable sensitivity are capable of destroying themselves as a result of excessive output current. The PIN photodiode is unaffected by exposure to room light or even direct sunlight.

8. Ruggedness: PIN photodiodes can tolerate exposure to extreme levels of shock and vibration. Typical shock capability is 1500 G's for 0.5 millisecond.

9. Magnetic Fields: Photomultiplier tube gain is affected by fields as small as one gauss. If the interfering field is fluctuating, the output will be modulated by it. The PIN photodiode is insensitive to magnetic fields.

10. Precision: The responsivity of the PIN photodiode is inherently precise and repeatable. Within a given type, the characteristics agree (from unit to unit) within plus or minus 0.1 decade. Responsivity of photomultiplier tubes may vary over more than a decade from one unit to another.

11. Sensitive Area: The small sensitive area of the PIN photodiode makes it unnecessary to establish an aperture, which may be required for some applications. However, in some applications good optical alignment is imperative due to the small area.

PIN PHOTODIODE DETECTORS

At the present time a variety of different types of solid-state photodetectors are available. Of these, the silicon PIN photodiode has the broadest applicability. The PIN photodiode's main advantages are: broad spectral response, a wide dynamic range; high speed, and extremely low noise. With appropriate terminal circuits it is well suited for many applications that require converting an optical signal to an electrical signal.

CONSTRUCTION

The construction of the PIN photodiode is shown in Fig. 1. Commencing with very high resistivity (intrinsic, or I) silicon material, an n-region is diffused onto the bottom side. The top surface is then passivated with silicon dioxide, (SiO₂) and a round window etched through the

passivation, and a P-region diffused into the silicon. The size and shape of this window varies with the product, and determines the diode's response. Diodes are made with .010", .020", and .040" diameter junction areas. Gold contacts are then evaporated onto the perimeter of the junction.

Even with no bias, the intrinsic region is almost depleted of carriers and a reverse electric field exists due to minority carrier diffusion. For optimum performance, however, the intrinsic region is depleted further by applying a reverse bias. This further increases the reverse electric field. Now the reason for starting with high resistivity silicon can be seen: The higher the sensitivity, the higher the electric field that can be created without excess current flow. For instance, the same electric field can be set up across a 1Ω resistor as across a 1 mΩ resistor, but the current through the 1Ω device would be one million times higher. In addition, higher stability and linearity is achieved with high resistivity material.

MODE OF OPERATION

When a photon is absorbed by the silicon it produces a hole and an electron. If the absorption of the photon occurs in the I-layer, as shown in Fig. 1, the hole and the electron are separated by the electric field in the I-layer. For the highest quantum conversion efficiency (electrons per photon) it is desirable to have the P-layer thin and the I-layer as thick as possible. The thickness of the P-layer also determines the value of the parasitic series resistance (R_s). The thinner the P-layer the higher the R_s . Since R_s affects high frequency performance there is therefore a design trade-off between quantum efficiency and bandwidth. Once the trade-off is settled, the desired thickness is then controlled during the diffusion process. The effective thickness of the I-layer is controlled partly by the manufacturing diffusion process and partly by the magnitude of the electric field applied to the diode — the higher

the field, the thicker will be the effective I-layer. It is therefore desirable to operate the diode with an external reverse bias. As the reverse bias voltage is increased from zero, there are three beneficial effects: hole and electron transit time decreases; conversion efficiency increases slightly; and most importantly, the capacitance decreases sharply with bias up to about ten volts and continues to decrease slightly up to about twenty volts reverse bias.

In the presence of optical signals there is a slight modulation of the shunt conductance as the presence of photon-produced holes and electrons in the I-layer modulate its conductivity. This effect can be quite significant at very high levels of illumination since the I-layer may become saturated, resulting in a decrease in quantum efficiency and an increase in rise time. Saturation can be prevented by applying a very high reverse bias voltage (up to 200 volts). However, such a high voltage, applied over a long period of time, may cause a degradation of the diode's leakage properties.

To wavelengths much shorter than 400nm, the silicon becomes opaque and the photon is absorbed in the p-region where no electric field exists. The holes and electrons produced by this photon absorption recombine

locally, without photocurrent production. For wavelengths much longer than 900nm, the silicon becomes transparent and the photons travel completely through the device and are absorbed in the n-region where again there is no electric field.

The effects just explained are shown more graphically in Fig. 2 which is a plot of photon conversion efficiency. Edge response is better than centre response because the centre region below the junction is fully depleted at about five volts bias. Further increases in the bias voltage have no beneficial effect on centre sensitivity. However, at higher levels of bias, the field at the edge continues to increase and edge response continues to improve. In fact, for short wave-lengths, edge response improves to the extent that occasionally more than one electron-hole pair is broken up by a single photon, leading to an apparent efficiency of more than 100%.

PERFORMANCE

Threshold performance can and has been specified in a number of different ways. The most commonly understood and usable expression takes the form of a noise equivalent input signal. This is the input signal which produces an output signal level that is equal in value to the noise level that is present

Fig. 3. Spectral sensitivity comparisons of photodetectors.

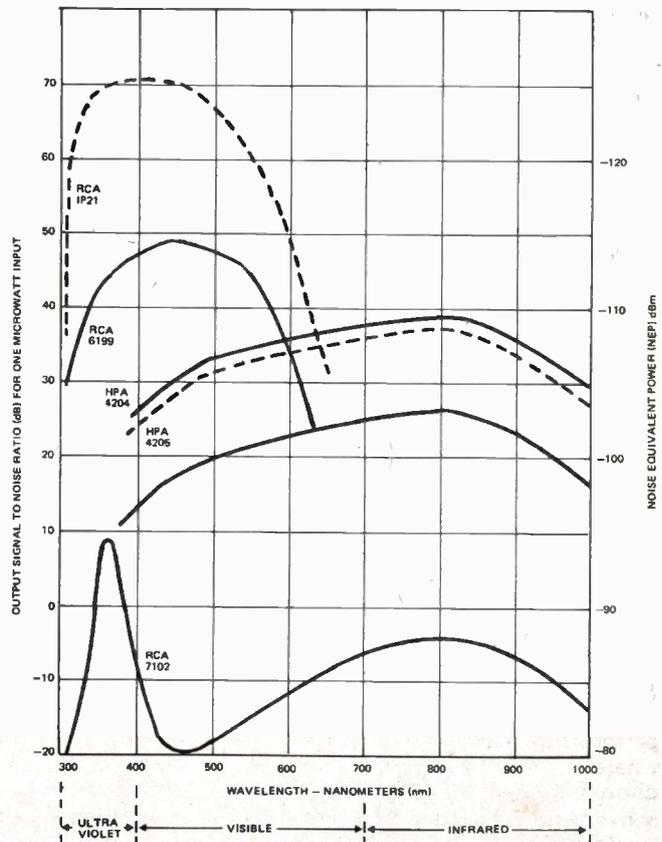
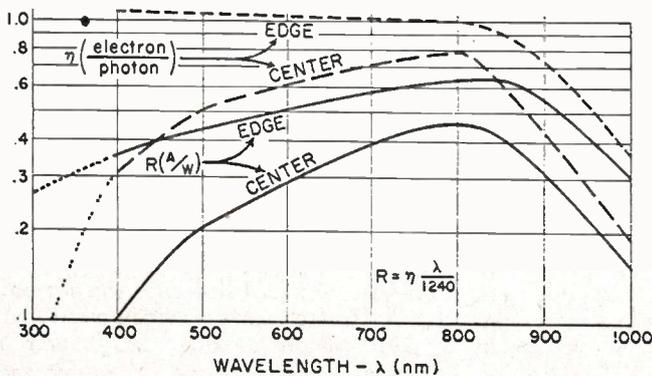


Fig. 2. Efficiency of photon conversion in PIN Photodiodes.



PIN PHOTODIODES

when no input signal is applied. The noise equivalent input in watts is called Noise Equivalent Power (NEP) and is defined by:

$$NEP = \frac{\text{Noise Current (amps per root hertz)}}{\text{Current Responsivity (amps per watt)}}$$

which has the units of watts per root hertz. Devices for photo-detection could then be compared on the basis of NEP. The lower the NEP the more sensitive is the device.

Another method of defining threshold sensitivity is on the basis of signal-to-noise ratio for given input signal power levels. Taking a power level of one picowatt, for example, the signal-to-noise ratio at the output can be obtained from:

$$SNR = \frac{\text{Responsivity} \left(\frac{\text{amps}}{\text{watts}} \right) \times \text{Input (watts)}}{\text{Noise current (amps)}}$$

This is a ratio of currents. To express it in dB we would take twenty times its log to base ten, even though the expression converts linearly to a power ratio. This is because the devices respond linearly to input power.

Figure 3 shows spectral sensitivity characteristics of several PIN photodiodes and multiplier phototubes. Sensitivity is given in terms of SNR and NEP. The latter is in terms of dBm. Several interesting features are evident in Fig. 3. Although the quantum efficiency for PIN photodiodes is constant from 500 to 800 nanometers, the sensitivity curve is not. This is due to the fact that the energy per quantum (photon) of radiant energy varies with wavelength.

The curves for the three different PIN photodiodes also show the dependence of sensitivity on leakage current. Here the highest sensitivity is obtained with the HPA 4204 which has a maximum leakage current of 100 picoamps. Next is the HPA 4205 with 150 picoamps and finally the HPA 4203 with maximum leakage of 2 nanoamps. The three curves are in effect displaced by the magnitude of the noise current difference because quantum efficiency is equal for all. These curves also show the inherent broad response of PIN photodiodes with respect to multiplier phototubes.

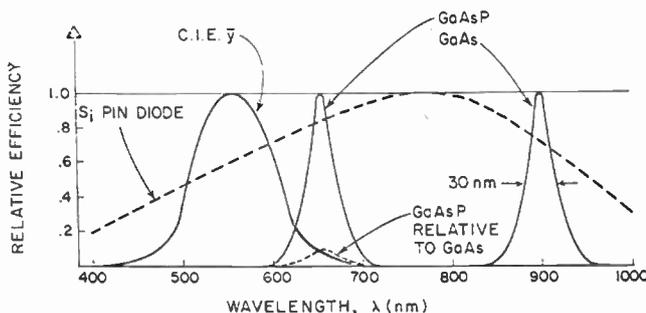
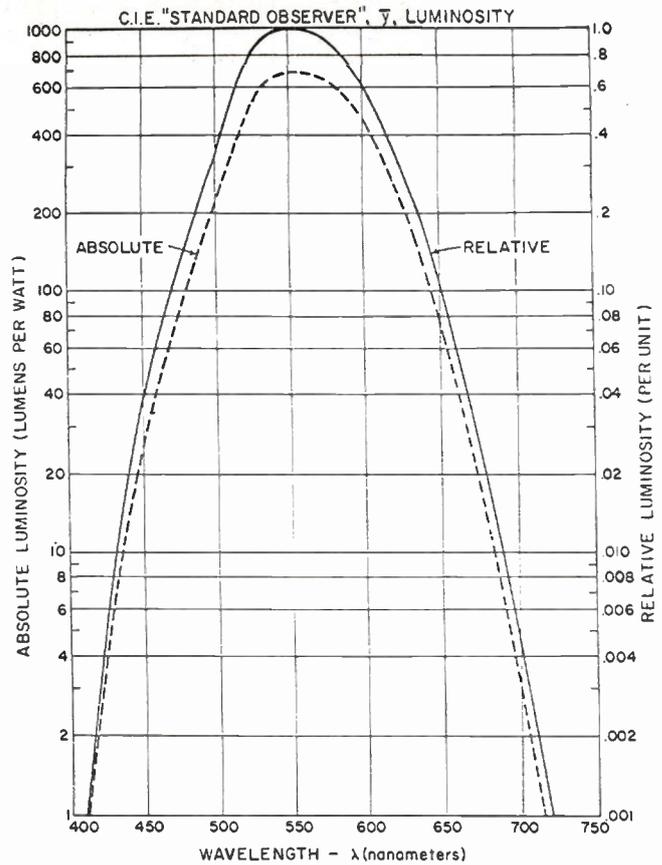


Fig. 4. Relative efficiencies of typical emitters and detectors.

Fig. 5. Photometric to radiometric conversion chart.



Therefore, the power responsivity of the PIN photodiode has a corresponding slope. Notice how the inherently broad response of silicon, enhanced by the thick I-layer construction, extends the range of useful performance over the response ranges of two types of photocathodes.

Although the threshold sensitivity of multiplier phototubes is superior in the visible region, nevertheless for many applications the advantage is not significant enough to outweigh the disadvantages of generally unstable and temperature-sensitive gain, large size and weight, and the need of very high and stable power supply voltages. On the other hand, the superior red and infrared threshold performance of the PIN photodiode does not necessarily mean it is better in any application, because one must take into account its small sensitive area and low signal levels. Realization of the performance capability described in Fig. 3 also requires fairly careful attention to the design of the terminal

circuits into which the PIN photodiode operates:

SYSTEM CONSIDERATIONS

If the relative efficiencies of the various types of emitters and detectors are plotted on the same graph, as in Figure 4, the relative merits of coupled emitters and detectors can be evaluated.

For example, if the detector was the human eye (C.I.E. curve) we could not choose a GaAs infrared emitter as a source. However, if the detector was to be a silicon PIN Photodiode the GaAs infrared emitter provides far greater coupling efficiency than the GaAsP emitter (compare the GaAs curve to the dotted GaAsP curve). One caution: Coupling efficiency is not always of prime importance. In fact, coupling an LED to a photo-diode would provide the following advantages over coupling an LED to a photodiode:

- 1) Cost saving of nearly 50%.
- 2) Ten times faster response.
- 3) Visible radiation is sometimes necessary for testing, alignment and verification.

Solid state photo detectors offer several advantages over conventional vacuum devices and the PIN diode, in particular, is useable as a replacement for photomultipliers.

Acknowledgement: Hewlett Packard Applications Note 915 Threshold Detection and Demodulation of Visible and Infrared modulation with PIN photodiodes.

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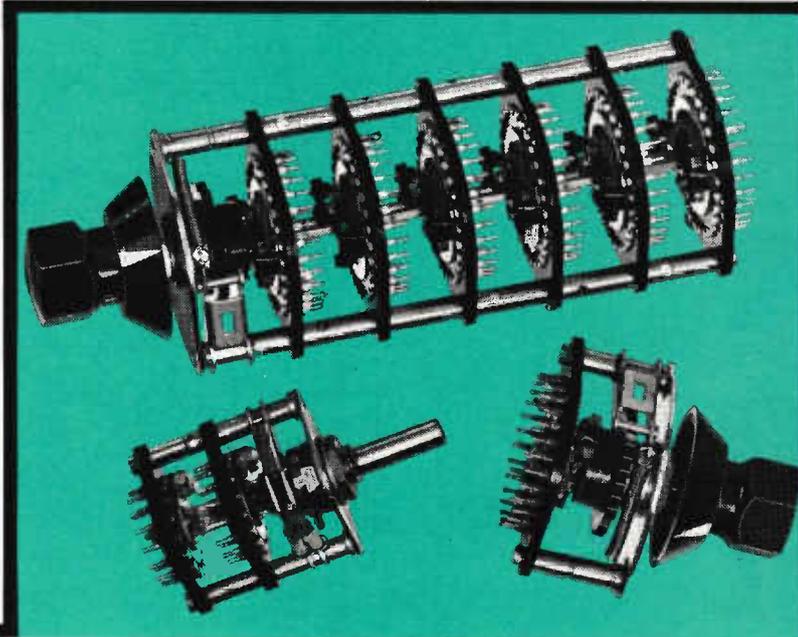
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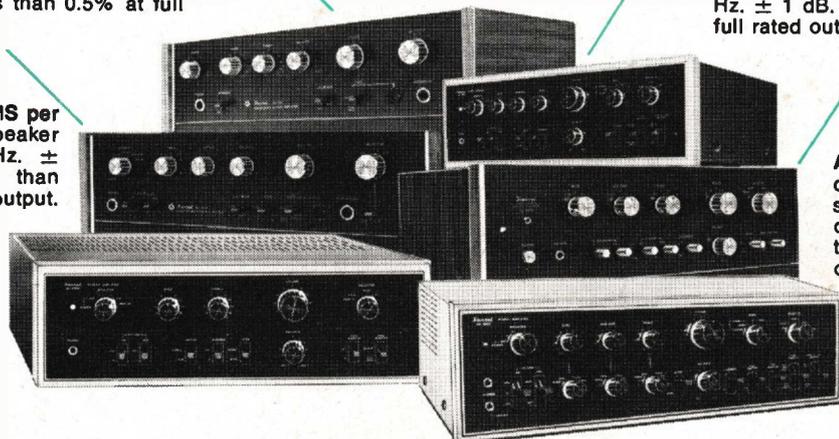
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ARC WELDING TODAY

Once a basic electrical power engineering application, arc welding now uses increasingly sophisticated electronic techniques. This article, by ETI correspondent Dr. Peter Sydenham, and Don Northcote of the Welding Services Division of Commonwealth Industrial Gases, explains.

DURING a demonstration lecture of sparks and discharges in 1876, Elihu Thomson realised that powerful electric arcs could be used to join metals by fusing them together, history records that two wires in his experiment unexpectedly welded. No doubt other people of that time had already had a similar experience, but it was Thomson who nurtured the idea in the years that followed. Progress was slow, however, for at that time only comparatively weak dc currents could be sustained.

In 1880, Thomson retired from teaching to form a company, (that eventually became the Thomson-Houston Electric Company) whose market aim was to promote the industrial and domestic use of electricity. In 1884 circumstances enabled him to begin the serious development of welding, for by then high-current ac generators had been developed enabling transformers to be employed to raise the available current to the tens or hundreds of amperes needed. Typical light construction welding requires from 70 amperes

upward, to heavy work consuming 650 amperes. The arc voltage ranges from 20 to 30 volts. (Few people are aware of the enormous energy needed to make an arc weld. The average weld requires some 5 kW liberated in a volume of 50 mm³. The arc temperature may rise to 6000°C.)

Electric arc welding soon became a practical reality, being used to join metals of all kinds in a diverse number of situations. It was not long before suitable dc generators were also designed and from then on, until the development of electronics, there was little change in the basic methods of arc welding.

In essence, arc welding uses a low-voltage, high-current source that provides an initially high striking voltage that drops once the arc is struck — to a limit that provides the desired current for the welding rod in use.

Initial development was slow, for the first electrodes were bare and did not produce as good a weld as did oxyacetylene flame welding. By the

1930s, however, coated electrodes were available and arc welding became the predominant method of joining metals. The coating includes substances that reduce oxidation, resulting from the burning action of the arc, and also forms a shield of slag that retains ionised gas which would otherwise escape, with resultant loss of the flame, at each zero-crossing of an ac power source. The simplest electrodes are single piece coated rods that are used one by one in the common process known as stick welding.

POWER SUPPLIES

Schematic diagrams of the two main types of ac welding plant are shown in Fig. 1. To strike an arc, it is first necessary to break down the air path, forming a conducting gas. The supply is designed to generate a reasonably high open-circuit voltage — 40 to 80 V is typical but is sometimes higher. This voltage drops as the current increases in the arc.

In one method of achieving this characteristic, the primary and secondary windings of the transformer are arranged on the laminated iron core such that the flux from the primary is only loosely coupled to the secondary. At no-load, full secondary voltage is induced. As the secondary current rises, flux is lost and the voltage falls. Fig. 1a shows a scheme by which this is done. Control of the short-circuit current is by movement of the shunt core.

An alternative method is to have the two windings more tightly coupled, using a separate inductor to control the current — see Fig. 1b. This gives better control by limiting the rate of rise of current as well as its final value.

Direct-current welding generators have field windings that are designed to give the same 'sloping' characteristics. In some generators a separate reactor is used to control the field winding currents.

The slope (of voltage drop) usually lies between 1.5 to 3.5 volts per 100 amperes of output current, having been established from experience as the characteristic that provides the

Fig. 1 Alternating current welding supplies. (a) Leakage-transformer design with shunt. (b) Improved characteristics can be obtained with a separate inductor.

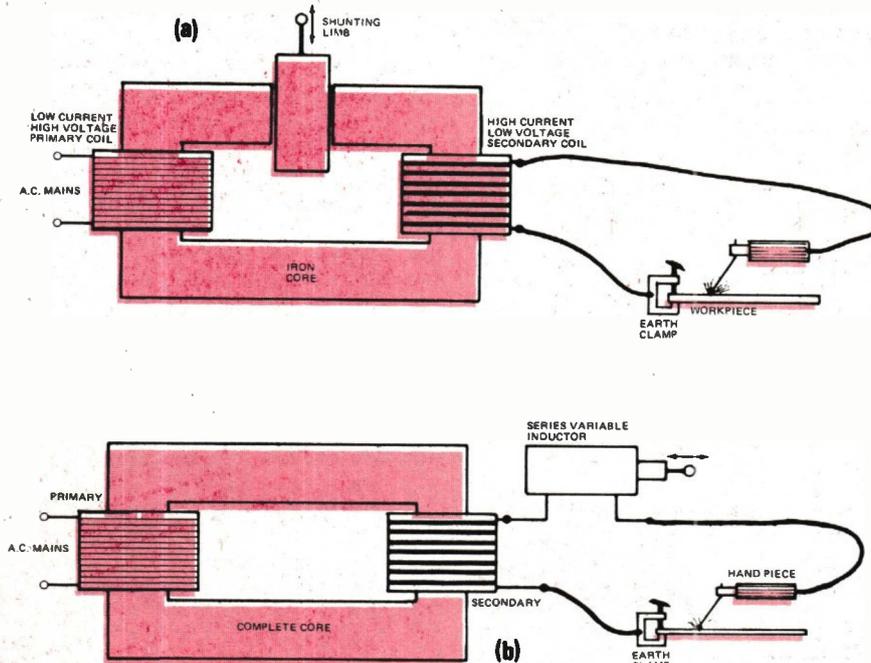




Fig. 2. The amount of in-line inductance alters the harshness of the weld attack.

kind of start that satisfies most welding operators. The effect of varying the inductance used is shown schematically in Fig. 2.

PILOT ARC WELDERS

If a means of maintaining the ionisation is provided, bare rods may be used with ac systems. The so-called pilot-arc welder incorporates extra components to do just this: it also provides better control of currents, especially for light sheet welding.

A resonant L-C system provides a superimposed 100 kHz current across the arc gap. This is achieved without the use of an active electronic oscillator, using the circuit shown in Fig. 3. Transformer T_1 provides several thousand volts to the capacitor C_1 , and when charged, the voltage breaks down the air-gap across the gap G. This momentarily short-circuits the output of T_1 and C_1 via T_2 , inducing a transient voltage in T_2 that recharges C_1 in the opposite sense. The sequence repeats until all energy is wasted in resistive losses — it provides a decaying oscillation that appears across the electrode-to-workpiece gap, ionising the air whenever the arc extinguishes.

Although the pilot-arc will provide a nasty shock, it is not lethal, for the high frequency signal travels only in

the skin. An automatic switch shuts down the pilot arc when there is no demand for an arc.

WIRE WELDING

It is somewhat tedious to be continually changing rods on a long weld run, and the break possibly introduces a faulty area of weld. A more recent development feeds a continuous wire — called wire welding — through a coaxial shield of gas (in the main CO_2 is employed for ferrous metals, argon for non-ferrous, but other gasses are also used) that serves the same purpose as electrode coatings. Many names are used to describe wire welders, for instance, it may be called MIG (metal inert gas), wicky wire, shielded wire or short arc, to name a few in common useage.

Flux-cored wire has also been marketed in which the metal forms a sheath that contains deoxidants and alloying elements needed to provide a satisfactorily strong and ductile weld.

The layout of a typical semi-automatic wire welding plant is given in Fig. 4. When the operator presses the trigger, wire is automatically fed through the handpiece making a sliding contact with an inbuilt electrode. The gas flow is also started, to shield the arc. No

slag is left on the weld with this method. Note that the ac supply is rectified to dc to obtain optimum welding performance.

ENTER ELECTRONICS

For many years arc welding equipment used little, if any, electronic circuitry. Today, however, we are seeing increasing use of it for control and rectification. This trend has been brought about by the need for increased sophistication, and by the rapidly reducing cost and increased reliability of electronic systems. Selenium rectifiers are, however, still used in many plants because of their high overload capacity under short-circuit conditions.

Many plants now incorporate a feedback servo that maintains the arc voltage at a preset value by continuously monitoring the voltage and comparing it with the reference. Any difference is used accordingly to reset the voltage to the correct value. This helps the operator to produce a consistent weld with less skill.

