AUSTRALIA'S NEW MONTHLY

JUNE 1971 50c

electronics TODAY

OMEGA: THE FACTS

4-CHANNEL SOUND

TEST: DESK-TOP COMPUTER

COLOUR TV REVOLUTION

ELECTRONIC ENGINE TESTING

TOP-INTEREST PROJECTS

Got a leaning to good listening

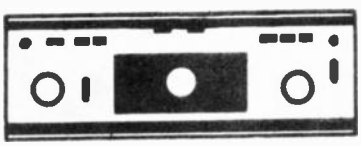
Here's a new SLANT —FRONT

SONY TAPE DECK

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

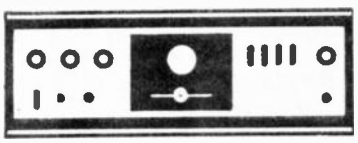
. . . and two superb SONY Amplifiers to team with it:

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



TA-1144

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



TA-1010

Rated output, 15 watts per channel, both channels operating
Less than 0.5% at rated output

Less than 1% at rated output
20 Hz — 100 kHz
Accepts all low and high impedance headphones
Bass 100 kHz ± 10 dB. Treble 10 kHz ± 10 dB

PHONO-1, PHONO-2, better than 70 dB, 3 mV, TUNER, AUX-1, AUX-2, TAPE, REC/PB, better than 90 dB (250 mV)
20 transistors, 5 diodes
16 9/16 (W) x 4 7/8 (H) x 9 11/16 (D)
10 lb

SONY®

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

NAME .....

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IMS/21-70

electronics TODAY

JUNE 1971 Vol.1 No.3

main features

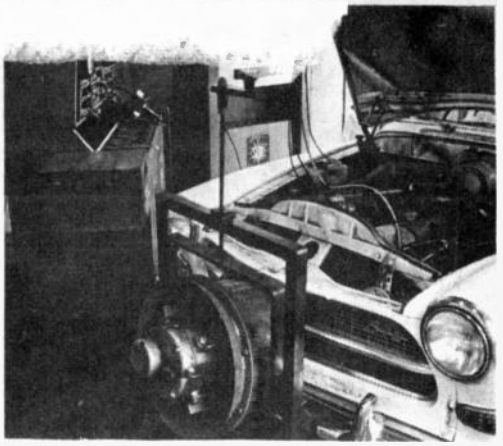
projects

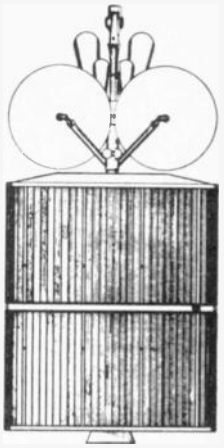
product tests

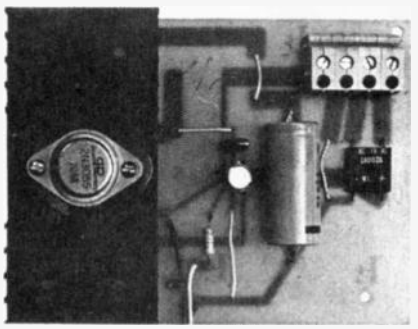
reviews

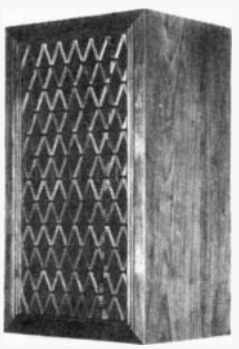
news & information

COVER: Shared this month by the Wang 700B computer-calculator (assessed in-depth on pages 64-69) and Akai's 'Surround Sound' 4-channel tape recorder (pages 72-73).









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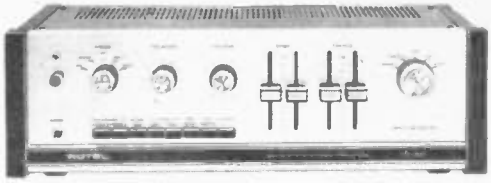
ENCEL HAS LOWEST PRICES ON HIGH QUALITY ROTEL AMPS

At Encel's unbeatable low prices these fine Rotel Stereo amplifiers are outstanding value for money!

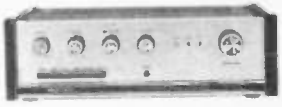


ROTEL RA 610

Reviewing this unit, Electronics Australia (January, 1971, page 109) says: "On test this amplifier performed impeccably. Harmonic distortion was less than 0.1% at 25 watts. Frequency response was exceptional with —3dB points at 6Hz and 200kHz. Square wave response was excellent and stability with capacitative loads was also good." The new RA 610 offers 32 watts RMS per channel. Housed in handsome wood cabinet and fitted with slide tone controls and extensive connection facilities on rear panel.
Encel price only $199.00*

ROTEL RA 310

Same high quality as the more powerful RA 610. 17 watts RMS per channel, with harmonic distortion less than 0.2% at rated output. Like the RA 610 this outstanding amplifier measures better than its quoted specifications on test.
Encel price only $129.50



FAMOUS ROTEL STEREO HEADPHONES

Model RH-711
(15-25,000 Hz)
Encel price $17.50
Model RH-600
(20-19,000 Hz)
Only $9.50
Both headsets complete with 10ft. of cord and standard stereo plug.
NOTE: All prices include sales tax. Write for full information on all these items. Technical reviews available on items marked *.

ENCEL OFFERS A COMPLETE RANGE OF "SEAS" SPEAKERS FOR BETTER SOUND AT LOWER COST!

The big new range of SEAS speakers offers a quality of sound reproduction that can't be matched at such low prices! SEAS speakers are renowned for their low distortion and excellent reproduction of transients. They have high power handling capacity and wide, even high frequency dispersion for a natural and stable stereo "image". Bass is smooth, extended and "clean". Enclosures are simple, compact and economical.

Also available in easy-to-assemble kits, complete with cross-over network, fibre glass and full cabinet details. Write now for full details!

Model	Type	Size (inches)	Frequency Range (Hz)	Natural Resonance (Hz)	Power Rating (watts)	Flux Density (Gauss)	Gap Energy (10^4 Erg)	Voice Coil Diameter (mm)	Depth (mm)	Price $
5TV-HF	Tweeter	2	5,000-20,000	—	10	11,500	30	13	33	5.80
9TV-HFT	Tweeter	3.5	3,000-20,000	—	4	11,500	30	13	45	5.80
87H	Dome Tweeter	1.5	1,500-20,000	⅄—1,000	35	13,000	230	39	50	19.80
13TV-GM	Mid-Range	5	200-4,000	80-100	20	10,500	230	26	85	24.80
15/11TV-2XM	Mid-Range	6 x 4	300-6,000	90-120	12	12,000	115	19·5	80	9.80
21TV-GD	Full Range Twin Cone	8.5	40-18,000	50-60	16	10,500	230	26	98	12.50
21TV-EW	Woofer	8.5	35-2,000	25-30	60	5,500	280	39	88	24.80
25TV-ED	Full Range Twin Cone	10	25-15,000	35-43	20	10,000	340	39	95	14.50
25TV-EW	Woofer	10	30-1,500	20-25	60	5,500	280	39	102	29.80
30WK	Woofer	12	45-3,000	35-40	100	11,000	570	39	150	58.50
30TV-COAX	Full Range Co-Axial	12	30-20,000	35-45	24	10,000/11,500	340/30	39.13	136	38.50
30DCOAX-LUX	Full Range Co-Axial	12	30-20,000	27-33	30	11,000/11,500	570/30	39.13	155	89.00

EE 129

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OUR Broadcasting Control Board is being stampeded into an action which is totally unnecessary and can only result in lowering the image quality of a number of programmes being telecast in Australia, without benefiting anyone.

The Board has directed all commercial TV stations to remove the colour data from overseas programme tapes that contain it before transmitting them — allegedly to protect the public from being salestalked into buying expensive colour TV sets prematurely.

The inference is that such sets are capable of receiving and correctly phasing the colour signals from these tapes, even though transmitted by the present equipment. This is not true.

The data currently being transmitted does not contain the 'colour burst' signal which ensures that colour information is directed to the correct part of the screen. This must be synthesized within the colour receiver — a modification which can only be successfully undertaken by a specialized engineer. Even then the receiver needs continual expert adjustment to maintain colour balance.

Tom Spencer, Chairman of the Australian Electronic Consumer Industries Association, says quite positively that he knows of no-one outside the TV engineering industry successfully using a colour receiver.

He estimates that there are less than 50 receivers throughout Australia which can successfully reconstruct the transmitted colour programmes — and at least 45 of these are owned by manufacturing companies working on colour TV development.

The colour content CAN be removed from the programmes. But the simple way of restricting the transmitted bandwidth spoils black-and-white picture resolution, whilst the alternative method of reconstructing the picture without colour content is complex and very expensive.

And why should the stations be put to this expense, when the present combined colour and black-and-white data is transmitted within each station's authorized frequency bandwidth?

The reason for the Board's action is said to be a number of articles published recently in the daily press, which claimed that colour TV could be received by anyone who could afford a colour receiver. It is significant that one of the journalists responsible for the reports approached the only company in Australia currently handling colour receivers and was told categorically that they were being sold only to the television engineering industry.

We can only assume that the Control Board has over-reacted to these newspaper reports, for no-one else in the TV industry knows of any logical reason for the Board's decision.

news digest

SENSOR–ED NEWS

An ingenious newspaper for blind people has been developed in Europe.

The newsprint is impregnated with tiny ferrite needles. The editorial and advertising content is then recorded magnetically, by a technique similar to tape recording.

The audio signal is subsequently 'read' by moving a magnetic sensor across the paper. Sound reproduction is said to be somewhat less than hi-fi, but adequate for its purpose.

PHONE FOR DEAF-BLIND

A simple add-on unit for the telephone which enables even deaf-blind people to talk to each other has been devised by the Western Electric division of the Bell Telephone System in Indianapolis, U.S.A.

Called Code-Com, the unit consists of a light, a sending key and a vibrating disc. Transmitted signals are converted at the receiver into flashes of light for deaf people, and into vibrations which a deaf-blind person can feel on the sensor disc. Morse code or, indeed, any other pre-arranged code may be used to transmit messages.

The Code-Com service has recently been put into commercial use for the first time, in Columbus, Ohio. Initially the rental for the Code-Com unit has been set at $3 a month.

NEW SEMICONDUCTOR PLANT

Melbourne-based Rutherford Electronics — Australian agents for National Semiconductor, a leading U.S. transistor and IC manufacturer — have opened a new $¼-million semi-conductor plant at Bayswater, 15 miles out of Melbourne.

With a change in name to NS Electronics Pty. Ltd. (NS implying National Semiconductor), the new company has commenced manufacturing transistors and move into IC production.

Announcing the opening of the new Bayswater plant, Mr. Jack Rutherford, NS Electronics' managing director, pointed out that the main reason behind his decision to manufacture in Australia stemmed from high protective tariffs.

Mr. Rutherford said: "Because of the high tariffs, we have never marketed transistors in Australia. But with ICs we have been a little bolder. We can modestly say that we have, in the past year, marketed more ICs than any other company in Australia.

"In July last year, when the tariff on ICs rose to 45%, we were obliged to protect the market we had already obtained. The only way to do this was to manufacture — we could no longer bring in and compete with companies manufacturing locally".

NS Electronics will not enter the high technology area of semiconductor manufacture. It will receive the wafers after fabrication and from that stage complete the manufacturing process for both transistors and ICs. Because of the worldwide operations of National Semiconductor, the wafers, depending upon the device type, will be imported from any of the company's plants in Singapore, Hong Kong, Scotland, Germany, or the USA.

Total plant area at Bayswater is 9260 sq. ft. of which the production area is 6250 sq. ft., the rest being office accommodation and administrative areas.

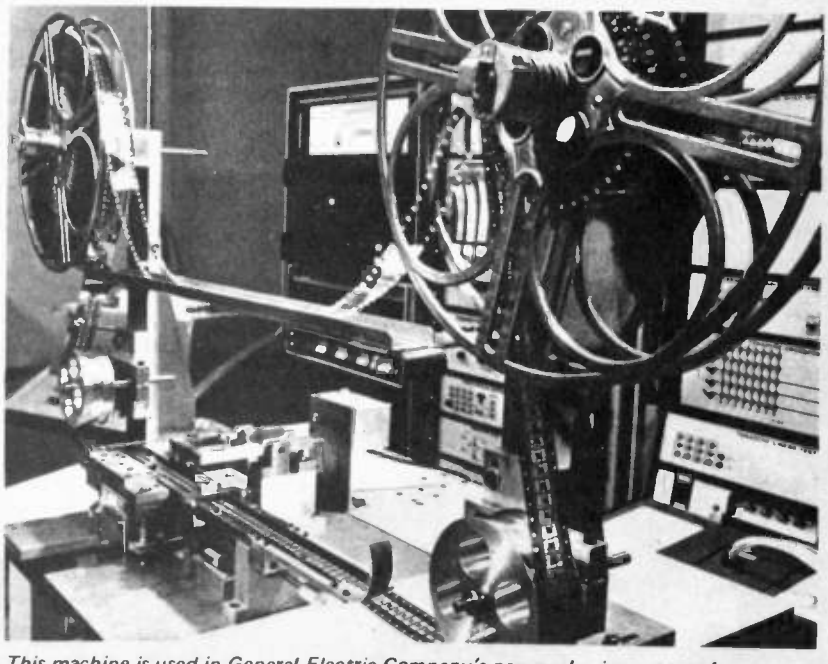
NS Electronics joins the select group of transistor manufacturers in Australia — AWA, Fairchild, Philips and STC. In ICs, the new Melbourne company, within the next few months, will compete with AWA, Fairchild and Philips as a local manufacturer.

SHIP-TO-SHORE BY SATELLITE

Satellite communication with ships at sea has been shown to be technically feasible in recent tests, including a series carried out between the United Kingdom and the Cunard-Brocklebank container ship Atlantic Causeway. The possibility of a commercial ship-to-shore service by satellite is now under study by several other shipping nations.

The tests were carried out jointly by the British Post Office, shipping and radio operating companies, and suppliers of equipment, with assistance from NASA and the U.S. Coast Guard.

Good-quality voice circuits have been reliably maintained, using relatively simple antennae and equipment over a VHF radio circuit from the Post Office radio station at Burnham-on-Sea, Somerset, through an Applications Technology Satellite (ATS-3) made available by NASA. Special tests were carried out using lincompex and



This machine is used in General Electric Company's new packaging process for integrated circuits, in which the chips are mechanically bonded to a lead frame that is part of a plastic film strip. The circuits can be tested fully automatically and customers are able to automate their assembly operations, thus reducing system costs.

Sansui

Sansui speaker systems look the best on the market. And that's the way they sound.

Most *women* prefer Sansui speaker systems because of the way they *look*. They like the hand carved Kumiko fretwork grilles, the carefully selected timber, the beautiful proportions of the cabinets and the unequalled Sansui craftsmanship.

Most *men* prefer Sansui speaker systems because of the way they *sound*. Because of the superior performance and advanced technical specifications.

Whichever approach *you* prefer, the answer is the same . . . *Sansui*.

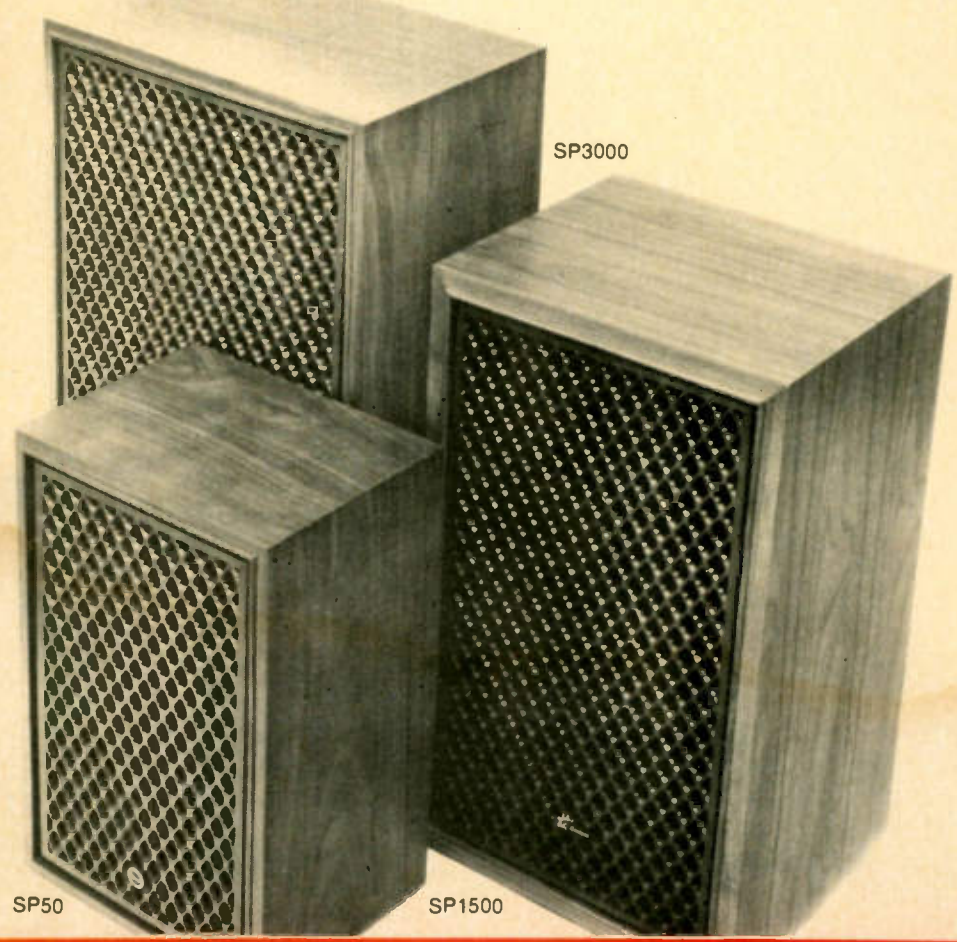
Take the popular SP50 speaker system. Although it's only 19¾" x 12¾" x 9¾", it handles 25 watts with ease and has a frequency range of 50 — 20,000 Hz. A rolled edge bass/mid-range speaker is used with a patented horn type tweeter. With a crossover at 7 kHz. the results are both surprising and satisfying, particularly for a compact speaker system.

Move up through the range to the Sansui SP1500. With a 12" high compliance woofer, 6½" and 5" mid-range speakers, twin 1" high dome tweeters and crossovers at 600 and 6000 Hz., the SP1500 has an effective frequency coverage of 33 — 20,000 Hz. and handles 60 watts of music power. Size is 25⅝" x 12¾" x 15".

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

Finally, let's look at the superb SP3000, prince of the Sansui range of quality speaker systems. With a massive magnet structure on the 15" woofer, bass is reproduced without color or restraint. Total flux is 187,000 maxwells! At 600 Hz. an electrical crossover introduces a lower mid-range speaker, the upper mid-range being handled by an exponential horn squawker. At 7 kHz. twin 2" cone tweeters take over . . . and then, at 10 kHz. the super tweeter.
Technicalities apart, what is the end result? A superb domestic speaker system. full of vitality and power — a system that makes the most of original Helmholtz principles. Size of the SP3000 which is rated at 80 watts is 25¼"x17¼"x11⅜"
We have illustrated just three of the Sansui speaker systems available at your franchised Simon Gray dealer. These are representative of Sansui's comprehensive range. Listen to them — *listen critically*. Sansui can withstand critical comparison — by the most avid music lover. Then compare Sansui *value!*

DISTRIBUTORS:
Australia, excepting W.A.: Simon Gray Pty. Ltd. Head Office: 28 Elizabeth Street, Melbourne. 3000. Tel. 63 8101. Telex: 31904. Sydney Office: 53 Victoria Avenue, Chatswood. N.S.W. 2067. Tel. 40 4522. Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. 2609. Tel. 95 6526. Adelaide Office: 81 Yacca Road, Seacliffe, S.A. 5049. Tel. 96 3107. N.T.: Pfitzner's Music House, Smith Street, Darwin. 5790. Tel 3801. Qld.: Sydney G. Hughes, 154-158 Arthur Street, New Farm, Brisbane. 4005. Tel. 53 1422. Tas.: F. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 7250. Tel. 2 5322. W.A. Distributors: Carlyle & Co. Pty. Ltd., 1-9 Milligan Street, Perth. 6000. Tel. 22 0191. Sansui equipment is manufactured by: Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-ku, Tokyo, Japan.



Sansui

SOUND SATISFIERS

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

Please send me additional information about Sansui speaker systems, particularly Model

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news digest

compandor speech processing techniques. There were also successful tests with teleprinters, facsimile, and data transmissions and selective calling systems.

A major advantage of ship-to-shore communication by satellite is that it is only marginally affected by ionospheric conditions which cause fading on the usual long-distance high-frequency radio circuits.

ELECTRONIC CONTROL FOR PERM. MAGNET ALTERNATORS

Lucas in England are investigating alternator designs employing ferrite permanent magnet fields. These studies involve new requirements in output control, since the existing arrangement of varying field current according to load demand is inapplicable to an alternator having no means of control of field excitation.

Concurrently with work on the alternator, attention has been given to the development of an electronic control system in which the permanent magnet alternator provides its output to the battery via a controlled rectifier bridge consisting of three diodes and three thyristors.

The bridge rectifier is triggered by high frequency firing pulses applied to the thyristor gates. Firing pulses are generated by a voltage-controlled oscillator when battery voltage is less than a predetermined value.

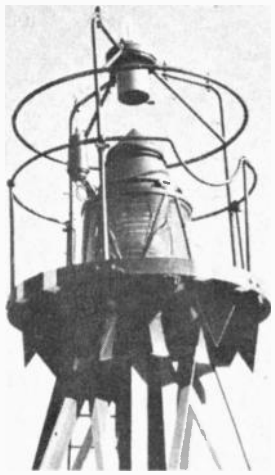
Whenever the firing pulses are present, the rectifier delivers the full output of the alternator to the battery, with each thyristor conducting once per cycle of alternator output. When battery voltage reaches the predetermined value, the firing pulses cease; each thyristor then completes its phase of conduction and becomes inoperative. Hence the complete rectifier ceases to conduct after less than one cycle, and remains inoperative until the firing pulses are resumed.