AUTOMATION IN PIPE-LINE WELDING

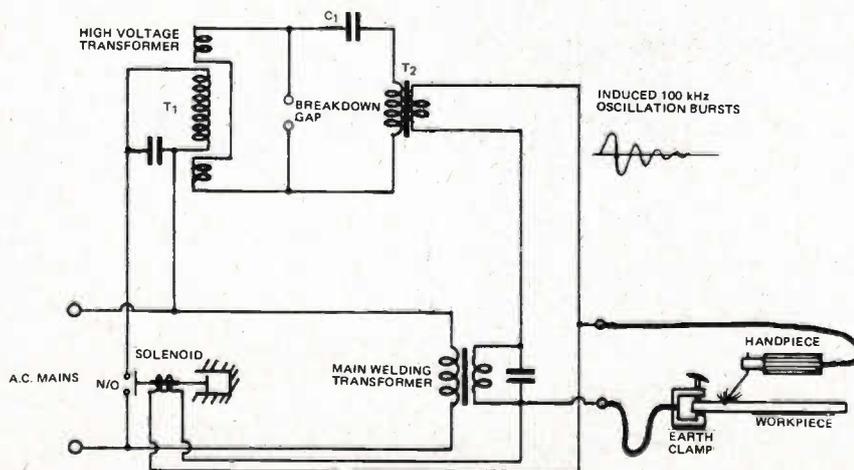
Circumstances where the welding task is repetitive and has a well-defined geometry set the scene for the serious consideration of fully automatic systems. Pipe-lines are such a case for there complete automation of the pipe-joining process can render great savings.

Lengths of individual lines run to hundreds of kilometres and there are literally tens of thousands of kilometres of large diameter (0.3 m — 1 m) pipe-lines in daily use at this time. Current projects in planning or execution include a 3000 km line, of 0.3 m diameter, running from Canada to Northern USA; a 1700 km line from central Australia to Sydney using pipe nearly 1 m in diameter to convey natural gas; a 611 km line of over a metre in diameter to carry ores in a slurry mix in the Gulf of Carpentaria area of Australia. The Lone-Star pipe-line system on the American continent has 22 000 km of pipe in operation. This year alone they are adding 880 km more.

Pipes usually arrive on site in (nominally) 12 m lengths, so there are numerous joins to be made in the field to obtain a one piece pipe-line. These joints must be executed rapidly as line-laying can only progress as fast as the individual welds are made.

Traditional methods of jointing use stick-welding by highly skilled welders. This may suffice in some contracts but the growing demand for trained men has become impossible to meet and fully-automatic methods are being

Fig. 3. Circuit for providing the pilot arc, high-frequency signal.



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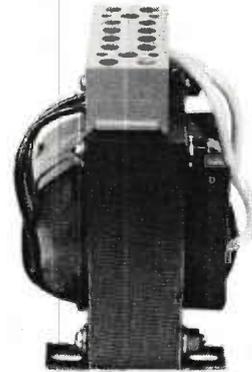
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TS24/200VA	24	200	8.33
TS32/30VA	32	30	.94
TS32/60VA	32	60	1.88
TS32/125VA	32	125	3.9
TS32/200VA	32	200	6.25
TS115/30VA	115	30	.26
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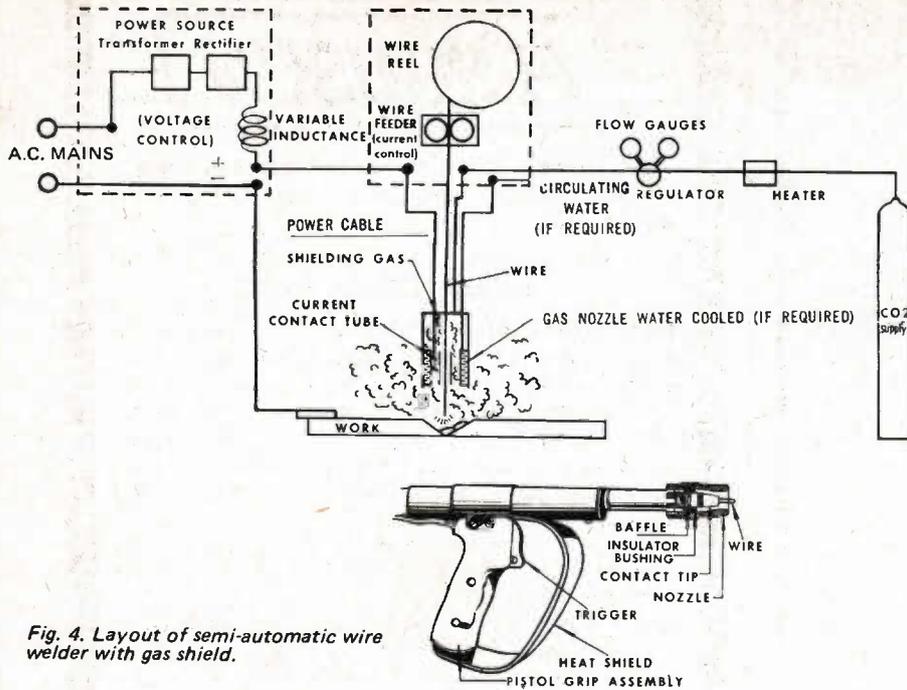


Fig. 4. Layout of semi-automatic wire welder with gas shield.

introduced to meet this need and to further increase the laying rate.

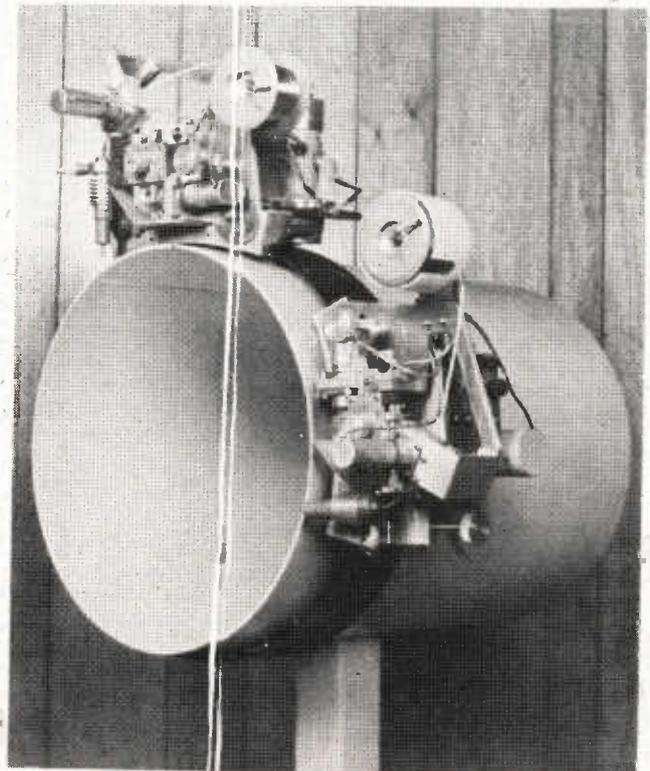
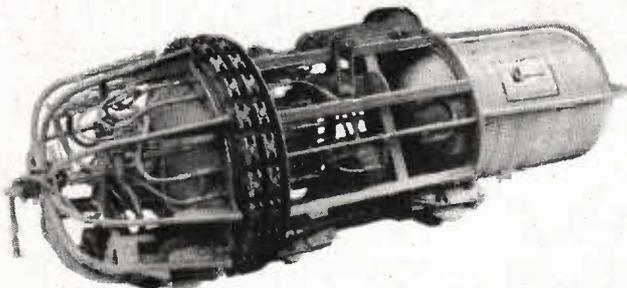
One automatic system that is gaining wide acceptance is the CRC-Croze internal and external welding machines. The degree of automation used in their design has been made possible by the use of electronic control systems. The main stages of pipe-laying with this system are as follows.

After the ends of the pipes have been bevelled to an accuracy of 0.2 mm with a special, portable, on-site, end-milling machine, they are brought into line along the string with the ends butted. The positioning and holding operation for the first weld is critical: for this the internal machine is used. This self-contained 500 kg device, (Fig. 5) moves up the free end of the pipe (which is usually two or even four 12 m lengths prejoined elsewhere on site) under its own battery power. Pneumatically-operated shoes expand outward on each side of the joint, forcing the two ends into circular

shape and holding them in alignment. Internal clamps such as that shown are now quite common, but the CRC-Cross method goes one step further, for their advanced system carries four MIG welding heads that weld the initial (or stringer) pass from the outside. Two heads, operating together, weld half the pipe joint, the other two then complete it. Whilst this operation is in progress the operators are attaching a band to the outside, on which the external welding machines run. The stringer pass takes just three

Fig. 6. Two welding bugs set up to demonstrate their use to weld automatically around the outside of a pipe.

Fig. 5. Internal line-up clamp for joining pipe sections.



minutes to complete, after which the internal machine is remotely released and driven out ready for the next joint, for this can proceed now that the joint has sufficient strength.

To fill the vee to full strength and seal, external machines (called bugs) are used. Two are shown in Fig. 6. They have velocity servo-control on the drive motor to ensure that the weld speed is constant regardless of position around the band. A second motor gently oscillates the welding head across the vee to produce a wider weld. The third motor feeds the wire. Electronic circuits monitor the arc voltage, controlling against the desired set value. Control is obtained by varying the alternator field using silicon controlled rectifier SCR techniques. The circuits have been designed to produce a power supply characteristic that has the desired amount of slope and effective inductance. This method eliminates the need for heavy and expensive control inductors. Conventional-style plug-in printed circuit cards are used on the controls; in the event of a fault the unskilled operators can easily effect a repair by exchange. It is vital in applications such as this, where a skilled electronic technician is not available, that the system does not lose favour due to inability to keep it running.

This equipment has been used in Italy, America, Britain and is currently in use on the 240 km line from the Forties Field to Peterhead in Scotland.

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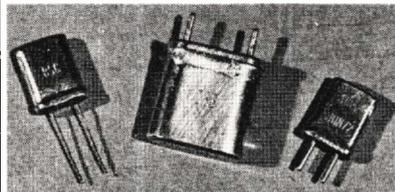
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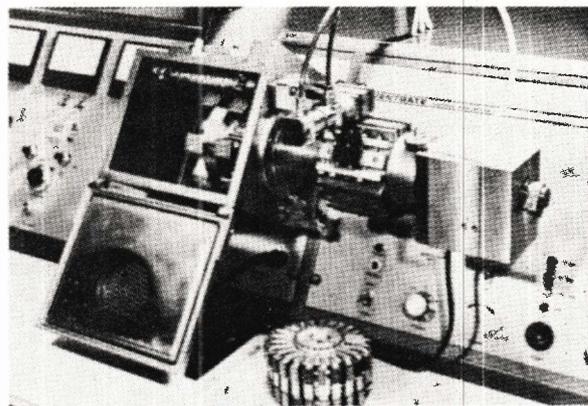


Fig. 7. A low-power work-
shop electron-beam welding
plant.

A recent record for the laying team
was to make 138 joints in an 8.5 hour
day. Other companies — Midwestern
Specialties Company, H.C. Price,
Thomas Contracting and Columbia
Gas Corporation — have also
developed pipe joining systems that
feature some of the CRC-Crose
facilities.

We have seen how electronics has
gradually been accepted as a means of
improving arc-welding. Current
research developments go even further.

ELECTRON BEAM WELDING

If a work piece is bombarded with a
dense stream of high-energy electrons,
it will be heated by virtue of the
impact energy exchange. This is the
principle of electron-beam welding. To
date, welding with electron beams has
been limited to comparatively small
tasks, but now work is in hand to
adapt the technique to pipe-line
joining.

The electron-beam, produced in an
electron gun, is focussed and
accelerated toward the work-piece, the
whole operation taking place in
high-vacuum conditions. A production
electron-beam welding unit, designed
to accommodate metals ranging in
thickness from 0.05 to 5mm, is shown
in Fig. 7.

Obviously many design problems are
involved to use electron-beam welding
when the workpiece cannot be placed
in a vacuum chamber and when the
plant must be rugged for use in
extreme cold or hot areas in the field.
The first difference is the need to
provide an annular doughnut-shaped
shroud, encircling the join, to provide
a vacuum. Internal and external
expanding rubber tubes are
incorporated to seal off the area for
pumping down to at least 10^{-4} torr —
better than the ultimate vacuum of a
two-stage mechanical vacuum pump.
In one proposed design, the beam is

made to track the pipe seam using
magnetic deflection coils. It is
generally agreed that a right angle gun
deflection system is also needed to
prevent back-sputtering from
contaminating the triode electron gun.
This may seem a lot of trouble to go
to, but there are important gains to be
obtained. Firstly, electron-beam
welding has greater depth of
penetration than conventional
methods, and this means a smaller vee
can be tolerated. In fact a straight cut
pipe can be joined successfully, saving
both time and labour.

Secondly, only one pass is needed to
join a thick pipe. Again, this provides
savings in the whole pipe-laying
operation.

PLASMA ARC WELDING

Yet another "arc" process gaining
acceptance is the plasma-jet torch used
to weld, cut or trim metals. An arc,
maintained between positive and
negative electrodes, has gas passing
through it to become ionised into both
positive and negative ions, the whole
retaining charge neutrality. Heat from
this torch is transferred to the
workpiece by virtue of the ion impacts
— it is an efficient process. Plasma-arc
welding holds attractions that the
joints need not be premachined to
close tolerances, the edges can be cut
straight (which is easier to do) and
that the method appears to be more
reliable. Already plasma torches are in
use to "turn-off" stock in a lathe, to
clean away the greasy surface of
railway lines and for cutting.

No longer is arc welding a power
electrical engineering discipline —
electronic methods are obviously
paving the way to new possibilities.
Who would have thought back in the
1930's that a modified cathode ray
tube device would be used to weld
metre-diameter pipe-lines!

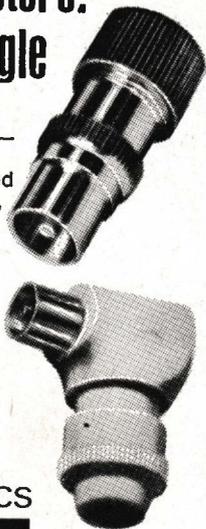


The Best Connections— Belling & Lee RF Connectors.

straight or right angle

Belling & Lee have today's widest range of RF Connectors—and they're generally available from stock. Shielded or insulated plugs; conductors for soldering, crimping or solderless; straight or the new right angle model L2156.

- Special collet clamps for efficient braid connections and anchorage in cable mounting members.
- Impedance 60-70 ohms.
- Mating conforms to BS3041 and IEC169-2.



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THE AU.DIOPHILE TAPE

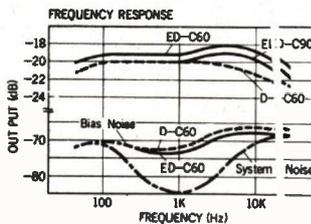


NEW ASTOUNDING MATERIAL

TDK "MAGNETITE"

● THE CASSETTE DEIGNED EXPRESSLY FOR PURE SOUND

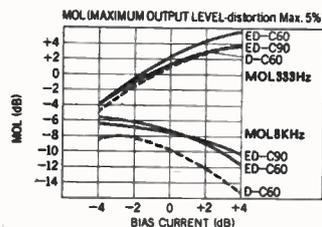
Performance data show ED superiority, but Your Ears also tell the difference of ED Cassettes. There is linearity of frequency



response from low to high frequency range. No need for Cro selector to correct for excessive high response and low frequency drop off. Any good recorder can now give balanced high fidelity recordings.

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The bias required is normal, that is the target for any magnetic tape. ED is the dynamic tape which suits almost every cassette recorder. No necessity for special bias settings. The superior performance of ED is achieved by the highest and even the lowest priced recorders.



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All listed prices are in Australian dollars, International Postal Money Orders (please send PO receipt with order for immediate shipment). Banque Chasiers check (preferably in US funds) and rated company cheques (with foreign exchange stamp approval affixed) will be accepted. Due to recent Australian government restrictions we are not able to clear personal checks... All goods are new unused surplus and are fully guaranteed. Orders will be shipped within two workdays of receipt of same. All customs forms will be attached. Minimum order amount is \$5.00, do not add postage — we pay postage. Surface mail for orders under \$10.00 and Air Mail for orders over this amount.

DATA SHEETS ARE PROVIDED FOR EACH ITEM PURCHASED

DIGITAL INTEGRATED CIRCUITS (dual in line package)

Signetic TTL (5 volt operation)	
8440 Dual 2/2 and or invert gate	\$0.35
8455 Dual 4 input buffer	0.40
8480 Quad 2 input NAND gate	0.40
8H16 Dual 4 input NAND (high speed)	0.35
8H70 Triple 3 input NAND (HS)	0.35
8H80 Quad 2 input NAND (HS)	0.35
8H90 Hex inverter (HS)	0.35
8H21 Dual JK flip flop (HS 60 MC)	1.10
8290 Decade counter (HS 60 MC)	3.15
8292 Decade counter (low power)	0.90
8251 BCD to decimal decoder	1.75
7480 Gated full adder	0.50
7413 Dual 4 input NAND Schmidt triggers	1.75
74181 Arithmetic logic unit	3.50
8260 Arithmetic logic unit	3.15
8261 Fast carry for above	1.35

Send for free brochure listing hundreds of bargains.

Signetic DTL (5 volt operation) dual in line

SP629 Flip flop	\$0.35
SP659 Dual 4 input buffer	0.25
SP670 Triple 3 input NAND gate	0.25
SP680 Quad 2 input NAND gate	0.25
SP690 Hex inverter	0.25

Signetic "Utilogic"

This family of logic offers medium speed combined with a greater noise margin than is available from either DTL or TTL logic. Power requirements are the same as TTL/DTL (single 5 volt supply).

"Utilogic" dual in line package

LU300 Dual 3 input expander	\$0.30
LU301 Quad 2 input diode expander	0.30
LU305 6 input NAND	0.30
LU306 Dual 3 input NAND	0.35
LU314 7 input NOR	0.35
LU317 Dual 4 input expandable NOR	0.30
LU333 Dual 3 input expandable OR	0.30
LU334 Dual 4 input expandable NAND	0.30
LU356 Dual 4 input expandable driver	0.30
LU370 Triple 3 input NOR	0.30
LU377 Triple 3 input NAND	0.30
LU387 Quad 2 input NAND	0.30

LINEAR INTEGRATED CIRCUITS

Fairchild and Signetic devices (no choice). Some of this line is not marked but it is fully tested and sold on a money-back guarantee. State first choice on package (TO-5, 8-pin dual in line, or 14-pin DIP—we will not ship flat packs).

NE526 High speed comparator	\$1.00
NE565 Phase lock loop	3.50
NF566 Function generator	3.50
NF567 Tone decoder	3.50
709 Popular operational amplifier	0.35
5558 Dual 741 op amp (compensated)	1.00
747 Dual 741 op amp	1.00

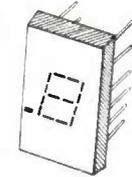
LED DISPLAY

The MAN1 is a seven segment diffused planar GaAsP light emitting diode array. It is mounted on a dual in line 14-pin substrate and then encapsulated in clear epoxy for protection. It is capable of displaying all digits and nine distinct letters.

FEATURES:

- High brightness, typically 350ft.-L @ 20ma.
- Single plane, wide angle viewing, 150°.
- Unobstructed emitting surface.
- Standard 14-pin dual in line package.
- Long operating life, solid state.
- Operates with IC voltage requirements.

ONLY \$4.00



"UTILOGIC" SPECIAL

Ten (10) pieces of LU321 dual JK flip flops and four pages of application information describing ripple counters (3 to 10) and divide by 12 up/down binary and decade counters, shift registers and self-correcting ring counters.

Complete package only \$3.60

LINEAR SPECIAL

Ten (10) 741 fully compensated operational amplifiers with data sheet and two (2) pages of application notes covering the basic circuits for op-amps.

EACH \$0.65 PACKAGE \$6.00

8 pin DIL Only 35c each
\$2.75 for ten.

LM309K—5 volt regulator

This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof, it is designed to shut itself off with overload of current drain or over temperature operation.

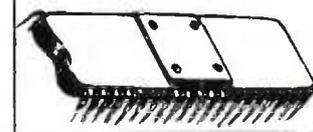
Input voltage (DC) can range from 10 to 30 volts and the output will be five volts (tolerance is worst case TTL requirement) at current of up to one ampere.

**EACH \$2.50
FIVE for \$10.00**

LSI—CALCULATOR ON A CHIP

This 40 pin DIP device contains a complete 12 (twelve) digit calculator, Add, Subtract, Multiply, and Divide. Outputs are multiplexed 7 segment MOS levels. Input is BCD MOS levels. External clock is required. Complete data is provided with chip (includes schematic for a complete calculator).

Complete with data \$9.95



Data only \$1.00

COUNTER DISPLAY KIT—CD-2

This kit provides a highly sophisticated display section module for clocks, counter or other numerical display needs.

The RCA DR-2010 Numitron display tube supplied with this kit is an incandescent seven segment display tube. The .6" high numeral 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) fiberglass 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 \$9.95
Assembled and tested \$12.00

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 \$8.95**

The MAN3M is a seven segment diffused planar gallium arsenide phosphide readout. It is capable of displaying 10 digits and 9 distinct letters and is encapsulated in a high contrast red epoxy package.

- 0.127" high led 7 segment display.
- Bright red 400 ft.-L at 10ma per segment.
- Compatible with standard digital IC's.
- Compact spacing 5 digits per inch.

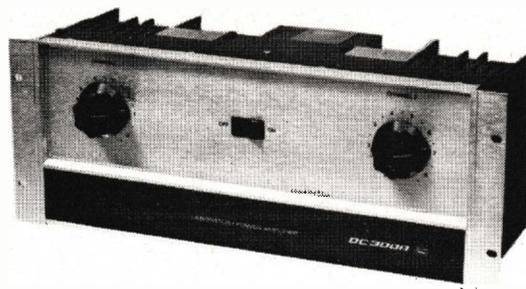
\$3.00 each. Ten or more \$2.50

Babylon Electronics Inc.

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

AMCRON DC-300/A

“they’ve done it again!”



Say farewell to the grand old DC300, and welcome to THE PROBLEM SOLVER, the amp that is going to make your job easier and your customers happier. The original model DC300 was a great amp – the first super-power low distortion amp in the world, when Amcron introduced it five years ago.

Meanwhile, top sound systems designers have used it successfully in hundreds of demanding situations, and made some excellent recommendations for improvements. The response of the Amcron design team was *not* an updated DC300, but a totally *new* and different amplifier, the DC300A. It is the *only* high power low distortion amp specifically *designed* for commercial sound applications. (CAUTION: *There are some large consumer-type amps attempting to sell in the commercial sound field without providing adequate continuous power for all load impedances.*)

Power You Can Count On

One of the DC300A's most outstanding features is that it had *double* the number of output transistors. This means effectively twice the muscle of the old DC300 – at the same price. Each channel has eight 150-watt devices for 1200 watts of power dissipation *per channel*. The DC300A is rated at 150 watts per channel continuous into 8 ohms with both channels driven, 300 w/ch into 4 ohms or 500 w/ch into 2.5 ohms.

Two Amplifiers in One

As a dual-channel amplifier with separate level controls and circuitry for each channel, the DC300A is almost *two* amplifiers in one. This gives you additional flexibility in controlling your speaker load, as when driving separate front and back speaker systems in a large auditorium, or when bi-amping a system. For 600 watts continuous output at 8 ohms, the DC300A converts to a mono amp with two plug-in parts. This makes it possible to drive a 70-volt line directly without a matching transformer.

Superior Output Protection

The DC300A output protection circuitry is a radically new design which completely eliminates DC fuses and mode switches and further reduces service problems to the negligible level. It is superior in every way to the old VI-limiting circuit pioneered by Amcron and now used by most other high power amplifiers, since it introduces *no* flyback pulses, spikes or thumps into the output signal, whether operating as a single- or dual-channel amp.

Gone too is the need to baby the amp by carefully juggling load configurations. The Problem Solver can drive *any* speaker load – resistive or even totally reactive – with *no* protection spikes! Parallel speakers with no deterioration of sound quality, since changing the load impedance only affects the maximum power available, not the ability of the amp to keep on producing clean sound.

Lowest Distortion and Noise

Also new is the DC300A's IC front end, which sets new world's records for low distortion and noise. At the 8-ohm rated output, IM and harmonic distortion is less than 0.05% full spectrum; hum and noise is 110db below. Servicing – if ever necessary – is a snap, since removing the front panel accesses the entire circuitry.

Although it is completely redesigned model, the DC300A has inherited some characteristics from its predecessor.

PRICE \$795.00 less than the DC300 sold for.

WARRANTY – three years, covering all costs of parts labor and round-trip shipping.

COOLING – excellent heat dissipation provided by massive cooling fins and the entire chassis itself.

DEPENDABILITY – stringent pre- and post inspection and testing proves every electronic component, every circuit module and every finished unit, to bring you one step closer to install-and-forget field dependability.

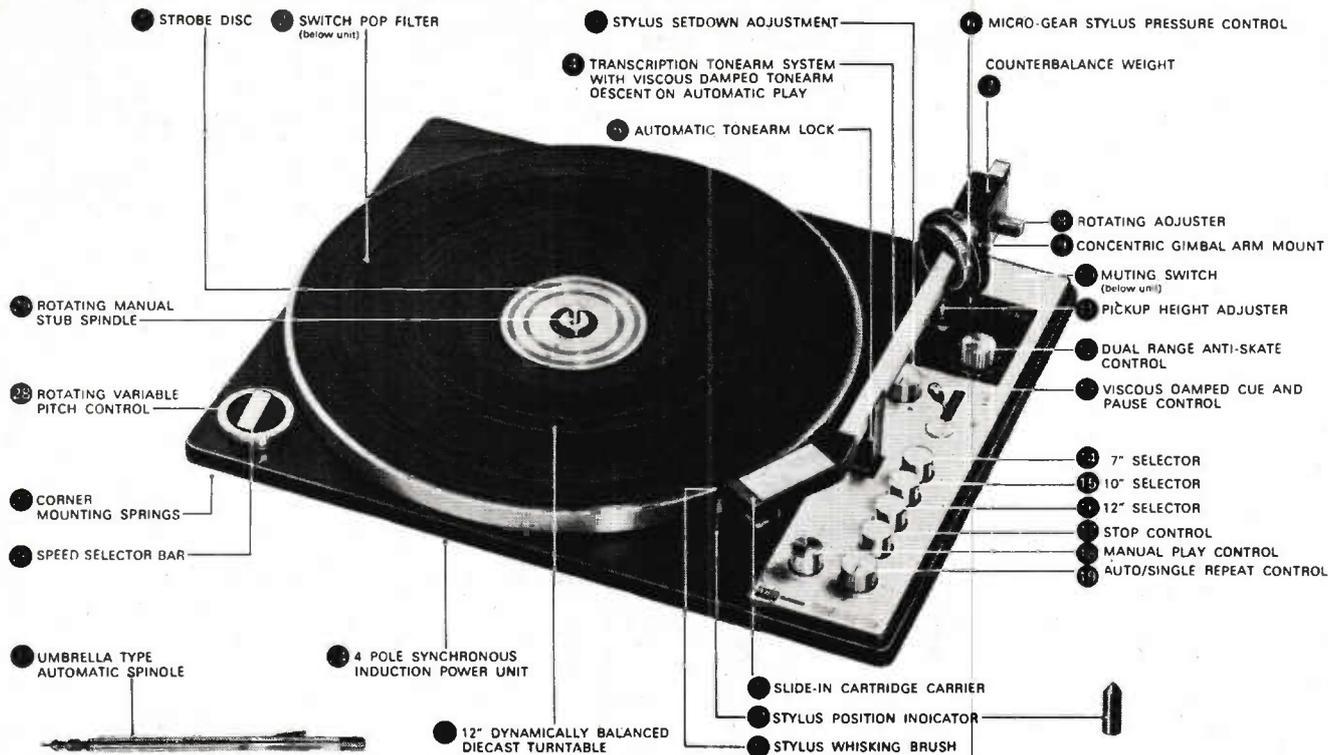
PEOPLE – the same innovative design team and careful craftsmen who made the DC300 such a sound success. And the same knowledgeable customer-service men ready to discuss your special application and send you detailed technical data.

 **AMCRON**

AUSTRALIAN DISTRIBUTORS:

B.J.D. Electronics Pty. Ltd. 190 Willoughby Road, Crows Nest, 2065 N.S.W. Ph. 439-4201.
202 Pelham St., Carlton, 3053 Vic. Ph. 347-8255

“Taking it all together — performance, features, styling — the BSR 810 moves into ranking place among the best automatics we know of. And at its price, the others may well be in for a real contest.” Hi-Fidelity Magazine, May 1972.



At \$149* for the kit, the brilliant BSR/810 transcription turntable is hardly cheap. But your ears will tell you it's a bargain.

* At recommended retail price.

BSR, manufacturers of most of the world's turntables, have now turned the tables on expensive units.

And here are the features that make the 810 such an attractive proposition: the unit weighs 17 lbs — the diecast turntable alone is a solid, dynamically balanced 7½ lbs. A 4-pole beautifully balanced synchronous motor automatically compensates for any fluctuation in voltage input, or for any record load. A pitch control gives absolute accuracy of speed, utilising a stroboscopic centre plate.

The low mass pick-up arm gyroscopically pivots in a concentric gimbal mount producing virtually friction free movement in both horizontal and vertical planes. It also has a slide-in cartridge carrier, decoupled one piece counterbalance for a minimum tracking pressure of ½ gramme with suitable cartridge. And the arm length is over 8½ inches to reduce tracking

error to less than 0.5" per inch.

Viscous cueing is also standard on automatic as well as manual operation, and a unique anti-skate device is also featured for elliptical and standard styli. Speeds are 33½ rpm and 45 rpm. (Which are all you need today.)

Single to automatic play conversion is achieved with the interchangeable umbrella centre spindle.

Start-stop, record size control and auto repeat and manual conversion are actuated by push button controls set in a handsome brushed aluminium panel.

Of course there is much more you'll want to know about the BSR 810. Write to BSR and we'll send you a colour brochure.

BSR (A/asia) Pty. Limited.
Anne St., St. Marys. 2760
TELEGRAMS "BSR" St. Marys. 2760
TELEX 23159. PHONE 623 0375

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Goldring Sales and Service (Canberra)
Unit 5, 83-85 Wollongong St., Fyshwick. 2069
Phone-95 8248
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32 Northwood St., Leederville. 6007 Phone-84988

BSR McDONALD
810

BSR:117R2

SENSORS ON

The human machine — will it ever be entirely replaced.

IN these times of increasing labour costs and available capital, the cry in industry is to replace labour by automation. For a while, back in the fifties, many people became alarmed at the then forecast capabilities of automation. It was portrayed as a demon that was slowly going to take over the human race. Such incidents as Schaffers "Robot", of the twenties, provided evidence for this line of thought, for "Robot", who could drive nails with a hammer, decided to do it on poor Schaffer's head.

Today we find that automatons are not much closer than they were then if we compare current performance attained with human capabilities. We do still regard automation as a worthwhile goal, but there is less panic about it overtaking us.

Upon reflection, now that we have experience with certain degrees of automation, it is not so bad a thing — machines appear unlikely to replace humans at everything. The experience has also revealed that automation usually requires an increased work-force, not a reduction. Reasons for this are that automation is economically acceptable, firstly, where a larger market (more labour in other ways) can be seen (and the costs of capital needed are therefore justified) and, secondly, where labour is so scarce that to automate is the only answer.

The most basic and relevant difference between the "its" and us at present are that we have been unable to give a chunk of hardware the ability to imagine and be intelligent. As far back as 1740, Lomethrie published writings on whether man is or is not a deterministic machine; in other words, given total knowledge of the human organism, can we predict the behaviour — is there a hidden factor never to be available to man? This question is unresolved.

Around the 1960's there was an upsurge in the idea of the intelligent machine — it always remains of course, but this period saw greater interest. The explosion of computer power and the almost ethereal rise of control theory into the higher levels of thought processes at that time aided visions of intelligent machines.

We view these ideas more soberly now. I am sure many people still believe in the possibility of man-made intelligence, but I feel their views are now tempered about the chances of real success in the near future.

It all boils down to the fact that computers — our most advanced

machine replacing the human. We do not possess enough intelligence to know how to do it. (In fact, some things the human races do, show that we do not have ourselves in control!)

So with these thoughts in mind we should let machines do machine-capable tasks and men the

	Machine	Man
Speed	Much superior	Lag 1 sec.
Power	Consistent at any level	1500W for about 10 sec, 350 W for a few minutes, 150 W for continuous work over a day.
Consistency	Ideal for routine, repetition, precision	Not reliable — should be monitored by machine.
Complex activities	Multi-channel	Single channel.
Memory	Best for literal reproduction and short-term storage	Large store multiple access. Better for principles and strategies.
Reasoning	Good deductive	Good inductive.
Computation	Fast, accurate — poor at error correction	Slow, subject to error. Good at error correction.
Input sensitivity	Some outside human senses, e.g. radioactivity	Wide range (10^{12}) and variety of stimuli dealt with by one unit, e.g. eye deals with relative location, movement and colour.
	Insensitive to extraneous	Affected by heat, cold, noise and vibration.
	Poor for pattern detection	Good at pattern detection. Can detect signals in high noise levels.
Overload reliability	Sudden breakdown	Graceful degradation.
Intelligence	None	Can deal with unpredicted and unpredictable. Can anticipate.
Manipulative abilities	Specific	Great versatility.

machines — are good at some tasks — and the human at others. There is little overlap between the two. Each has a role. Somewhere in recent times a list of the relative abilities of each was devised. It is known as a Fitts List and is reproduced on this page.

Looking at this we see that even young children win hands down in many tasks. It is hard to envisage the

more generalist aspects of existence. From the list it is clear that a man in a control-loop, say, at the control panel of a processing plant or an aircraft, must be regarded as a fallible machine who needs to be treated and serviced in certain ways to maintain the desired performance. His versatility can be pushed only so far to make him conform. ●

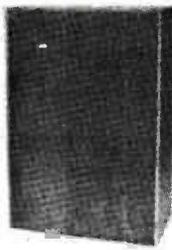


SONATA

All silicone solid-state Hi Fi Stereo Amplifier Model NS-1600D

10 watts R.M.S. per channel. Each channel has separate bass/Treble controls.

Inputs for magnetic or ceramic cartridge, crystal mic., radio, tape - tapeout stereo headphones. 8-16 ohms. Instruction booklet, circuit supplied. Timber cabinet. Dimensions: 14½" x 8" x 4". Price \$67.50. Pack & Post \$1.50. Interstate \$2.50.



NEW MAGNAVOX 8-30 SPEAKER SYSTEM

1.6 c.ft. 8 ohms and 15 ohms. Oiled Teak Veneer.

Complete, ready for use \$59.00
8-30 Speaker Only \$16.50 ea
3TC Tweeter Only \$3.40 ea
Philips 1" Dome Tweeter
per pair \$20.00
Fully Built Cabinet \$32.00 ea
Cabinet Kit \$22.00 ea

The 1.6 cu.ft. Cabinet can be supplied with a Baffle Board pre-cut to suit your Speakers. Some of the other combinations available are 12" + 6" + Tweeter - 10" + Mid + Tweeter - 2 x 6" Tweeter, etc.

STEREO RECORD CHANGER

C141 - C142 - C142-A3

Current models, 4 speeds, automatic or manual operation.

Deluxe model with 12in turntable. Cueing device, Ceramic cartridge, Diamond Stylus \$40.00
Deluxe model as above with - adjustable counter balance, 2 spindles, calibrated stylus pressure control added . . \$46.50
Deluxe model as above with 12in. Diecast Heavyweight Turntable, 4-pole Shielded motor. Suitable for magnetic cartridge \$56.50.

Pre-cut oiled teak mounting platform and fully moulded tinted perspex cover, \$20.50 p/p \$1.50



Model C142 and C142-A3 can be supplied with Magnetic Cartridge and Diamond Stylus at \$10.00 extra.

PANEL METERS



Type Size Barrel Dia.	MRA-38 1¾" sq. 1½"	MRA-45 2" sq. 1¾"	MRA-52 2½" sq. 2"	MRA-70 3¼" sq. 2¾"	MRA-85 4¼" sq. 3¼"
50uA	\$5.75	\$6.40	\$7.00	\$8.15	\$10.25
100uA	5.45	5.80	6.40	7.65	9.60
500uA	4.60	4.85	5.50	6.65	8.50
1mA	3.95	4.45	5.00	6.40	8.00
10mA	3.65	4.25	4.85	5.80	7.65
50mA	3.65	4.25	4.85	5.80	7.65
100mA	3.65	4.25	4.85	5.80	7.65
500mA	3.65	4.25	4.85	5.80	7.65
1mA'S'	4.25	4.65	5.25	6.40	8.50
V.U.	4.50	5.25	5.60	6.65	9.50
15V DC	4.40	4.85	5.35	6.40	8.50
500V DC	4.40	4.85	5.35	6.40	8.50
300VAC	4.75	5.25	5.80	6.65	9.00
1 Amp. DC	4.40	4.85	5.35	6.40	8.50
10 Amp. DC	4.40	4.85	5.35	6.40	8.50
30 Amp. DC					9.00

MAGNAVOX WIDE RANGE FREQUENCY RESPONSE TWIN CONE SPEAKERS, 8 or 16 ohms. 30 - 16000 Hz.

6WR Mk.V	12 watts RMS	\$ 9.90
8WR Mk.V	16 watts RMS	\$10.75
10WR Mk. IV	16 watts RMS	\$11.50
12WR Mk. IV	16 watts RMS	\$12.50

Pack & Post 65c. Send S.A.E. for Data Sheet.

STEREO HEADPHONES

Fully padded, 9ft curl cable with plug. 25-18,000 Hz. 8 ohms deluxe - slide vol. control. \$11.35. Rotary Vol. control \$10.95. P/P 65c.



Standard Stereo Headphones \$4.70

Sennheiser HD-414 stereo headphones \$25.00 P & P 65c.

GARRARD

STEREO TURNTABLES

Zero 100 \$177.80 less cartridge
SL 72B \$97.00 less cartridge
SP 25 MK III \$55.80 less cartridge
Base and Cover for all the
SL 65B ceramic cart \$82.80
above units \$23.80
Send S.A.E. for technical specification

ROLA SPEAKERS

12U50. 50 watts 25-11kHz \$35.00
12U x 50. 50w. 40-13kHz \$40.00
C100. 20w. 40-11kHz \$14.90
Send S.A.E. for data sheet.

C100X \$14.00
C8MX \$8.35
C100 \$12.75

CAR RADIO SPEAKERS

Ferrite magnet, Lantor cloth cover for cone protection. All available with 3-8- or 15 ohm voice coil.

Size	6" x 4"	7" x 5"	8" x 4"	9" x 6"
Freq-Hz	115-8500	85-8500	85-7500	85-8500
Watts	6	7	7	8
Price	\$5.25	\$6.55	\$6.90	\$7.25

P & P 50c

CAR SPEAKERS

Top quality - black sloping front cabinet. 8 ohms 5" \$12.50 per pair.

Hi Fi Speaker System

Bookshelf style 14" x 8½" x 8¾".
6½" quality speaker 8 ohms. 8 watts. Timber Cabinet walnut.
\$20.80 each P & P 95c \$40.00 pair.



STEREO RECORD PLAYER

240V Ac operation. Chromed tubular metal 9" tone arm with adjustable counter balance and rest - ceramic cartridge, sapphire stylus. 4 speed motor and 6¼" metal turntable with mat. \$7.90 - post 50c.

PHILIPS AD0160

1" Dome tweeter. 8 ohms \$8.95 P & P 50c.

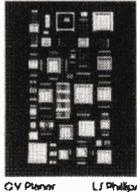
12VOLT TACHOMETER

4 on 6 cylinder 0-6000 rpm. 2¼" Dia. \$9.00

BOOK REVIEWS

REVIEWER: BRIAN CHAPMAN

Thick Film
Circuit



THICK FILM CIRCUITS by Planer and Phillips, Published by Butterworths 1972. Hard covers 152 pages 215mm x 140mm. Price \$11.20.

The uses of thick film microcircuits are widespread and they are finding ever increasing popularity as their advantages become more generally known.

They are particularly suitable for the manufacture of relatively small numbers of identical circuits. The plant cost is relatively small allowing small companies to have their own in-house facility which is relatively simple to operate.

It is expected that thick film techniques will progressively replace printed circuit board techniques for many commercial equipments as the technique provides greater mechanical and electrical stability (particularly at high temperatures), and since a large proportion of the thick film components are integrated with the substrate, higher power dissipation is allowable.

Moreover resistors and capacitors may be fabricated on the substrate with a far greater range of values, and what's more, may be readily trimmed for any desired accuracy.

Their greater ruggedness and reliability coupled with their small size and relatively uncritical manufacturing process make them particularly suited for aerospace or military applications. But they are now finding their way into computers and even into consumer fields such as washing machine control and automobile regulators.

This book provides a coverage of the basic theory, materials and processes of the technology to a depth adequate for those who require merely a better understanding of the devices or those who intend to design them into their own equipment. — B.C.



UNDERSTANDING ELECTRONIC CIRCUITS by Ian R. Sinclair. Published by Fountain Press 1973. Hard covers, 205 pages 215 x 130 mm. Review copy supplied by publisher. Australian price \$10.65.

This book is a companion work to the previously published "Understanding Electronic Components" by the same author. It is intended for the middle-of-the-road reader; those who already have knowledge of components and elementary electrical theory and wish to extend their circuit knowledge.

Mr. Sinclair knows his electronics and has written many worthwhile articles in journals such as *Wireless World*. In this new book he covers the usual field — amplification and various types of amplifiers, oscillators, pulse circuits, logic and counting, power supplies and the whole oscilloscope. There is a lot of worthwhile

information given and much of it would be of considerable interest and value to the practical serviceman or technician who is reasonably fresh to electronics.

Examining the book from the point of view of its intended audience and content, however, it would seem that the author has tried to cram too much information into too few words. As a result, although the information is there, and is correct, I feel that people trying to learn electronics from this book would find the task difficult.

The subject matter is simple but the style isn't. A great pity because it spoils what could otherwise be a good book. — B.C.

COMPUTER SECURITY. By Peter Hamilton. Published by Cassell/Associated Business Programmes Ltd 1972. Hard covers, 122 pages 235 mm x 150 mm. Review copy supplied by publisher. Australian price \$10.50.

In the technical press (and to some extent the popular press) there has been a increasing number of articles and editorials decrying the misuse of computer data banks. A less publicized issue, but one that should also be of great concern, is that of computer security.

The first issue concerns the protection of people from computer aided bureaucracy whilst the second, understandably less popular issue, is concerned with *protecting the computer from people*.

It is the latter issue which is the subject of this timely book by Peter Hamilton.

As a preface to examining crimes against computers and the means of combating them, an analysis is given of the trends and motivations involved in criminal activities resulting from the emergence of our technocratic society. It is pointed out that the crime rate is rapidly on the increase and that illegal activities are by no means restricted to those who are unintelligent.

In fact many cases have been reported where large sums have been misappropriated by the manipulation of computer programmes. In most cases detection of the crime have been purely a matter of luck (or bad luck depending on your point of view) and there must be many more cases where such activities have been carried out so expertly that the theft will *never* be discovered.

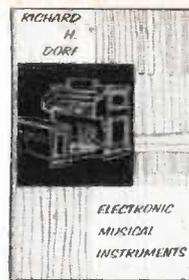
In addition to pure larceny, the book examines aspects such as the protection of the computer from arson or sedition. Many people see the computer as some kind of ogre which threatens their employment. Yet others see the destruction of data storage or tampering with programming as a means of getting their own back on the company. What would happen to a large company whose operation was controlled by computer, should the computer and/or its data bank be destroyed? No doubt the result would be utter chaos from which the company may take years (if ever) to recover.

Further the computer is very vulnerable to industrial espionage and indeed the book suggests that a computer based society may well be conquered by gaining access to and then ultimate control of, the nation's computer complex.

The surveillance of people and property as an aid to minimizing security risks is discussed from the conflicting aspects of the need for such surveillance, and the individual's entitlement to privacy. The best methods of implementing such surveillance for the protection of the computer complex is then discussed in detail and a full tabular assessment of the security risks and suggested remedial action is given in the rear of the book.

An extremely interesting and easy to read book which should be of vital interest to company management as it gives practical advice on the best methods and techniques of protecting a most vulnerable management tool. B.C.

ELECTRONIC MUSICAL INSTRUMENTS by Richard H. Dorf.
 Published 1968 by Radiofile.
 Available from Schober Organs
 (Australia) 124 Livingstone Ave.,
 Pymble NSW 2073. Price \$10.00. Hard
 covers 393 pages 225mm x 150mm.



COMPUTER PROGRAMMING MANAGEMENT By Jeff Maynard.
 Published by the Butterworth Group
 1972. Hard covers, 99 pages 215
 mm x 140 mm. Australian price
 \$8.00. (limp cover \$5.15).

Since the first edition of this book appeared in 1955 it has been the best and most complete coverage of electronic organ circuitry and practice available.

This new third edition is more than just a new edition, it has been completely and totally revised to such an extent that very little if any, of the original material is in the present volume.

After a general description of the elements of music and the theory of organs the book describes, in detail, the circuitry and constructional details of eleven different makes of electronic organ. The majority of the circuitry described is transistorized and hence reasonably up to date. Published as it was, in 1968, the latest integrated circuitry was not able to be included but the principles of operation of course remain the same.

The book provides a really excellent treatment of electronic organs and must be an almost essential purchase for anyone interested in electronic organs.

My one criticism is the title. The book covers organs only and does not deal with other electronic instruments such as synthesizers and the like and the title is therefore too broad. Excellent value nevertheless. - B.C.

In the early days, computer programming was a highly specialized task requiring very specialised skills and abilities. As a result, programmers were considered a very special breed and were held in considerable awe by the rest of us.

This is no longer true as machine language has given way to high level languages which can be taught to anyone of average intelligence in a few days.

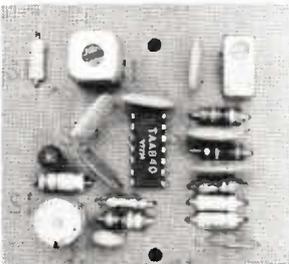
Hence in a company which relies heavily on some form of computer base, the programming department becomes merely another form of production department. In such departments the manager will usually be a young programmer of exceptional ability who has risen to the position in a relatively short space of time.

Unfortunately skill in programming does not necessarily imply skill in management and too often the management function is second best to the problem solving function - to the detriment of efficient departmental operation.

This book is specifically written to aid the programming manager to organize and run his department in the most efficient manner. It covers all facets of the task including estimating and scheduling, documentation, personnel management, the function of the programming manager and last but not least programming techniques. - B.C.

NEW!

AM TUNER MODULE



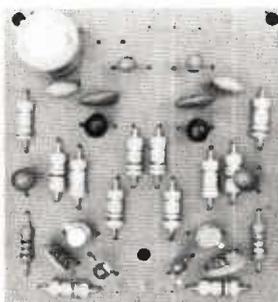
A neat little tuner module on a 2 11/16" x 2 1/2" printed circuit board. It is packaged in a transparent plastic bag with instructions ready for display. The module is already aligned and can be used with an A.W.A. 39260 gang and ferrite rod aerial, the aerial also available from T.V.T. if needed.

Brief specifications:
 Tuning range 510-1625 KHz. Output 750 mV into 100 K. Power supply 7 to 9V DC, 20 mA from battery etc.