This system of regulation results in the alternator's output being supplied in bursts having a duty ratio which automatically adjusts to give the required average output for load balancing and battery charging.

All the rectification and control circuits are housed within the alternator and are fan-cooled.

MARINE NAVIGATION AID

An important aid to navigation, particularly in congested waterways and difficult approaches, is undergoing evaluation tests on Hornby Light, at the entrance to Sydney Harbour.



The distinctive racon signal clearly shows the position of a seamark or landmark on a ship's radar screen by providing its range and bearing. This is useful when the landmark or seamark is not visible, is indistinct, or cannot be discriminated from other echoes.

The URSA Minor racon (unattended racon semi-conductor apparatus is manufactured by Kelvin Hughes, of Rainault, Britain. It can operate on buoys, lighthouses, lightfloats, lightships, drilling rigs, headlands and temporary marine hazards.

Once installed, the equipment remains quiescent until triggered by any ship's radar set operating in the three-centimetre international marine radar frequency band.

When triggered, URSA Minor responds by transmitting a pulse of predetermined characteristics, which clearly distinguishes the navigational mark from all adjacent shipping and land targets.

AUSTRALIAN-DESIGNED NOISE EQUIPMENT

A contract has been awarded to Teknis Pty. Ltd., of Crows Nest, N.S.W., for design and development of noise-measuring equipment.

The equipment measures the length of time that noise exceeds pre-set levels in a voice bandwidth channel.

These measurements are specified in CCIR requirements for broadband microwave bearers such as satellite links.

Teknis won this contract against world-wide competition.

SPECIAL OFFER

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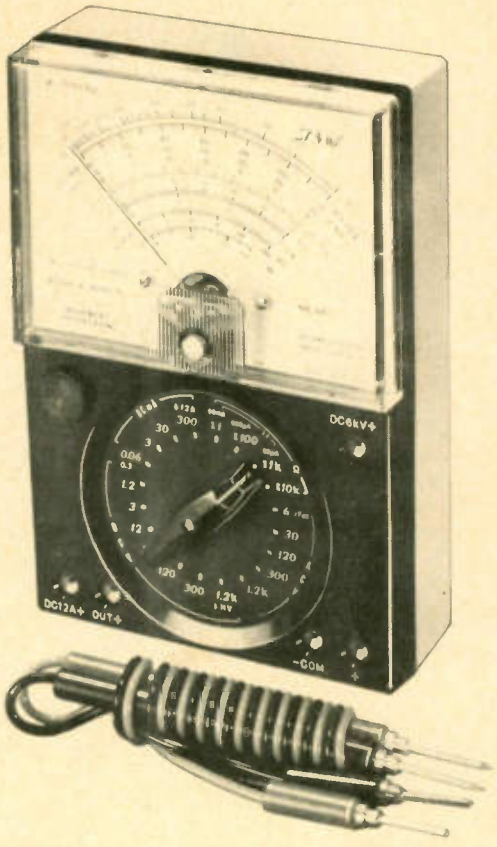

SANWA A303TRD MULTIMETER

*A top quality unit built around a meter with 44 micro amp sensitivity. Input impedance is 20,000 ohms per volt. This versatile instrument is an invaluable tool for testing all electronic equipment.

Features:—

- Fully protected meter movement
- Measures DC current to 12A
- Measures DC voltage to 6 kV (25 kV with optional probe)
- Inbuilt scales for testing semi-conductors
- Measures resistance to 50 MΩ
- Accuracy ± 2.5% f.s.d.

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electronics TODAY *SPECIAL OFFER*

YES: send me my SANWA A-303 TRD Multimeter.

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Enclosed is my *cheque/postal notes for $22.50. (I understand that my money will be refunded in full if I am not completely satisfied.

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Chatswood. N.S.W. 2067.

* Make cheque/postal notes payable to WARBURTON FRANKI, Chatswood.

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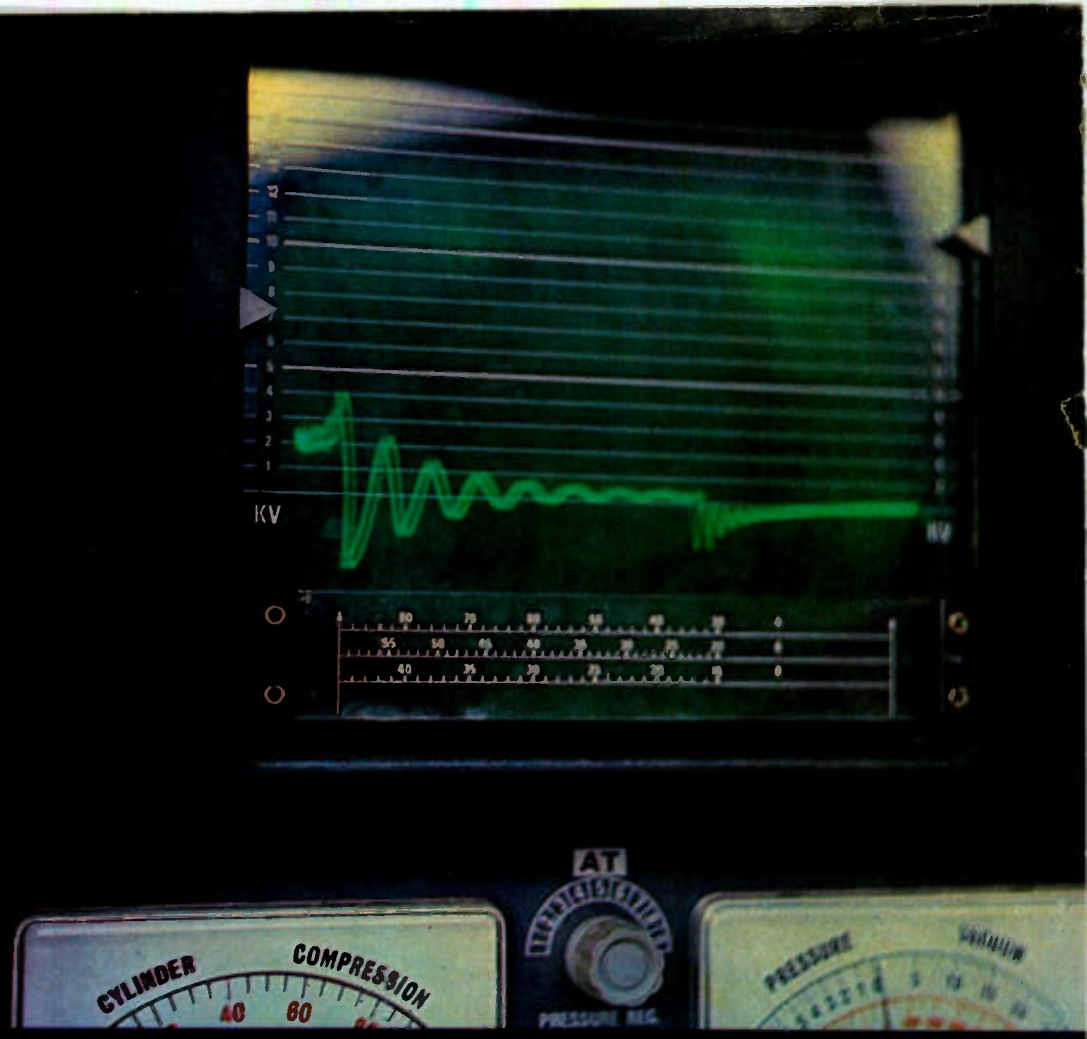
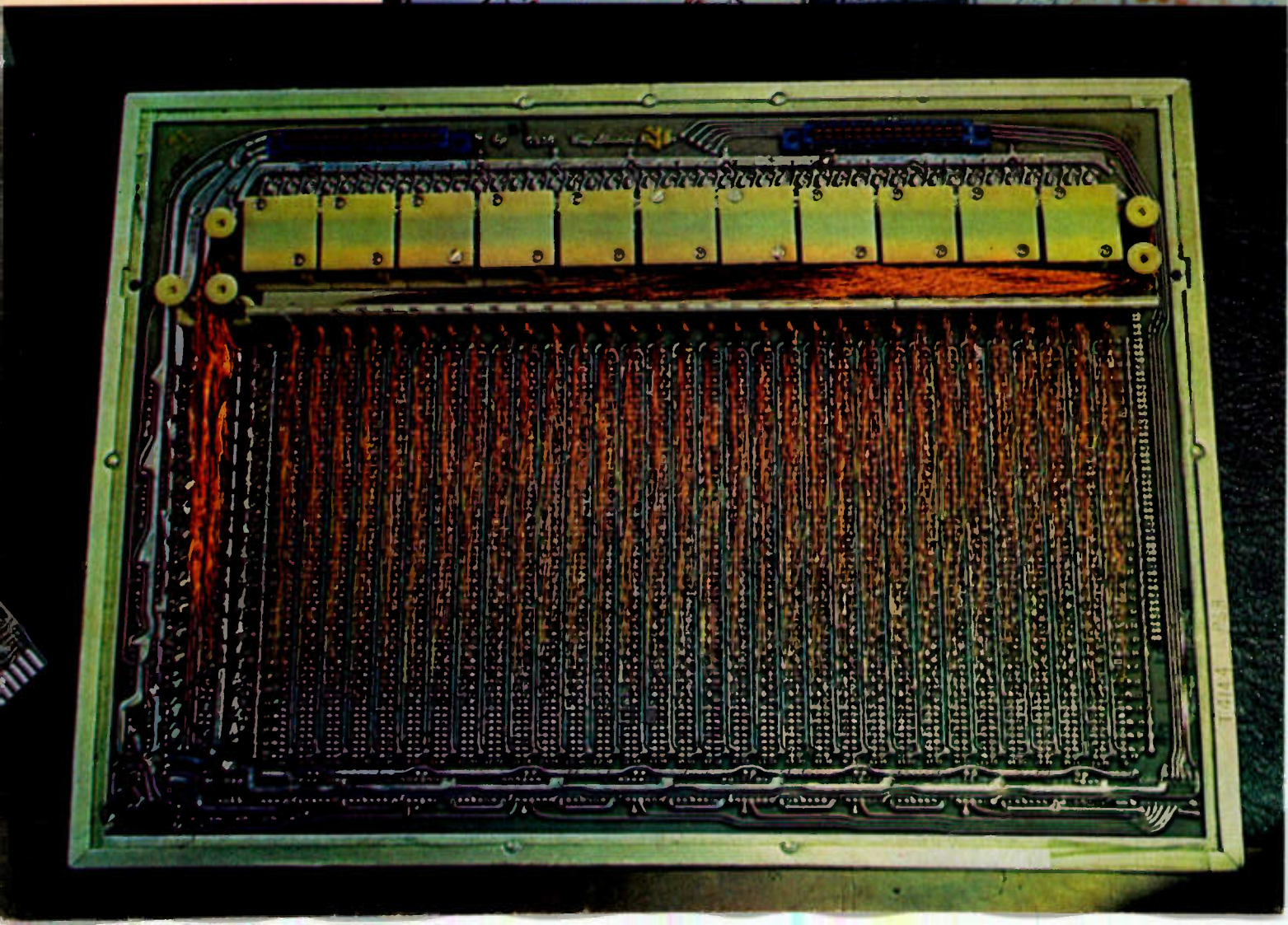
ELECTRONIC TAKEOVER

Scientific testing equipment is replacing the old-fashioned type of garage mechanic who relies purely on past experience. Photo at right shows the waveform of a complete ignition cycle on one cylinder, displayed on a Crypton engine scope. See 'Electronic Engine Testing' — pages 16-21 this issue.

CALCULATORS GROW UP

From its modest beginning as a hand-punched adding and subtracting machine, the calculator has assumed increasingly sophisticated forms, to the point of taking on the complex functions of a computer. A good example is the Wang 700B computer/ calculator, whose intricate diode matrix board is shown below. Our test report on the Wang 700B is on pages 64-69.





news digest

SOLID-STATE SNOOPER

A misguided Swedish company has produced a managerial-study device called a Frekvensor.

It is a 'compact apparatus designed for the executive desk top . . . equipped with a random impulse generator and producing punched cards for data processing routines.'

At random intervals, 'which should not exceed forty times a day,' this transistorized Mata-Hari rings a bell or flashes a light whilst thrusting a punch card at its victim.

When this occurs, the wretched executive must punch data into the card, indicating what he was doing when interrupted.

Like thinking where the Managing Director can put his Frekvensor?

CUSTOMERS WILL PAY MORE

A recent survey carried out by America's Supermarkets General Corporation showed that nearly 90 percent of the packaged goods sold in their food departments were incorrectly priced.

Although the errors bracketed the correct price and weight, the overall error favoured the customer — by 4 percent.

The company is evaluating a computerised weighing system, which displays the nett weight and calculates the total price of the pre-packaged item.

Preliminary reports indicates that the new scales have reduced errors dramatically.

OPTICAL DATA LINKS

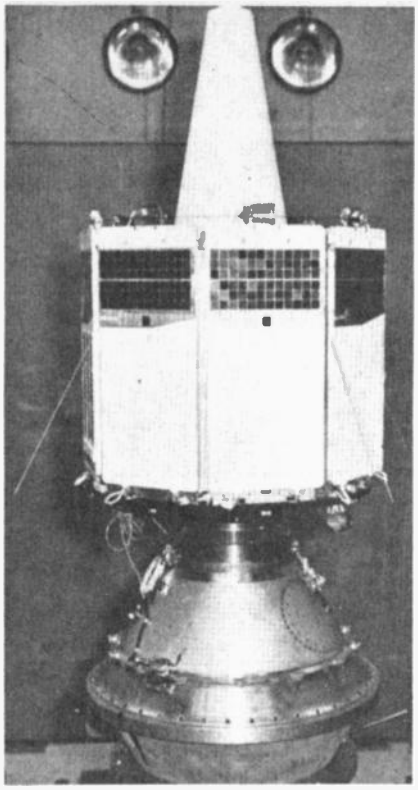
The Laser Link Corporation, of the U.S.A., has patented a method of using laser beams for data transmission.

The Corporation envisages the transmission of monochrome or colour television signals, or radio broadcasting signals from a main transmitter, to local receivers mounted on the tops of buildings.

Previous problems of non-linear modulation are claimed to have been overcome by housing the modulating crystal in an hf oscillator which is frequency modulated by the data to be transmitted.

A practical limitation to transmission distance must surely be set by atmospheric attenuation — for, as someone recently observed, conditions in many American cities are comparable to living in a bowl of dirty soup.

INTERROGATOR SATELLITE



The French 'Peole' satellite was launched recently from its space station at Kourou, French Guiana.

The satellite carries an interrogating system to gather data from meteorological balloons.

STANDARD TC CABLES

The Standards Association of Australia announces publication of Australian Standard 1049, Polyethylene Insulation and Sheath of Telecommunication Cables. The standard has been produced because the major users of telecommunication cable in Australia have found Australia's environmental conditions too severe for polyethylene sheathing produced to previous requirements.

Specified are types of polyethylene suitable for use as insulation and sheathing of telecommunication cables. Polyisobutylene is specified as an additive to improve the resistance of polyethylene sheathing to environmental conditions in Australia. Standard methods of testing, to define comprehensively the polyethylene both chemically and electrically, are prescribed.

The standard does not apply to polyethylene for insulation or sheathing of electrical power cables, nor does it apply to cross-linked or cellular polyethylene or to polyethylene copolymers.

Copies of AS 1049 may be obtained from the various offices of the Standards Association for $2.40 each.

news digest

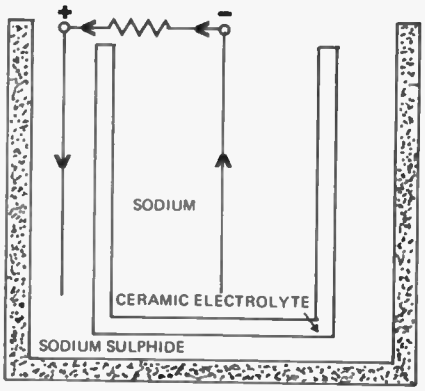
NEW TYPE OF RADAR

A lateral-scan radar, called Toros, has been developed by Soviet scientists in Leningrad.

From an aircraft, a radio beam 30 km. wide sweeps the ice-fields lying on the routes of arctic vessels. The Toros screens reproduce a faithful image of the surface and the exact co-ordinates of the locality being flown over. A pulse, transformed into a light beam, is transmitted by the radar and the localities appear on a film. The beam can even traverse layers of snow covering the ice-fields and filling the cracks. In this way it gives a true picture of the situation, which is impossible with ordinary observation methods.

The efficiency of Toros is not affected by darkness, fog, or the thickest of clouds, and it ensures for all vessels a safe passage through the ice.

LATEST SUPER-BATTERY



SODIUM SULPHIDE BATTERY – ARROWS SHOW CURRENT FLOW

A sodium sulphide battery developed in the U.S.A. is said to produce 15 times the power of its lead-acid equivalent.

In the new battery, positive sodium ions pass through a ceramic electrolyte to form sodium sulphide. Sodium electrons which are unable to penetrate the electrolyte pass into the external circuit, thus forming the output current.

The electrons pass from the negative terminal through the load to the positive terminal, then into the sodium sulphide, where they attract more positive sodium ions through the electrode.

The battery is recharged simply by connecting it across a higher voltage of opposite polarity.

The sodium-sulphide battery offers high energy storage and low cost — but one major operating problem may lie in the ceramic electrolyte. This passes sodium ions and blocks everything else — but only when heated to 425°C.

GET YOUR DEGREE BY WATCHING TV

Japan's University of the Air is scheduled for inauguration in April 1972, the government having adopted the recommendation to this effect of the Preparatory Study Committee.

Minister for Education Michio Sakata says that among recommendations the Government has adopted are:

1) the University is to have regular status, degrees carrying the same prestige as those of established universities.
2) Its chief aim will be to cater for high school graduates who lack the normal opportunities for university study, such as working youths and housewives.

But anyone willing to learn, or wanting to bring past learning up to date, will be eligible.

STC EXPORT TO ARGENTINA

A contract valued at over $100,000 for the supply of microwave link equipment to ENTEL, the national telephone company of Argentina, has been won by Standard Telephone and Cables Pty. Limited.

The equipment will form the basis of two separate microwave systems and comprises the radio units, plus associated aerials and feeder-cables.

The radio units are Australian-designed and are being manufactured in STC's Liverpool (N.S.W.) factory.

Shipment of all items will be direct to Buenos Aires later this year.

The radio units are from the ML2A range of equipment. This is an all solid-state design for use in the 2GHz microwave link band.

The Argentine systems will connect Buenos Aires with the town of La Plata, and Mogote with the town of La Falda.

Remote supervision of the latter system will take place in the city of Cordoba. Each system is bi-directional and has two radio bearers in each direction, arranged in a frequency diversity manner.

In one direction of each system, simultaneous transmission of 600 telephone channels and a 625-line television programme will take place.

The television programme, comprising video plus sound, will be transmitted on one bearer while the other carries the telephony.

In the event of failure of the telephony bearer, the television programme is automatically removed from its bearer and the higher priority telephony traffic substituted for it.

Supervisory apparatus is incorporated into both systems, to enable maintenance staff to assess the operational status of each radio station from a conveniently located centre.

When placed into service, the equipment on this contract will enlarge ENTEL's traffic handling capability in the areas covered and provide a new television programme capability.

SATELLITE WATCH OVER LONE WORLD FLYER

When pilot Sheila Scott set out on a new solo flight around the world in May, she became a flying guinea-pig for a series of experiments.

Miss Scott was to start on her record-breaking 34,000-mile flight as this issue of Electronics Today went to press. The experimental programme planned for her trip was described as follows.

As soon as her light plane, called Mythre, has left London en route for Australia, it will begin sending signals via satellite to a ground station at Fairbanks, Alaska.

The signals will come from an interrogation recording and location system which is being fitted to a light aircraft for the first time under an experiment conducted jointly by NASA and scientists from Royal Aircraft Establishment at Farnborough in England.

This equipment will measure Miss Scott's body reactions to various conditions on the flight, as well as record data about the atmosphere and the general environment throughout the time she is in the air.

After this information has been

news digest

transmitted from the aircraft to Alaska, it will be passed on to a computer centre at Greenbelt in Maryland, U.S.A.

The tests will also tell scientists just how useful satellites can be in watching over light aircraft making long flights.

ASTRONOMERS UPSET

An X-Ray pulsar located in the constellation Cygnus has been detected by NASA's Explorer 42 satellite.

The newly-discovered pulsar is causing some furious academic rethinking.

Until a few weeks ago all theories of pulsar formation were predicated on prior supernova explosions — bangs of such magnitude that evidence of their happening stays around.

The newly-discovered pulsar beats away at 15Hz, implying that it was formed recently. Problem is that it has no nebula at all!

ELECTRIC VAN FOR BELGIUM

A battery-powered Crompton Leyland electric vehicle has been purchased for evaluation by the Belgium Government's electricity authority.

Designed for use in urban areas, the vehicle is the latest model from Crompton Leyland Electricars, a jointly-owned subsidiary of the British Leyland Motor Corporation and the Hawker Siddeley Group. Based in Wales, Crompton Leyland claims to be the largest manufacturer of electric road vehicles in the world.

Known as the A1, the model is available as a van or a pick-up. It uses Mini-Minor front and rear subframes, running gear and suspension, fitted to a steel chassis. A pair of transverse-mounted electric motors drive the front wheels via a triplex chain.

Capable of speeds up to 33 mph, it has a range of over 25 miles using conventional lead-acid batteries. As a battery charger is built into the vehicle, the daily range can be increased by plugging into any domestic power-point while the vehicle is standing.

Carrying capacity is nearly 5 cwt., and both van and pick-up bodies are constructed in glass fibre, hinged at the rear, with a separate cab unit.

TC OEVELOPMENTS IN U.S.S.R.

A start has been made on conversion of the telecommunication system in the U.S.S.R. Scientists in the Kiev Telecommunication Institute (Ukraine) are working on new cable-link systems.

The present system, in existence for some time, has a serious drawback in that telegrams are routed through a series of exchanges. Not only is this a time-consuming and laborious process, but it also gives rise to more errors.

As a result of the new system of direct lines, it will be possible to connect up any number of points throughout the Soviet Union. In this way not only post offices but also factories, collective farms and various public administrations could be connected to the network. This system will release large numbers of people for other work and improve the reliability of data transmission.

Tests have already been carried out on equipment which transmits information at three or four times the normal speed in the U.S.S.R. and abroad.

The Kiev Institute is at present working on the improvement of the existing main channels. A bandwidth of 200 to 340 Hz is required for the transmission of the text. By frequency division, it can now transmit 24 telegraph texts in the place of one. Since several dozen telephone conversations can now be routed simultaneously via a cable pair, it will soon be possible to transmit up to 2000 telegrams simultaneously.

One of the interesting trends in current research relates to the development of automatic telegraph exchanges which can be used for postal traffic, network subscriber telegraphy and rapid data transmission. The first station, in Zhitomir, was tested towards the end of last year. It is comparatively small, cheap, and reliable in operation.

Savings resulting from these developments are estimated at 5.5 million roubles in a period of three years.

New appointment at A.W.A. — Mr. Bruce Rogerson, manager of A.W.A. Network which operates broadcasting stations in N.S.W., Victoria and Queensland.

3 SIMPLE STEPS TO RECORD PLAYING SUCCESS.

1. INVEST IN THE BEST TURNTABLE AVAILABLE. THORENS

Choose from the Model TD-125 or the TD-150 Mk. II. Then you can share the opinions of leading overseas reviewers: *"the best three-speed manual we've ever tested"* — ("High Fidelity"), *"wow and flutter were as low as we've ever measured"* — ("Stereo Review"), *"a favourite contender in the best turntable category"* — ("Audio"), *"it would be hard to imagine a unit that performs better"* — ("Electronics World").

Examine Thorens specifications closely and cr tically. The new Model TD-125 features: ● Transistor governed 16-pole synchronous motor ● ±2% speed control on all speeds ● Belt drive ● 7½ lb. 12″ turntable ● Wow and flutter ±0.08% ● Rumble —68dB. ● Fine Swiss craftsmanship.

The lower priced Thorens TD-150 Mk. II offers: ● 16-pole synchronous motor ● Belt drive ● 7 lb. 12″ diameter turntable ● Two speeds — 33⅓ and 45 rpm ● Wow and flutter ±0.09% ● Rumble —65 dB.

When you've purchased your Thorens turntable . . .

2. ADD AN ORTOFON M15 STEREO CARTRIDGE.

After many years research, Ortofon have designed a new stereo cartridge which maintains the proud traditions of the Ortofon name. Featuring new principles, the high performance standards which have made Ortofon world famous have been preserved in the new Series M15 and MF15. Over 80% of professional users such as the radio and television stations (and recording studios) specify Ortofon equipment.

BASIC SPECIFICATIONS:

Weight of cartridge: 5 *grams.*
Frequency response: *20 Hz. to 10 kHz. ± 1 dB.*
20 Hz. to 20 kHz. ± 2 dB.
Recommended load: *47 k ohms.*
Channel separation at 1 kHz. *Greater than 30 dB.*

Having equipped yourself with a fine player and cartridge . . .

3. KEEP YOUR RECORDS CLEAN WITH WATTS EQUIPMENT.

Airborne dust and dirt are the greatest enemies of your records and cause untold amounts of noisy interference.

We recommend:

THE WATTS "DUST BUG" . . . which cleans the record, removing dust and static charges as the record plays. Surface noise is reduced considerably.

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 "MANUAL PARASTAT", Model Mk. IIA. . . . is a dual purpose record cleaner designed to maintain new records as new and to restore fidelity to older discs.

Ask for a copy of the Watts Guide to Record Cleanliness when you visit your record store.

**It's easy to follow the Three Steps to Success. Call at your nearest franchised Simon Gray dealer's showroom. He'll be delighted to tell you all about Thorens turntables, Ortofon stereo cartridges and Watts record cleaning equipment!*

SG TOW 3/71

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth St., Melbourne, Vic. Tel. 63 8101*, Telex 31904; **Sydney Office:** 53 Victoria Ave., Chatswood, N.S.W. Tel. 40 4522*; **Canberra Office:** 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 95 6526; **Adelaide Office:** 81 Yacca Road, Seacliffe, S.A. Tel. 96 3107. **INTERSTATE REPRESENTATIVES: N.T.:** Pfitzner's Music House, Smith St., Darwin. Tel. 3801; **Q'land:** Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. Tel. 58 1422; **Tas.:** K. W. McCulloch Pty. Ltd., 57 George St., Launceston. Tel. 2 5322; **W.A.:** Athol M. Hill Pty. Ltd., 613-615 Wellington St., Perth. Tel. 21 7861.

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

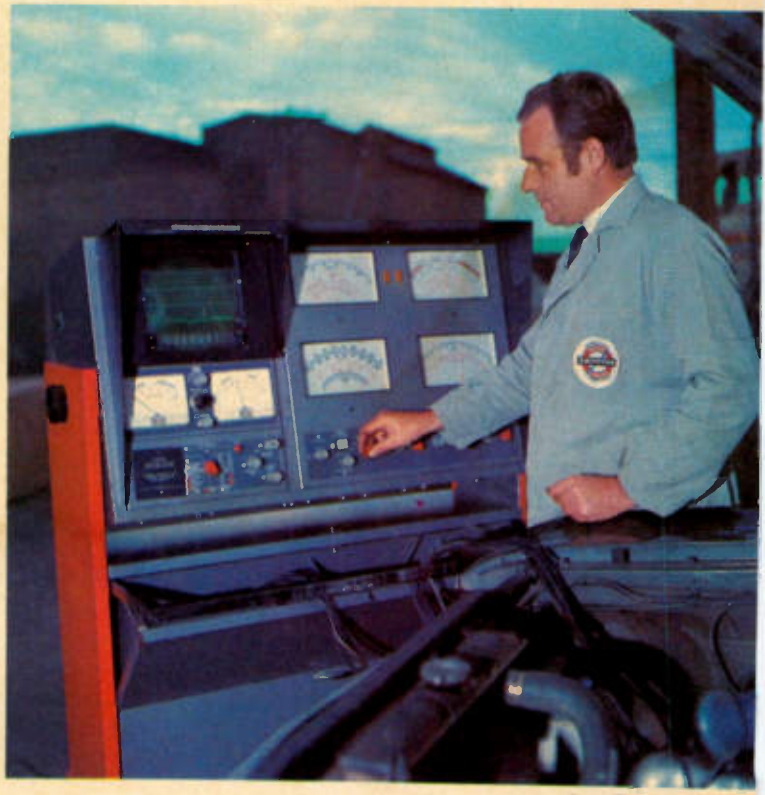
Please send me all the facts about: (a) Thorens turntables; (b) Ortofon cartridges; (c) Watts record cleaning equipment . . . and the name of my nearest franchised Simon Gray dealer.

NAME .....

ADDRESS .....

POSTCODE .....

ABOVE: One complete cycle of ignition is displayed on screen of Sun oscilloscope – compare this picture with Fig. 1 in main text. BELOW LEFT: Blower at front of car force-cools engine during dynamometer power testing. BELOW RIGHT: Crypton engine tuning console checks all engine functions, including cylinder and gasket conditions affecting the compression.



ELECTRONIC ENGINE TESTING

GOOD MECHANIC, old Bill – has a feel for engines. No time for this newfangled electronic trickery – doesn't need it anyway – not with his experience. He can tune any engine by ear – been doing it for forty years . . ."

If your garage has an attitude like this, watch out!

It's all rubbish.

Tuning is a misnomer to start with.

The average mass-produced engine produces optimum all-round performance when all adjustments are set to the manufacturers' specifications.

And, with modern high-output engines, a mechanic has no more chance of doing this by ear than he has of assessing battery voltage by feel.

Hence the rapidly increasing acceptance of electronics in the garage industry. Today's mechanic is just as likely to be using an oscilloscope as a set of feeler gauges – for electronic instrumentation not only enables accurate adjustments to be made to carburation and ignition, it is also an extraordinarily effective diagnostic aid, enabling faults to be located in a fraction of the time previously required.

ENGINE OSCILLOSCOPE

The central feature of most testing consoles is the engine oscilloscope.

This displays a graphic picture of all phases of the ignition cycle at the same instant that they occur in the operating engine.

And (as most mechanics are surprised to discover) the oscilloscope not only shows factors affecting the ignition system, such as plug voltage requirement, spark duration, coil and condenser action, contact-breaker points actions, interference suppression, etc. - it indicates many mechanical conditions as well.

Tuning by gosh and by guess isn't good enough for modern car engines – here's how it is done scientifically.

Technician uses electronic strobe to check ignition.

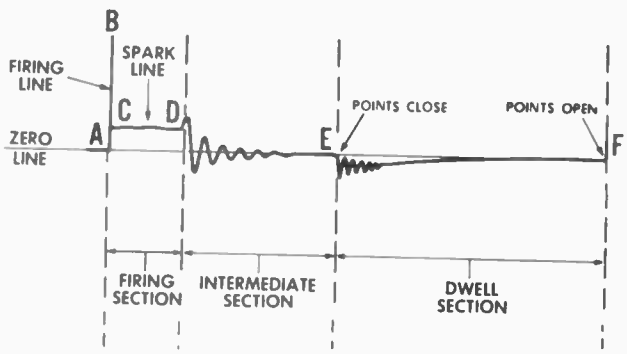


FIG. 1 – BASIC SECONDARY WAVEFORM

Point A marks the opening of the breaker points which, by causing a sudden collapse of the magnetic field in the spark coil, induces a high voltage in the secondary winding.

Called the firing voltage, this rises until it is high enough to ionize both rotor and spark plug gaps (B). This normally requires between 9kV and 15kV, measured by a vertical kilovolt scale on the oscilloscope screen.

Once the rotor and plug gaps have ionized, the voltage required to maintain the spark discharge drops to a much lower level (C). This is shown as the 'spark line'. The voltage remains substantially at this level until there is no longer enough energy in the coil to maintain the spark.

At this point (D) the spark is extinguished. The remaining coil energy is dissipated by losses in the coil and capacitor and reduced practically to zero by the time the contact breaker points close (E).

The Dwell section (E–F) represents the angle during which the contact breaker points are closed – and energy is being stored in the ignition coil prior to the points re-opening at the beginning of the next ignition cycle (F).

ELECTRONIC ENGINE TESTING

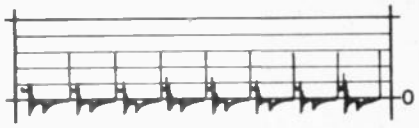


Fig. 2. Complete firing sequence of eight cylinder engine.

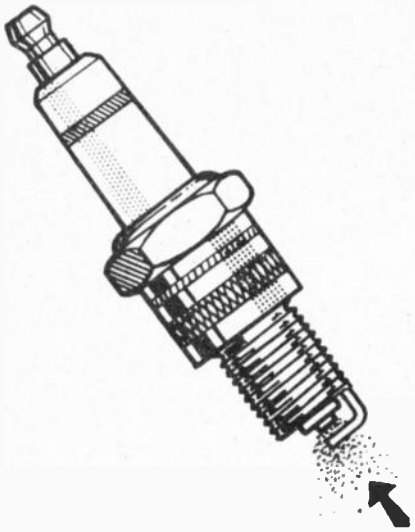


Fig. 3. Hot centre electrode of spark plug emits electron cloud which assists spark to jump to positive (colder) earth electrode.

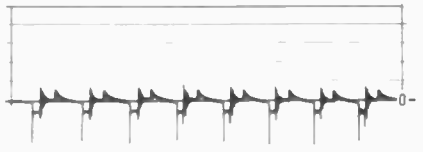


Fig. 4. Reversed coil polarity – complete pattern is inverted.

Fig. 5. Spark line with optimum resistance suppression (10,000 ohms).

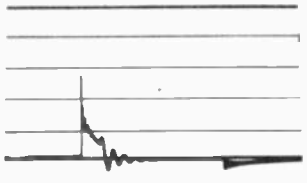


Fig. 6. Spark line – excessive resistance (approx 100,000 ohms).

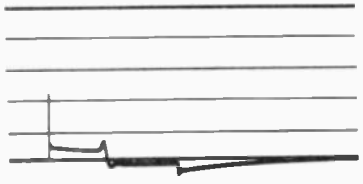
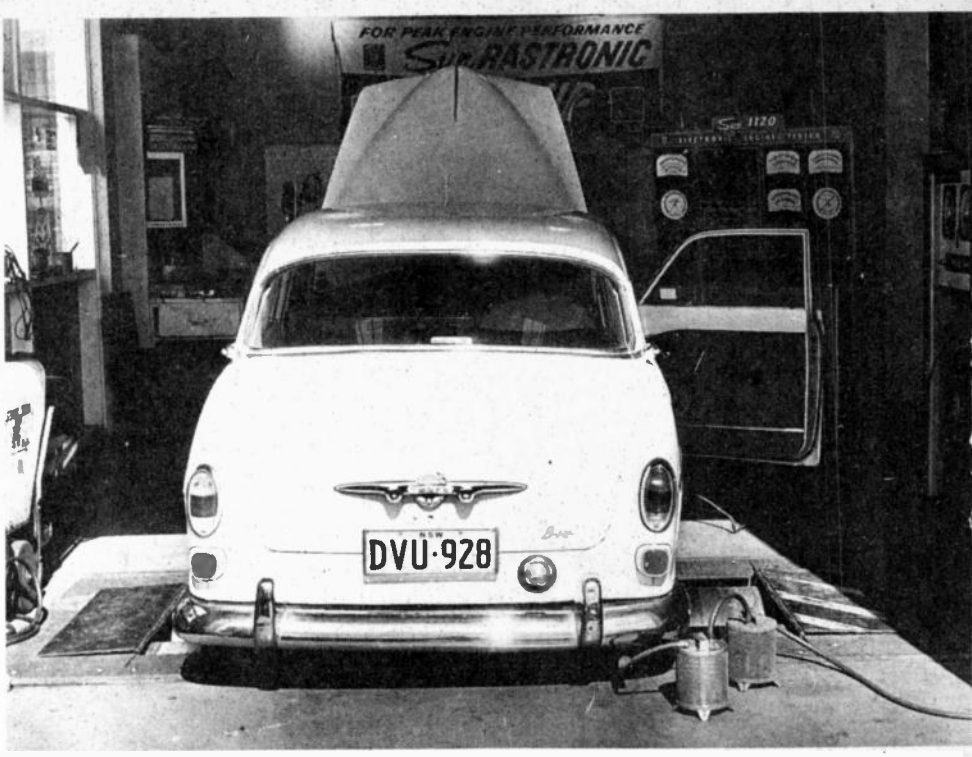


Fig. 7. Lack of oscillations in intermediate section indicates faulty coil or condensor.



Volvo's power output is checked by chassis dynamometer. Units near exhaust pipe remove water vapour from gas sample.

Engine oscilloscopes are similar to industrial oscilloscopes, with one main exception – namely, that the time base is synchronized to engine speed, to keep the trace length constant despite changes in engine speed.

Two connections are made to the ignition system via capacitive or inductive pick-ups. A 'trigger' (or synchronizing) pick-up is connected to the sparking plug of the first cylinder in the engine firing order, and a second, 'pattern' pick-up is inserted in the main coil lead in the distributor cap.

A connection need not necessarily be made to the low voltage side of the ignition system, for all characteristics of the system's primary side will be reflected through the ignition coil and can readily be seen on the high voltage or 'secondary' pattern.

SECONDARY WAVE FORM

The basic secondary pattern is shown in Fig.1. Each part of this wave form shows a specific phase of one complete cycle of ignition operation, from the time the points open to the time that they reopen to fire the next spark plug in the engine firing order.

The horizontal time base of the oscilloscope can be adjusted to show any given cylinder in the firing order, or it can be compressed to show the complete firing pattern of all cylinders. Fig. 2 shows the complete firing sequence of an eight-cylinder engine. In this case, the first cylinder in the firing order will appear on the extreme left of the screen and the remaining seven will appear in their normal firing order.

It will be noted that the firing line of number one cylinder will be at the extreme right-hand end of the trace. This is because it is necessary for the number one spark plug to fire in order to trigger the oscilloscope and begin a new trace.

The horizontal axis of the oscilloscope is calibrated in degrees representing the angle through which the distributor cam rotates during one complete ignition firing cycle (for one cylinder). This facility enables measurements to be made of the relative periods taken up by each phase of the firing cycle – in particular the points closed (or dwell) period.

Three dwell scales are usually provided, for four, six and eight-cylinder engines; these scales are calibrated from 0^{o}-90^{o}, 0^{o}-60^{o}, and 0^{o}-45^{o} respectively.

The waveform of any given firing cycle is 'fitted' to the appropriate scale by adjusting the horizontal gain and horizontal shift controls until the two point-opening signals (A and F) line up with the beginning and end of the calibrated scale.

WHAT IS DISPLAYED?

An extraordinary amount of information is displayed by the oscilloscope, much of which is not only necessary to ensure that the engine is functioning as its manufacturer intended, but is quite difficult to obtain by any other means.

A very good example of this is correct coil polarity, a factor which can vitally affect an engine's performance.

Regardless of the polarity of the main electrical system, the secondary side of the ignition system must always be positive earth. This is necessary because the hot centre electrode of the spark plug emits a cloud of electrons (consisting of negatively charged particles) which will assist the negative coil voltage to jump the gap to the colder (positive) earth electrode (Fig. 3).

If the polarity is reversed, electrons have to pass from a cold electrode and 'fight' their way through the electron cloud to the hot centre electrode.

Incorrect polarity may increase plug firing voltage requirement from a nominal maximum of 16kV to as much as 22kV, and this may be beyond the capability of the coil to produce. The higher voltage requirement will also cause a severe strain on insulation throughout the system.

Incorrect coil polarity will frequently result in misfiring (especially at light engine loads), increased fuel consumption, and insulation breakdown of plugs, leads and distributor caps. It is nearly always caused by fitting a coil intended for a positive earth vehicle to a negative earth vehicle (or vice versa).

The condition is absurdly easy to see on an oscilloscope – the whole waveform appears upside-down! (Fig. 4). Correction is equally simple. The low tension leads on the coil are merely reversed.

Incorrect coil polarity is not all uncommon – it is quite frequently the cause of poor engine performance – yet it is a fault that very few of the 'Old Bill' type mechanics are even aware of.

Many other engine faults are equally simple to spot, while others require more skill and experience – but it is a fact that a knowledgeable mechanic equipped with an engine oscilloscope will know more about an engine in 30 seconds than his 'scopeless' counterpart will find out in a day.

This is a strong statement, but it can be justified by considering the amount of information given by each section of the waveform.

FIRING VOLTAGE

Firing voltage is the voltage required to establish a spark across the plug electrodes. It is a function of compression, mixture, timing, plug condition, breaks in coil or plug leads, etc. In an engine running off-load at 1500 rpm it will generally be between 5kV and 8kV.

Higher than normal firing voltages can usually be attributed to worn spark plug electrodes, late ignition timing, lean air/fuel mixtures, excess rotor gap, or a break in the coil lead.

The actual fault – or combination of faults – causing the condition is readily isolated.

Assuming that the firing line is abnormally high on one cylinder, and, shorting out the plug causes the line to drop, then the condition must be within the cylinder; if it does not drop, then the condition must be external – i.e., a broken plug lead, etc.

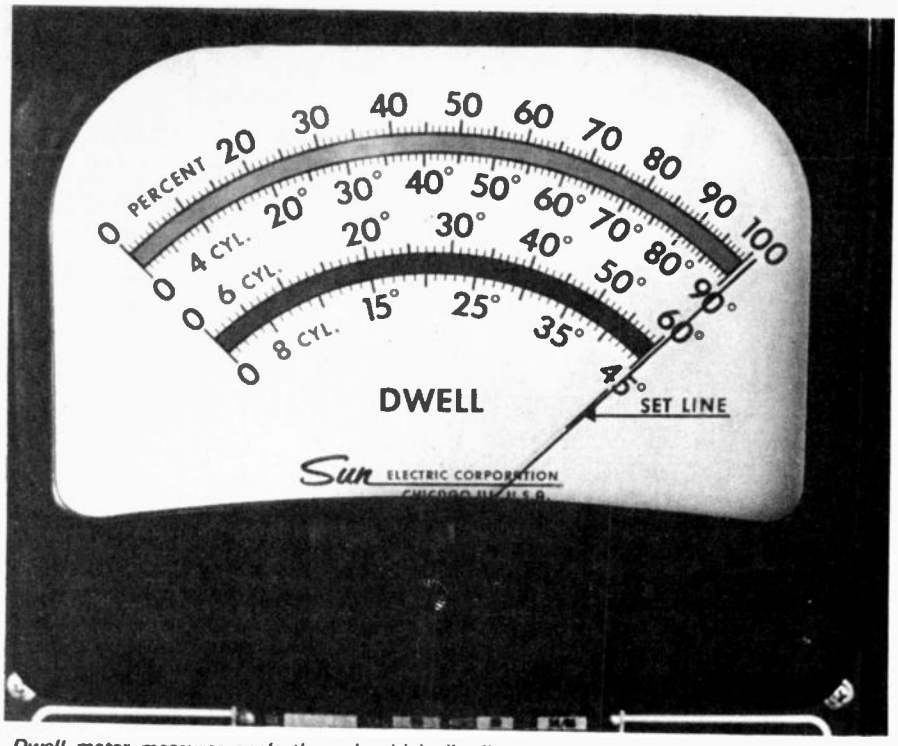
A *low* firing line is an indication of low compression, a faulty plug, or insulation breakdown in the associated plug lead or a section of the distributor cap. Pulling off the plug lead will immediately locate the area of the fault. If the firing line rises to the full coil voltage of 20kV or so, then the fault will be within the plug or cylinder; if it remains low, then the fault will be insulation breakdown of the plug lead, etc.

Firing voltage is more or less inversely proportional to mixture strength – the leaner the mixture, the higher the voltage required to fire the plug. The range is from approximately 7kV, to fire a 12:1 mixture, to 12kV for a 15:1 mixture.

If compression pressures, plug gaps, etc. are equal, this phenomenon can be used very effectively to balance multiple carburettors (an exhaust gas analyser is also used, to indicate average mixture strength).