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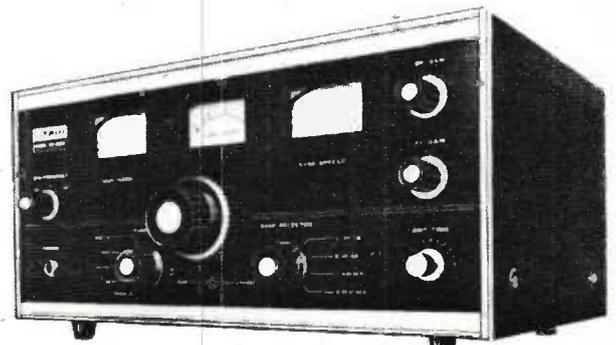


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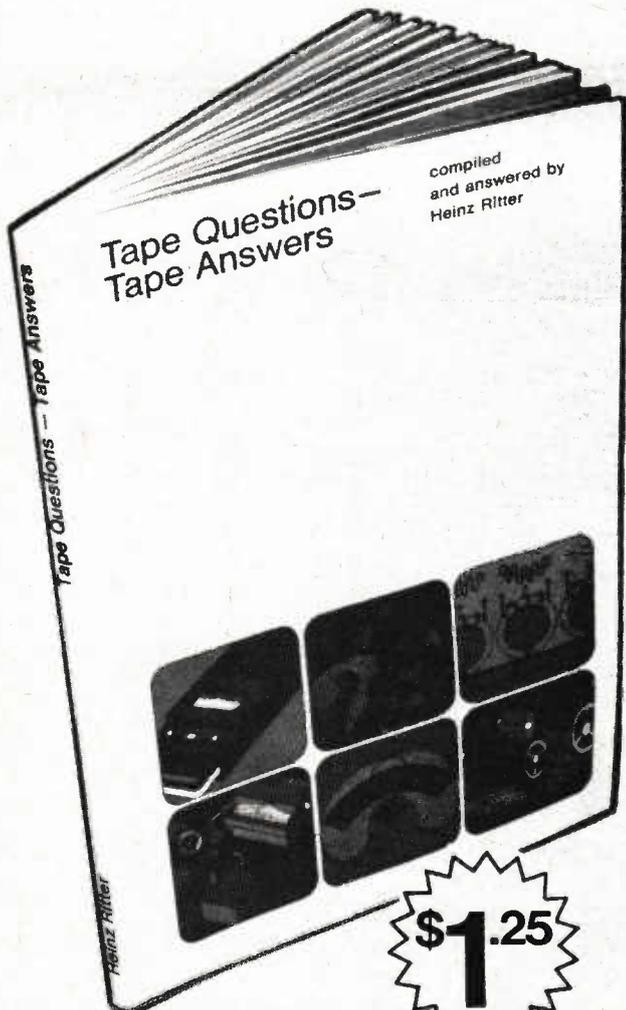
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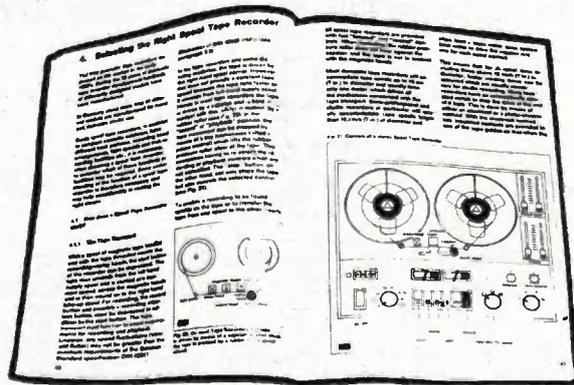
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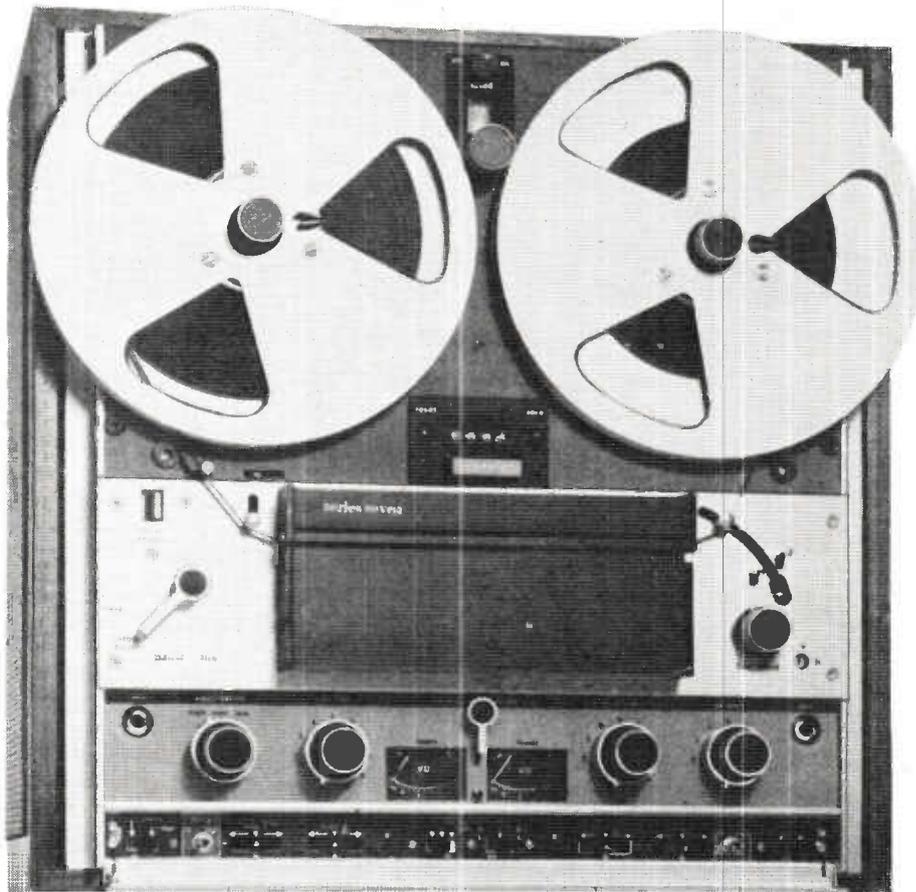
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ELECTRONICS TODAY INTERNATIONAL — NOVEMBER 1973

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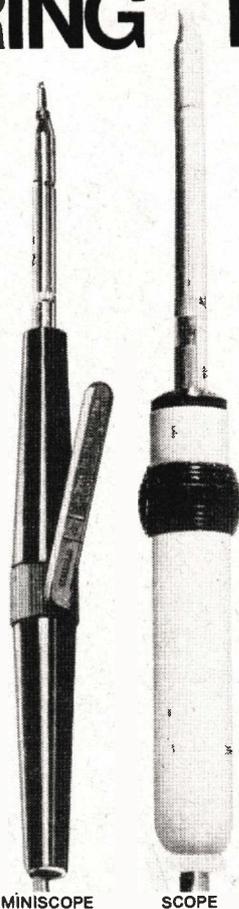
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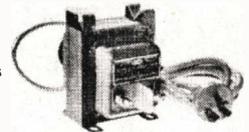
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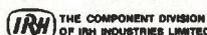
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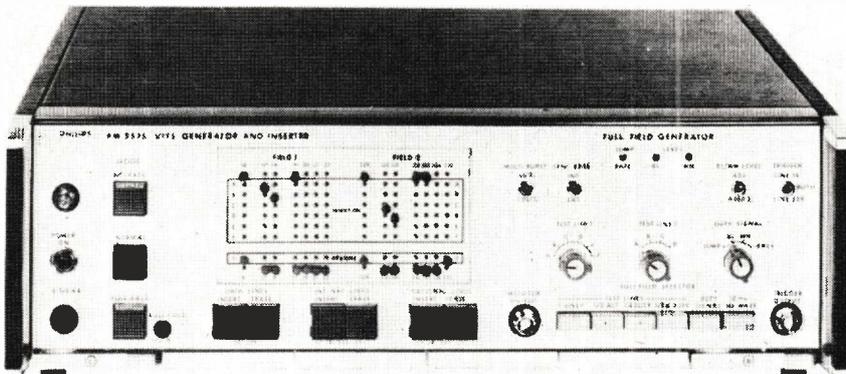
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"IN TRANSMISSION" MONITORING OF TV-PICTURE QUALITY



Philips Test & Measuring Instruments has announced the release of two interfield test signal generator and inserter units for "in transmission" testing and automatic analysis of television-picture signals. Such units have assumed greater importance with the increase of TV programme transmission times and consequent reduction of non-programme testing time.

One unit, the PM 5575, is intended for use in TV studios, switching centres, transmitter and link stations, and wherever the characteristics of video equipment and transmission lines need to be monitored during transmission. The second and simpler unit, the PM 5576 is for those applications where the insertion test-signals need to be introduced at the program-signal source — for example in a studio or outside broadcast unit.

The concept behind these signal generators is that of providing test signals to continuously monitor transmitted picture-signal quality at any or all the stages along their route from studio to transmitter, which with link stations can involve a distance of several hundred kilometres. Their use permits rapid detection of any defect in the picture-signal transmission chain so that picture quality can always be maintained at the highest standard.

With both the PM 5575 and 5576 units insertion-test signals can be generated and inserted into the picture-signal transmission chain and also erased. Signals generated by the PM 5575 conform to EBU standards for both national and international transmissions, and can easily be adapted to German television, B.B.C. or other national standards as required.

Programming of all signals may be undertaken remotely or via a front panel

pinboard matrix, as can signal-erasure operations.

So as to meet the many different operational needs, the PM 5575 can operate in any of three modes. In the first, the by-pass mode, all picture signals can be set either manually or automatically to by-pass the unit in the case of a power failure, defective operation of the instrument, or when the instrument is pulled out of its cabinet. Also important is the fact that in the event of a power failure the selected test signal programme is stored in a built-in memory so that when power is restored it is automatically available for transmission again without any signal loss. Further, if there is any disturbance of the video or sync-pulse amplitudes which might adversely affect operation of the instrument then it automatically switches to the by-pass mode until normal conditions are restored.

The second mode is the normal operational one in which internally-generated or externally-supplied test-signals are inserted into the programme signal, and simultaneously incoming insertion test-signals can be erased from the signal.

In the third mode, the full-field one, the instrument acts as a full-field generator, and a broad range of test signals for use in this mode can be selected via various controls on the unit's front panel. In this mode the unit can be controlled by either an external TV sync generator or by its own generator.

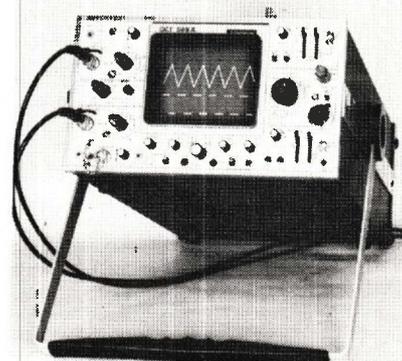
Signals available in the full-field mode comprise the four basic signals officially laid down by the EBU in different modes, and are combined in different modes with black, grey and white intervening lines. Apart from these signals, a special 50 Hz square-wave signal is provided that is very useful for low-frequency response checks. A special

trigger pulse is also provided on the two data lines (16 and 329) so that a standard oscilloscope can be connected to the instrument.

Apart from operating the PM 5575 by manual control, it is possible to remotely programme and operate the unit via rear connectors. In the latter mode the relevant front-panel lights are still illuminated to indicate the signals and mode being used. Since the same controls are normally duplicated at the point of remote control, the status of the unit's operation is clearly indicated at both places.

Since the PM 5576 is designed for insertion-test signal generation and insertion at the point of picture-signal originations, it is a much more economically-priced unit with less controls and facilities than the PM 5575. Thus facilities for full-field-mode operation, programming of test-signal insertion via front-panel controls, and synchronization from programme signals have been omitted. Apart from these omissions, however, the unit operates in a similar manner to the PM 5575. Both units are designed for 19-in rack mounting and can operate in the temperature range 0-45°C.

NEW SCHLUMBERGER OSCILLOSCOPE



An improved version of the Schlumberger OCT.569 Oscilloscope has been released. The new model, the OCT.569A is designed to fill the need for a high reliability portable instrument and the manufacturer's confidence in this is reflected in a three year warranty.

The oscilloscope features dual channel 60 MHz operation, with the facility to operate the two amplifiers in cascade at 0.5 mV sensitivity.

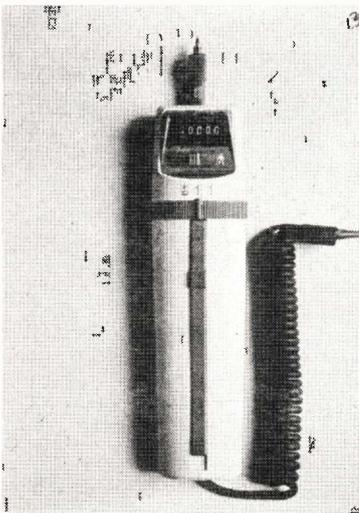
The timebase is a dual delayed sweep type with fully independent triggering of each unit. Various filters are available for HF or

LF trigger suppression and in the optional OCT.569A/TV unit, television line and field triggering is incorporated. Full sensitivity X amplification is available for X-Y plotting.

The oscilloscope is supplied complete with probes which are contained in the protective front panel cover.

Further details: Schlumberger Instrumentation Aust. Pty. Ltd., 112 High Street, Kew, 3101.

HEWLETT PACKARD 970A DIGITAL MULTIMETER



Further details are now available of HP's new 'miniature' multimeter, featured in our September issue.

HP uses a five-digit Light Emitting Diode (LED) cluster in their 3½-digit DMM, so that all probe voltage readings are in volts, and resistance readings in kilohms. There are no scales to misinterpret. Decimal placement is automatic.

Automatic decimal point placement and automatic polarity indication save time. After setting the function selector (ac V, dc V or kΩ), the user simply touches the probe tip to test point, presses the Push-to-Read bar, and the solid-state LED readout automatically displays the correct reading and polarity. When measuring ohms or dc volts it takes typically less than two seconds to range and settle to a proper reading.

Since the display is close to the point of measurement, a user working in closely-packed circuits can hold the probe in one hand without head movement while making a measurement. The display can even be electronically inverted. He needn't worry about reading 6's for 9's, or the

proper decimal place if the probe is used upside down.

Dc voltage from 0.1000 V full scale to 500 V is read to an accuracy of $\pm(0.7\%$ of reading + 0.2% of range). Full scale ranges are 0.1, 1, 10, 100, 1000 V (500 V maximum input).

Ac voltages from 1 volt through the highest range, (500 V rms maximum) from 45 Hz to 1 kHz, are read to $\pm(2\%$ of reading + 0.5% of range). Accuracy from 1 kHz to 3.5 kHz is $\pm(3\%$ of reading + 0.5% of range). On the 0.1 V range and below, accuracy from 45 Hz to 1 kHz is $\pm(2\%$ of reading + 0.5% of range). On these same ranges, accuracy from 1 kHz to 3.5 kHz is $\pm(5\%$ of reading + 0.5% of range).

Resistance measurement accuracy is $\pm(1.5\%$ of reading + 0.2% of range). Ohms ranges are 1 kilohm full scale (1 ohm resolution) through 10 megohms. Maximum test current will not exceed 10 mA.

Input resistance on the voltage ranges is 10 megohms. Input capacitance on ac is less than 30 pF. On all voltage ranges, the Model 970A is protected to 1000 V peak. Input voltage protection with the probe, measuring resistance, is fuse protected up to 250 V rms for up to 10 seconds and will not damage the instrument. Should the resistor fuse become damaged from greater overloads, it can be easily replaced in its clips without soldering.

Three tips which can be extended to various lengths are included with the Model 970A. A short tip is used for most applications, a longer tip for reaching difficult circuit test points, and a concave tip for mechanically cupping over wire-wrapped terminals and test pins. The tip detents into three working positions as well as a folded storage position. A standard banana plug with a clip lead can be plugged into the probe tip socket for measurements requiring two clip leads.

Nickel-cadmium rechargeable batteries and a battery charger come with the Model 970A. Battery life permits greater than 2000 measurements using the "Press-to-Read" switch, or at least 2½ hours' continuous operation with a full charge. Batteries can be recharged in about 14 hours.

The probe case is made of high-impact plastic with built-in stress reliefs should the probe be dropped accidentally from a work-bench. The probe is 16.5 cm long by 4.1 cm wide. The instrument weighs 200 grammes.

Included with the Model 970A is the battery charger, one battery pack, a belt-clip carrying case, sun hood, three probe tips, and an operating manual housed in a hard, compartmented case. To be available in late 1973, an optional (\$36.00) current shunt/bench cradle converts the HP 970A

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EQUIPMENT NEWS

into a five-function bench instrument. A six-position manual switch selects six ranges of ac and dc current from 0.0001 A full scale to 1 A full scale. A straight-through position is for measuring ac and dc volts and ohms.

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

PRECISION SOUND LEVEL METER TYPE 1404B



Dawe Instruments Limited, UK manufacturer of sound level measuring equipment, have announced their Precision Sound Level Meter Type 1404B. This instrument is the latest addition to the Dawe range and has been designed for applications which require the highest possible accuracy.

The Type 1404B covers the range 34 to 130 dB(A) and fully complies with B.S.4197:1967 and IEC Publication 179:1965 for precision sound level meters. This grade of instrument is now called for in many specifications and is recommended in the UK Department of Employment's Code of Practice for reducing the exposure of employed persons to noise where the measurement is likely to be used for legal enforcement of a noise limit. As with many other specifications, this calls for dB(A) measurements which correlate best with subjective noise ratings.

The instrument is compact and robust for field use and may easily be held in one hand. It employs solid-state circuitry throughout and consists of a condenser microphone, weighting network, attenuators, high-gain amplifier and an easily read taut-band meter.

The Type 1404B is powered by a small, inexpensive battery which gives a typical operational life of 80 hours. The complete unit, including battery weighs only 1lb. 14oz. (0.86 kg) and is provided with a

convenient carrying case. An optional Wind Shield Type 1404-1B is available for the microphone to greatly reduce wind noise when taking measurements out of doors.

Further details: Tecnico Electronics, Premier Street, Marrickville, NSW 2204.

POSITIVE DRIVE THROUGH SOLIO WALLS!

An entirely mechanical and positive means of transmitting continuous rotary motion through an unbroken solid barrier has been developed by a British company — particularly for use in fluid handling. Typical applications cover stirrers for pressure and vacuum vessels and certain medical and nuclear-energy applications where fluids must not escape into the environment.

The principal feature of the system is that it provides the possibility of getting true rotation into, or out of, a completely enclosed environment without using a gland, shaft seal or stuffing box. Unlike magnetic

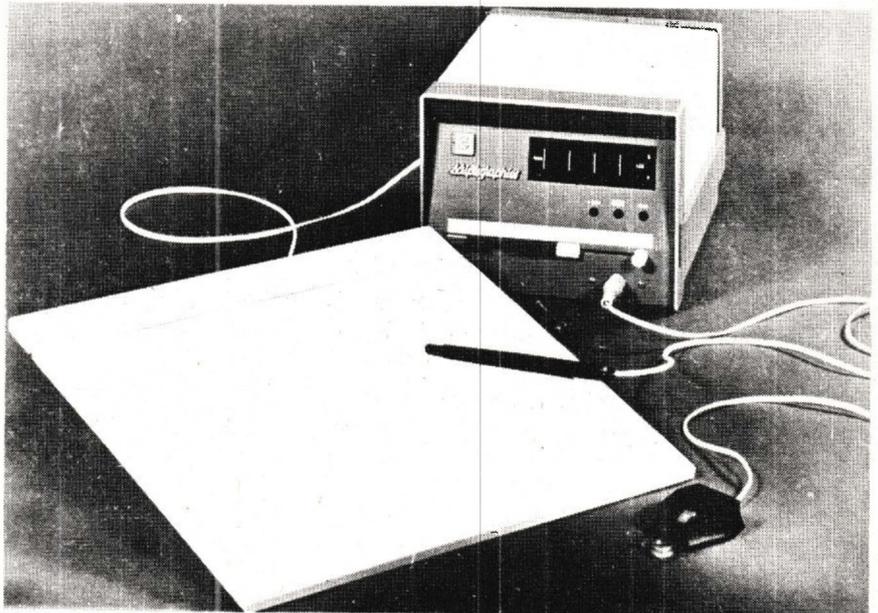
drives, it transmits the full torque available from the prime mover and copes with varying loads and speeds.

Transmission is effected by generating a number of compound wave-forms in part of a wall and in a circular path. Each half-cycle of the wave is backed by a profiled roller, one each side of the wall. The rollers are attached to shafts each side of the wall, so that rotation of either shaft causes the wave-form to travel round its circular path, pushing the other half cycle (and hence roller) ahead of it.

The Refson Solid Wave Drive unit comprises a section wall, which can be statically sealed into place, and rotating shafts on either side. The mechanism is constructed in materials appropriate to the chemical conditions. Wall materials need only be slightly deformable and can include all elastomers, most flexible plastics and, during testing, some metals. Units are offered in various sizes to suit different applications:

Further details from: Chemical Construction & Equipment Co. Pty. Ltd., 36-38 John Street, Mascot, NSW 2020.

LOW COST X-Y DIGITIZER



Anderson Digital Electronics (ADE) has just released the Scriptographics HW series Digitizer. This low cost system is available in areas from 28 cm x 28 cm up to 91.5 cm x 122 cm.

The Scriptographics digitizer is claimed to be the only unit usable with both stylus for inking or fast informal work, and cursor for precision and zero parallax. The stylus may be inking or non-inking. The cursor is available with up to four buttons providing functions as selected by the user's program.

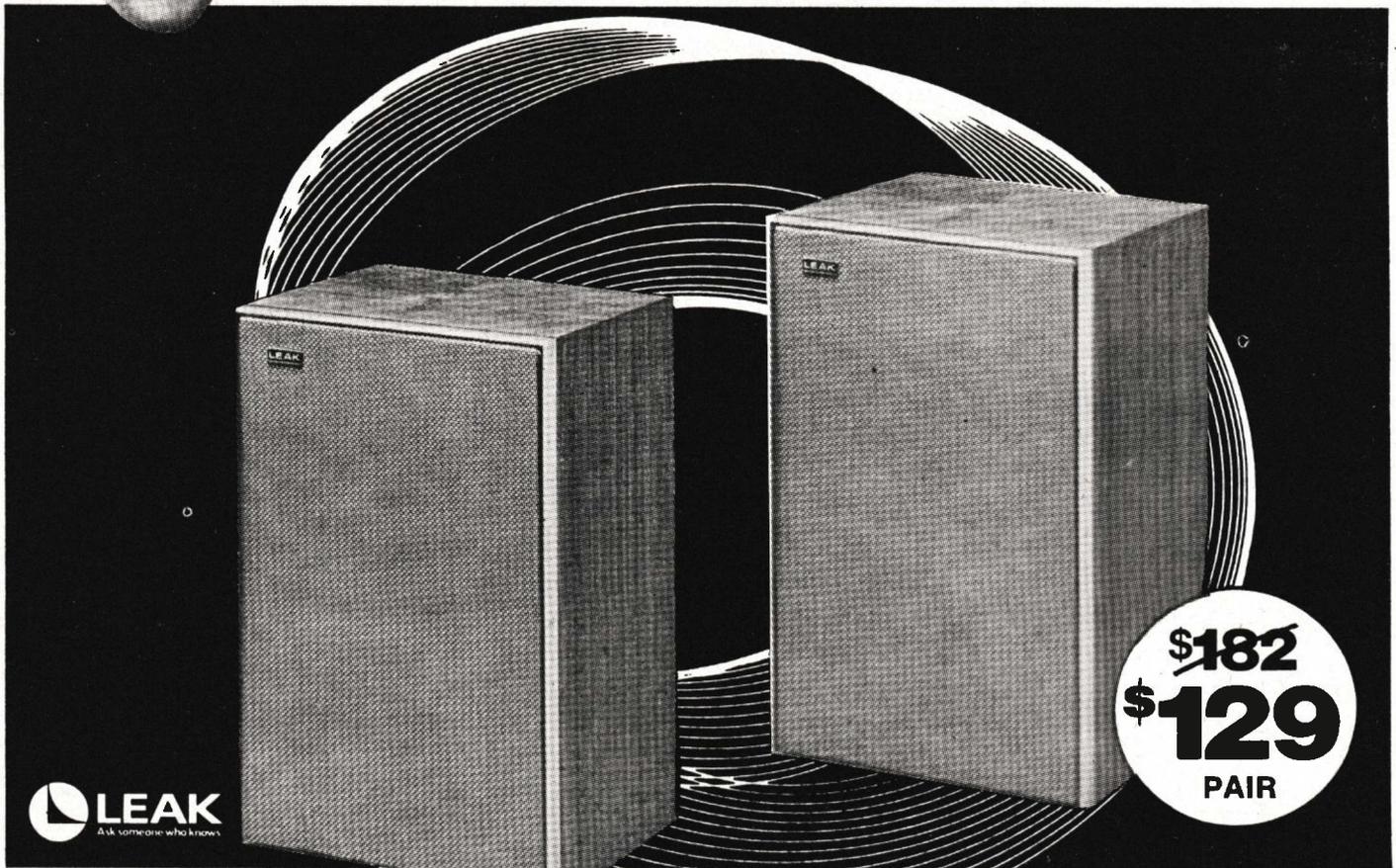
Operating on the magnetostrictive ranging principle, the Scriptographic's digitizer has no mechanical linkages to stylus or cursor. It is claimed to be unaffected by temperature, dust, humidity or moisture.

Available standard sizes include 28cm x 28cm, 50.8cm, 61 61cm, and 91.5 x 122cm. The smaller tables (tablets) are approximately 1cm thick and are used on a standard desk or drafting table.

Further details from: Anderson Digital Electronics, 11 Hamilton Place, P.O. Box 322, Mt. Waverley, 3149.



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JS016/FP

Never before has this little noise accompanied this much music.

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

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

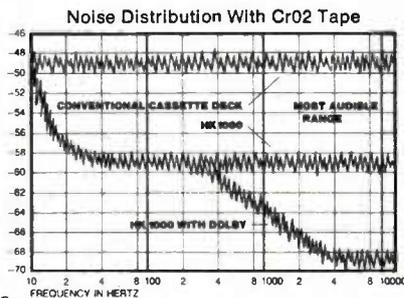
Signal-to-noise (unweighted) is -58 dB with Dolby and -70 dB in the audible hiss level above $4,000$ Hz. The frequency response curve is essentially flat from less than 30 to beyond 15 kHz, ± 1.5 dB, with CrO₂ tape. (This curve is due largely to the way we drive our heads. Instead of the conventional constant *voltage* drive to the head, the HK-1000 is designed for constant *current* drive. Many studio model reel-to-reel decks are designed the same way.)

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

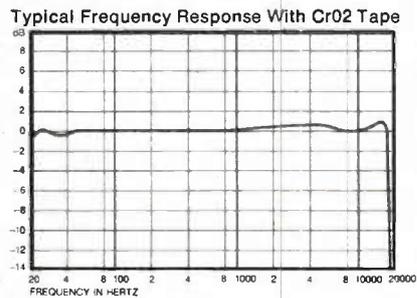
Ours is the first cassette deck designed for maximum phase linearity. Square wave response is better than every other cassette deck and even some expensive reel-to-reel decks. And the better the square waves, the cleaner and more transparent the music.

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

The HK-1000 is also designed so you can use it often



Noise.