This interdependence of firing voltage and mixture strength is not always understood by mechanics, unless they have used electronic testing equipment.

It is not unknown for a mechanic to mistake an ignition fault due to incorrect coil polarity for a carburation fault, and to 'cure' the problem by increasing mixture strength. This stops the engine misfiring – but now the engine has *two* faults, plus increased fuel consumption.



Dwell meter measures angle through which distributor cam turns while the contact breaker points are closed.

SPARK LINE

The spark line represents the 'fat' or inductive component of the spark. The angle of this line, as seen on an oscilloscope, indicates the amount of resistance in the secondary circuit. Whilst some resistance is desirable, not only to reduce radio interference but also to reduce spark plug erosion, there is an optimum amount – and if the total resistance in any one lead exceeds 30,000 ohms, there may well be a decrease in engine performance.

Fig. 5 shows how the spark line will appear with the optimum amount of resistance (approx. 10,000 ohms), Fig. 6 indicates excessive resistance (approx. 100,000 ohms).

This again is a very common fault, especially with 'distributed resistance' plug leads – but one immediately apparent on an oscilloscope.

INTERMEDIATE SECTION

This section normally appears as a series of diminishing oscillations. (D to E in Fig.1). Abnormally rapid

ELECTRONIC ENGINE TESTING

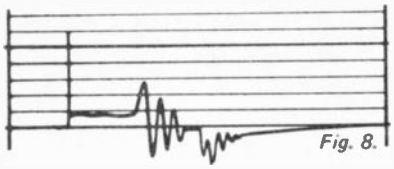


Fig. 8.

Poor point contact or misalignment.

Fig. 9.

Point bounce condition

Fig. 10.

Unusual display at point opening indicates burnt or dirty points.

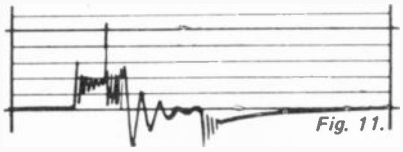


Fig. 11.

Faulty points or series resistance in condenser.

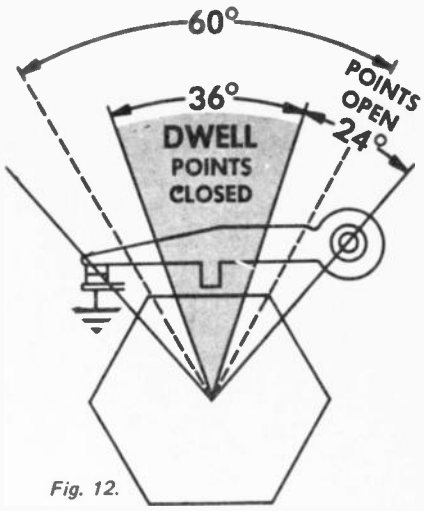
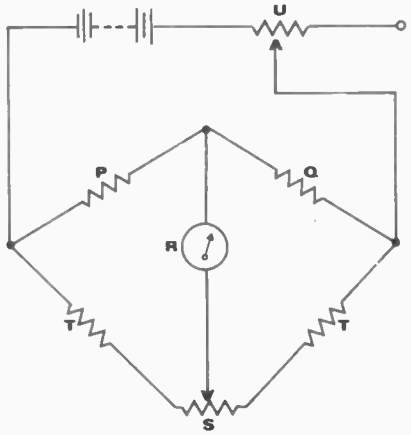
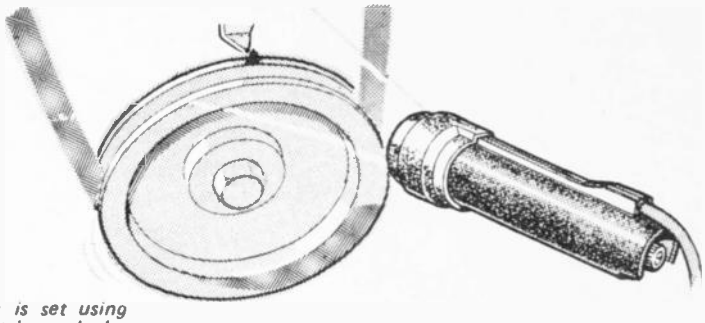


Fig. 12.

Dwell angle is the angle through which the distributor cam turns while the contact breaker points are closed.



Electrical Circuit of thermal conductivity Exhaust Gas Analyser: (P) gas cell, (Q) air cell, (R) air-fuel ratio meter, (S) air-set calibration, (T) fixed precision resistors. (U) bridge voltage calibrator. Fig. 14.



Ignition timing is set using strobe light triggered by firing of number one spark plug. Fig. 13.

dissipation of these oscillations indicates a shorted turn in the coil or a leaky condenser (Fig.7). The indication can often be seen on an oscilloscope some weeks before total breakdown of the faulty component.

CONTACT BREAKER ACTION

A display similar to Fig. 8 is an indication of poor points contact or misalignment, whilst oscillations extending above the zero line shortly after the points have initially closed indicate that the points are bouncing (Fig. 9). Although this is not a common fault, it is very difficult to diagnose without testing equipment. It is usually caused by a weak or incorrect type of contact breaker assembly.

An unusual display at the instant of points opening is due to dirty or burned points, or high condenser series resistance. Figs. 10 and 11 show typical examples.

DWELL ANGLE

The dwell angle is the angle through which the distributor cam turns while the contact breaker points are closed. (Fig. 12). During this period – between E and A in Fig.1 – primary current is building up the coil's magnetic field in preparation for the next ignition cycle.

The dwell angle is determined by the contact breaker gap. In theory the specified contact breaker gap will provide the correct dwell angle. In practice this rarely happens, especially with worn distributors. The important factor is the dwell angle, for this represents the time available for the coil to gather energy. The contact breaker gap is merely a means of adjusting the dwell angle. Nominally the gap will probably be .016". In practice, to obtain the correct dwell, this gap may be as much as .20" or as little as .010".

The dwell angle can be measured by fitting the pattern to the calibrated scale on the oscilloscope, and in the case of some engine testing consoles this is the only measuring aid provided.

TACH/DWELL METER

An accurate method of measuring engine speed is very necessary, especially for tuning cars fitted with torque converters and other forms of automatic transmission. As the circuitry of an electronic tachometer is easily combined with that of a dwell meter, it is common to combine the two instruments.

The dwell section of the meter is, in effect, connected directly across the contact breaker points. When the points are open, full battery voltage will be applied to the meter, which then indicates zero % dwell. When the points are closed, there is no voltage across them and the meter reads 100% dwell. In terms of degrees, 100% dwell depends on the number of lobes on the distributor cam.

Thus, for a four-cylinder engine, 100% dwell will be 90° – and the meter will indicate 90° when the points are closed, and 0° when they are open.

As the distributor rotates, the meter will attempt to swing alternately between 100% and zero %. However, the mechanical inertia of the meter, combined with suitable damping capacitors, will prevent rapid movements of the meter and cause it to register an average value representing the dwell angle.

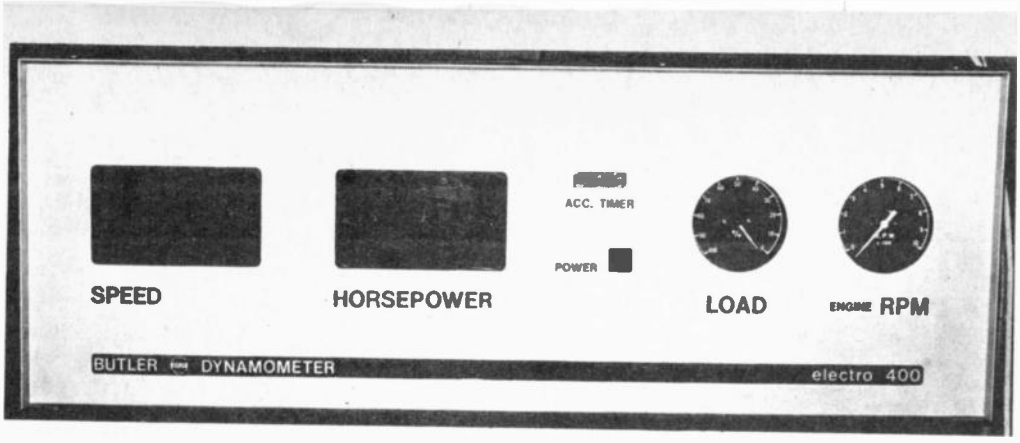
IGNITION TIMING

The electronic timing light uses the principle that, if a disc revolving at a given speed is illuminated by a light source flashing at the same frequency, then the disc will appear stationary to the eye.

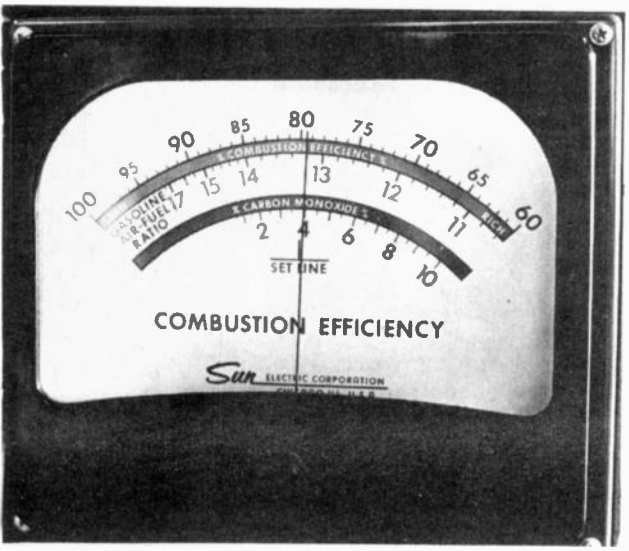
The flashing of the electronic timing light is synchronized with the firing of number one spark plug, and this causes the crankshaft pulley to appear stationary the instant the plug fires.

Thus, by providing a suitable pair of

Chassis dynamometer has digital readout of speed and horsepower.



Exhaust analyser measures thermal conductivity of gas sample.



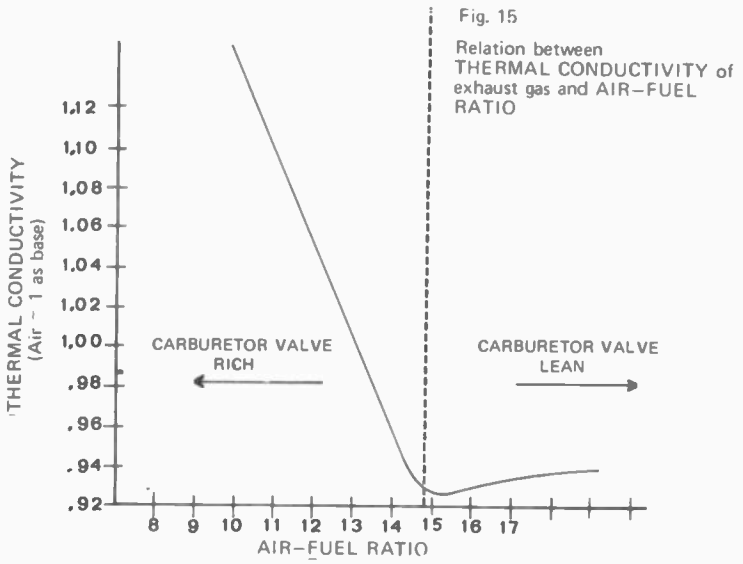


Fig. 15
Relation between THERMAL CONDUCTIVITY of exhaust gas and AIR–FUEL RATIO

marks (or one mark and a calibrated scale) correctly positioned on the crankshaft pulley (or vibration damper) and the engine block, ignition timing can be adjusted by aligning these marks (Fig.13).

Provision is usually made in the timing light to include a delay adjustable by a period equal to a given number of crankshaft degrees at a given speed. This enables the amount of centrifugal and vacuum advance to be measured.

EXHAUST GAS ANALYSER

The final instrument normally considered essential for electronic engine testing is the exhaust gas analyser, most of which operate by measuring the ability of the exhaust gas to transfer heat (thermal conductivity).

Exhaust gas produced from an air/fuel ratio of 13.3:1 has the same thermal conductivity as air; a mixture leaner than 13.3:1 will have a thermal conductivity *lower* than air (or, in other words, will not transfer heat as effectively as air). The converse is true of mixtures richer than 13.3:1.

The relative cooling effect of exhaust gas is measured by passing the gas over a heated platinum wire. This causes a change in the temperature of the wire and hence a change in its resistance.

Both the platinum wire and a similar reference wire are connected in adjacent arms of a Wheatstone bridge (Fig.14). Exhaust gas is pumped over one wire, while the second (reference) wire is open to the air and thus provides a reference level.

A centre zero meter is connected across the bridge; by showing bridge unbalance it indicates the thermal conductivity of the exhaust gas and hence the air/fuel ratio.

The operating limit of thermal conductivity measurements is an air/fuel ratio of 14.8:1 (known as the stoichiometric ratio).

As the air/fuel ratio increases beyond this ratio of 14.8:1, the carbon-dioxide content in the exhaust gas diminishes because of the increase in oxygen. This causes an increase in thermal conductivity and the meter starts coming back the other way (Fig.15).

Until recently this was not a serious handicap, as it was seldom necessary to operate engines at mixtures leaner than the stoichiometric ratio; however, forthcoming anti-pollution laws insist that engines must be made to run on mixtures leaner than the thermal conductivity tester can measure.

As a result, new instruments are currently being investigated, using both calorific and infra-red absorbtion techniques. (A full report on these instruments will be published in next month's ELECTRONICS TODAY.)

WILL ELECTRONICS REPLACE THE SKILLED MECHANIC?

A question commonly posed is whether or not electronic testing equipment will ever replace the skilled mechanic. Until very recently the answer could only have been no; in fact, the equipment was only really effective when used by a first-class mechanic who could interpret what the meters showed.

Today one cannot be so positive. At least one European manufacturer is seriously considering installing a multi-way socket for direct connection into a testing console; computer-controlled equipment is already developed which performs all tests automatically and prints out the results on a typewriter.

It is perhaps ironic that the garage industry has taken this great leap forward into accepting that electronics is here to stay at a time when the future of the internal-combustion engine is in doubt.

But, in the meantime, don't trust Old Bill! ●

Computerised colour television camera

Latest development in colour telecasting equipment, described by Brian Sexton, C. Eng., M.I.E.R.E.

AN AUTOMATIC colour television camera, which will eliminate lengthy manual alignment and colour balancing routines at the beginning of the operational day and subsequent adjustment during broadcasts, has been developed by Marconi Ltd. in England.

This achievement has been made possible by building a miniature computer into the camera channel to perform the necessary functions automatically.

The company claims its development to be the most dramatic since the introduction of automatic black-and-white television cameras almost a decade ago.

Sensitivity of the new Mark VIII camera is comparable with that of most black-and-white units and at least one stop more sensitive than current colour cameras. It has a standard operating figure of 750 lux (approximately 75 foot-candles), although usable pictures can be obtained at very much lower levels — acceptable pictures have been obtained at 50 lux (five foot-candles).

Three-tube camera

Three Leddicon video tubes are used in the camera which, by automatic registration and equalised colour lag, give a level of performance associated with four-tube cameras. The tubes have been specially designed to diminish 'lag' smears on fast-moving objects and uncontrollably burnt-out highlights.

The tube deflection coils are constructed in the form of printed circuits on cylindrical glass tubes. These are said to offer a higher degree of accuracy and stability in the registration of the three camera tubes than attainable by conventional methods.

Operation of a single push-button situated on either the camera or the control panel provides complete and automatic alignment of the pictures from each of the three pick-up tubes. Accurate colour balancing of the three output signals is also initiated with a single pushbutton providing a true 'white' combination and ensuring that optimum colour fidelity is maintained over the full spectrum.

Automatic registration and line-up

As part of the automatic registration and lining-up sequence, a diascope test-slide in the optical system of the camera is brought into operation by means of a motor-driven mirror shutter. The image is reflected into the light-splitting optical system and thus into the path of the three camera tubes. Actual registration and lining-up is then carried out automatically by the miniaturised computer in the control unit of the camera channel.

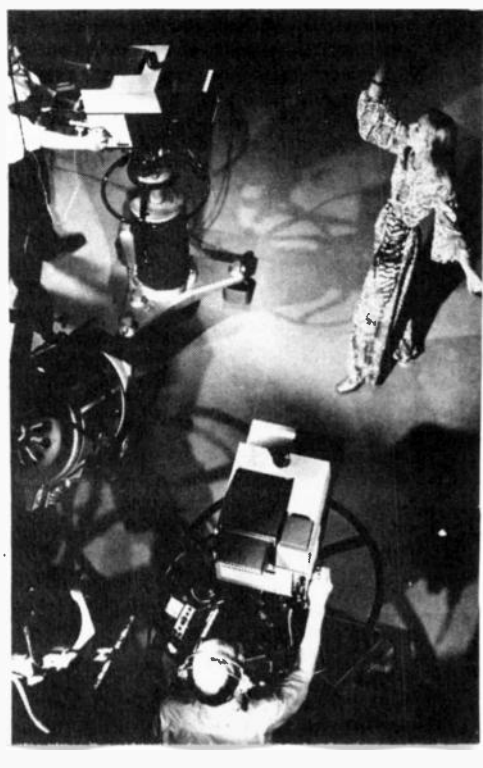
The computer automatically adjusts the gains of the red and blue camera channels to correspond with the output coming from the green tube (with all three camera tubes focused on to the image of the test slide). A focus rocking voltage is then applied to each tube, and tube alignment currents are adjusted in sequence to produce minimum displacement of the three signals at the centre of the picture.

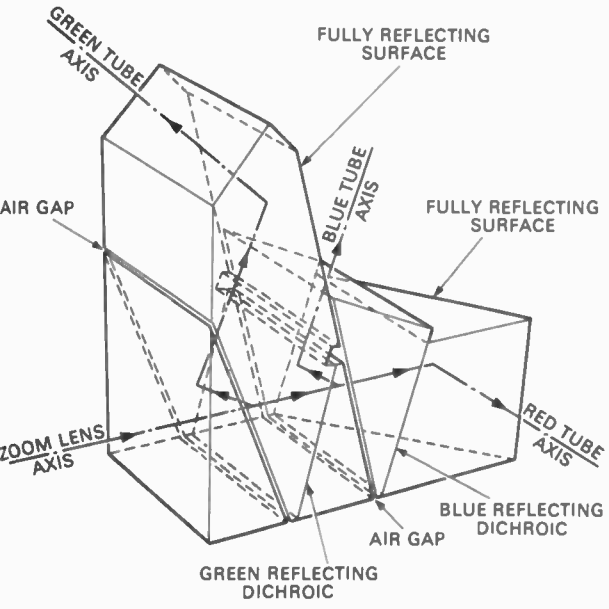
Then the computer examines the picture at several other points, to detect any relative displacement of the red and blue signals with respect to the green. If there are any discrepancies in the geometry of the three pictures, the computer automatically adjusts the width, height, rotation, skew, horizontal and vertical centre of the appropriate channels to achieve optimum alignment.

All these adjustments are made by way of small motor-driven potentiometers, each fitted with thumbwheel attachments to permit manual adjustment to be made for test purposes, or in an emergency. At the same time, the motor-driven controls represent mechanical information stores which cannot drift or be changed accidentally during operation. This sequence normally takes less than a minute to complete. In extreme cases of misalignment it may take up to three minutes, which still is much quicker than manual methods.

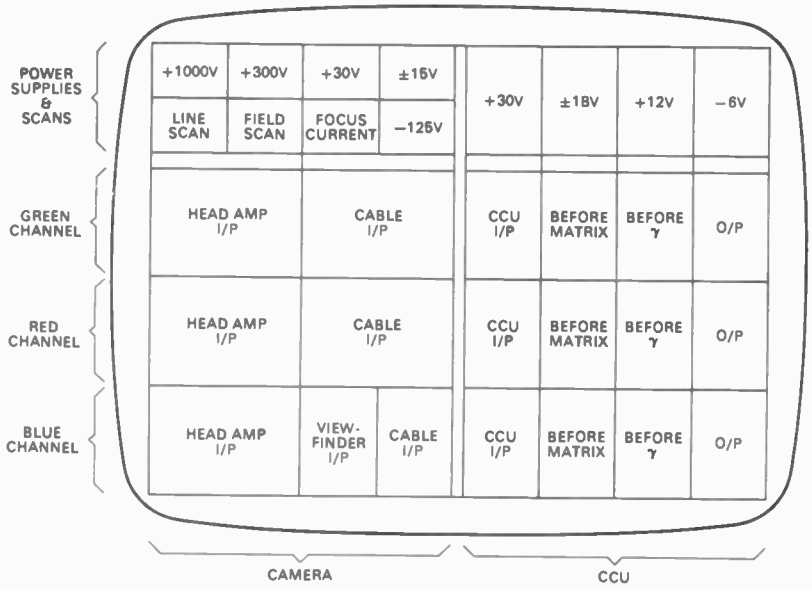
Colour balance

For colour balance it is necessary to point the camera at a white object, which should occupy at least 10 percent of view roughly in the centre of the picture area. The iris of the camera then automatically adjusts so that the green channel gives a peak output of 0.6 volt, and then the automatic balancing circuits set the blue and red channels to match this level. This operation takes about ten seconds and can, if required, be carried out during a transmission when the camera is not being used 'on air'.





Simplified diagram of prism system used in the Marconi mark-VIII automatic colour camera.



Automatic test display offered with the automatic colour camera. The screen remains white except when there is a fault, the area at fault being indicated as shown on the diagram.

Dynamic centring

Another built-in feature is dynamic centring, which provides a continuous check on the registration of the three tubes while the camera is in operation. The signals from the three colour channels are examined continuously for transitions in the picture waveform. This is done electronically, and if an error of 3 percent or more is detected, the appropriate tube deflection circuit is adjusted automatically.

Automatic testing

Besides operational test facilities, provisions have been made for checking the serviceability of the camera automatically. On pressing a push-button, a pattern of white rectangles is displayed on the channel picture monitor. Each of these relates to the supply voltages or the video signals from a specific area of the camera channel. If any measurement falls outside specified limits, the appropriate area of the display will be blanked out. Again, this automatic test procedure takes only a few seconds and can be done during a broadcast (while another camera is being used 'on air') if there is any doubt as to its serviceability.

Black level control

An automatic black-level control circuit is provided to stabilise the output to an optical black signal. Gamma laws of 0.4, 0.45, 0.5 and 0.55 provide adequate coverage of a contrast range of 60:1. Both horizontal and vertical aperture corrections are provided to ensure the highest possible picture quality; a comb filter unit minimises noise in the video circuits.

Overcoming lag problems

A problem associated with previous three-tube colour cameras was the much greater degree of lag in the red and blue tubes, which produces colour distortion in the smear behind a moving object. A fast-moving white object tends to produce a multi-coloured smear as it moves across the screen. This problem has been overcome in the new camera by using differential image sizes on the three tubes to increase the relative brightness of the red and blue images.

Since lag is inversely proportional to image brightness, it has been possible to balance the lag in all three tubes. Smearing from fast-moving objects is therefore the same colour as the object itself, and is far less noticeable.

The latest type of Leddicon lead-oxide camera tube minimises the effects of lagging; and, to ensure the highest possible picture quality under the most adverse conditions, a highlight overload protection gun has also been developed. This electron gun discharges scene-highlight overloads and thus eliminates burnt out 'puddles' caused by specular reflections from glass and other bright objects.

The tubes also incorporate 'light-bias' to reduce the lag which is encountered with most lead-oxide tubes at low light levels. The combination of 'light-bias' and 'differential lag elimination' provides a remarkable increase in picture quality and rapidly moving objects.

An additional feature of the tubes is the use of optically coated faceplates which reduce the loss of light input due to reflections at the front surface. This coating gives an increase in picture quality with rapidly moving objects.

An additional feature of the tubes is the use of optically coated faceplates which reduce the loss of light input due to reflections at the front surface. This coating gives an increase of some 3 percent in the light input to the tube, and also improves the contrast ratio of the resultant picture.

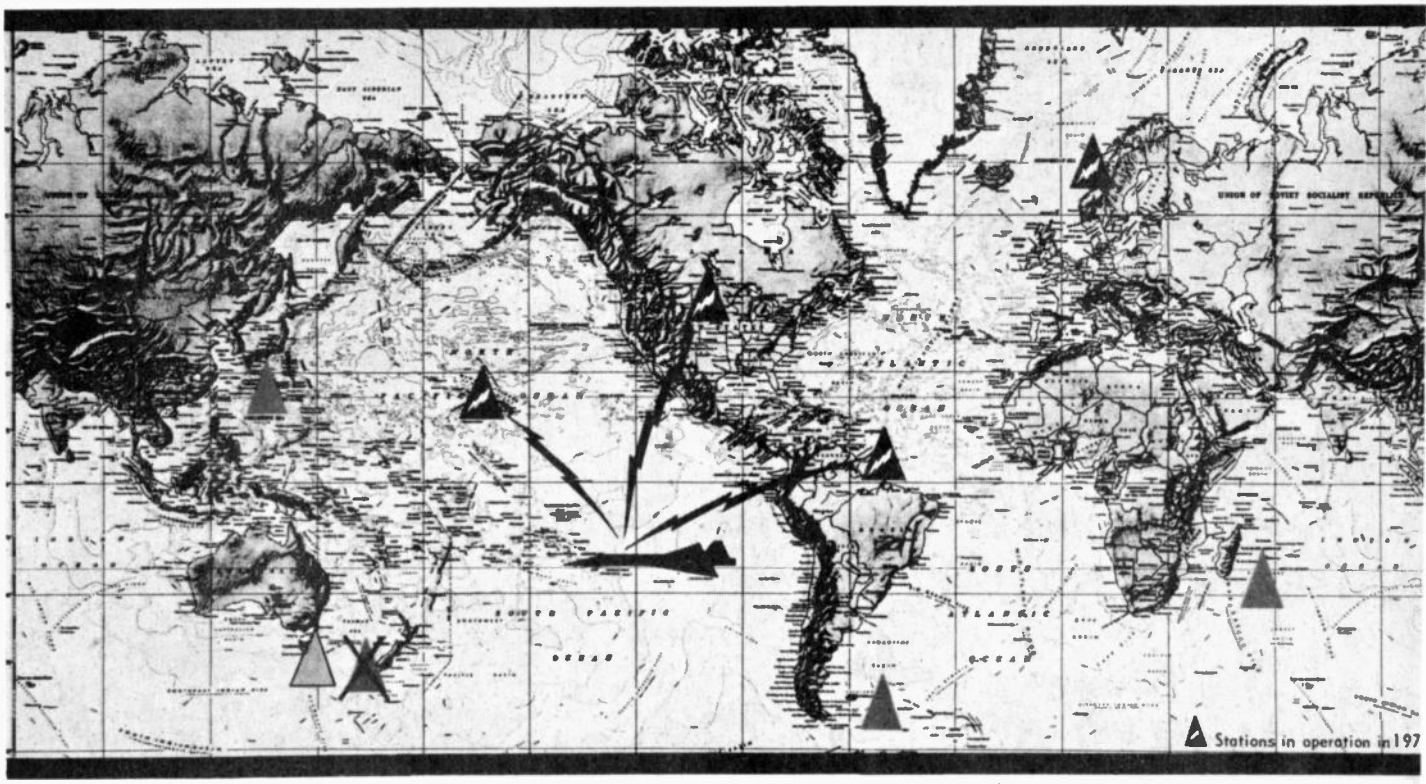
Although the Leddicon tube provides obvious advantages in operation, any standard 30 mm. lead-oxide tube, including the well-known and widely used Plumbicon tube, may be fitted to meet user requirements.

Deflection yokes

High-precision deflection yokes have been developed for the three camera tubes in the automatic camera. They are etched on to copper-plated precision-ground glass tubes. One tube carries the field deflection coils and a second, mounted co-axially, carries the line deflection coils. A very high degree of accuracy in the initial alignment of the deflection system, and long-term mechanical stability, is provided by this method of construction. All three yokes are fully screened from external magnetic and electric fields.

The new camera made its public debut at the International Broadcasting Convention in London last September. During this event the British Broadcasting Corporation expressed an intention to buy several for a new mobile television unit, subject to the successful outcome of field trials. The first firm order, worth nearly $1,000,000, was placed shortly after the BBC announcement by London Weekend Television (Independent Television Authority) — for 20 cameras and ancillary equipment. ●

OMEGA: the facts



Arrows on this map show locations of existing and proposed OMEGA beacons. Those arrows with a flash across them indicate existing operational beacons. Plain arrows indicate proposed beacons. Permission to use the New Zealand location has been refused by the NZ government.

The Prime Minister, Mr. McMahon, has stated that Australia is prepared in principle to grant the use of a site in the Bass Strait area for a beacon of the U.S. Navy's controversial Omega radionavigation system. Government spokesmen say the system is solely a civil navigation aid – the Opposition says its use is mainly military and points out that New Zealand has refused a similar request from the U.S. for that reason. With no political axe to grind, we present a technical assessment of the Omega system's capabilities, so readers can decide for themselves. The author, P.A.G. Howell, of the Physics Department of the University of Canterbury (Christchurch, N.Z.) is a leading authority on VLF navigational systems.

The use of radio waves for direction finding and position location is as old as their use for communication.

For the first 40 years most of the systems used triangulation techniques in association with angle measurements dependent upon the assumed rectilinearity of electro-magnetic wave propagation. A direction or position line was established by $\emptyset_1$ and a position from the intercept of two or more position lines obtained from $\emptyset_2$, $\emptyset_2$, . . . $\emptyset_n$, etc. (Fig. 1).

Refinements in propagation theory showed that lateral deviation of a ray occurred more often than was satisfactory. This, together with difficulties in error reduction, caused

scientists working in the middle and late 1930s to look at alternative methods, collectively described as extended or far-field systems, based on the assumption of constant electro-magnetic propagation. Although this assumption is true only in the first order, it did allow an enormous increase in accuracy before it in turn ran into difficulties.

Neglecting the 'radar' aids – which are classed as 'active' since the user must transmit a signal – the 'passive' and hence unsaturable systems may be divided into those for which a time difference between the reception of several signals is measured, and those for which the several ranges are established more directly.

These are subclassed as hyperbolic and 'rho-rho' respectively and are exemplified by OMEGA and VLF (Very Low Frequency) relative navigation.

The term hyperbolic arises from the fact that the position lines obtained from plotting successive stations at which there are the same time differences between reception of two beacons appear on a plotting chart with rectangular coordinates as curves called hyperbolae, since they are related by the equation $B_1P - B_2P = K$ (Fig. 2). Such hyperbolae are of course the nodal lines of the interference pattern generated by the wave trains from the two stations. Further information can be obtained from any physics text book dealing with interference.

EARLY HYPERBOLIC SYSTEMS

The first hyperbolic system to be set up for extensive use was the GEE system of R. J. Dippy. This system, used extensively during and after World War 2, operated in the region between 20 and 85 MHz; thus the range was limited to about 300 miles. This was followed by LORAN, developed for the U.S. by J. A. Pierce, of the Cruft Laboratory at Harvard. It used frequencies between 1.7 and 2.0 MHz and provided effective operation of several thousand miles over seawater, compared with several hundreds of miles for GEE, but at the expense of some loss of precision. This system is now known as LORAN A.

Greatly improved accuracy – in fact, the best accuracy of any of the radio-wave systems – is obtainable from LORAN C, which operates at approximately 100 kHz and for which only the ground wave is sampled.

These systems all use pulse transmission. Any straightforward attempt to increase the range by lowering the carrier frequency is self-defeating, since the permissible form of the pulse becomes a source of imprecision due to bandwidth considerations.

As the frequency is lowered, eventually it is necessary to abandon pulse techniques and revert to continuous wave emission when the lines of position are marked by constant phase difference. This restores the accuracy of line determination, but introduces an ambiguity arising from the

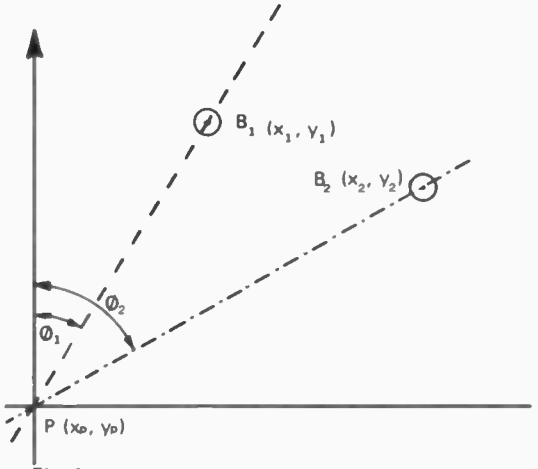


Fig. 1

Traditional position location by radio direction finding (long distances). The ordered number pairs (x_1, y_1) and (x_2, y_2) of the beacons B_1 and B_2 are latitude and longitude. In addition, the direction of true North is desirable as a reference. The ordered number pair (x_p, y_p) for the observers position is obtained from the solution of the spherical triangle, P, B_1, B_2.

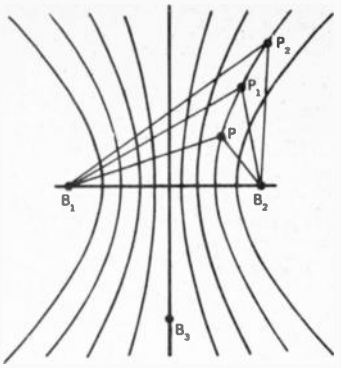
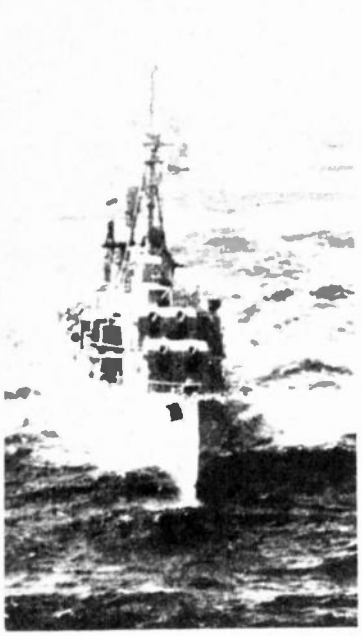


Fig. 2

Family of hyperbolic lines of position described by the equation $B_1P - B_2P = K$. At the successive positions P, P_1 and P_2 the observer sees the same time (phase) difference between reception of signals from B_1 and B_2. Ambiguity is resolved by the further sets of intersecting lines generated by a third beacon at, say B_3.

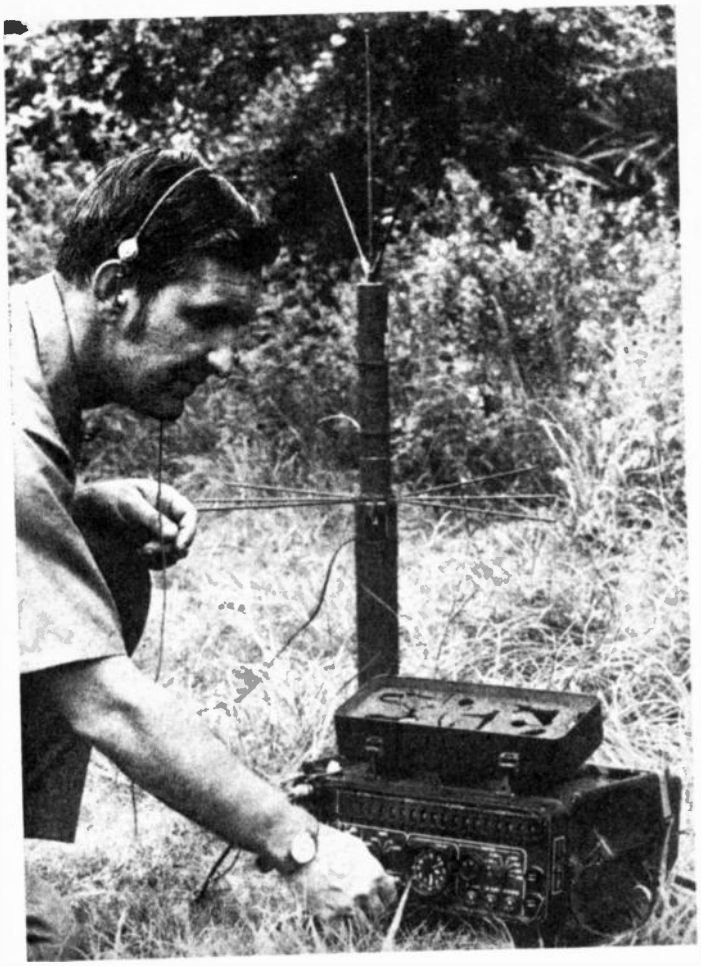


USE IN SURFACE AND SUBSURFACE NAVIGATION

Omega is the only navigation method that is as well-suited for submarines as for aircraft or surface vessels. Its low frequencies penetrate seawater to appreciable depths. They also travel through sea ice. Thus a completely submerged submarine can be guided by Omega through any seas, including those that lie beneath the frozen polar regions. Only reception is required, so the submarine user does not reveal his position.

This illustration is from the brochure distributed by the US Navy OMEGA Project Office in 1968.
The brochure is titled "OMEGA a Worldwide General Purpose Navigational System for Air, Surface and Subsurface."

OMEGA: the facts



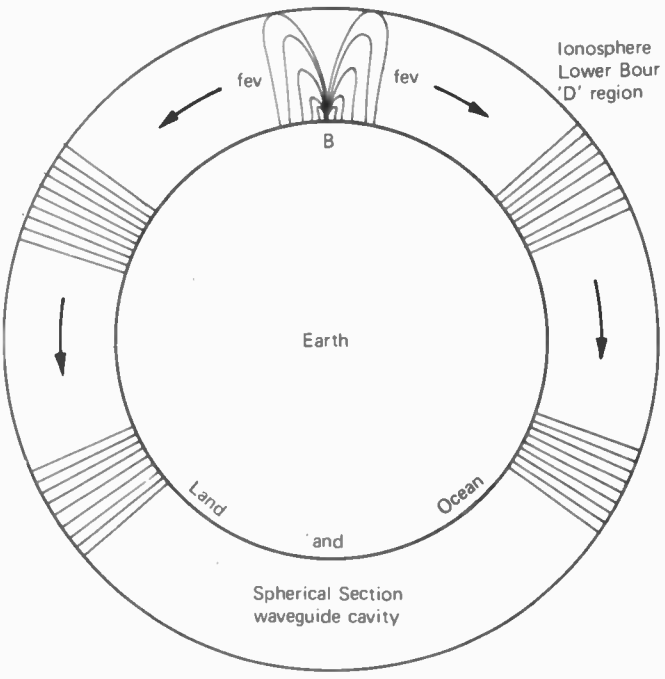


Fig. 3 illustrates a two dimensional view of the propagation of the electric field vector fe_v omni-directionally, with vertical polarisation. Note that to a first approximation the ray path illustrated by the arrow is substantially tangential. (For higher frequencies it zig-zags in the familiar series of hops).

An alternative system. This receiver provides exact position on the earth's surface using signals from U.S. Navy's navigational satellite system — but its vhf signals will not penetrate seawater.

fact that the phase repeats itself at distances corresponding to every half-wavelength for the frequency concerned. The user must know therefore between which pair of position lines his vessel lies (or which 'lane' he is in). This he may deduce from dead reckoning or by resort to coarse lane identification, using difference frequencies.

RADUX-OMEGA

In 1947 Pierce proposed, and between 1954 and 1957 had set up and evaluated, a 40 kHz system named RADUX, which gave a positional accuracy of plus or minus 5 nautical miles out to ranges of 2500 or 3000 nautical miles, but which would have needed at least 24 stations for global coverage; so this in turn was abandoned for his RADUX-OMEGA system, since his measurements of VLF phase stability suggested that in its simplest form it would give lines of position with an error of less than one nautical mile, while requiring only six stations to cover the globe. In practice, due to a combination of physical and political geography, this minimal number had to be increased by two to make a total of eight beacons.

The U.S. Navy, which was implementing its sub-surface nuclear deterrent force at this time, was quick to realise that this reduction in frequency in the 10 to 14 kHz band would make it possible for its submarines to obtain navigational guidance while remaining submerged, since the very long waves would penetrate sea water sufficiently to be received at adequate strength at depths of 40 to 70 feet below the surface of the ocean.

Hence the development and implementation of the OMEGA system was commenced by the U.S. Navy Laboratory at San Diego, California.

The Navy's plan called for the construction of eight VLF transmitters together with their antennae and programmers, power supplies and stand-by plant; each able to radiate some 10kW on four frequencies lying between 10 kHz and 14 kHz and controlled by synchronized cesium beam clocks at sites in Hawaii, mainland U.S.A., Norway, Trinidad, the Western Indian Ocean, the Philippines, Japan region, the Tasman Sea area, and near the Southern tip of South America.

In order to judge the feasibility, commercial and general military utility of this scheme it is necessary to realise that, during World War 2, radio navigation — despite the fact that far less than global coverage existed — tended to displace the earlier astronavigation methods as the most important means; and that all through the successive development of the LORAN systems, DECCA, etc., and the RADUX system, little serious thought was given to satellite navigation systems.

It was not until the end of 1957 that the first artificial earth satellite was successfully launched. However, from the moment that it was orbited, all radio wave systems subject to ionospheric propagation vagaries were rendered obsolete; and when the first TRANSIT navigation satellite was launched in 1961, they became obsolete for precision position determination. Thus, had it not been for the unique advantage of its sub-surface utility, the OMEGA system would probably have been stillborn.

A more detailed consideration of how the OMEGA system works will illustrate why this is so. Neglecting for the moment errors introduced by the variability of propagation, the basic system accuracy evidently depends upon the precision with which phase can be measured, and the accuracy with which the several stations in the network can be synchronized. At the time of its proposal some 15 years ago, the irreducible system errors made the radius of the circle of probable error for a single running fix about 2000 ft. This was degraded in practice by a further factor of two or three by day, and four to six by night, giving figures for light and dark paths of about one and two nautical miles. This degradation was due to the variability of propagation.

Thus, at its inception the OMEGA system looked like a pretty good general-purpose navigation system providing all weather global coverage, whose accuracy could be

improved locally in selected areas where the error correcting sub-routine technique was economically justified. This could be achieved by setting up monitoring stations which measured the local deviations of the lines of position and transmitted correction data to OMEGA receivers up to 150 miles away (this correction technique is variously known as differential or micro-OMEGA).

VARIATIONS AFFECT ACCURACY

For those VLF waves whose length varies from about 20 to 30 km., the spherical shell lying between the surface of the earth (or sea) and the lower surface of the 'D' region of the ionosphere at an average height of 80 km. acts as a waveguide, allowing the long distance propagation of the TM_1 mode. (Fig. 3).

The TM_2 is also present as a quasi-evanescent mode which is able to cause severe destructive interference out to distances of about 1000 km., so that each beacon of the OMEGA system is surrounded by a circular area of over 600 miles radius which it cannot serve. Furthermore, the phase is advanced and retarded diurnally in a fairly regular fashion by the changes in the effective height of the 'D' region, typically 70 km. by day and 90 km. at night. This source of error can be largely overcome by the provision of tables of corrections for the solar zenith angle and the locality. Similar corrections are applicable for seasonal variations. Over and above these are the irregular variations, chiefly occuring at times of high solar activity and arising from sudden increases in the ionization of the 'D' region, so reducing its effective height. These are caused by solar X-ray and ultra-violet emissions, and subsequent particle influx.

It is precisely freedom from such limitations which gives the satellite systems their great advantage.

Again, propagation is attenuated far less on a West-to-East path than on an East-to-West path, because of the interaction of the horizontal component of the earth's magnetic field with the ionosphere; hence, in certain cases, the navigator must take care lest signals coming round the long path are not confused with those propagating in the desired direction.

It also follows from the generally low attenuation of about 2dB per Myriameter (1 Mm equals 1000km.) that the power which may be permissibly radiated is limited. The considerable power radiated from NWC (about a Megawatt) not only generates whistlers on occasion – its signals echo round and round the world.

Another source of error, which, it is held in some quarters, may set the ultimate limit to the attainable accuracy for simple receiving equipment, arises from the leakage of energy from the earth ionosphere waveguide and its transmission to magnetically conjugate regions by the whistler mode.