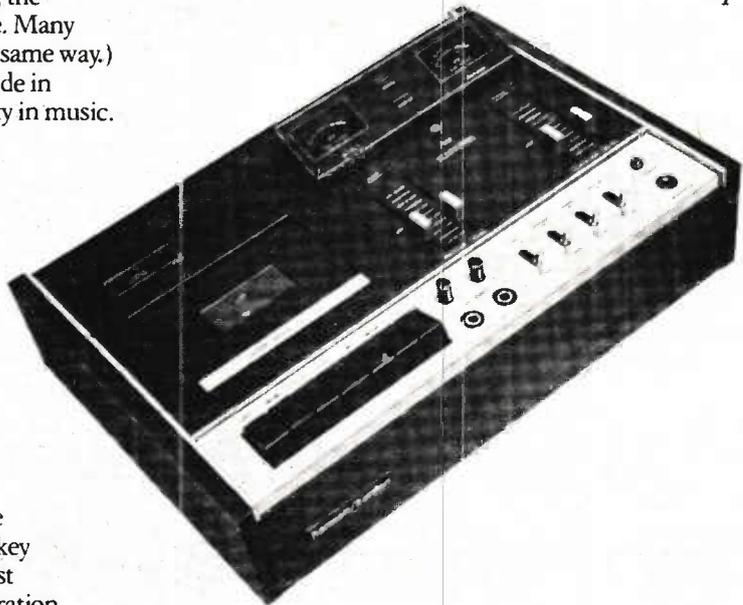
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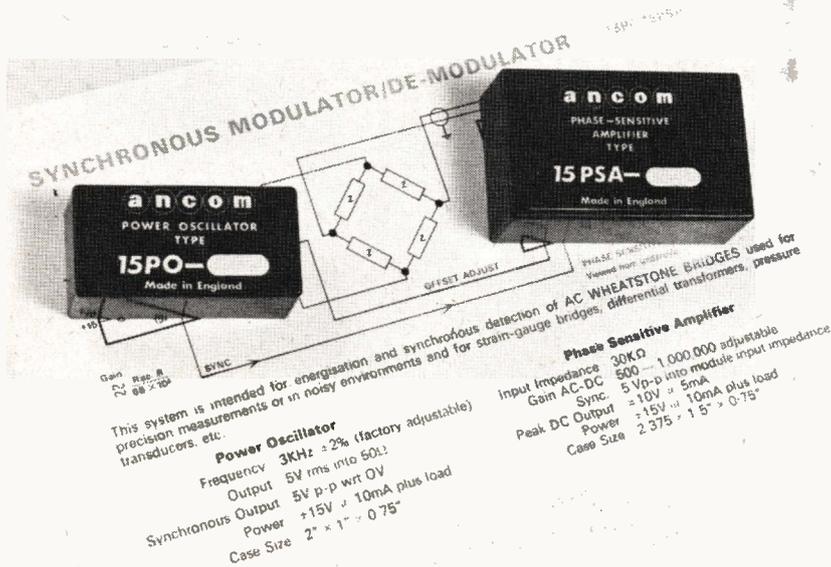
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COMPONENT NEWS

BRIDGE MEASUREMENTS WITH AC OSCILLATOR/AMPLIFIER MODULES



Many of the problems of interference, drift and other factors associated with dc bridge measurements are said to be eliminated by a new ac oscillator/amplifier system now being marketed by Ancom Limited, Cheltenham, UK.

The system comprises two modules - a power oscillator and a phase sensitive amplifier - used together, respectively, to energise the bridge and synchronously to detect the measurement signal.

The principle is not, of course, new and is an integral part of many electronic instruments. Ancom believe, however, that this is the first time that suitable basic modules have been made commercially available as 'building blocks' for users' own instrumentation needs.

Applications are wherever precise bridge measurements are required, particularly of very small values, and where electrical interference from industrial environments or where there are difficulties with temperature drift or power supply quality. Typical uses are with strain gauges, differential transformers, linear-potentiometer displacement transducers, pressure transducers and so on, in the civil engineering, batch weighing, machine tool, nuclear, research and industrial fields generally.

The modules can be used in ac symmetrical resistance bridge or differential transformer bridge configurations. Though normally applied in pairs, one power

oscillator module can drive up to six bridges in parallel, depending upon the load.

Because the system is ac energised and transformer coupled, the synchronous differential amplifier is sensitive only to its own frequency and is immune to outside interference. For the same inherent reasons, there are no problems with drift - even with high gains - and precise measurements of very small bridge deviations of the order of 1 μ V are possible.

Standard available frequencies for the modules are 3, 5 and 10 kHz. The output of the oscillator (ref. 15 PO) is 5 V rms into 50 Ω minimum load - adjustable approximately \pm 10 per cent. Output stability is \pm 1/2 per cent in a temperature range 10 $^{\circ}$ C - 50 $^{\circ}$ C at constant load, and distortion ranges 1-5 per cent depending on load. Input power requirement is + 15 V and -15 V at 45 mA and the synchronising output is square wave, \pm 15 volts, 33 k source impedance. The module measures 51 x 25 x 19 mm).

The amplifier (ref 15 PSA) has an input impedance of 30 k at 3 kHz and a synchronising input of 5 V p-p, square or sine wave, 40 k input impedance. Gain is 500 to 100 000 adjustable by fixed resistors. Output is \pm 10V @ 5 mA and power requirement \pm 15 V @ 10 mA. Size is 60 x 38 x 19 mm.

Further details:- Ancom Limited, Denmark House, Devonshire Street, Cheltenham, England.

MULTI-PURPOSE INTEGRATED CIRCUIT

Motorola Semiconductors have just announced a new integrated circuit which has a variety of uses in many different applications. It can be used as a logic circuit interface element - ECL or CMOS to TTL for instance - or as a line driver, a line receiver or line repeater.

Known as the MC696, the new device contains two identical interface circuits. It is the latest addition to Motorola's family of high threshold logic circuits (MHTL), and as such enjoys the very high noise immunity exhibited by this family.

Internally the MC696 looks more like a linear than a digital IC with its Darlington style differential input stage and on-chip voltage reference source. The reference voltage, which can be altered by adding external components, sets the point at which the circuit switches. Hysteresis - the difference between the input voltage needed to switch the device on, and that voltage below which switch-off occurs - can be set anywhere between 100 mV and several volts.

The versatility of the device is increased by its tolerance to different power supply voltages. A supply voltage anywhere between 10 and 25 V is suitable.

A high input impedance - about 20 k Ω - enables CMOS logic circuits to drive the MC696 directly. Frequency response is deliberately limited to <500 kHz, in common with other devices in the MHTL family, to attenuate fast rising noise transients.

Each dual-in-line package houses two of the interface circuits and each circuit has two outputs - true and complement. An output impedance of 20 Ω is typical.

3M AGENT

The Electrical Products Division of 3M Australia Pty. Limited has announced the appointment of Tecnico Electronics as distributors of Scotchflex Brand products for the electronics industry.

Main lines include Scotchflex flat cable and connectors. These flat cables offer many advantages including reduction in space and weight, greater design flexibility and consistent electrical characteristics. Other products include Scotchflex cable clips and cable ducting made of tough vinyl backing with a form pressure sensitive adhesive - ideal for routing wires and cables inside console cabinets, supporting wire and cable systems around desks, counters, etc.

Further details:- Tecnico Electronics, Premier Street, Marrickville, N.S.W. 2204 or Tecnico Electronics, 2 High Street, Northcote, Vic. 3070.

ONE CHIP CALCULATOR

A one-chip calculator circuit from National Semiconductor permits efficient, low-cost calculator designs to be implemented with a minimum of external components.

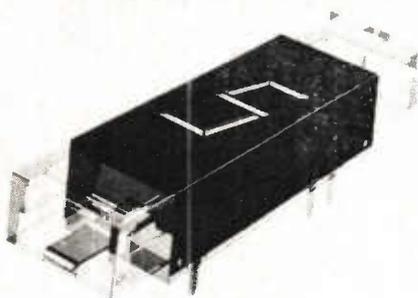
The MM5725 is a complete 8-digit calculator on one MOS/LSI chip. It employs three registers to provide the four arithmetic functions — addition, subtraction, multiplication, and division. The MM5725 contains a 16-place decimal point register and a self-contained oscillator and clock driver.

The MM5725 can be connected to almost any type of display including LEDs, Panaplex II neon display tubes, and fluorescent display tubes. With the latter, for example, all that is necessary to interface the MM5725 to the fluorescent tubes is eight resistors, thus the MM5725 is the only active device required for operation (excluding the power supply).

Further details:— NS Electronics Pty. Ltd., Stud Rd, Bayswater, Vic. 3153.

NEW CONCEPT DIGITAL SWITCH

A new concept in digital switches has been introduced by McMurdo (Aust.), electronic component manufacturers. The switch is designed around the dual-in-line package system for the direct output of digital



numerical values in the BCD code.

The large 11mm x 7mm display is easily readable. With a short switching path of 11mm for ready control, it is precisely graduated so that switching position can be set reliably.

Contact is provided by a beryllium/copper spring gold plated to 5 micron.

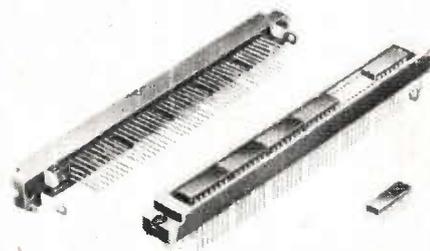
Three versions are available:

- for installation on a front panel of an instrument from the front;
- installation through the front panel from the rear with a PCB, or
- for direct mounting on the PCB.

Applications include use in digital systems such as counters, measuring devices and controls where predetermined values in the form of a code are required.

Further details:— McMurdo (Aust.) Pty. Ltd., 19 Carinish Road, Clayton, Vic. 3168.

MULTIPLE 14 AND 16-LEAD SOCKETS



McMurdo announce two new D.I.P. Socket Packs which, in single mouldings, incorporate six 14-lead sockets or five 16-lead sockets; they provide a convenient means of mounting integrated circuits for breadboards, prototypes and production purposes.

Both types incorporate moulded-in buss bars for Vcc and ground. Three terminal pins for these are provided adjacent to each socket.

All terminal pins are 0.025 in. square and are suitable for three standard wire wraps.

Bodies are moulded in glass-filled polysulfone for continuous operation at 150°C.

Further details:— McMurdo (Australia) Pty. Ltd., P.O. Box 321, Clayton, Vic. 3168.

Designed to provide reliable, high-speed and long life operation, OKI series MRD and URD relays are employed in a wide variety of applications including transistor, integrated circuit, general purpose control, telephone and telegraph switching and data processing equipment circuitry.

OKI relays are extremely small and lightweight, highly sensitive and of magnetically shielded construction to enable close proximity mounting with each other without interaction.

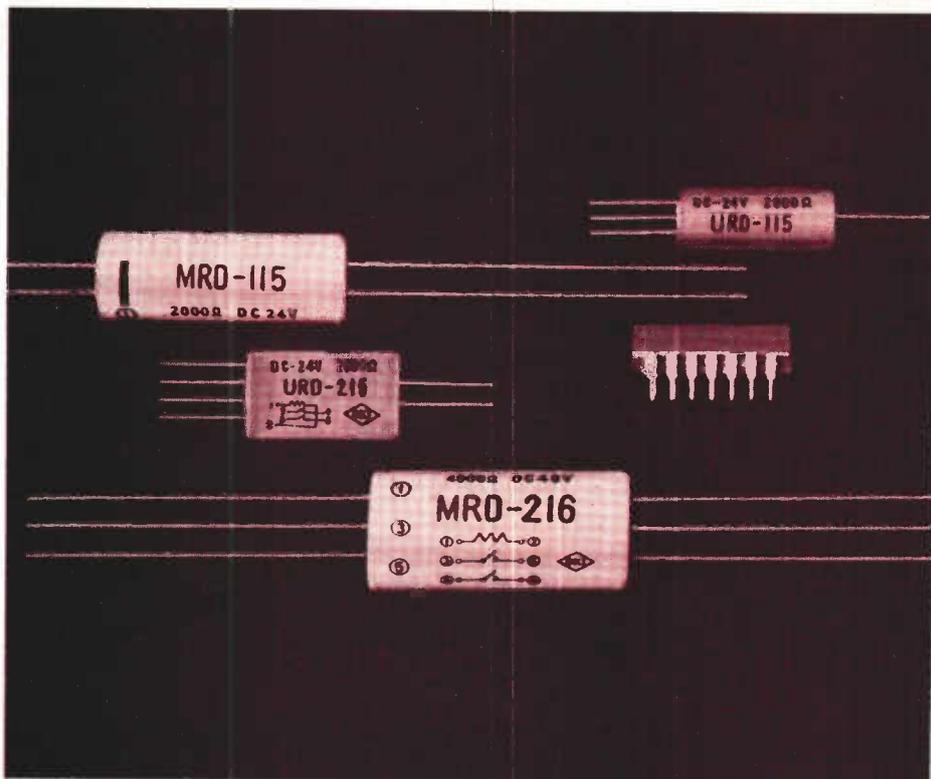
A wide range of packages are available: all are shock, vibration and humidity resistant. Series URD are miniaturised versions of the MRD and include a 14 pin DIL package. They are particularly suitable for switching circuits with high output/input ratios.

OKI relays incorporate miniature reed insert switches and coil assemblies. Switch contacts employed in the range are of rhodium or gold diffused material for maximum reliability and life.

Comprehensive literature is available on request to the Professional Components Division.

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THE STATE OF THE ART

Diversity reception and its techniques.

DIVERSITY reception techniques have been little exploited by amateurs although widely used in commercial communications systems for many years. Perhaps this apparent aversion to a potentially very useful technique is due to the amount of space necessary (or thought necessary) to set up the appropriate antennae. Local authorities often show considerable hostility towards towers, or any antenna structure, and many amateurs experience difficulty in obtaining permission to erect even the most unobtrusive or minimal structure. These problems notwithstanding (you could always move!) many amateurs pursue their interests, particularly with regard to activity on the HF bands, in a more or less traditional fashion and overlook techniques which often require little expenditure either in time or money. Diversity reception is an area that appears to have been overlooked in the amateur literature apart from rare mentions in old issues of QST, CQ, 73, and Radio Communications. Pat Hawker's (G3VA) column in the last mentioned magazine has mentioned it from time to time and it is worth researching past issues.

DIVERSITY RECEPTION TECHNIQUES

There are basically four types of diversity reception that take advantage of the various observed characteristics of signals propagated by any means. These are:- (1) Frequency Diversity; (2) Space Diversity; (3) Polarisation Diversity; (4) The MUSA system or Angle-of-Arrival Diversity.

Frequency Diversity

Unfortunately, amateurs are not allowed to have two transmissions in one band simultaneously. This limits any experimentation with this technique although it should be noted that frequencies differing by as little as 100 Hz tend to fade independently. Consequently two separate receivers could be arranged separately to detect

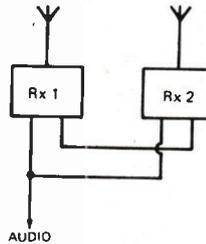


Fig. 1. Simple diversity systems.

the upper and lower sidebands of a double sideband transmission, the outputs and AGC circuits being suitably combined to produce the desired result. More on this perhaps at some other time.

Space Diversity

A signal received on antenna spaced five to 10 wavelengths apart exhibits an independent fading pattern from each antenna. If the output of three or more antenna is passed to separate receivers, and the outputs combined, the resultant signal will rarely fade out completely.

The simplest system is shown in Fig. 1. Here, only two antennae are shown, the audio output of each receiver is combined and fed to an audio amplifier and the two AGC lines are connected together. Thus either AGC line controls each receiver simultaneously and the one receiving the strongest signal dominates, the other receiver contributing little in the way of signal or noise.

The use of two antennae in space diversity reception will show an

improvement over a single antenna but quite deep fades will still be experienced. Three antennae show marked improvement over two, as will more than three antennae. However there is less and less gained in going beyond three antennae. Three separate receivers would stretch most amateur's resources in any case, apart from the real-estate necessary to accommodate the antennae!

A very rudimentary experiment to show the differences in signal strength from three spaced antennae can be performed by arranging to switch input of the receiver to each antennae in turn. The antennae, of course, must be of the same type and exhibit similar gain, and be similarly oriented. Beams are not necessary, dipoles being used in some experiments described in the professional literature.

The antennae should be arranged in a line, the direction of which coincides with the great circle bearing to the transmitting station. This immediately places a limitation on the usefulness of the system in that only signals arriving from that bearing, plus or minus a few degrees, will benefit from the space diversity effect. The arrangement is illustrated in Fig. 2. Ideally, the feedlines should be the same length to equalise phase and feedline losses. However, providing there is no great disparity and only one frequency band is being considered, the feedlines can be any odd multiple of a half wavelength.

There is quite a simple and versatile system that overcomes the above

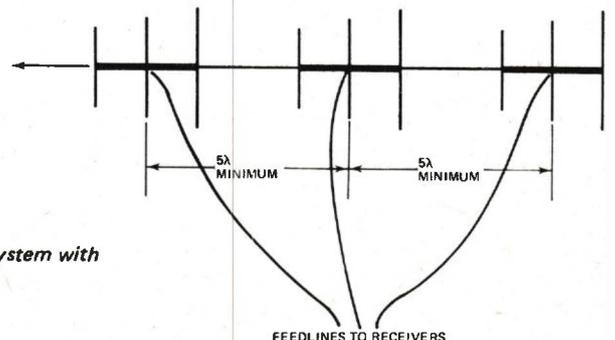


Fig. 2. Space diversity system with three channels

limitation of only one direction from which diversity reception is possible. Three antennae can be arranged such that they form the corners of an equilateral triangle. Rotatable antennae can be used, so that combining any appropriate two, diversity reception is possible from any point of the compass. Alternatively, the humble groundplane antenna could be used at each corner resulting in a very simple arrangement indeed. Horizontal dipoles could be also be used but results would be degraded for signals arriving off the ends.

The sides of the equilateral triangle should be a minimum five wavelengths long. If multiband antennae are used, the sides should be calculated for the lowest frequency. Orientation of the triangle is immaterial. The unused antenna resulting from the combining of the best two found by experiment, can be used for transmitting!

Polarisation Diversity

Plane polarised signals undergo variations in polarisation when propagated via or through the ionosphere. The troposphere (or lowest layer of the atmosphere) has a similar effect on VHF signals. It has also been found that circularly or elliptically polarised signals experience different fading on the separate vertical and horizontal components. These characteristics, together with the fact that the plane polarised waves propagated for some distance, often exhibit distinct ellipticity in polarisation at the receiving terminal. Thus, polarisation diversity reception, which can be the simplest to arrange, can offer distinct advantages in many situations.

On the HF bands two antennae for a polarisation diversity system should be readily accommodated in the average (?) suburban back garden. Large rotatable beam antennae are not really

Fig. 3. Triangular space diversity system.

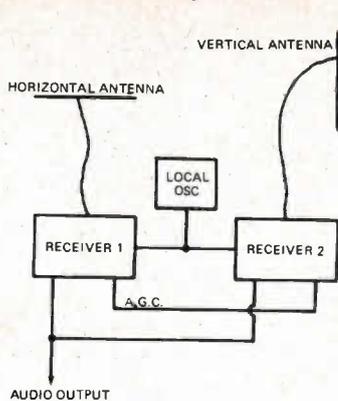
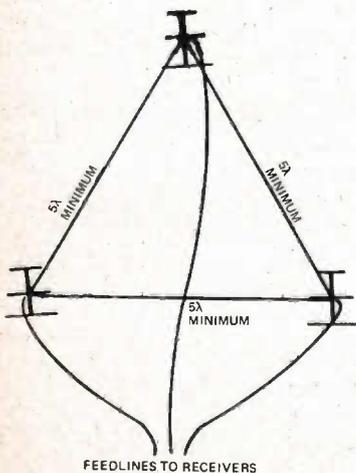


Fig. 4. Polarisation diversity systems.

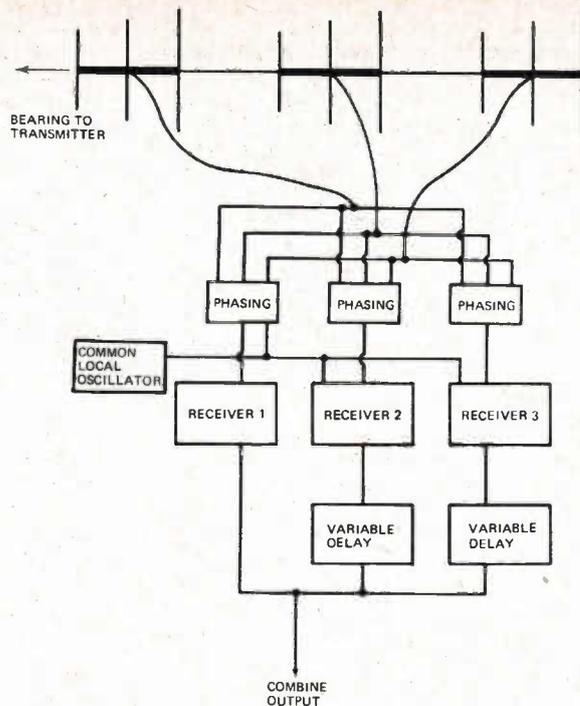


Fig. 5. MUSA system

necessary but do offer some obvious advantages. Physical separation of the antennae is not necessary either, but they should preferably be at the same height or arranged to have similar radiation angles. This isn't necessarily a strict rule and a little experimentation would not go astray.

Polarisation diversity reception would be a distinct advantage in working through amateur communications satellites — particularly for the first few months until the satellite stabilises. Polarisation changes are not all caused by the tumbling of the satellite. Radio waves in passing through the ionosphere, undergo changes in polarisation, the effect extending to VHF waves as well. Neil Sandford, VK1ZT used a manual system of polarisation diversity to great effect for working through Oscar 6.

In a polarisation diversity system, two separate receivers are not really necessary. Common local oscillators can be used with separate RF and IF stages. Combining is accomplished at the detector outputs while AGC is separately derived either from the resultant audio output signal or separately by an envelope detector from each IF stage, the AGC lines being connected together.

A polarisation diversity system is shown in Fig. 4.

The MUSA System

This system exploits the observed phenomena that HF signals propagated via the ionosphere arrive at the receiving terminal at certain preferred vertical angles that remain stable for

appreciable intervals of time. The signal arriving at a particular angle may exhibit amplitude fading but little if any phase distortion as a result of the familiar "selective fading".

In this system a number of antennae are equally spaced along a line and the vertical directivity can be adjusted by variable delay units in the receiver IF stage which vary the phase of each channel, before the outputs of individual channels are combined. Each receiver includes means for combining the output of the various antennae in the phase relations required for the desired vertical directivity. A block diagram is shown in Fig. 5.

I mention this system mainly for interest's sake not really with a view to suggesting that anyone actually try it... but then some amateurs will try anything!

Mobile Diversity

In VHF mobile operation, considerable differences in received signal strength, together with differences in 'flutter', can be observed between antennae mounted in different positions on the car. The roof mounted whip is not always best! Two receivers connected to differently mounted antennae can be combined as in Fig. 1 or Fig. 3. This system has actually been tried and a remarkable improvement reported. Mounting of the antennae is really not very critical. One could be mounted on the front and one on the rear, or one on the roof and the other on the front or rear. It's an idea that is relatively simple to try considering the dearth of VHF mobile gear around. ●

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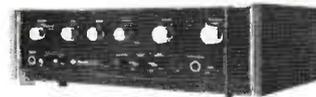
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CYCLONE DETECTOR

This simple adaption to your TV receiver will detect cyclones up to 18 miles away.

MANY areas in Australia's "cyclone belt" do not have adequate cyclone alarms, and even in areas where such facilities exist it is tedious constantly to monitor the radio for weather bulletins.

Here is a simple method — devised initially by the Marshall Space Flight Centre — that enables individuals to set up their own automatic warning alarm. The system will sound an alarm when a cyclone is within 18 miles (29km).

Principle of the alarm is that electrical disturbances within the vacuum funnel of a cyclone will cause the screen of a switched-on but dark TV set to become bright. This white

condition is then sensed by the simple circuit shown below.

The circuit consists of a light-detecting resistor (the old Mullard ORP 12 — now known as Philips 2322-600-95001 is ideal) mounted by a suction cap to the picture tube — a capacitor which provides a protective time delay to damp out transient voltage spikes — or the effect of nearby lightning, a silicon controlled rectifier, and sensitivity adjusting potentiometer.

The alarm, which could be a bell or sonalert, may be mounted remotely from the rest of the circuit.

CONSTRUCTION

Construction of the unit is quite

straight forward. The battery and on/off switch may be located apart from the main unit but it is advisable to have the photocell, SCR and potentiometer built into one unit.