SEQUENCE OF SIGNALS

The network of eight stations provides 15 probable lines of position; and in the worst case, using the simplest of receivers, at least two should be available for a fix to a navigator anywhere in the oceans of the world. Only one station is transmitting at any one time, and each sends a sequence of dashes for about 10 seconds, spaced by 0.2 seconds; it then ceases transmission until the other seven have transmitted in turn.

Each beacon radiates on four different frequencies during its 10-second period – the three navigation frequencies at 10.2, 11.33 and 13.6 kHz, plus its own specifically assigned side frequency.

The dashes vary in length from 0.9 to 1.2 seconds for the three navigation frequencies, and are also sent in different orders from the various beacons, while the identification frequency may be sent as a single dash or a series of longer dashes. This latter frequency also serves variously for interstation synchronization: rho-rho and theta-theta navigation use. It may also be used at a low bit rate for transmission of coded information.

A study of the format (Fig. 4) will show that unambiguous identification of each beacon is possible through consideration of the sequence of the navigation frequencies, their dash lengths, and the specific side frequency. All signals are synchronously related.

An immediate consequence of this sequencing regime is a need for the receiver to store phase information from each beacon examined, so that the phase information may be subsequently compared with that from subsequent units sending later. This requires that the receiver contain a precision oscillator of very good short term stability. This is generally met by a temperature controlled quartz crystal of high quality, and is consequently the first source of sophistication and cost in any OMEGA receiver.

Along the base line connecting any pair of stations, the lane width provided by the 10.2 kHz signals is about eight nautical miles, so that it is generally necessary to provide for sets of wider lanes. Thus, use of the 3.4 kHz difference frequency between the 10.2 and 13.6 kHz signals generates a lane pattern with a minimum width of 24 nautical miles. A further set, of three times this width, are procurable by resort to the 11.33 kHz frequency. If the navigator has to resolve an ambiguity of more than 70 nautical miles, he may resort to redundant OMEGA phase measurements, dead reckoning or astro-navigation, etc.

RECEIVING EQUIPMENT

A wide variety of receiving equipment can be used to transform the OMEGA phasors into the required geographical coordinates of latitude and longitude.

In the simplest case, a single channel receiver (tuned to 10.2 kHz) is manually operated by a suitably trained and qualified navigator, who applies the necessary corrections from books containing the appropriate tables.

In the most complex, an automatic computer is programmed to sample the

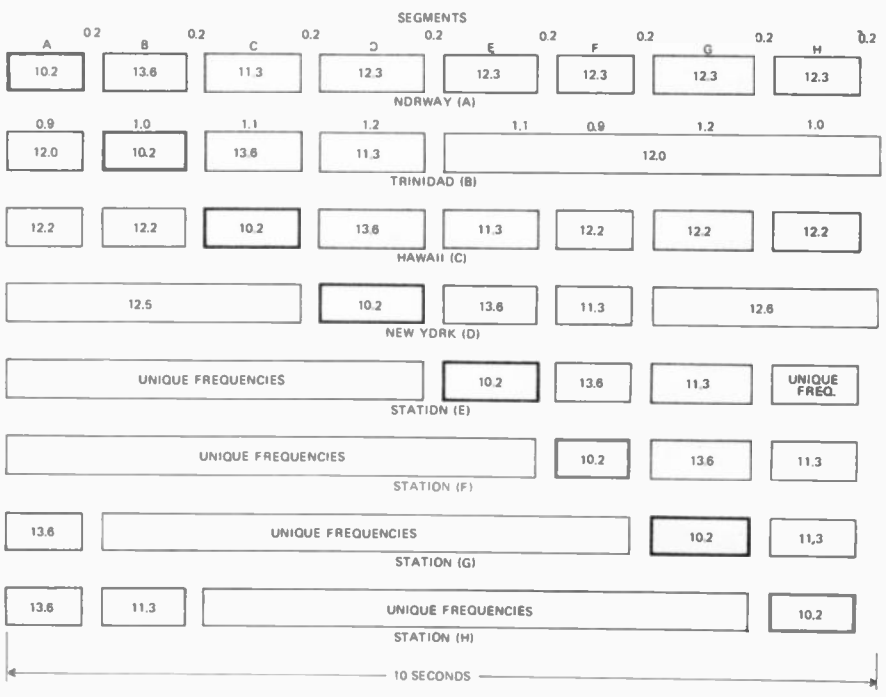
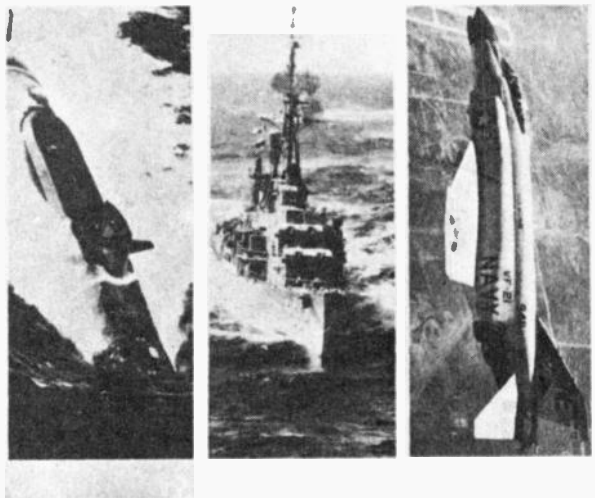


Fig. 4. Complete signal format. The 10.2, 11.3(33), and the 13.6-kHz segments constitute present system and are firm operational frequencies. Other frequencies are under test.

US Navy AN/SRN-12 OMEGA receiver, is solid-state, tunes four stations simultaneously, and displays three lines of position. Receiver, controls are in bottom drawer. Upper drawer contains graphic recorders and oscilloscope.

OMEGA: the facts

A WORLDWIDE GENERAL-PURPOSE NAVIGATION SYSTEM FOR AIR, SURFACE AND SUBSURFACE



This illustration is from the brochure distributed by the US Navy OMEGA Project Office in 1968.

Prepared by the Naval Electronics Laboratory Center San Diego, California 92152.

REVIEWED AND APPROVED 8-11-67

Chief Staff Officer

transmissions with a multi-channel receiver, apply the necessary corrections from its memory store and present the coordinates as digitized readout, while simultaneously plotting a course and feeding this to the vessel's auto-pilot.

The cheapest sets – which are least attractive because they require considerable skills to operate usefully – will probably cost between $2000 and $5000. The multi-channel but manually operated sets will range from $10,000 to $15,000, while computerized models will be upwards of $50,000.

The U.S. Navy is known to have paid about $330,000 each for fully automated sets designed to tie in with the SINS (Ships Inertial Navigation Systems) aboard its nuclear submarines.

At present, four stations of the proposed group of eight have been set up – namely: in Norway, mainland U.S.A. (currently being moved from New York State to North Dakota), Hawaii and Trinidad. The U.S. Navy hopes to have the remaining four stations in operation by 1972 or 1973.

The individual transmitters require to have a power output of about 100 kW to provide for the radiation of about 10 kW; the inefficiency is due to the simplicity and low effective height of the antennae being erected.

The antennae are usually a 'T' Marconi type, with a flat top of up to several thousand feet, and a single down-lead of comparable length – with, possibly, indifferent earthing facilities.

The U.S. Navy has hoped to keep the total system cost below $50 million for all eight stations by using convenient terrain (e.g. mountains instead of masts) and simple antennae configuration. This is possible because the bandwidth requirements are not great.

POTENTIAL OMEGA SYSTEM USED

This is an age of extremes, in which many new systems are extravagantly extolled by their promulgators while their claims are denigrated or denied by their detractors, so it is most difficult to make an assessment of their utility.

OMEGA is no exception.

Estimates vary widely – from the enthusiastic speculation of some of the system's supporters who envisage an OMEGA receiver on every vessel or aircraft (and some land vehicles) that roam the world, ranging to the sourest predictions of 'no use whatsoever' coming from rival competitors for funding in the U.S. Armed Services.

There is the additional difficulty of judging the value of a system overtaken by technically better schemes – the satellite navigation systems – but which continues in competition by virtue of a mixture of commercial inertia and development for a special purpose.

It is fairly certain that for small ships, fishing vessels and the like, where there is a choice of either OMEGA or radar, the latter will be preferred. W. Kuebler, writing in the U.S. journal 'Navigation', cites OMEGA as uneccessary to the present requirements of seaborne commerce, which is already adequately served.

On the other hand, the roving vessels of the world's oil tanker fleets, now coming increasingly under computer control and less constrained to use the regular shipping lanes, might find it an advantage in reducing running costs; and they could certainly afford the initial capital investment.

Nevertheless it is reasonable to assume that, if OMEGA was the invaluable world-wide general purpose aid claimed by its protagonists, the various agencies of the U.N. concerned would have taken it up. They have not done so.

For fast-moving vehicles such as aircraft the sophistication required is comparable with Doppler radar and inertial systems. But OMEGA is also subject to the sudden vagaries described above, and these would take an aircraft too long to evaluate and correct.

SUBSURFACE RADIO

The first part of this report stated that radio navigation techniques are as old as radio communication. The association of submarines with radio methods likewise commenced in the early 1900s. Alfred Story's 'Wireless Telegraphy' (Hodder and Stoughton, 1913) carries a photograph facing page 190, captioned 'The D1 Submarine, the first fitted with wireless'.

Experiments conducted by the military engineers of the Allies and the Central Powers during World War 1 independently verified the physics of the propagation of electromagnetic waves in a lossy medium (sea water), and it became generally known that for frequencies in the range from 40 kHz down to 10 kHz the attenuation rate drops from about 2.2dB/ft. to 1.1dB/ft., compared with some 15dB/ft. at 2MHz.

This confines radio communication with a submerged vessel over any appreciable distance to the one-way transmission of administrative traffic from high-powered VLF land stations. The submarine's dimensions (which limit antenna length), power resources, and the fact that when submerged it is buried in a conducting medium combine to preclude any appreciable return transmission. This is not as much of a disadvantage as it may at first seem, since the tactical advantage of such a vessel is chiefly due to its ability to remain hidden – and to break radio silence is to

court immediate detection and prompt destruction.

This two-way communications restriction places no limitation on the use of passive radiowave navigation systems. During World War 2 a giant VLF station built on the marshes of the Milde river, near Calbe in mid-Germany (code-named Goliath and radiating 0.7MW on 16 kHz) provided command communication and conventional D/F facilities for U-boats running submerged, to antenna depths of about 40ft. anywhere in the world.

Although Hertz had commenced his experiments in the late 1880s at decimetre wavelengths – corresponding to frequencies of hundreds of megahertz – Marconi's addition of ever-larger aerial conductors had necessarily selected successively longer wavelengths, corresponding to lower and lower frequencies, from the pulses generated by the spark transmitters of the day. Hence, during the first 20 years, longer ranges came to be associated with the production of longer wavelengths. (Tuned circuits confining transmission to discrete frequencies were a later invention.)

Just when a combination of exponentially rising capital costs for the associated antenna installations, and an appreciation of the falling bit-rate capability, were bring this trend to a halt, Marconi's high frequency experiments opened up the shortwave bands.

The following 20 years were given over almost entirely to Dekametre waves, corresponding to frequencies between 1MHz and 30MHz. Many of the expensive long-wave transmitters which had been built fell into disuse. The fact had been noted, however, that in periods when the HF bands were blacked out during high solar activity, trans-Atlantic telegraphy traffic was still possible using the long-wave transmitters.

At the end of World War 2 the U.S. inherited large blocks of German technology, including the details of her VLF techniques. In consequence, when the U.S. began to build up its submarine fleet, U.S. Navy engineers renewed their interest in the very low frequencies.

This interest is documented in a series of articles gradable from comment to exposition and appearing in magazines and journals ranging from the popular press to the 'Proceedings of the Institute of Radio Engineers'.

Among the most acute of the problems involved in the viability of the sub-surface arm was the ability to maintain VLF communications and navigation facilities in the event of hostilities. The vulnerability of the great VLF antenna complexes at sites like Jim Creek (Washington), Cutler (Maine) and The Australian North-West Cape installation has been a source of continuing embarrassment and cause of comment from Naval personnel. A writer in USNIP as far back as 1963, when the IRBM was being abandoned for the ICBM, drew attention to the necessity for the maintenance of these VLF links and, likening the ballistic missile submarines to the blinded Polyphemus in their absence, specifically warned that countries harbouring VLF communications and navigation facilities would surely draw nuclear retaliation onto their territories.

The problem that the U.S. and her allies had to face was the possibility of the VLP network, serving the ballistic missile submarine fleet, being destroyed during a first strike against the U.S.A.

A GIFT FROM THE GODS

To the sub-surface strategists the OMEGA system must have looked like a gift from the gods. Here was a system that could be used as a general purpose navigational aid for both civil and military use, with the added advantage that at least some of the beacons would be in foreign countries.

And, had it not been for satellite navigation systems, OMEGA might well have become the global navigational aid of the U.S. Navy's brochures.

The ability of the OMEGA system to provide sub-surface guidance was taken for granted in the U.S. Navy's promotional activities. U.S. writers – including service representatives preparing official pamphlets – openly described the system's ability to provide sub-surface guidance.

The brochure produced by the U.S. Navy's own OMEGA Project Office describes this facility twice and carries two photographs of nuclear submarines by way of illustration.

In recent times denial of the OMEGA system's utility for, and use by, ballistic submarines has always been made on the grounds of accuracy. It is stated that the fixes provided insufficient accuracy, and that these vessels have alternate and better means of navigation at their disposal.

It is worth examining the validity of these claims in some detail. The term 'ballistic', used to describe the missiles themselves, means that during their flight toward their targets they do not receive any additional guidance over and above that stored in their computers at the time of launch. The accuracy of a ballistic missile depends upon the initial aim.

Providing that the position of the launching site is known precisely, even the earlier Polaris missiles (A1, A2, A3) can be depended upon to land at their extreme range inside a circle of one-mile radius.

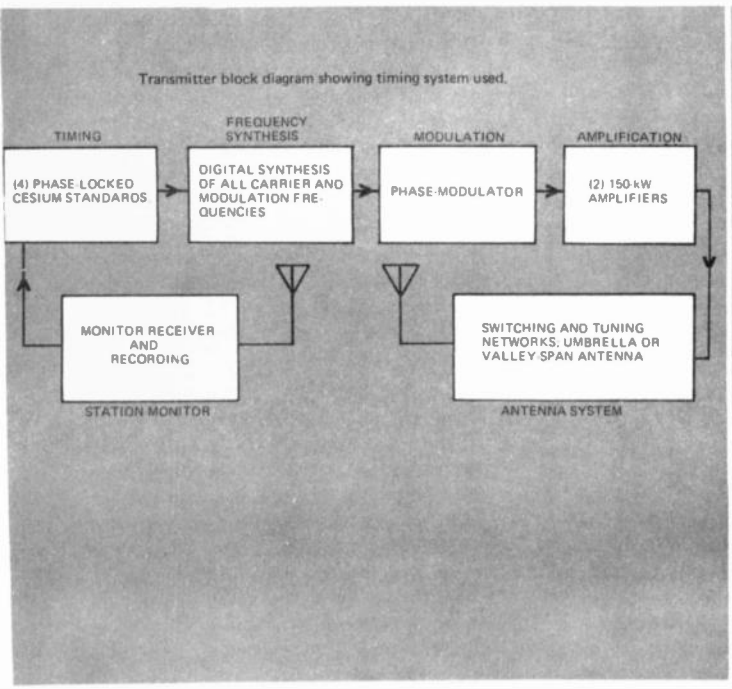
For a hydrogen warhead of one Megaton TNT equivalent this is more than sufficiently accurate for destroying industrial targets, centres of population and most types of military installations – except hardened missile silos and the like. It is evident from the theory of errors that any form of navigational guidance which allows the launch site to be determined within one mile is adequate.

HOW SUBMARINES NAVIGATE

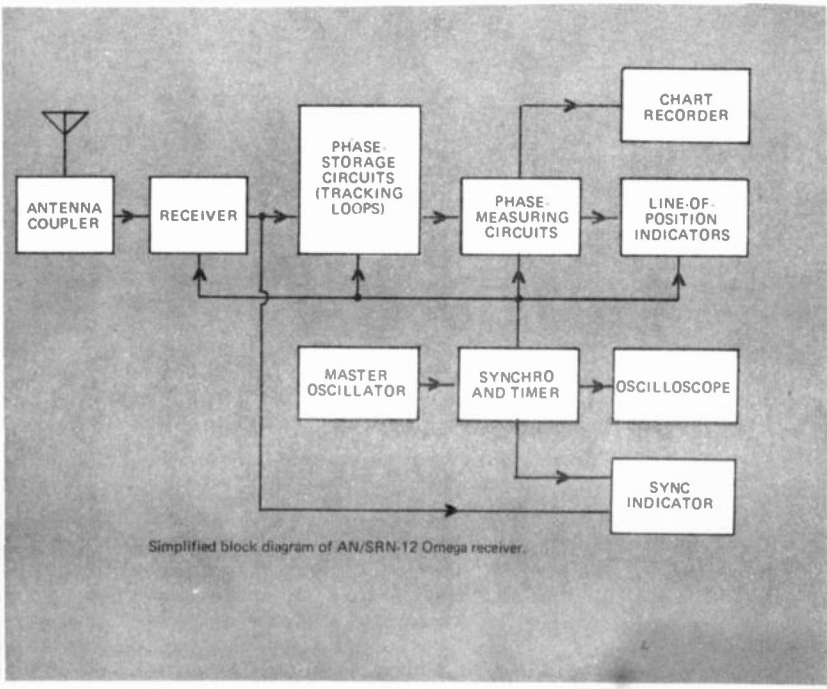
In its simplest form, as we have seen, the OMEGA system provides this order of accuracy for a single running fix.

However, submarines are not normally dependent upon anything so crude as a

(Continued on page 115)



Transmitter block diagram showing timing system used.



Simplified block diagram of AN/SRN-12 Omega receiver.

Hand-held Phystester used for evaluation purposes.

BUILT-IN DETERRENT FOR DRUNKEN DRIVERS

For more than a year and a half General Motors' Delco Electronics Division in U.S.A. has been working on a device that may some day keep motorists from operating their vehicles if they are drunk or impaired in other ways.

Called a Phystester Ignition Interlock System, the device is aimed at one of the largest (some say THE largest) single causes of automotive fatalities and disabling injuries: crashes involving drivers with significant levels of alcohol in their blood. If the Phystester proves feasible, it could be built into the instrument panel of future vehicles – taking up no more space than an electric car clock.

The Phystester is designed to work like this: when the driver switches on the ignition, a five-digit random number is displayed for a brief interval. Then the number turns off, and the keys on a board below the display light up. The keyboard is similar to that of an office calculator.

The driver then has a short time in which to punch into the keyboard the exact number he has just seen displayed. If he does this successfully in the time allowed, the car will start. If he fails the test, the driver has two more chances to start the vehicle – although a different number will be displayed for each separate try. If he fails two more times, the vehicle is inhibited from starting for a pre-set period of time.

Delco engineers – and researchers from the Medical College of Wisconsin who are collaborating on the project – believe this simple test, which takes a few seconds to perform, can quickly check four human faculties that are degraded early by excessive amounts of alcohol: visual acuity, short-term memory, coordinated motor response, and judgment.

First, the driver has to see the number that is displayed. Second, he must memorize the number and be able to recall the digits. Third, he must be able to punch the digits, in the proper order, into the keyboard within a given time.

MEDICAL EVALUATION

From data gathered in the medical evaluation of the Phystester, it is clear that the device can be effective in identifying people who are under the influence of alcohol. The effectiveness of the Phystester depends on test factors, and upon levels of inebriation.

Delco engineers and Medical College scientists are trying to find a test which all of the driving population can pass sober, but which will sort out a significant percentage of the population when legally drunk. The Delco research and development team believes it can devise a Phystester that will be approximately 50% effective in preventing drunk people from starting their motor vehicles. This would mean a test that most of the population could pass at least one try out of three when sober, and which 50% of the people would fail three tries out of three when their blood alcohol concentrations were 0.10 or higher.

Test results so far have shown that the effectiveness of the Phystester increases as the blood alcohol concentration of the test subjects increases.

From the thousands of individual tests that have been run, the following design and test characteristics have evolved as most promising for a Phystester configuration:

HOW PHYSTESTER WORKS

Most likely configuration	Comments
1. Typical display time is one to one and a half seconds.	*Testing has shown that people are able to grasp a number almost as well when it is displayed for only a half-second as they are for a number displayed for one, or one and a half seconds.*
2. Response time of 3 to 5 seconds appears to provide a suitable check.	*This response time range was arrived at from thousands of individual tests. The response time required to pass the test appears to be a significant factor, when coupled with the other factors that are incorporated in the tester. The critical factor of response time will be tested more extensively in the next phases of the evaluation programme.*
3. Four- to six-digit numbers appear to be the most suitable length for the test number.	*Four- to seven-digit numbers were evaluated.*
4. A secondary test is important in sorting out the drunk individual from the sober person.	*A secondary test calls for divided attention and helps to test judgment, short-term memory, peripheral vision, and coordinated motor response. All of these human factors and capabilities appear to degrade after a person has been drinking alcoholic beverages. In other words, it's very difficult for a person under the influence of alcohol to begin one task, have it interrupted by another task, and then return to complete the first task – all within a time limit of a few seconds.*
5. A fixed ten-button keyboard, resembling that of a pushbutton telephone, seems practical.	*Testing was done with random keyboards (where the numerical value of each key changes with each test) because it was thought at the outset that people with key punch skills might have an unfair advantage with fixed keyboards. Results have shown, however, that a fixed keyboard is adequate for proper testing. A ten-key board also allows more numerical variety for a test number than does a five-button keyboard.*

Another direction also is being reviewed: tailoring the Phystester tests for individuals or groups of individuals. The medical researchers and the Delco engineers believe that individualizing the tests can make them highly discriminatory, but this more complex route would have to be proven feasible and practical.

Experimental Phystester built into Oldsmobile instrument panel.

Electronic physiological tester prevents people from driving when drunk or drugged – this report tells how.