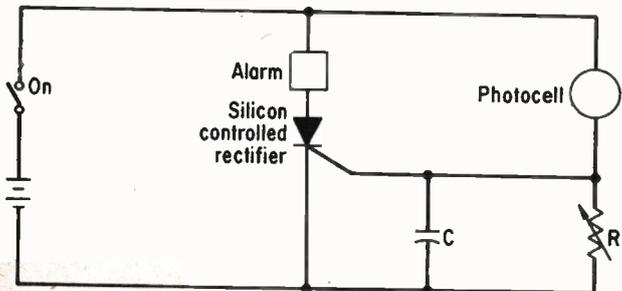
The only difficulty in setting up the alarm is to prevent, as far as possible, ambient light reflected from the TV screen from affecting the light detecting resistor. It may be necessary to mount the ldr in a shielded mounting painted matt black internally.

The actual setting up procedure is to switch on the TV set and starting with the brightness at zero — slowly increase the brightness until the screen is beginning to glow white.

Leave the TV set at this setting and slowly decrease the setting of the alarm sensitivity potentiometer R until the alarm operates. Turn down the brightness of the TV set until the screen is just dark — and that's it. (The receiver should of course be switched to a disused channel).

The sensitivity potentiometer will not require any further adjustment and may be locked in position if required.

Current drain of the unit is negligible unless the alarm is sounding — however for reliability they should be replaced every six months or so.



PARTS LIST

- | | |
|---------------------------------------|---|
| Light detecting resistor (photocell) | — ORP 12 (Philips 2322-600-95001) or similar |
| SCR | — Silicon controlled rectifier C106 or similar |
| C | — Capacitor — .1uf (any voltage will do) |
| R | — Potentiometer 1k (linear). |
| Battery | — Twelve volt dry cell battery — capacity to suit alarm used. |
| On/off switch, suction cap, wire etc. | |

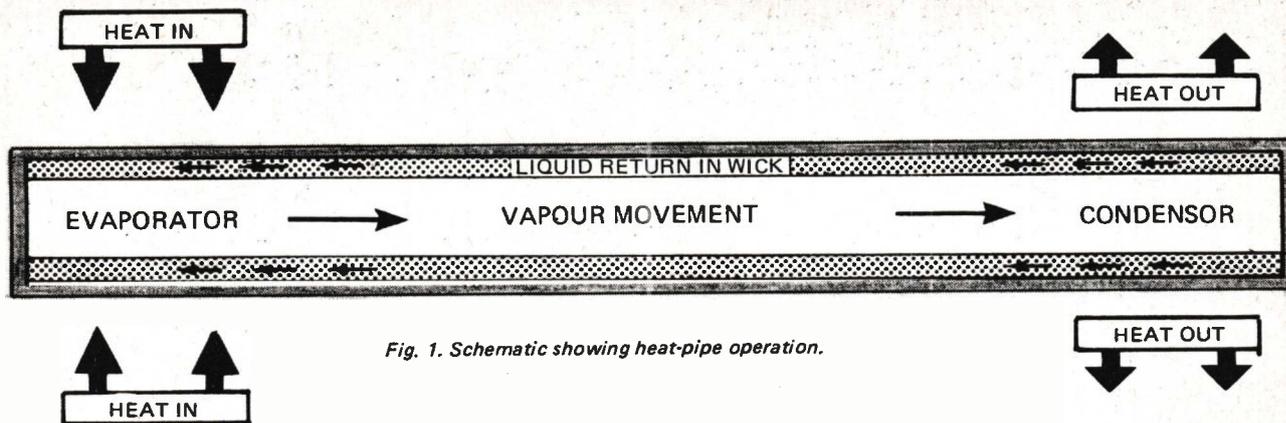


Fig. 1. Schematic showing heat-pipe operation.

HEAT PIPES

Heat pipes transfer heat up to 500 times more efficiently than any known solid conductor.

HEAT pipes, first patented in 1942, are unique in that they use surface tension, generating capillary pressure, to return the condensed liquid to the evaporator. This process was first patented by R.S. Gaugler in relation to the cooling of an ice box. The term "heat pipe", however, was first used in a paper by G.M. Grover, et al, reporting work carried out under the auspices of the U.S. Atomic Energy Commission. This work, entitled "Structures of Very High Thermal Conductance", was directed towards the use of sodium filled heat pipes for thermionic generators and thus was the first electronic application of heat pipes.

Although the efficiency of electronic components has steadily improved since their inception, the higher packing density and more stringent environmental requirements have resulted in thermal problems of increasing difficulty. Consequently, early consideration is now given to the thermal design of many advanced electronic equipment projects.

In many cases the more conventional techniques such as heat sinking, are found to be inadequate and designs embodying heat pipes are gaining popularity. In the main, applications are potential rather than current, a situation which is changing rapidly as

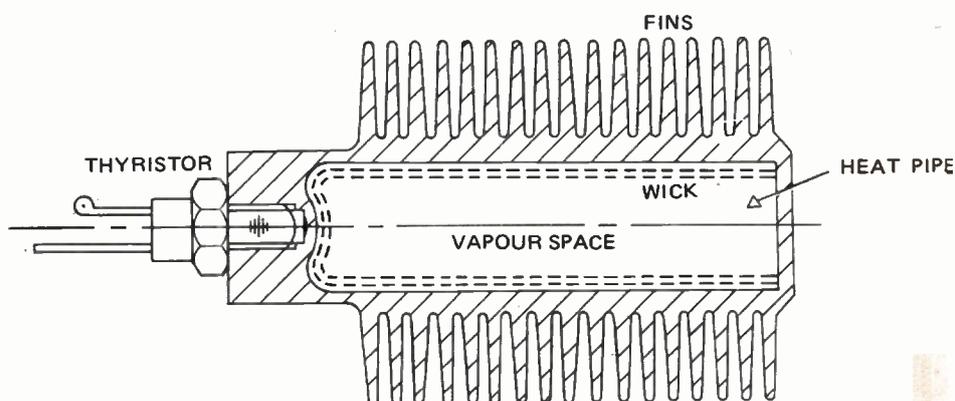


Fig. 2. This Heatsink/Heatpipe combination was designed by Marconi as cooling for a thyristor used in space research. The unit is 65 x 75 mm.

engineers become better acquainted with design parameters, and as an increasing demand leads to lower prices.

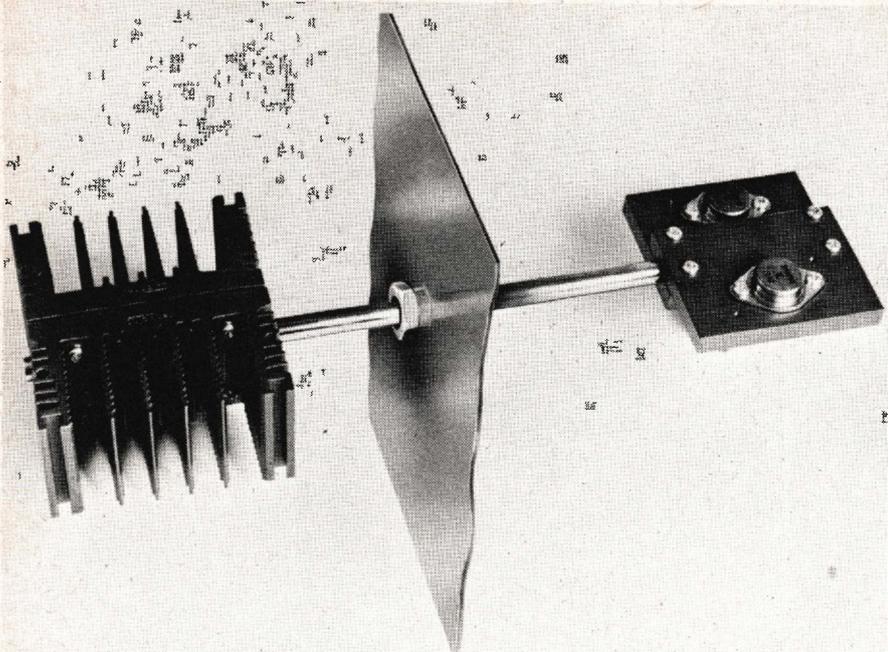
WHAT IS A HEAT PIPE?

A heat pipe is a sealed tube containing fluid and a "wick". Figure 1 shows a cross-section of a simple tubular version of a heat pipe. One area of the tube is heated, causing the fluid to evaporate; another area is cooled, causing the vapour to condense. The fluid carries the heat, as latent heat, from the heated area to the cooled area and is then recirculated from the condenser to the evaporator by the capillary action of the "wick". Gravity aids this capillary action when the evaporator end is downward and opposes capillary action when the evaporator end is upward. In simple versions of the heat

pipe, the "wick" is uniform throughout the length of the tube, and the roles of the evaporator and condenser can be interchanged.

The range of fluids which may be used for cryogenic heat pipes is limited, (liquid hydrogen being one of the most favoured) those that can be used suffer from the low performance inherent in the physics of low temperatures. Although high temperature heat pipes enjoy outstanding performance, the working fluids (such as molten sodium, potassium or lithium) must be of the utmost purity and the methods of construction are not easily adapted to the production line. Both cryogenic and liquid metal heat pipes are expensive and at present in fairly low demand. Prices range from \$1000 to \$6000.

The demand for cheaper heat pipes



This stock 3/8" O.D. x 300mm long heat pipe with standard source and sink attachments shown, facilitates remote cooling of the two TO-3 devices, whilst at the same time minimising the temperature difference between them. Attachments for semiconductor sources, water coolers and cartridge heaters are available.

Fig. 3.

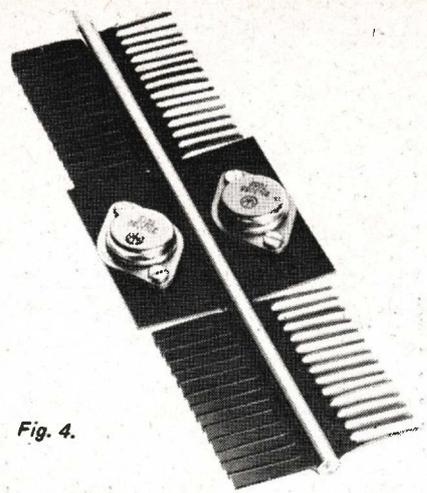


Fig. 4.

The ability of heat pipes to transfer heat from the heat source to the remote parts of the sink, results in an efficient, small, lightweight unit. The unit shown is 200mm x 60mm, weighs 60gm, accepts TO-3 devices and has a forced convection performance of 0.3° C/W. This patented Redline series includes dual in line packages and P.C. board accessories.

in the more moderate temperature range is increasing, and in some measure this market requirement can, and is, being met by tubular forms with simple woven wire mesh wick structures.

PERFORMANCE PARAMETERS

Table 1 shows typical values of some heat pipe performance parameters for a number of working fluids. In this temperature range (-40 °C to +350 °C), where water can be used, it has the best physical properties, but can give chemical corrosion problems with some wick and container materials. Chemical passivation of these items has been proved to be effective and lifetimes in excess of five years are forecast as a result of trials at elevated temperature.

Water filled heat pipes, with simple woven wire mesh wick structures will operate satisfactorily at temperatures between 15 °C and 250 °C, and will function against gravity with up to 150mm vertical displacement between source and sink.

It is unusual for axial heat transfer to limit the performance of a heat pipe. This is well illustrated by water filled heat pipes which have a typical axial capability of 500 W/cm³. The heat pipe relies upon capillary action to

provide the pressure difference along the wick, so returning the working fluid to the evaporator, and this capillary action can be destroyed if nucleation (boiling) takes place within the wick. Using water, nucleation occurs typically at 3W/cm² when operating against gravity, this can be increased to 10W/cm² for horizontal operation, and up to 30W/cm² when the heat pipe is being used as a thermal

syphon with full gravity return. The pipe diameter is therefore chosen in such a manner that these radial fluxes are not exceeded.

The major part of the temperature drop in a heat pipe occurs across the wick at the source due to the radial input flux. This is about 5 °C to 8 °C at the fluxes quoted above for heat pipe operation. At the highest fluxes possible with gravity return, this

TABLE 1

	Boiling Point °C	Axial Flux W/cm ²	Limiting Superheat °C	Radial Flux W/cm ²	Capillary Rise cm
Ammonia	-33	109	1.8	0.3	7.2
R11	24	12	1.7	0.4	2.2
R113	48	8	1.5	0.3	1.8
Acetone	56	34	1.8	0.8	3.9
Methanol	65	49	2.1	1.1	3.9
Ethanol	78	24	3.9	1.7	4.2
Water	100	450	5.0	10.0	10.0
Toluene	111	22	2.3	0.8	4.4
Thermex	257	25	3.4	1.1	5.0

NOTE: This data refers to boiling point temperature and atmospheric pressure. It is only approximate

HEAT PIPES

increases to a maximum of 30 °C. In most designs the temperature losses along the length of the pipe and at the condenser amount to less than 10% of these values.

PROPERTIES

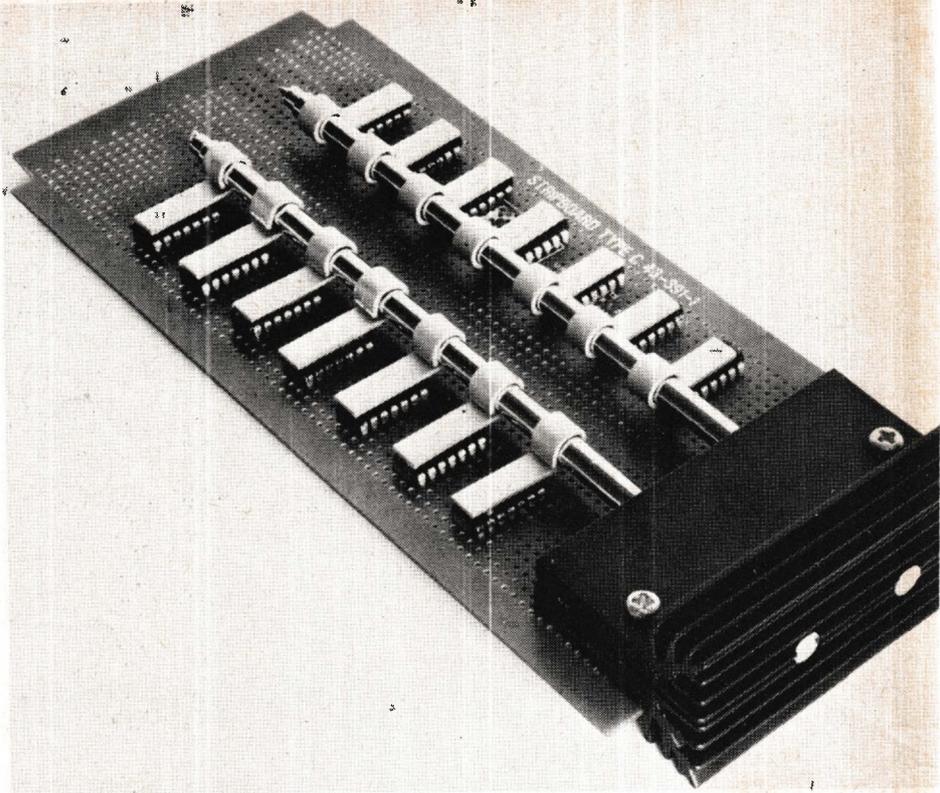
Within the design performance parameters above, heat pipes may be used to transport heat, bidirectionally, with temperature differences some hundreds of times smaller than any known solid conductor. This ability to transfer heat efficiently makes the heat pipe a useful tool in the design of equipment for remote heating or cooling, temperature balancing and for heat flux transformation.

APPLICATIONS

When heat is generated at a point where it is impossible or ill — advised to dissipate it, a heat pipe may be used to transfer the heat, with negligible loss to a more convenient point. Such a design is shown in Fig. 3. The heat is transferred from the TO-3 transistors to a flat mounting platform which is in intimate contact with the pipe. As explained above, it is this area of contact between the mounting platform and pipe which determines the maximum power capability of the assembly. The thermal rating of the condenser assembly is the major factor in determining the overall performance.

Conventional high performance heat sinks are large and heavy. In contrast heat pipes may be used to transfer heat to the remote parts of a heatsink, resulting in a lightweight efficient unit. Such a heatsink is shown in Fig. 4. It is approximately one third of the weight of a conventional heatsink having the same performance. The lightweight heatsinking which heat pipes allow, may be combined with the facility of separation, to design a lightweight assembly with a high packing density, for example a stack of power diodes.

Thermal balancing heatsinks have a variety of applications, not the least of which is batch testing a number of solid state devices all at the same temperature. Conventionally, large masses of metal are used to provide the thermally conductive path, but heat pipes give far superior performance. In this field, in order to maintain a near isothermal (one



Thermal problems often limit further size and weight reduction in many advanced electronic equipment units. Designs embodying heat pipes are rapidly gaining popularity. One such design by Redpoint Associates Ltd., is shown in the accompanying photograph. The board handle doubles as a heat sink, cooling fourteen D.I.P.s via the two 1/4" O.D. heat pipes. With the D.I.P.s running at 1 watt each, the temperature drop from D.I.P.s to handle is less than 5°C. All the components of the thermal system including adhesive, D.I.P. "flags", heat pipes, handles and heat transfer compound are available from Redpoint Associates Ltd., who can also supply thermal systems to customers' specification.

temperature) surface, design values of the radial flux are kept as low as possible consistent with the geometry of the device mounting. A flux of 0.1 to 1W/cm² is typical, with temperature variations of 0.1 to 1 °C respectively.

An example which embodies remote cooling, lightweight heatsinking and near isothermal operation is the application to card frame units. In one such application, the heat from all the D.I.L. packages on the PC board is transferred to the handle, which doubles as a heatsink.

In the field of microwave components there are many instances where large amounts of heat can be generated in a confined space. Examples include circulators, isolators, dummy loads and rotating joints as well as such active devices as klystrons, magnetrons, crossed field amplifiers and travelling wave tubes. The current use of heat pipes in this field is minimal, but the potential is considerable.

Although the heat pipe has mainly found application as a means of

removing heat. It may also be used as a means of introducing heat. An outstanding example of this is the cooking pin. This device, now on sale in the US, is inserted by the housewife into her roast and conducts heat into the centre of the meat which therefore cooks more quickly and uniformly.

CONCLUSION

The design parameters of heat pipes may generally be expressed as performance limits such as those given in table 1. The overall thermal performance of a system is usually determined by the heatsink when the heat pipe is operating within those limits. Thus heat pipes for a design may be simply specified in terms of these performance limits, and when operating within these limits may be considered as near isothermal conductors of heat.

Although applications are presently potential rather than current, interest is at a high and increasing level. Increasing demand will inevitably lead to a further reduction of prices and widening of economic application. ●

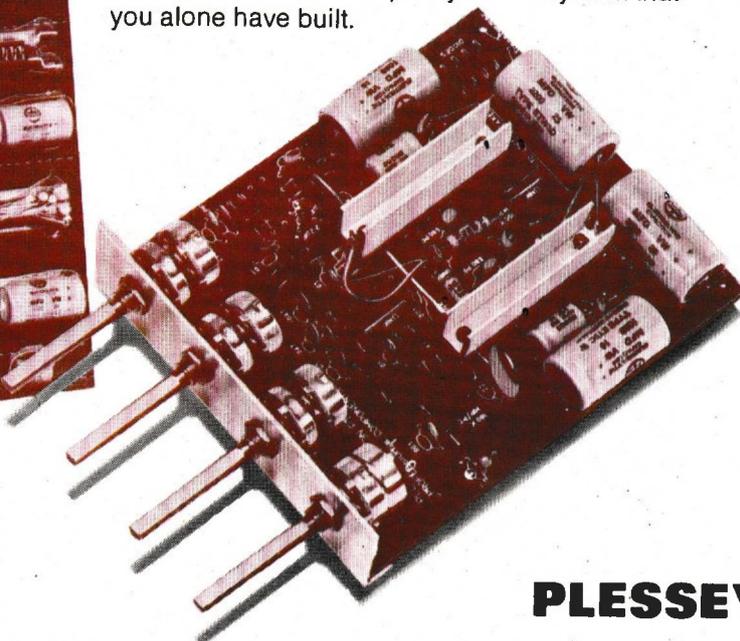
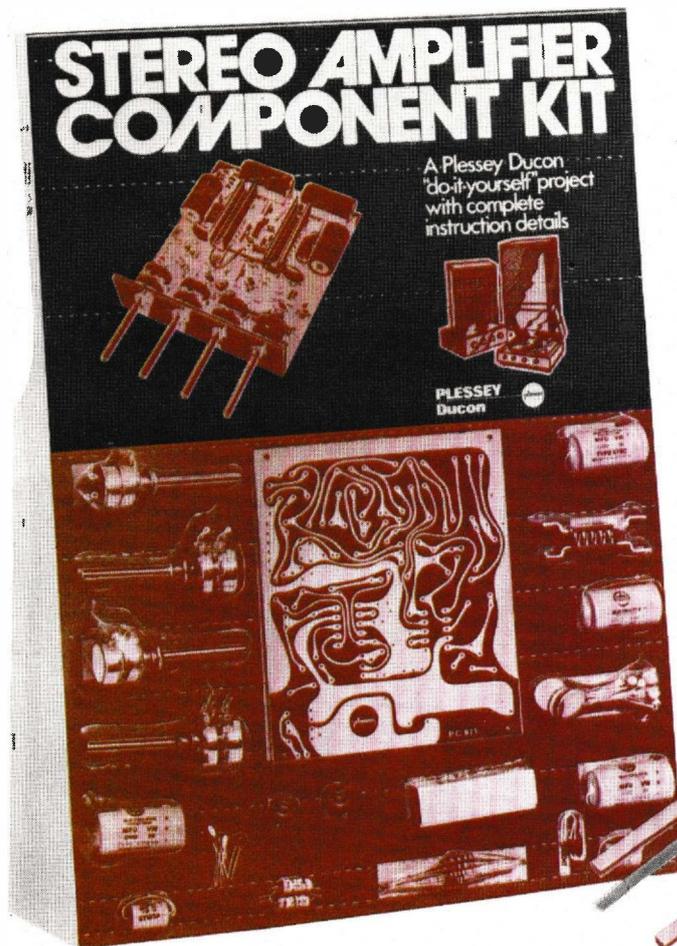
Enjoy top class stereo reproduction with this simple amplifier kit

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PAUL KLIPSCH COMMENTS

The review of the Klipschorn speakers (August 1973) in general was well done and appreciated.

It was stated that I claim 50% efficiency. Back in 1940-1941 using the Bostwick methods (JASA, 2, 243, 1930) using motional and blocked impedances, the efficiency was calculated to be 50%. But this obviously is not corroborated by sound pressure measurements which suggest 10% as more realistic.

If one assumes a point source in a right trihedral corner, 116 dB SPL at 4 feet equates to approximately one watt output. We get about 106 dB for one watt input so efficiency is down about 10 dB from 100%. (Altec uses 118 dB at 4 feet for a solid angle of 90 x 60 degrees).

I am not going to explain why the Bostwick method is wrong, but tentatively it must ignore some mechanical to acoustical losses.

I wish I could have examined the review before it was printed; there were some errors.

I do not claim "28 Hz"; using IRE Standards of 1935 I can justifiably claim "down 10dB at 35 Hz".

Test frequencies for IM distortion should be chosen so that both frequencies are radiated from the same speaker unit. Thus if a bass speaker covers 40 to 400 Hz, frequencies of 50 and 350 would be appropriate (we use

41 and 350); use of 50 and 500 results in the upper frequency being radiated from the midrange, and negligible IM distortion occurs. (One maker of a 4-way speaker uses 50 and 5000 Hz; two crossover frequencies intervene so IM distortion should be nearly zero).

About spacing for stereo and the "geometry problem": the same problems exist with any speakers; corner placement has been found to improve tonality and geometry of *all* speakers tested here, from small bookshelf speakers to large free-standing "cabinet" type speakers. The article misquotes me in recommending 3 x 5 x 8 metres; we use the long wall (7.9 metres) for the array, with a centre speaker to "put a leg chain on the soloist"; the bridged centre speaker was another Bell Telephone Laboratories teaching (Symposium, 1934). Many satisfactory installations using large and small speakers are much smaller than this. (Note 3 x 5 x 8 is nearly "golden mean" ratio; the terms are in the low range of the Fibonacci Series).

The "complaint" about impedance variations is invalid. One can always mismatch a high impedance load to a low impedance generator. As for tubes (valves) disliking such impedance level, remember the speaker system was developed before solid-state devices existed, and amplitude response curves and distortion tests were made using

"valves". One could write a whole thesis on speaker impedance matching and mismatching. I think Wente and Thurax (Bell Telephone Laboratories Symposium, 1934) should be read before adversely criticizing a speaker for its impedance variations. If an amplifier "likes" 4 ohms, it will like 40 ohms even better. Our HERESY speaker goes up to 120 ohms.

The amplitude response curve reproduced in your review resembles closely what we get with a sweep oscillator, X-Y recorder, and a "fast sweep" relative to the X-Y recorder writing speed. We get a trifle better response beyond 8 kHz, and the difference may be due to dispersion and the "pink noise" technique. Our experience with Pink Noise corroborates Dr. Saponas' (et al) finding that the best test signal for amplitude response is the gliding sine wave, "Plain and Fancy Test Signal", JAES 19, 4, April 1971, pp 294-305 by Saponas, Matson and Ashley.

Paul Klipsch' letter is objective and raises a number of interesting factors.

Firstly, he points out that original claims for efficiency were in apparent error due to a lack of corroboration of technique with the practicalities of measurement.

Paul's comment concerning a 28 Hertz cut-off is justified, because we measured a 28 Hertz cut-off and

ELAC PUZZLE COMPETITION

PRIZE — AN ELAC STS.244-17 Cartridge
Awarded to first correct entry opened on publishing date
of next issue of Electronics Today International

A few words regarding Puzzle No. 5. The result previously published is incorrect. The min. no. of moves is $2^{64}-1$ which is 18,446,744,073,709,551,615 moves at approximately one per second it would take 584,942,417,355.07203244 years, give or take a little. Our apologies for publishing an incorrect answer. A prize has been awarded to a correct entrant J.C. Bonnett, 3 Ottawa Avenue, Panorama, S.A.

SOLUTION TO PUZZLE No. 6

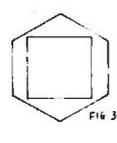
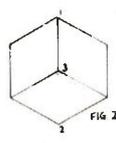
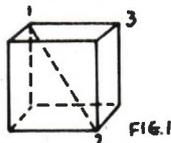
If the cube shown in Fig. 1 is turned so that the diagonal 1-2 is vertical, its projection will be as shown in Fig. 2, i.e. it will be a hexagon.

Fig. 3 shows the hexagonal projection with a square — one side of the original cube superimposed.

It is now obvious that the cube can be cut so that a cube of the same dimensions can pass through.

It is also obvious that a slightly larger cube could be passed through.

Hence the slightly larger cube, which remains uncut, will still be the heavier.



The first correct entry opened was sent in by W.G. Evans, 13 Sunnyside Avenue, Camberwell, Vic. 3124.

PUZZLE NO. 8

Four young couples, the Jones', the Smiths', the Browns' and the Whites' are all table tennis players. They have organised a mixed-doubles tournament. The conditions are that each husband will play one match in partnership with the wife of each of the others, against every similar partnership.

In no case will a husband and wife play together. Two matches will be played on each evening set aside for the tournament.

How many evenings will the tournament occupy?

POST YOUR ENTRY TO —

ELAC PUZZLE COMPETITION NO. 8
P.O. Box 150, Crows Nest, N.S.W. 2065.

Permit No. T/C 4108

inadvertently stated this as the cut-off frequency claimed by him.

With regard to intermodulation distortion tests, Paul Klipsch's criticism is objective and we accept it. Next time we perform this type of test we will be particularly careful to make sure that the two test zone frequencies both lie within the pass-band of the speaker being evaluated.

The recommendation of separation for adequate stereo was taken from a pocket facts document which came with the Klipschorn. This refers to adequate stereo spacing and suggests a minimum of 17 feet and points out that the Bell Telephone Laboratories use 42 feet which led us to believe that Klipsch and Associates are proposing that something between these spacings would be about optimum.

With regard to the comment about impedance variations, we referred to this possibility bothering some valve amplifiers. We have observed this phenomena particularly in many of the small valve amplifiers in use twenty years ago. These had neither the capacity nor the stability to cope with extreme variations in impedance on the output load of the amplifier under sustained drive conditions.

I have not seen Wentz and Thurax's paper and look forward to reading their comments.

The amplitude response curve that Paul Klipsch refers to is not a normal on-axis frequency response, but as our article clearly points out, is the total sound power measured in a 340 cubic metre reverberant chamber, corrected for spatial effects, and then subsequently corrected for room response, to provide a total reverberant sound power response for the speaker. Obviously high directionality of the tweeter will result in an apparent drop of response as the total sound power radiated by this tweeter has a smaller solid angle of radiation and as a consequence the total sound power at the top end of the spectrum must drop.

We also favour the Plain and Fancy test signal of a gliding sine wave and use it extensively on speakers which can be more readily evaluated under anechoic conditions. It would be true to say that those speakers would also show a comparable drop in the high frequency response when measured under the same conditions as the Klipschorn.

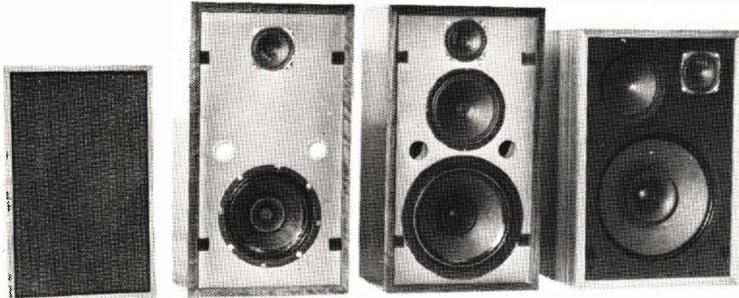
Although Klipsch did not see the review before publication, we did in fact telephone his company in the USA and asked if they would care to comment. These comments were published at the end of the review.

Louis A. Challis,
Louis A. Challis &
Associates Pty Ltd.

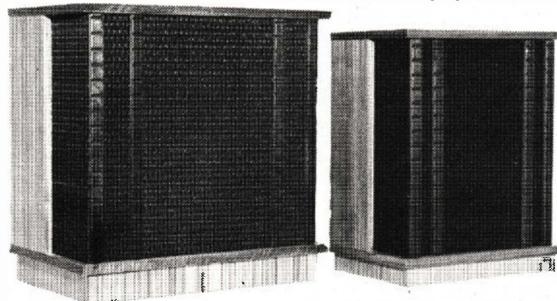
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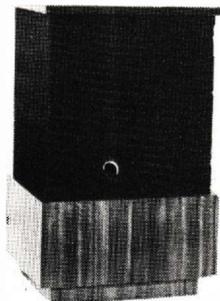


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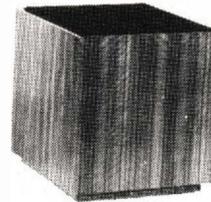


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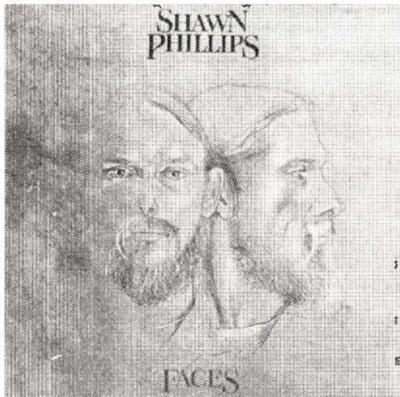
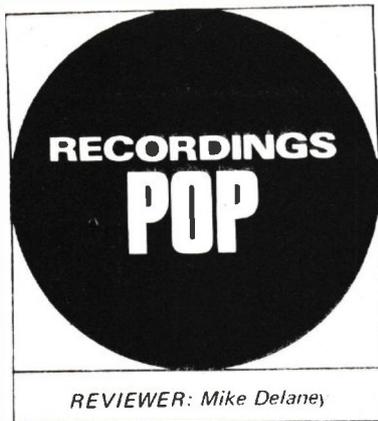
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"FACES" - Shawn Phillips. Festival/A & M. Stereo. AML. 34790. **"RIVER"** - Terry Reid. W.E.A./Atlantic. Stereo. SD.7290.

Two fine musicians, both singer/guitarists, both with their first album in a number of years - Shawn Phillips and Terry Reid. Each is a tone/texture imagery freak, dealer with atmospherics broadly styled on the Tim Buckley hypnosis-psychosis-carthasis school - subtle, poetic/reflective, endlessly undulating. Phillips leans toward acoustic-derived folk/rock forms; Reid concentrates on light, billowing jazz/rock. Both play around most of the time with vagueries - dusky, undefined rhythms dilating weightless.

"Faces", all previously issued material, makes up a varied, interesting album approximately covering Shawn Phillips over the last four years. "Landscape", "L'Ballade", "Chorale" and "Parisien Flight II" are the picks.

Terry Reid's "River", notable mostly for the three tone pieces across the second side, could have done with some more variety in tempo and mood. Otherwise though, particularly for "Milestones", "Dream", "Dean" and the title track "River", it's quite excellent. Real laid-back lucid jazz/rock - evocative, smooth; almost breathless.

"LET THE GOOD TIMES ROLL" - Original Motion Picture Soundtrack. Phonogram/Bell. Stereo. 2614.103.

Excellent double-set released to coincide with Australian screen schedules - essentially 'live' in format, "Let The Good Times Roll" rekindles much of the frenzy,

recaptures great pulsing chunks of that old fifties' madness. It's rock 'n' roll revival time with a whole batch of the people who made it happen: Chubby Checker, Little Richard, Bill Haley, Fats Domino, The Shirelles, Danny & The Juniors, The Coasters, Bo Diddley, The Five Satins - all here and firing hard with definitive performances, classic material.

Compiled by Jim Pewter and Richard Nader, "Let The Good Times Roll" presents a thought provoking, timely insight into our rock heritage - its origins, artistry and the then prevailing social attitudes. A thorough, exceptional album: from sock-hop-high-school ("Soldier Boy" - The Shirelles, "Let's Twist Again" - Chubby Checker) through to the real dirty spade jive (Little Richard's "Good Golly Miss Molly"/"Lucille", "Hey Bo Diddley"/"I'm A Man" - Bo Diddley). Real good sense of perspective.

See the movie too.



"THE CAPTAIN & ME" - The Doobie Brothers. W.E.A./Warners. Stereo. BS.2694.

Slick, polished West coast rock strictly lethal in terms of the verse-chorus-verse; SONGS - well groomed, angular, crisp and exacting; GOOD SONGS - real romance fodder to help turn that heartbeat with more sunshine, much happiness. The Doobie Brothers, a mightily little band, second only to Boston's Steely Dan in the third generation hefty pop stakes - real 100% competent; refreshing in their immediacy, thoroughness. A potential killer act with all the right amounts of everything: melody, funk, command - pure class.

"The Captain & Me", album number two, takes up from where the last Doobie hit "Listen To The Music" left off - SONGS: precisely defined, climatic; CLEVER - a fine blend of 12-bar raunch, persuasive latin rhythms and real sharp L.A. presentation. But sophisticated.

Mostly original, almost individual (with sincere thanks to California and all its musicians). Just exactly what the whole world needs - another rock 'n' roll band.

Ah! Bonjour, les freres Doobie. Geez it's nice.

"LINDISFARNE LIVE" - Lindisfarne. Phonogram/Charisma 'International'. Stereo. 6393.902.

A high-spirited, generously melodic 'live' budget set from the original and defunct Lindisfarne: seven cuts all drawn from the first two albums, "Nicely Out Of

Tune"/"Fog On The Tyne" - December '71 vintage. Very warm, insistently rollicking stuff - good time traditional acoustic; a gently, loving character with much optimism, taste and sensitivity. One of the finest English bands from over the last five-or-so years - keenly musical, always charming. Real gracious. A good one: "No Time To Lose", "Meet Me On The Corner", "Alright On The Night", "Fog On The Tyne" and an extended "We Can Swing Together" are the picks. Production is pretty slack though.

"TWICE REMOVED FROM YESTERDAY" - Robin Trower. Festival/Chrysalis. Stereo. CYL.34835.

An exacting, relatively animated guitarist - Robin Trower presents his first album since the split with Procol Harum, almost wholly within the techniques innovated by Jimi Hendrix. His aim seems to be centred more on re-sketching much of Jimi's earlier forms circa "Are You Experienced?"/"Axis: Bold As Love" - a move which succeeds only on the most basic, obvious levels.

Mostly without adventure, "Twice Removed From Yesterday" only offers limited insight into the character of Hendrix's rock-blues groundwork: Trower proves his ability to play within a set context, but loses out by not being prepared to interpret, accentuate or even re-state the essential themes. Very little is attempted to either isolate or highlight the depth, tone breadth and sense of shading that remains the key to Jimi's genius.

Robin Trower is good because he's consistent, not because he's prone to sudden bouts of creativity. A reasonably fluid, up-front agile guitarist, much more the product of his influences - a contextual player; as resourceful and expressive as his current genre allows.

"Twice Removed From Yesterday": a consumer's guide to the Hendrix 12-bar; a short hand notation of what one can and should do with guitar/bass/drums - all good licks, lots of feedback and reverb and wah-wah and fuzz lead tricks. Far from definitive. Absolutely lacking in spirit.

Simply, Trower bit off a whole lot more than he can chew.

"FRAMED" - Alex Harvey Band. Phonogram/Vertigo. Stereo. 6360.081.

Aggro/bowyer boogie - very aggressive; the full punch drunk PUNK - 'C' grade British rock '73 in the wake of Slade: same old riffs, same old 12-bar rhythms, even the same old songs to what was once the '63 blues revival. Old genres never die, they just get held over and diluted down, resurfacing every so often with bands like Alex Harvey - essentially the same form as Status Quo with less style, less grit and no gravel rash. A good support band - more 'image' than originality. Stack-heeled STOMP power. But butch.

"GP" - Gram Parsons. W.E.A./Warners. Stereo. MS.2123.

One of the most influential exponents of country music via rock 'n' roll, Gram Parsons can be singularly credited with much of its present character: through his work for the Byrds circa "Sweetheart Of The Rodeo"; by launching the Flying



Gram Parsons

Burrito Brothers with their classic first album "The Gilded Palace Of Sin"; in his strong working ties with musicians the likes of Jagger/Richard, Eagles, Don Nix, Jackson Browne etc. A talented, vastly underrated man.

Briefly, "GP" is a beautiful, mellow album — straight traditional country; warm and gracious and all over peaceful — across the meadows, down through the valley, back to the farm. A fine blend: the disarming simplicity of Gospel, the depth and directness of hillbilly/bluegrass, the sentiments of Nashville.

Presuming nothing, asking for nothing in return — Parsons goes about his music the same as always; "Find a way to love", that's the essence. Music of the spirit/Goose bump music — the note that's all there is: "Find a way to love".

"She", "The New Soft Shoe", "Big Mouth Blues", "That's All It Took", "Streets of Baltimore", "Cry One More Time" — Exultation/Exaltation; superbly arranged and produced. Musicians include ex-Burritos Bryon Berline, Al Munde, Al Perkins; Glen D. Hardin and James Burton from the Presley studio band; ex-Byrd John Guerin and vocalist Emmylou Harris. Simply fine.



STEPHEN STILLS

MANASSAS

DOWN THE ROAD

"DOWN THE ROAD" — Stephen Stills/Manassas. W.E.A. Stereo. SD.7250.

Second, finest and possibly final album from Stills/Manassas — easily one of the best recording outfits currently working in rock. Everything Stephen Stills has involved himself with has always come off fully

realized; every bit of potential GONE — WAM — right into the music.

Buffalo Springfield — Crosby, Stills & Nash — Crosby, Stills, Nash & Young — Manassas.

Everything just perfect — each inflection, each note, each melody; everything mellowed out clear and whole; everything so beautifully varied, balanced. Real eloquent. Real rich in texture — FULL.

"Down The Road" is an immensely subtle, consummately detailed album — laid back boogie, from country to calypso; warm all over and loving real hard — getting it on more and more with the latin rhythms. It's not a soloist thing the way it would be with, say, Neil Young or Graham Nash; Stills can only work solid on a one-to-one basis — as a member of a good band. Thus, Manassas — a whole lot different to session men; a whole lot more fluent and accessible. Each works with Stills as a musician on equal footing.

An amazing album.
Buy this one for sure.



Johnny Winter
Still Alive & Well

"STILL ALIVE & WELL" — Johnny Winter. C.B.S. Stereo. SBP.234318.

Back from his smack habit, Johnny Winter still spits it out pungent, molten hot. Real solid super lick boogie; 12-bar choogle dynamite riffing it right up your spine. Ornerly and hard and unclean — cleaving swift; sure and sharp like a steel razor. But good.

Featured again with guitarist/producer Rick Derringer, Winter's musical foil. "Still Alive & Well" continues along the path gouged out by "Johnny Winter And" — the first album to successfully break him from under the blues tag; the first of his discs to reach a major audience — rock 'n' roll.

An expert, dynamic set — real meaty and dense; pulsing, throbbing, heaving it up in extra concentrates. Fat, juicy licks — real dead centre bulls-eye stuff: "All Tore Down", "Cheap Tequila", "Rock 'n' Roll", "Too Much Seconal" and a superb rewiring of the Stones' "Let It Bleed" are four of the best.

Real fine guitar.

"ON THE AIR" — Carson. E.M.I. Stereo. SHVL.611.

Carson's second album, a 'live' recording of their last performance at Sunbury '73 — quality averages out somewhere between luke-warm and dull. Essentially a

spontaneous affair towards the end, Carson always had trouble keeping the fires smouldering — very inconsistent; occasionally real hard — 12-bar boogie all down-home-bluesman. Mostly though, it wasn't — certainly not at Sunbury. A very predictable, listless set with little dimension and even less command. The great shame about this band is that nobody got them on tape when they had it together.



Testimonial

Spectrum
Indelible Murtceps

"TESTIMONIAL" — Spectrum/Murtceps. E.M.I. Stereo. EMC. 2503.

Final album from the now defunct Spectrum/Murtceps chock-a-block with My Crudd's inevitable shuffle — tasty, impulsive, mostly mid (plod eternal) tempo and EASY; fond farewell boogie-woogie from what was Australia's most underrated and prolific band. A good set, less commanding in retrospect than either the double Spectrum "Milesago" (E.M.I. Stereo. SHDW.50/51-D), or the first and only complete Murtceps album "Warts Up Your Nose" (E.M.I. Stereo. OCS.D.7697); both of which are highly recommended — two excellent releases.

"Testimonial" lacks the drive and vitality of its predecessors, sticking far too regularly within that old indelible shuffle: everything's 12-bar; everything just gets laid-back listless and L-O-N-G. Simply, it holds no surprises — retracing what was largely the style of all previous Spectrum/Murtceps material. A might too repetitive and lack-lustre after its third (fourth) time around.

Michael Rudd's lucid, conversational lyric approach and his constant atmospherics a la the Spectrum cuts "Homesick Valium Blues", "Essay In Paranoia" and "I Think I Even Missed The Station" still sound fine, though somewhat less finished as studio product.

Still, not bad as a last album: very polished, very capable.

Ariel, three quarters of the old Spectral line (Messrs. Rudd, Putt and Mills) plus the lead/drums from Miss Universe (Tim Gaze etc), already have their first single "Jamaican Farewell"/"Red Hot Momma" out through E.M.I. (EMI.10287). A dynamite band you can be sure — caught them at Paddo Town Hall. Almost superb. Keep your eyes on this number, real guaranteed proof.

"HOPE YOU LIKE IT" - Geordie. E.M.I. Stereo. EMC.3001.

Nothing new, just the typical branka-branka-branka-and-a-branka-sturm-drang - sledge hammer riff rock 'n' roll, firmly embedded in the Page/Plant tradition circa "Led Zeppelin II" and the post "Black Night" Deep Purple(s). Geordie, another working class energy machine, fresh from the English industry belt - heavy metallic TOUGH. Very loud, very basic, very derivative: an awkward, obvious mesh jammed tight with all those three chord skeletons left over from the mid-sixties - all still intact; all reasonably functional. Lots of enthusiasm, lots of drive - competently uninspired, Geordie come across like a poor man's Slade - excessively raucous; lacking style, imagination and melodic quality. Very LOUD.

"STILL POINT" - Madder Lake. Festival/Mushroom. Stereo. MRL. 34.915.
"OUT OF THE BLUE" - Mackenzie Theory. Festival/Mushroom. Stereo. MRL.34925.

Two debut albums from Melbourne's latest batch of cosmic kiddies, Madder Lake and Mackenzie Theory. Neither is totally successful - Mackenzie Theory more so than t'other.

Briefly, "Still Point", the first from Madder Lake, covers large areas of post-psychedelic - rock 'n' roll halvah: 12-bar, lots of tempo/mood/instrument changes, a modicum of excitement: Very thorough - getting close to the point where they could start doing some really novel things. Not as yet though. "12lb Toothbrush", "Good-bye Lollipop" and "On My Way To Heaven" are the picks. Relatively tight, consistent and reasonably imaginative. Good Oz-rock, world-class potential, a great 'live' act.

Mackenzie Theory's "Out Of The Blue", billed as 'the first completely original, instrumental Australian album', recorded 'live' at Melbourne's TCS Studios, is a mostly dynamic, largely successful (dare-I-say-Zappa-esque) attempt at organized blowing: Pop/rock/jazz - guitar/drums/electric bass/electric viola. Very animated. Pick cuts: "Extra-Terrestrial Boogie", "Opening Number", "0.9.53" and "New Song". More Oz-rock out for some good adventure; at the worst, Theory suffers from sameness and lack of form. Still interesting. Rob Mackenzie sounds to be one of Australia's better electric guitarist - fast, high, clear; always penetrating.

Two high standard first sets for the newly-formed 'Mushroom' label, Australia's first company not afraid to take chances. Hopefully, they'll grow.

"VOLCANIC ROCK" - Buffalo. Phonogram/Vertigo. Stereo. 6357.101.

Second set from Australia's Buffalo - the first and, thus far, only local band to be signed to England's prestigious Vertigo label, home of the heavies. Basically, "Volcanic Rock" is a less than mediocre attempt at Grand Funking Black Sabbath - another slag pile; another exercise in late sixties' three chord riff resurrection, aimless solo raving and decibel power. Tastelessly

self-indulgent. As a group, Buffalo shapes up right poorly, lacking any sense of discipline or structure; any sense of dynamic control. An ugly, uninventive album. Bad news.



"DESPERADO" - The Eagles. E.M.I./Asylum. Stereo. SYL. 9011.

'Stage was set, the sun was linking low - as they came to town to face another show down.

The lawman cleared the people from the street.

All you blood thirsty by-standers better try and find your seat.

Watchin' Doolin,
 Doolin Dalton -
 high or low, it's all the same.
 Easy money, faithless women -
 you'll never kill the pain . . .

A brilliant album, one of this year's classic releases; "Desperado" - a tale of the early American West, masterfully conceived, fully realized; meticulous in its detail, overwhelming in its impact, its drama. Pure and absolute STYLE. A vivid, involving piece of music - each lyric a world, each song a chapter - intensely moving.

'Go down little Doolin, don't you wonder why -
 Sooner or later, we all have to die.
 Sooner or later, it's a stone cold fact:
 Four men ride out and only three come back . . .'

The Eagles, third generation West coast, furthering the style laid down over a decade ago by the Byrds (ILK-Burritos - ILK-Poco), possibly the finest band in their genre; without a doubt, one of the finest acts currently on record. Melody-rock in all its subtlety, depth, breadth and scope. Damn near perfect.

'Desperado, you're a hard one.
 And I know that you've got your reasons -
 These things that are pleasin' you,
 can hurt you somehow.

Don't you draw the queen of diamonds,
 she'll beat you if she's able.
 You know the queen of hearts is always
 your best friend.

Now it seems to me some fine things
 have been laid upon your table.
 But you only want the ones that you can't
 get.

Desperado, you ain't getting' no younger -
 Your pain and your hunger,
 they're driving you home.

And freedom -
 OH! freedom -
 that's just people talkin'.
 Your prison is walkin' through this world.
 All alone.

Don't your feet get cold in the winter
 time -
 Sky won't snow, sun don't shine.
 It's hard to tell the night time from the day.

You're losin' all your highs and lows -
 It's funny how the feelin' goes
 A-W-A-Y

Desperado -
 Why don't you come to your senses.
 Come down from your fences.
 All the day through -
 It may be rainin' -
 But there's a rainbow above you.
 You better let somebody love you.
 You gotta let somebody love you
 before it's too late!
(Lyrics, courtesy Warner Bros. Music)

A selection of 'must-haves' mightily dug:
 "Bursting At The Seams" - The Strawbs.
 Festival/A & M. Stereo. AML.34846.
 "Sing It Again Rod" - Rod Stewart.
 Phonogram/Mercury. Stereo. 6338.248.
 "A Wizard/A True Star" - Todd
 Rundgren. W.E.A./Bearsville. Stereo. BR
 2133.
 "ELO.2" - Electric Light Orchestra.
 E.M.I./Harvest. Stereo. SHVL.806.
 "The Best of B.B. King" - B.B. King.
 E.M.I./Probe. Stereo. SPBA.3054.
 "Back To New Orleans" - Sonny
 Terry/Brownie McGhee. Festival/Fantasy.
 Stereo. FYL.431/2.

Apologies to Michael
 and several thousand
 baffled readers for the
 extraordinary mix up
 in the first two columns
 of Michael's reviews
 in our September issue.

Incredibly, two or
 three lines from one
 of our associated
 journals (Rugby League
 Week!) somehow found
 their way into Michael's
 copy.

Ours read oddly enough,
 but you should have seen
 the corresponding issue of
 Rugby League Week!