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PRACTICAL GUIDE TO TRIACS

Triacs are simple, versatile devices used throughout electrical and electronic engineering. Yet most electricians regard them with almost superstitious awe. This three-part article describes their uses in a totally practical way.

Part 1–Switching circuits

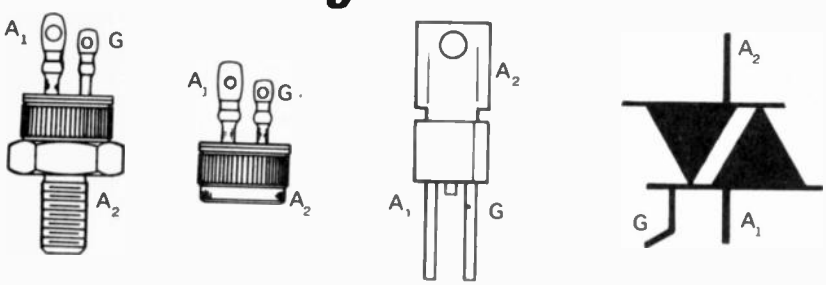


Fig. 1. Construction and electrical connections of typical Triacs.

ELECTRONICS, according to a friend of ours, is anything electrical that he doesn't use or understand.

Triacs, by this definition, must soon be considered non-electronic, for they are finding ever-increasing use throughout electrical engineering – in both consumer and industrial applications.

In effect, a Triac is similar to a latching relay. It closes – practically instantaneously – after being triggered, and remains closed until the supply voltage is reduced to zero (or changes polarity). When this occurs (twice every complete cycle if used on ac) the Triac opens, but will close again almost instantaneously if retriggered.

STATIC SWITCHING

Triacs can usefully replace mechanical switches in ac circuits. They allow the control of relatively high power by very low triggering current – and as Triacs latch each half-cycle there is no contact bounce; nor, as they open only at current zero, is any arcing or transient voltage developed due to stored inductive energy in the load or power lines. They eliminate completely the contact sticking and wear associated with electro-mechanical relay, contactors, etc.

Triggering arrangements are very flexible – most Triacs can be switched into conduction at any point on either half-cycle of the ac waveform by applying a low voltage of either polarity between the gate electrode and anode I. (A few types of Triac can only be switched by a negative-going gate voltage or pulse.)

The triggering voltage can be obtained from a battery (Fig. 2) or simply from the ac mains (Fig. 3). In either case, full wave current will flow when SI is closed and current will cease to flow at the end of the half-cycle (whether positive or negative) in which SI is opened (Fig. 4).

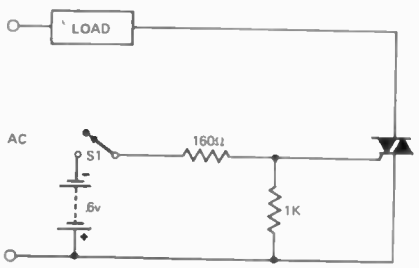


Fig. 2 Triac triggered by external dc voltage.

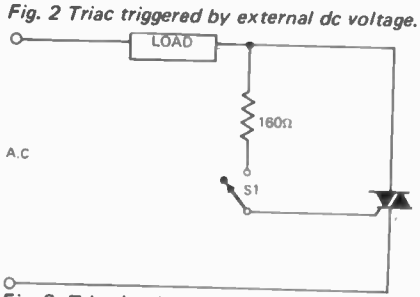


Fig. 3. Triac is triggered by input ac, in this application switch S1 will be 'live'.

ELIMINATES BURNT CONTACTS

The simplest possible method of triggering is shown in Fig. 3. This circuit is often used to eliminate burnt contact breaker points in thermostats and similar devices which have to make and break large currents at frequent intervals. The existing make and break arrangement is retained but used only to switch the Triac, which in turn switches the main load current. The current flowing through the contacts is reduced to a few milliamps.

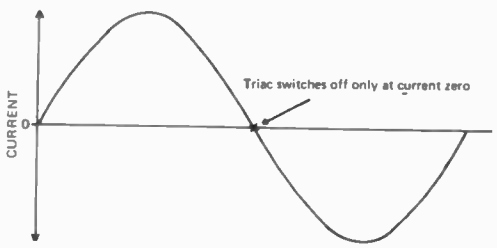
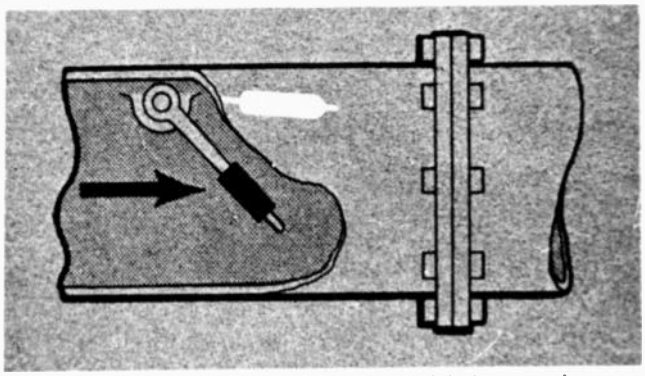


Fig. 4. A triac can be triggered into conduction at any point along the sine-wave, but will only switch off at current zero.

MOVEMENT SWITCHES TRIAC

A magnetic method of triggering may be used when a mechanical movement actuates an electrical circuit. To do this, a magnetically operated reed switch is used as SI. The switch contacts are closed when a magnet is brought near the switch. The actual distance will depend upon the sensitivity of the reed switch and the strength of the magnet (½" to 1" is typical). Various applications of this principle are shown in Fig. 5.

PRACTICAL GUIDE TO TRIACS



Magnetic reed switch used for flow control minimises restraint on moving parts and avoids perforating tube wall.

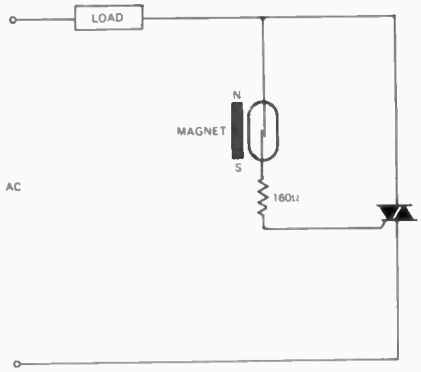
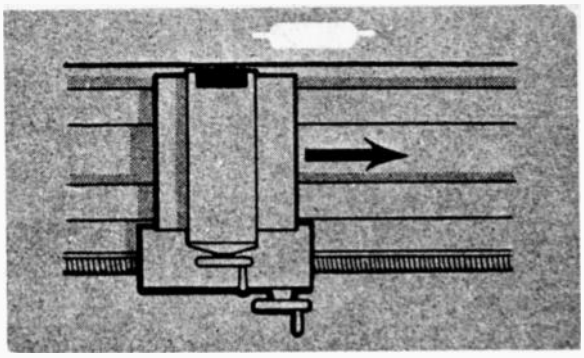
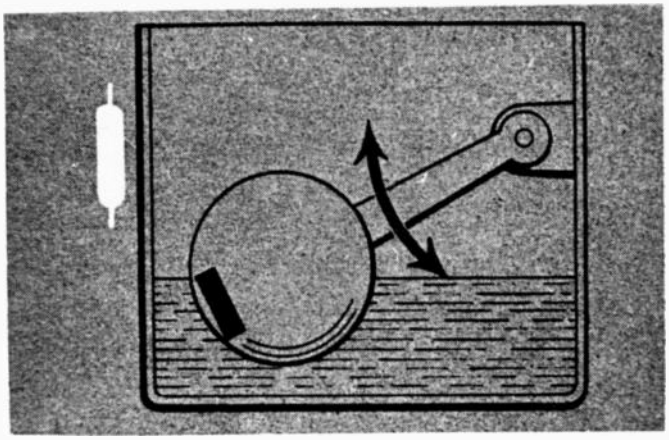


Fig. 5. A magnetically operated reed switch provides electrically isolated triggering from mechanical movement. The switch will close when the magnet is brought within half an inch or so. Suggested applications are shown in Figs 5a, 5b and 5c.



Reed switch simplifies positional control.



Liquid level control.

Reed switches may also be used to provide electrical isolation between the Triac and the triggering circuit. The reed is inserted in a coil which is then switched by a suitable low voltage dc supply (Fig. 6). As the life of reed switches exceeds several million operations, this is an extremely reliable method of switching.

Other simple methods used to isolate the triggering circuit from the Triac are shown in Figs. 7 and 8. The photo-cell coupling shown in Fig. 8 provides extremely high electrical isolation. Photo-cell couplers, in which a light source and photo-cell are integrally mounted, are commercially available for as little as a dollar.

An unusual off/half-power/full-power circuit is shown in Fig. 9. When half-power is required, the diode is switched in series with the triggering lead. This causes the Triac to conduct only on alternate half-cycles. The circuit is suitable for heating, or other resistive loads that have thermal inertia. It is not suitable for lighting control, as the halved frequency will cause an irritating flicker; nor should it be used for inductive loads such as motors or transformers.

A latching circuit is shown in Fig. 10. Momentarily depressing SI will cause the Triac to conduct and to *remain* conducting after SI is released. The circuit is reset by momentarily depressing S2. C1 should be a 0.5 μf to 2.0 μf, 630 volt working, non-polarised capacitor.

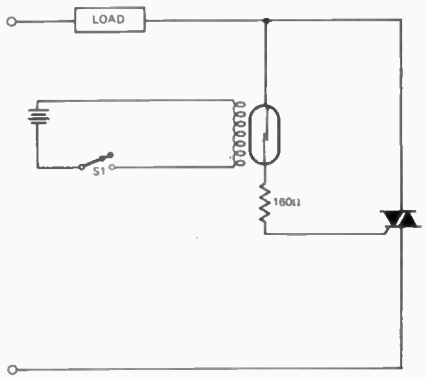


Fig. 6. Reed relay can be electrically operated to provide electrical isolation.

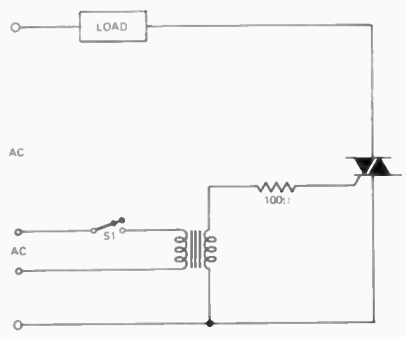


Fig. 7. Isolated ac provides triggering.

TIME DELAY CIRCUITS

Triac time delay circuits are shown in Figs. 11, 12 and 13. All three circuits will provide time delays up to 100 seconds or so and may be used for applications such as photographic timers, industrial machinery, etc.

In the circuit shown in Fig. 11 the Triac will conduct as soon as SI is closed. After a time – determined by the setting of the one Megohm potentiometer – the unijunction will fire, causing SCR1 to conduct thus removing the triggering voltage from the Triac.

Another version of this time delay circuit is shown in Fig. 12.

A different type of time delay circuit is shown in Fig. 13. In this circuit the Triac will conduct after SI is closed. The time interval is set by the one Megohm potentiometer.

Liquid level is used to switch the Triac circuit in Fig. 14. The Triac will conduct when the resistance between the sensing probes falls below 100K. The pulse transformer in this circuit must be well insulated to ensure that

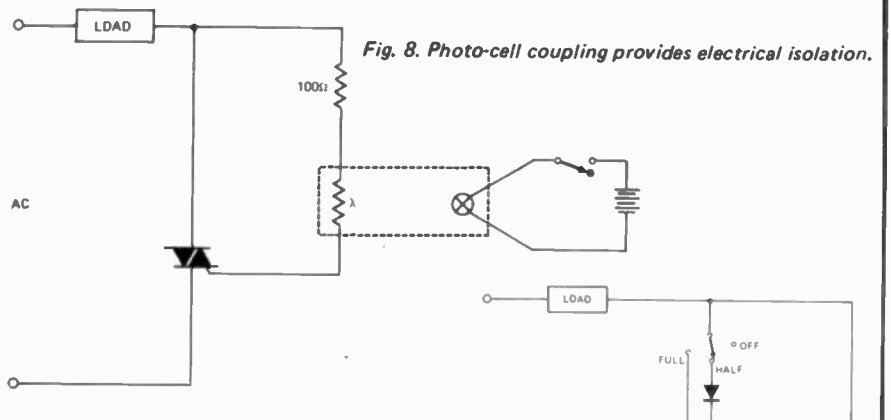


Fig. 8. Photo-cell coupling provides electrical isolation.

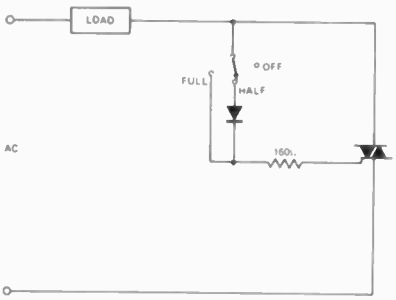


Fig. 9. Circuit can be switched to provide half or full power into load.

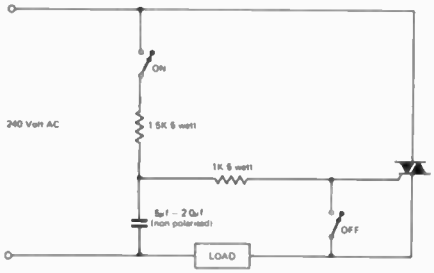


Fig. 10. This triggering circuit provides latching action.

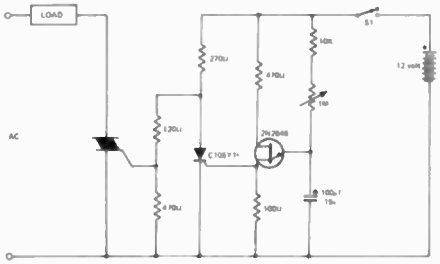


Fig. 11. Time delay circuit – power is disconnected from load after pre-set time.

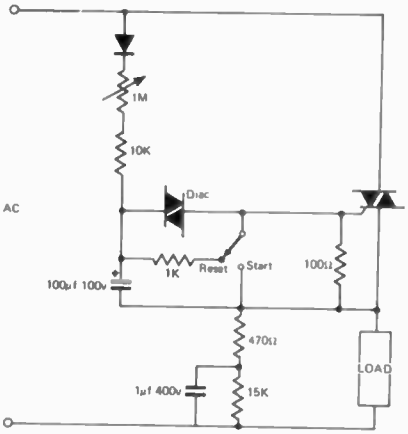


Fig. 12. Time delay circuit – action similar to Fig. 11.

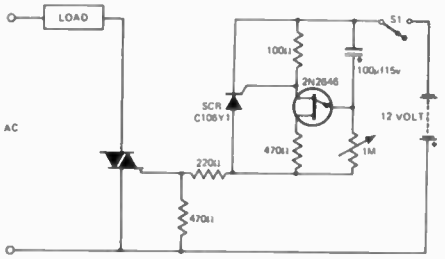


Fig. 13. Time delay circuit – power is connected to load at end of pre-set delay.

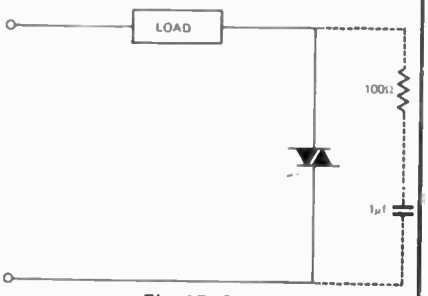


Fig. 15. Capacitor and resistor should be connected across the Triac when switching inductive loads.

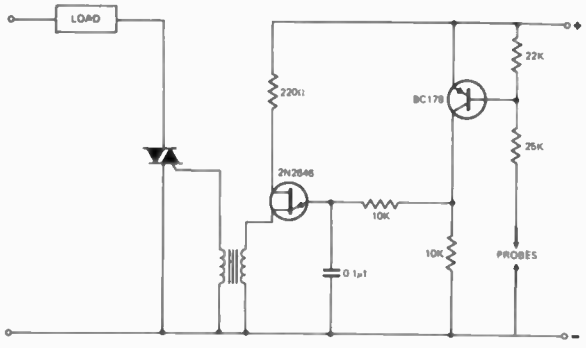


Fig. 14. Liquid level switch. Triac is switched when liquid covers probes.

mains voltage cannot appear across the probes.

INDUCTIVE LOADS

All the circuits described so far will operate reliably with resistive loads. Inductive loads present a minor problem. For reliable operation it may be necessary to limit the rate of voltage rise immediately following turn-off. This is done by connecting a capacitor and series resistor across the Triac (Fig. 15).

A Triac's power rating is a function of its operating temperature. Thus a unit of 6 amps nominal rating used without a heat-sink must be derated to 1½ amps. A rough guide can be obtained from the Triac's external case temperature. This should not exceed 75-80°C.

In the majority of circuits the outer case of a Triac will be 'live'. Because of this it is necessary either to insulate the heat-sink from surrounding metalwork, or to insulate the Triac from the heat-sink.

Two flat mica washers and a Teflon collar will effectively insulate the Triac from the heat-sink, but there will be an appreciable loss in cooling efficiency. Where possible, it is better to have metal-to-metal contact and then to use an insulated mounting for the heat-sink itself.

Providing Triacs have adequate heat-sinks, it is permissible to run them permanently at their maximum designed rating. They can also withstand considerable overloads for short periods. A typical unit can withstand ten times its nominal rating for one half-cycle of a 50 Hz waveform.

DO NDT OVERLOAD

Despite this tolerance of short-term overloads, Triacs must not exceed their designed ratings for more than a fraction of a second. A short circuit will destroy them instantaneously. Fusing is usually ineffective, as a Triac will almost invariable fail first and protect the fuse.

An almost certain symptom of overloading is loss of gate control; the Triac will appear to have a short circuit from one anode to the other, although overloaded Triacs will occasionally still operate on one half-cycle only.

The second part of this article – to be published next month – describes the use of Triacs in power control, covering both zero voltage switching and phase control circuits. ●

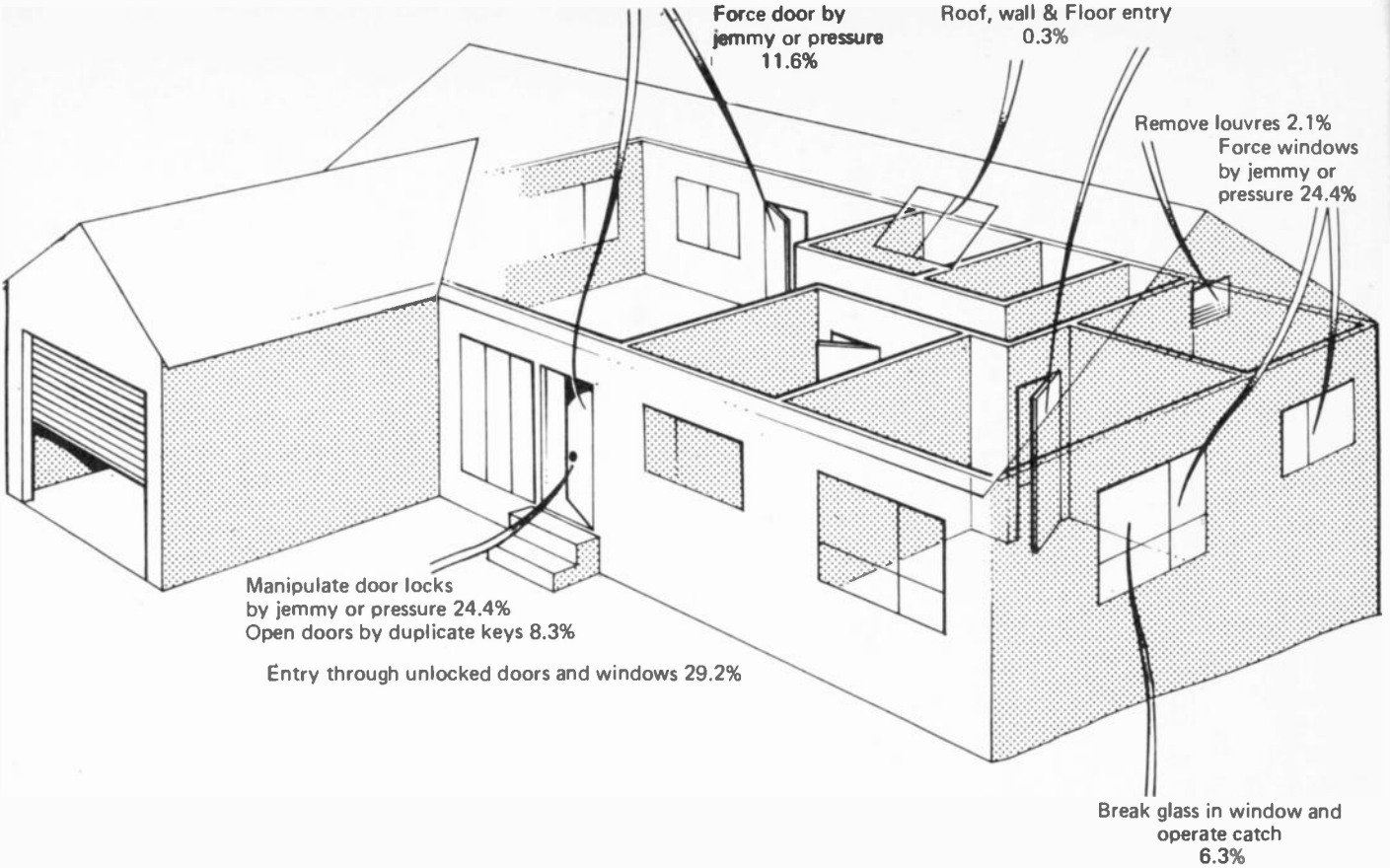


Fig. 7. This drawing shows the various ways in which criminals will enter a house. In particular note the high percentage of entries made through unlocked doors and windows. The necessity for adequate locking arrangements is obvious. Electronics Today acknowledges the assistance of the Crime Prevention Dept. of the NSW Police in making these statistics available.

Part 2 of a series

INSTALLING THE ET INTRUDER ALARM

Last month we described the operation and constructional details of the ELECTRONICS TODAY intruder alarm. This article outlines the most effective ways of installing the various types of sensors and warning devices.