RECORDINGS classical

REVIEWERS: *Tanya Buchdahl*
John Araneta

LISZT: Hungarian Rhapsodies Nos. 1-19; Spanish Rhapsody. Erika Lux, Erzsébet Tusa, Gabriella Torma, Gabor Gabos, Kornel Zempleni (pianos). Hungaroton LPX 11488-90 (3-record set with booklet) \$11.85.

Raymond Lewenthal once told me that Liszt's Hungarian Rhapsodies needed rediscovering — I can't for the life of me think why. I find Liszt to be an unfortunate exorcism of a failing (Romantic) idiom, and sitting through 6 sides of rhapsodies, purgatory.

But for those who wish to do so, the present set is the only complete version available in Australia. For those who obtain it, you will find a production much more lavish than previous Hungaroton recordings, though the standard of their notes is as high as ever. The sound is a little thin, however, with a somewhat hard and metallic sound in the upper register. It improved when I used the bass-treble boost, and it may well sound much better on systems which do not have as dry a sound as mine.

Unlike the locally-unavailable Vox set, this version generously includes the much less known Spanish Rhapsody, giving an average time of nearly 27 minutes per side. All the pianists are highly proficient, but I admit to a special partiality to the playing of Erika Lux — it has just an extra dash of excitement (she unfortunately has only 3 pieces, Nos. 1, 7, and 11).

Excitement is, after all, a very large factor in Liszt's music. From this point of view, records are the worst way of listening to it, because it was the actual performances given by Liszt which caused so much impact. Liszt was a brilliant virtuoso — he played Grieg's A minor piano Concerto perfectly at sight — and his arm-waving, hair-tossing, windmillesque performances caused many a lady to swoon in adoration. The first pop star, I suppose.

He was very much right for his times — a school of thought such as the Romantic one which emphasized emotionalism and expression lends itself to abuse and rapidly turns to sentimentalism. As with many schools of art which pass their prime, such as the 4th century Greek sculpture which led to Hellenism, the aims of the art form polarize into extreme emotionalism (sentimentality) and miraculous mechanism. Unless of course someone

turns up who can transform the old aims to new and original forms, and so add to the art's development. Liszt couldn't, and neither could Grieg. But Mahler, Strauss and on occasion, Brahms, did — they understood their tradition.

So one can admire the digital acrobatics, even though we no longer have the charismatic character of Liszt performing them, but what about all those embarrassing indulgences? That second rhapsody which in its orchestral version accompanies the Barnum and Bailey elephants? Not rhapsodies — crhapsodies. But ideal for bravura-oriented sentimentalists. — T.R.B.

ARCANGELO CORELLI: 12 Sonatas for Violin Solo and Continuo Op. 5. Denes Kovacs (violin); Ede Banda (cello); Janos Sebestyen (harpsichord). Hungaroton LPX 11514-15. Distributed by Avan Guard Music.

Of the 72 undoubtedly authentic works by Corelli, only 12 are known much at all, and of those 12 (the Concerti Grossi Op.6) only one could pass as well-known (the Christmas Concerto, No.8) One! Despite the fact that Corelli is ubiquitously quoted as a strong influence on Bach, he is ridiculously little-known, just as it is for Cherubini who eternally anticipates Beethoven, and Field, who similarly anticipates Chopin. What has happened to the first four works, each consisting of twelve trio sonatas, and the fifth containing 12 solo sonatas?

At last, there is at least an edition of Op.5, and an excellent edition it is too. In fact, it is one of the best issues I've heard from this company; my only complaint would be the folder format in which it is presented, making it fairly easy for one record to drop out while taking out the other. In all other respects the presentation is first-rate. The cover notes (in four languages) are highly informative and beautifully translated — furthermore, the entire opus is filled onto only two records — with no reordering of the sonatas or turnover breaks either. A remarkable feat, and a generous timing of 120'07" — other companies would blandly spread the sonatas out at 20' a side (there is, I gather, a three-record set on Everest, if you can find it).

But the real delight of this set is the performance itself. I can't say I have heard very many performances, even of chamber music, which sound as if the players are quite delightedly having a good time, but this one certainly does. Janos Sebestyen is quite well known in the West, and Ede Banda is known anonymously as a member of the Tatrai Quartet, but it seems that Kovacs (like Corelli) is unjustly neglected. I have very great regard for Kovacs — I first heard him (on another Hungaroton record) in a remarkably fine performance of the Beethoven Violin Concerto — and have no idea why he is not better known. I hope these records will give him the recognition he deserves.

The Op.5 is made up of sonatas da chiesa (church sonatas) and sonatas da camera (chamber sonatas): the latter are made up of usually five dance movements, while the former are of a more 'serious' nature, with more structured, often fugal, movements. The first six here are church sonatas thinly disguised as chamber sonatas, but done so

successfully that one would have to know which was which to identify them with certainty. Only No. 12 is obviously a chamber sonata, a set of variations on the theme "La Follia", used also by Vivaldi and Bach, amongst others.

Baroque music, with the exception of Bach who belongs strictly to no period, is the music of comfort. Disharmonies are infrequent and resolved with a minimum of discomfort to those who hear it. Its so-called elegance is the sort of comfort afforded by the interior of a seventeenth-century drawing-room. One may even feel comfort because of the sense of harmony and ease of mind which reason of proportion can give. This certainly doesn't make it after-dinner music, or music to snooze by — I suppose all I can say is that it is music to be comforted and comfortable by. In that case, these records are ideal. — T.R.B.

BRAHMS: The Piano Concerti. Emil Gilels (piano), Ottomar Borwitzky (solo cello); Berlin Symphony Orchestra/Eugen Jochum. DGG 2707-064 (2-record set) \$12.40.

Brahms pianists can all pack up and go home. Here it is, this is it. In just three records, these two and last year's G minor Piano Quartet (DGG 2530-133) Gilels has established himself as probably the best Brahms pianist alive today. The Berlin Philharmonic, too, sheds its customary rather bloodless perfectionism and gives a performance of equal brilliance. Other reviewers who know these works well were staggered at the difference between these performances and other earlier ones; I must confess I knew neither concerto at all well and came at this new set quite unprepared, and consequently by the end of it I was wondering what had hit me. In particular, I was quite unprepared for the slow movement of the second concerto, which not even Richter and Leinsdorf (on RCA) can match: as I listened to the impressionist shapes of the piano at a magical *ppp* it was as if a fine gossamer net was being spun around me, and everything became total calm — and there rose out of it such a song of beauty as I have never heard the likes of before, the return of the solo cello. I wept with joy when I heard it; and though I have been in as many different moods as times I have now heard it, it still has the same effect on me. Even if the rest of the performances were terrible, which they most certainly are not, this set is worth having just for that passage which is little short of miraculous.

A performance like this takes many more than one hearing to get any idea of what's going on, and it's the type of performance for which trying to explain *why* it is so good is a totally useless exercise. It is certainly more than just outstanding performances from both soloist and orchestra, more even than the magnificent communication between the two (even including the spectacular sound-quality). Some claims in aesthetics suggest that it is because it just sounds *right*, and that we are "better people for having heard it". It is an idea which usually strikes me as vague and idealistic at least, but this time I can just about believe it.

(continued on next page)

T.R.B.

VIVALDI – The Five Compositions on Christ's Passion. Aafje Heynis (alto), I Solisti di Milano, Angelo Ephrikian (cond.). TELEFUNKEN SAWT 9590.

This is a surprising record. For the lover of Baroque music, Vivaldi is delightful but too often sounds the same all the time. "Oodle-oodle" music, as a particularly smug acquaintance of mine puts it. But a record like this makes one think twice before generalizing about certain very prolific baroque composers. For one thing, it makes one wonder what other Vivaldi can be like particularly some of his other religious music and opera. Naturally enough, only scholars have the time and inclination to search for works of equal stature as this one in Vivaldi's output. For this reason we must be grateful that Telefunken has begun to release a number of highly interesting material in their Musica Italiana series. Certainly the compositions recorded here are among the most moving religious works to come from the Baroque period, and more than this, they give us an added dimension to the picture most of us have of Vivaldi.

Starting to play this record with the *Sinfonia* on side 2, largely because I had thought I was already familiar with the *Stabat Mater*, I was rather taken aback by the sombreness and dissonances in the music. In fact, unless one knew this was Vivaldi, one would be quite at a loss to be sure whose music this actually is. The familiar Vivaldi is hardly here at all. One has in fact to go to Monteverdi, Schutz and Bach to find religious music of equal power

that expresses so well the epitome of Christian tragedy. No, there is little here like the over-familiar *Gloria* or the less known *Kyrie* and *Credo*. Unique, you may well say, and no-one should miss this record who fancies himself a knowledgeable listener of baroque music.

My own surprise makes it in fact very difficult to describe this very shadowy music. The performances are in general excellent. One wishes Telefunken had elected to use original instruments, what the string writing must be like with the right timbre one can well imagine. I rather think that a more idiomatic sense of ornamentation should have been used here particularly in the da capo sections but none of these works are easy to ornament properly in keeping with the character of the music and ornamentation, less than well sung, can so easily detract from interest in the music. The recording, originally an Arcophon release in Europe is very good.

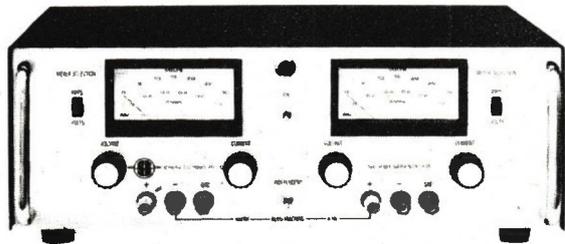
One minor but important quibble, why are none of the records in this series equipped with translations of the text? – J.A.

BACH: Complete Cantatas Volume 6: BWV 21 "Ich hatte viel Bekuemernis"; BWV 22 "Jesus nahm zu sich die Zwoelfe"; BWV 23 "Du wahrer Gott und Davids Sohn". Soloists of the Vienna and Toelzer Boys' Choirs (sopranos); Paul Esswood (alto); Kurt Equiluz, Marius van Altena (tenors); Walker Wyatt, Max van Egmond (basses). Vienna Boys Choir, Toelzer Boys Choir,

Kings College Choir, Cambridge; Concentus Musicus Wien/Harnoncourt and Leonhardt Consort/Leonhardt. Telefunken Das Alte Werk SKW 6/1-2 (2-record boxed set with notes on works and performances, and full scores. \$12.40.

It seems to me that with every issue this group of performers improves. I recall being quite stunned with their St John Passion (SKH 19/1-3) a couple of years ago, but this latest issue in the mammoth project of recording the complete cantatas seems now so much more polished and crystalline (also not entirely without aid from the engineers). BWV 21 is a wonderful cantata (a very early one – Weimar 1714), and the performance given here is quite remarkable – really outstanding. The honours, however, go to the boy soprano from the Vienna Boys Choir, studiously left unnamed. Particularly when one considers the necessarily limited amount of training he could have had, his precision and self-assurance are not only amazing, but the sheer joyous excellence of it really does the heart good. And for those who claim that all-male voices makes Bach too dry (I now find 'ordinary' or mixed performances very strange and generally too heavy) – I suggest listening to the alto and soprano duet section of the chorus "Was betruerst du dich, meine Seele", which is some of the most sensuous Bach I have ever heard – in any case, I don't think it is possible to make Bach too dry at all, and quite a lot of Bach performances would be vastly improved for some dryness.

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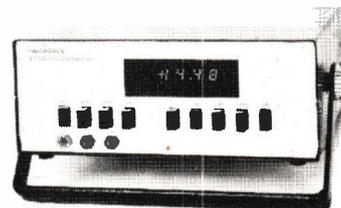
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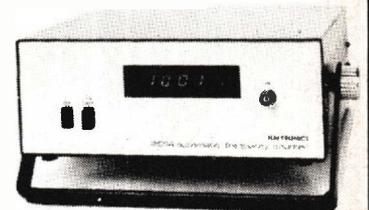
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NEW AUDIO- VISUAL AID

This new device from Convoy International provides a means of implementing Talking Books inexpensively.



A NEW Audio-Visual Aid, which should have a profound impact on teaching methods, has been developed by the Japan Chemicals and Metal Company of Tokyo.

The new unit called the "SOPIC" is a completely self-contained record player, 100mm in diameter and 150mm high. It plays 45rpm ultra microgroove records which hold up to 4½ minutes of recorded material and have a surprisingly good frequency response.

Rather than rotate the record, the stylus is rotated and moves inwards under impetus from the record grooves. This mode of operation has provided particular advantages for educational applications.

As the records are thin and flexible, one may be attached to each page of a book or lesson material. Thus the printed information is supported and enhanced by words and/or music as required.

The SOPIC itself is relatively inexpensive and we understand that records can be made to order in minimum quantities of 1000 off at 15 cents each.

Thus the unit should achieve rapid popularity with educators especially as more recorded "talking book" materials become available in the English language.

We have seen some of the Japanese

language material and were very impressed with its quality and presentation. The units are readily used by young children without fear of damage, as a single push button control causes the stylus to be

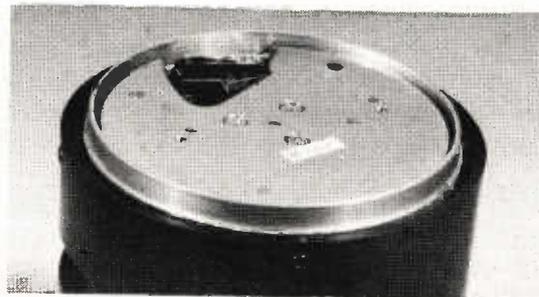
retracted when the unit is switched off, the only other control being that for volume.

The unit is manufactured by Japan Metals and Chemicals Company Ltd. of Tokyo.



The Sopic record is flexible transparent and may be pasted to the pages of lesson material as it does not have to rotate.

The underneath of the unit showing the stylus assembly.



ACTIVE FILTERS

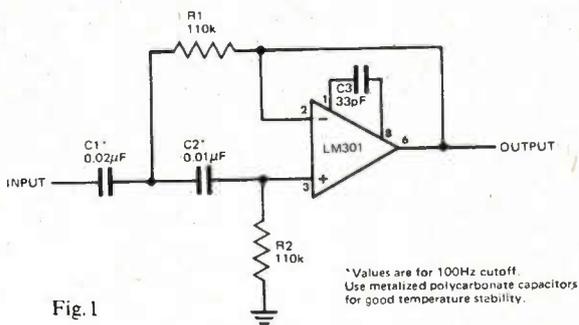


Fig. 1

*Values are for 100Hz cutoff. Use metallized polycarbonate capacitors for good temperature stability.

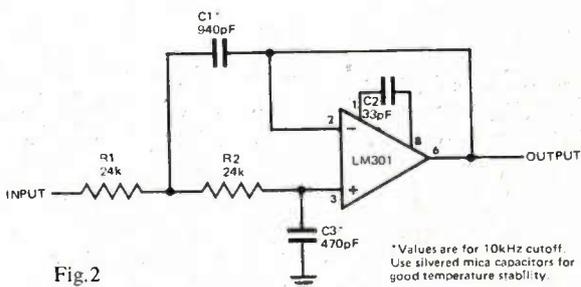


Fig. 2

*Values are for 10kHz cutoff. Use silvered mica capacitors for good temperature stability.

ACTIVE RC filters using operational amplifiers are increasingly being used to supplant LC filters because of the small size and ever-decreasing cost of integrated circuit operational amplifiers. Here are two useful general purpose circuits which may be readily incorporated into other circuitry where needed.

Figure 1 shows one of the simplest forms of filter, the low pass. The circuit has the same characteristic as two isolated RC filter sections with the additional advantage of a buffered low impedance output.

The attenuation is 12 dB per octave at twice the cut off frequency with an ultimate of 40 dB per decade.

There are two basic designs for this filter, the Butterworth (maximum flatness), and Linear Phase (minimum settling time for pulse input). The equations for the Butterworth design are:—

$$C_1 = \frac{R_1 + R_2}{\sqrt{2} R_1 R_2 \omega C}$$

and

$$C_2 = \frac{\sqrt{2}}{(R_1 + R_2) \omega C}$$

For the Linear Phase design simply substitute $\sqrt{3}$ for $\sqrt{2}$ in the above equations.

To make a high pass filter we merely substitute resistors for capacitors and capacitors for resistors, as shown in Fig. 2, and apply the same formulae.

HIGH INPUT IMPEDANCE AMPLIFIER

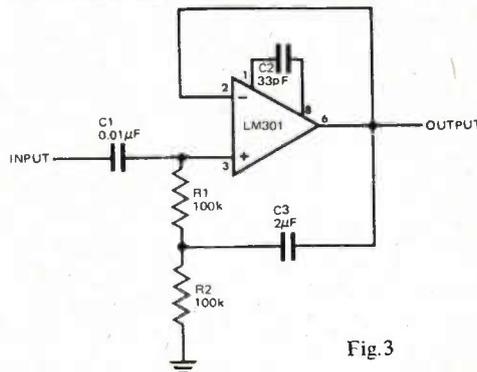


Fig. 3

The LM301 may also be used to construct a simple high input-impedance ac amplifier as shown in Fig. 3. In this circuit even though the bias resistor is only 200 k, as required for good dc stability, the bootstrapping by C3 provides an input impedance of 12 M at 100 Hz increasing to 100 megohm at 1 kHz.

POSITIVE PEAK DETECTOR

A positive-peak detector having gain may be constructed using two LM301As as shown in Fig. 4.

The output is the peak voltage at the input amplified by the ratio $(R_1 + R_2)/R_2$. Typical error is $2(R_1 + R_2)/R_2$ millivolts.

If unity gain is required R2 is deleted. The combined resistance of R1 and R2 should be in the range of 10 to 100 k and the minimum load resistance 2.2 k. Where negative peak detection is required reverse the polarity of both IN914 diodes.

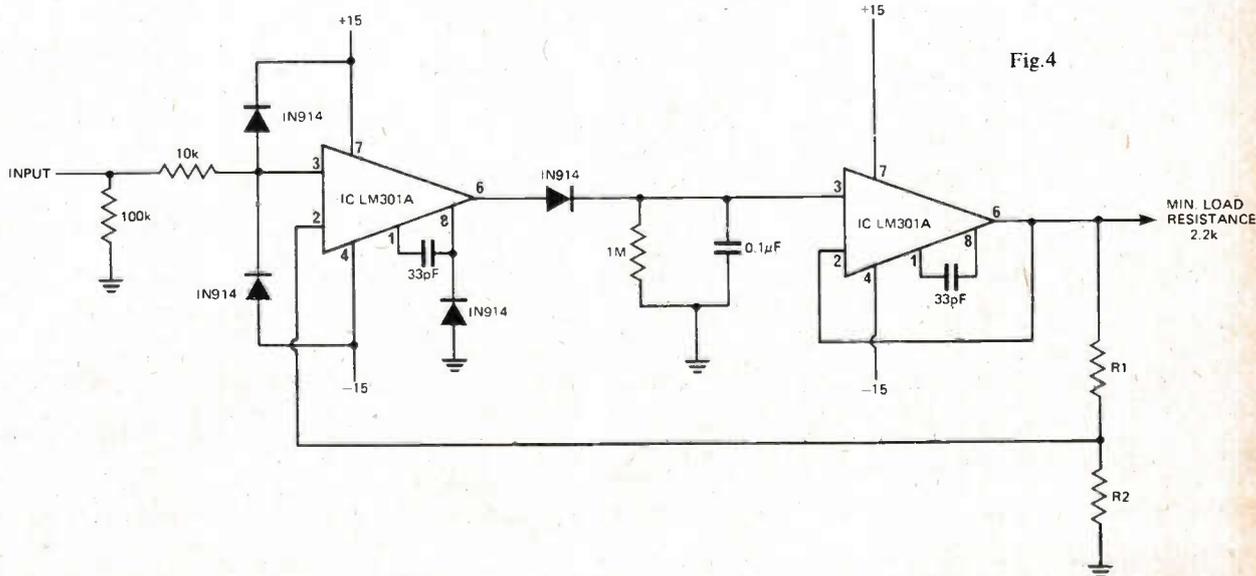
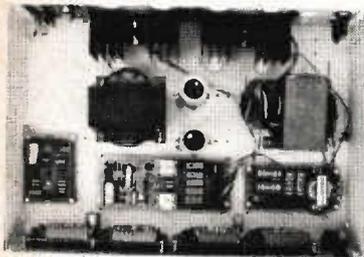


Fig. 4

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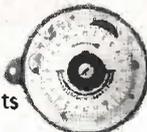
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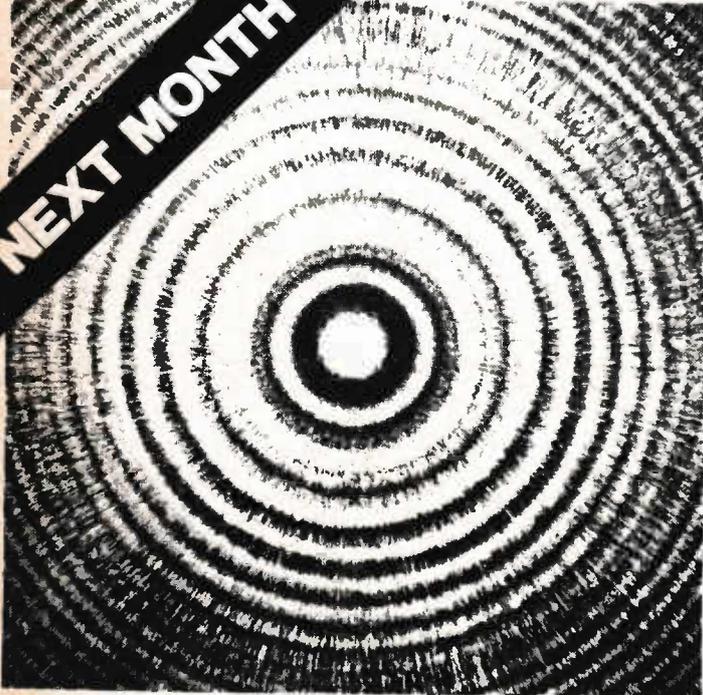
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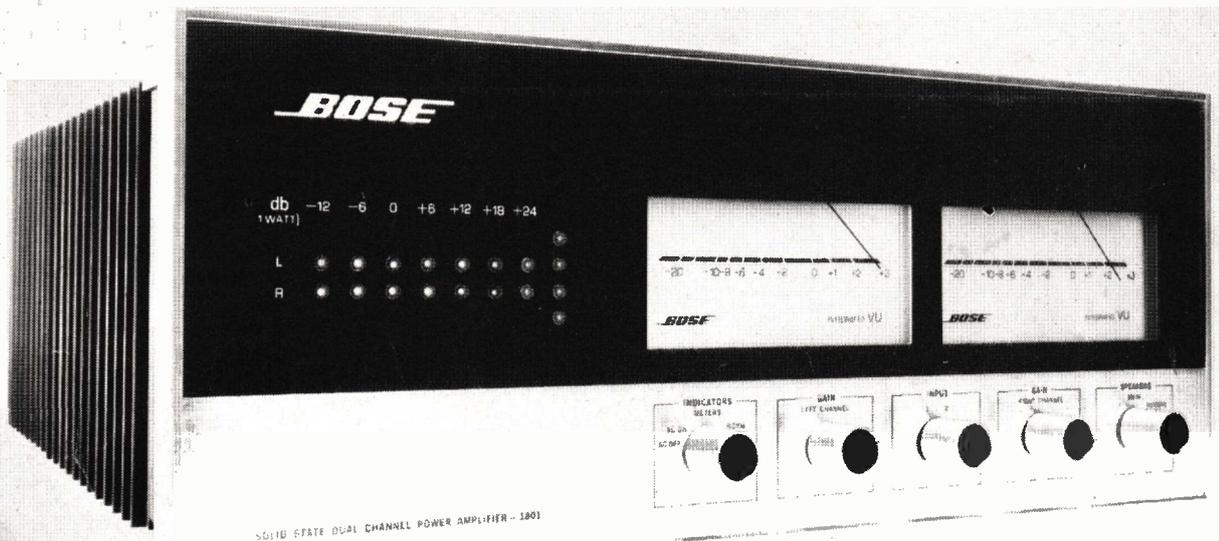
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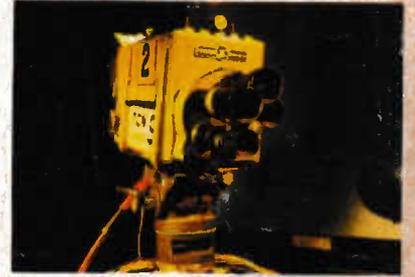
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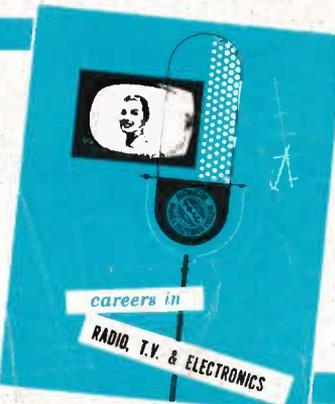
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