IT IS commonly believed that a really determined and skilled burglar can find a way of entering any protected premises.

To a limited extent this is true – but burglars in this category are truly professional criminals. They will be far too busy sizing up the local bank to bother about the average home or small business. Also – and luckily – criminals with this degree of skill and knowledge are very rare.

Who, then, is the type of man or woman who breaks into the average low-to-medium risk premises?

Criminologists say that, although this type of offender may be of any age or background, it is very likely that he will be 15 to 25 years old and from a low-status background. He is unlikely to be very intelligent.

HOW CRIMINALS BREAK IN

Fig. 7 illustrates the most common ways in which they will attempt to break in. The methods are surprisingly simple – 37 percent just walk in through a door.

For the average premises, it is

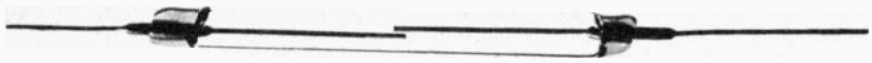


Fig. 8. Magnetic reed switch (see text).

primarily necessary to install sensing devices on front and rear doors, garage entrances, windows, large ventilators and skylights.

A very small proportion of break-ins are made by removing cladding materials from the walls or roof – and very occasionally entry will be made through the floor. Although few homes or small businesses are broken into like this, it is usually possible to find a strategic passage or zone through which an intruder will pass – i.e., the door into the master bedroom, the area around a safe, etc.

It is a simple matter to locate sensors in these areas and include them in the alarm circuit.

The ELECTRONICS TODAY intruder alarm is specifically intended for 'closed loop' operation. A number of switching devices – all held closed in the 'safe' position – are wired in series. If any switch is opened, or if the series loop is cut in any way, the alarm will be activated.

MAGNETIC REED SWITCHES

The simplest and most reliable switching device for alarm installations is the magnetic reed switch.

This consists of a pair of ferromagnetic contacts in a small, hermetically sealed glass enclosure. (Fig. 8).

Normally the switch reeds are cantilevered from the ends of the glass tube and overlap slightly at the approximate centre of the tube, with a small air gap between them.

When a magnet is brought near the reed switch, the extreme ends of the reeds assume opposite magnetic polarities. As the magnetic flux between the two contacts increase, the attracting forces increase and overcome the stiffness of the reeds, bringing them into contact with each other. The magnet must be brought within a specific distance of the switch – depending on the sensitivity of the switch and the strength of the magnet. For the reeds and magnets commonly used for intruder alarms, this will be approximately half-an-inch.

When the magnet is removed, the contacts reopen. The relative distance for pull-in is always less than for drop-out. This is a valuable feature for alarm installations, as it ensures that small movements of doors and windows will not cause false alarms.

Reed switches purchased for alarm installations must be of a type specifically intended for the purpose – standard reed switches are not suitable. If standard reed switches are held closed for a long time, they tend to remain closed when the magnet is removed. One type of switch designed specifically for security applications is the XS7, marketed by Plessey Ducon.

The most suitable magnets are ferritic-ceramic bar types – such as the Rola type FM 448.

Many professional security companies install reed switches and magnets encased in plastic mouldings. (Fig 9). Whilst these mouldings are neat and simple to fit, it is better to conceal both reeds and magnets within the framework of the doors and windows.

Figs. 10 and 11 illustrate various methods of locating the reeds and magnets (note that the magnet is always fixed to the moving part of any door or window frame).

Although magnetic reed switches are surprisingly rugged, care must be taken when bending or cutting the external connecting leads. If these have to be bent, hold the reed as shown in Fig. 12. Do the same if the connections have to be shortened.

All the reed switches are connected in series (except the one fitted to the 'silent entry' door). Use 23/0076 wire and make quite certain that all connections are properly soldered.

Close all protected doors and windows and check the series resistance of the loop with an ohmmeter. The resistance should not exceed a few ohms. If it does, check all connections for dry joints.

Connect the circuit to the instantaneously operating, normally closed input (connections 7 and 8 on

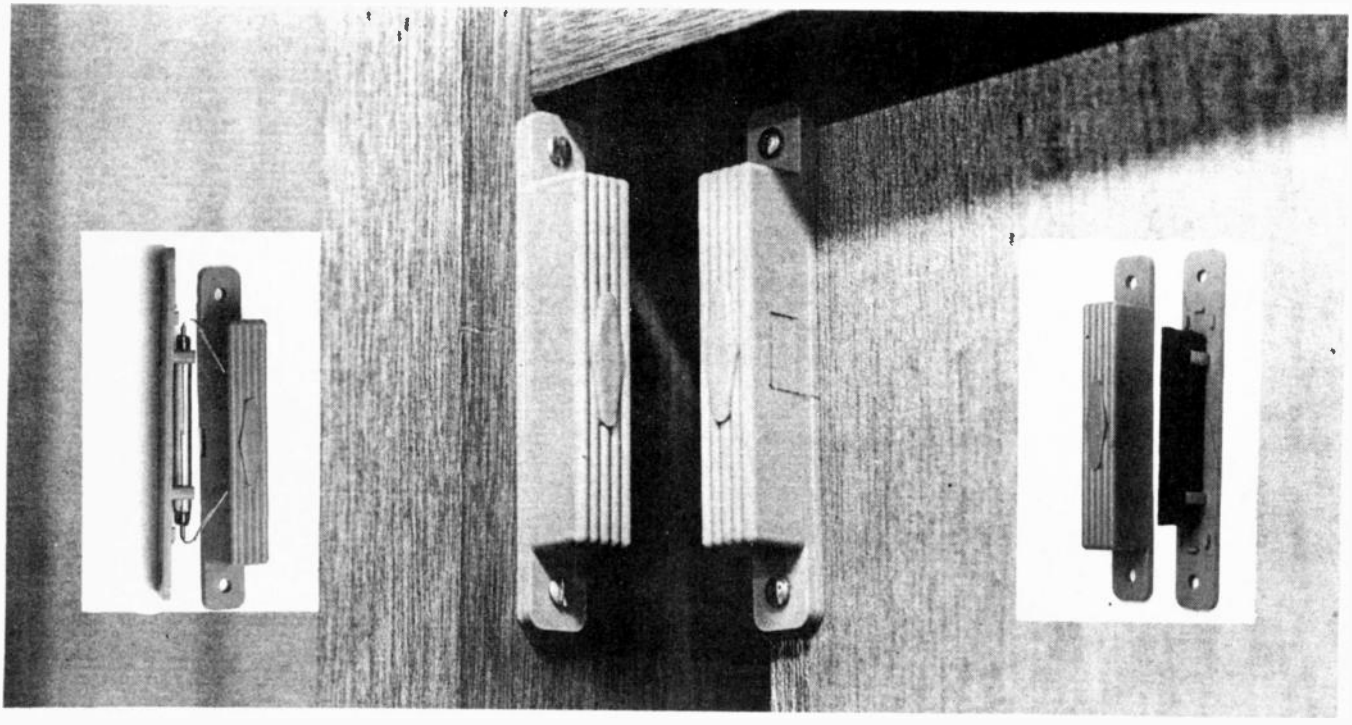
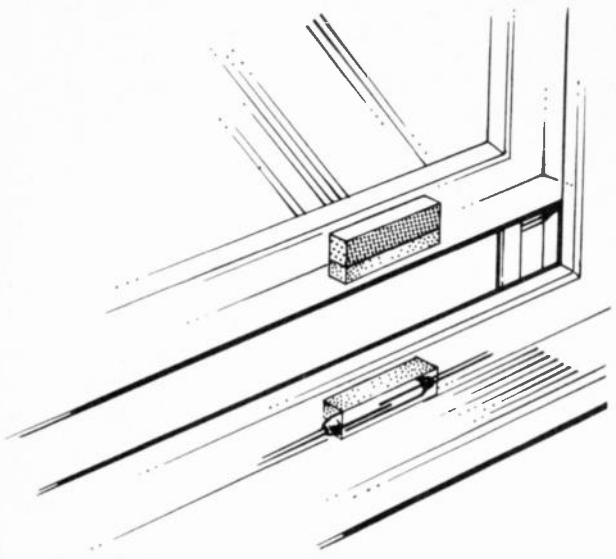


Fig. 9. Magnetic reed switches can be obtained in plastic mouldings. This illustration shows how they are mounted.

Fig. 10. The reed switch is recessed into the frame of casement window. The magnet is set into the moving part.



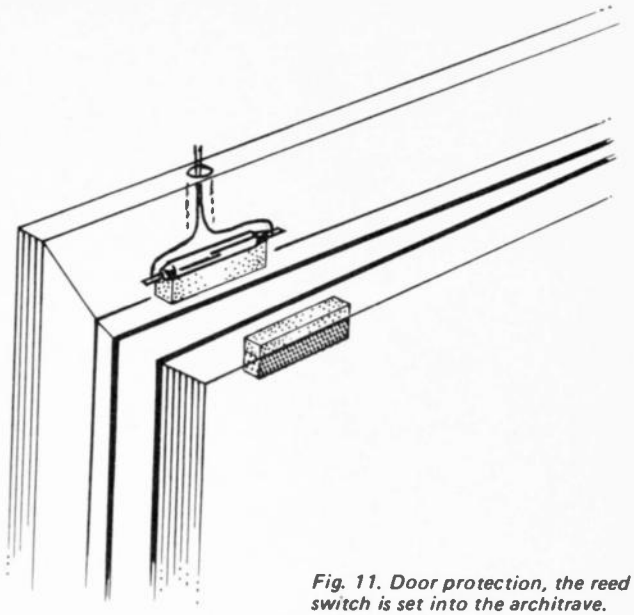


Fig. 11. Door protection, the reed switch is set into the architrave.

the circuit board). Connect the leads from the 'silent entry' door switch to the appropriate input on the board (connections 1 and 8).

EMERGENCY SYSTEMS

The emergency alarm push-buttons should now be installed. These switches should be mounted on the architraves of the front and rear doors. They enable the occupant to set off the alarm if a caller forces his way into the house when the door is opened. Although this is not a common event, the emergency switches provide elderly or timid people with a feeling of security.

Use good-quality bell pushes and connect in parallel across the emergency inputs on the circuit board (connections 5 and 8).

Fire alarm sensors are also wired across the emergency input connections of the alarm unit. The sensors chosen trigger at an ambient temperature of 140°F – 160°F. A suitable choice is the Microtherm type T10-063-1 (normally open). The agents for this are Australian Solenoid Co. Pty. Ltd., of Ashfield, N.S.W.

The fire sensors should be mounted in the ceiling of rooms in which there is a fire hazard – kitchen, living room, rooms with electrical or other heating appliances, or where people smoke; they should also be installed in the roof of the garage – especially if this is attached to the house – laundry, worksshop, etc.

Wire all fire sensors in parallel and connect across the emergency input on the alarm unit.

OTHER DEVICES

Many other types of intruder sensing devices can also be included in the system. Pressure mats, for example, can be placed under carpets in strategic passageways – or even under the doormat. The mats contain a large number of normally open contacts, some of which will close when the mat is trodden on. These mats are connected to the normally open input on the board (connections 6 and 8).

Infra-red beams can be installed if required (a design for an advanced type of beam, as well as for other types of sensing devices, will be included in this series during the next few months). These and other commercially available intruder dectectors use a change-over relay output stage. The appropriate change-over relay contacts should be connected in series with the normally closed loop.

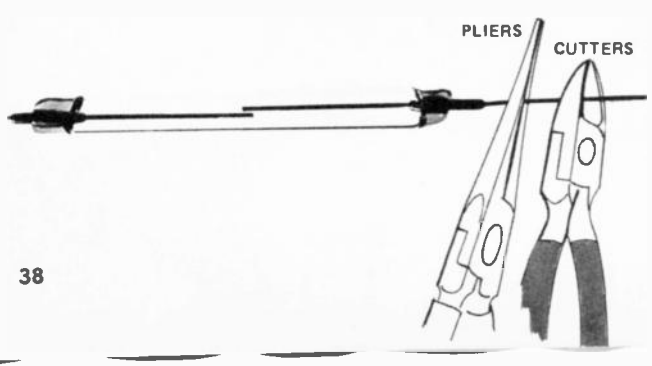


Fig. 12. Care must be taken if the reed switch connecting leads needs shortening. Hold wire tightly with pliers (as shown) to prevent breaking the glass seal.

WARNING SYSTEMS

The intruder alarm itself should be reasonably accessible to people entering and leaving the premises via the 'silent entry' door, but well-hidden from the sight of an intruder.

The intruder alarm output stage is a double-pole change-over relay of which one set of contacts latches the relay when an alarm signal is received, whilst a second set is used to switch the actual alarm warning device. This may be either a bell or siren, or a back-to-base line, or a telephone dialling unit.

For household use, a good-quality 12 volt alarm bell will be adequate. Being mechanically resonant devices, bells have a very high conversion efficiency of electrical to acoustical energy; in fact, the average 12 volt bell draws less than 500 milliamps and can be heard several hundred feet away.

Good sirens can be heard well over half-a-mile away, but they draw a lot of power and also cost more than a good bell. Small, cheap sirens cannot be recommended.

If at all possible, householders should make mutual arrangements with neighbours to contact the police if the alarm is heard. Similar arrangements should also be made so that neighbours can switch off the alarm after the police arrive.

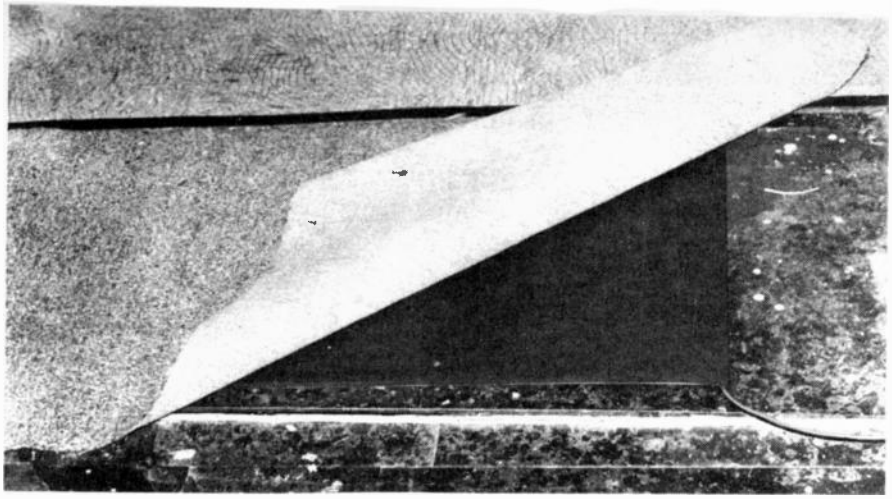


Fig. 13. Pressure mat installed under carpet or rug in strategic passage.

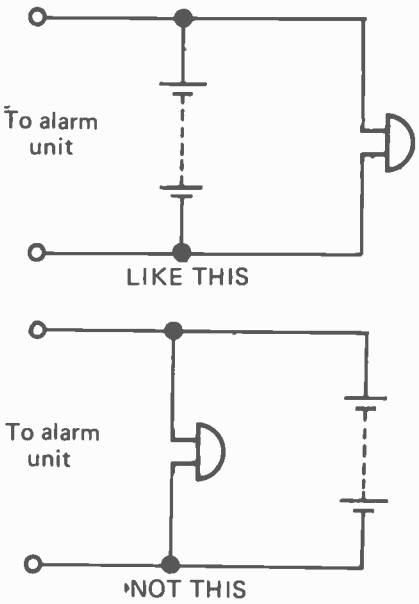


Fig. 14. It is preferable to power the bell from a separate battery – if the main alarm battery is used, the power to the bell must be taken directly from the battery.

The alarm bell should be mounted unobtrusively, high up in an inaccessible place. The leads to the bell should be run in 40/0076 (to reduce voltage drop) and concealed from view. Although the bell can be powered from the main alarm battery, we strongly recommend that a separate 12 volt battery be used. If the main alarm battery is used, the power to the bell must be taken directly from the battery (Fig. 14).

For business premises where expensive goods are stored, a simple unprotected bell is inadequate. For these purposes the bell should be enclosed within a louvred case, and the leads taken directly into the building from the rear of the case. A micro-switch, actuated if the cover is removed, should be wired into the alarm circuit.

An even safer method is to install both the bell batteries, and the circuit shown in Fig. 15, inside the bell enclosure.

This arrangement uses the normally closed contacts of the intruder alarm output relay to hold off the alarm bell. If the bell leads are cut or shorted, or the alarm relay switches over, the alarm will sound.

POSSIBLE VARIATIONS

Professional security organisations may use the intruder alarm output to switch 'back-to-base' lines; these are private telephone lines from the protected premises, terminating in the central control room of a security company.

Another warning device that can be connected to the alarm unit is an automatic telephone dialling unit, a number of which are now on the market. When triggered, these devices telephone a predetermined number and deliver either a coded tone or a verbal message. A good dialling unit will have facilities for ensuring that it has obtained the correct telephone number before delivering its message.

An approach worth considering is to connect the alarm output relay to switch on a number of floodlights. It will probably be necessary to drive a heavy-duty contactor to carry the lighting current. Intense lighting will dissuade an intruder as thoroughly as will an audible warning, and it's less traumatic for the awakened householder. Where business premises are concerned, the bell should also be retained.

The installation of an intruder alarm should only be *part* of a co-ordinated campaign to dissuade burglars. There are a number of simple precautions that should also be used. Details of these are contained in an excellent series of leaflets obtainable from the Crime Prevention Bureau of your local police headquarters.

Further articles in this series will describe the design and manufacture of sophisticated detection devices, all of which will interface with the main control unit. ●

FOOTNOTE: Those who missed the first article can obtain a back copy of the May issue from the publishers. Address your request to ELECTRONICS TODAY, 21 Bathurst Street, Sydney 2000, N.S.W. Enclose 70 cents to cover cost of magazine, packing and postage.

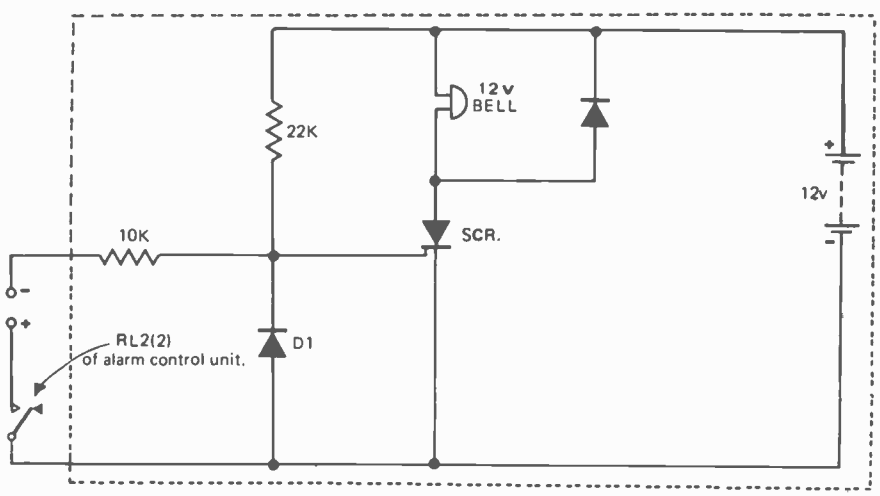
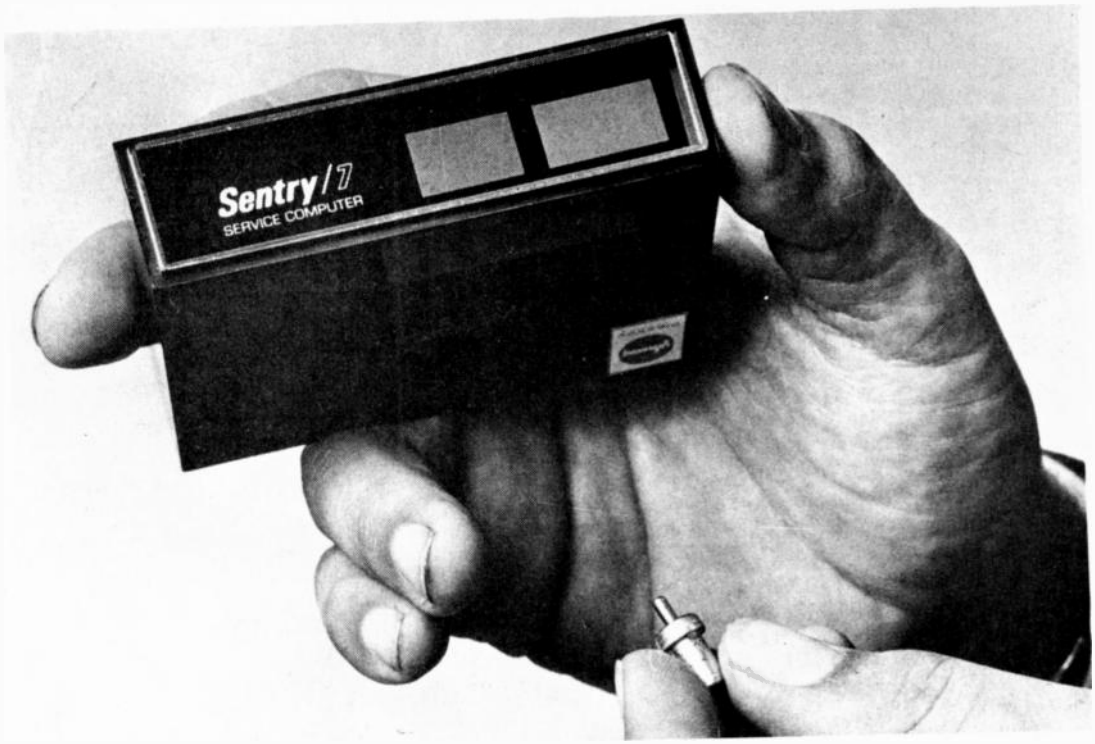


Fig. 15. Inherently safe alarm bell circuit. The components inside the dotted lines are installed within the bell case. The external leads are wired through the closed contacts of the alarm control unit output relay RL2(2) and then across the battery in the same unit (note polarity). In the safe position the alarm control unit battery reverse biases the SCR in the bell case. If the bell leads are open circuited, shorted or reversed, the bell will operate. The commutating effect of the bell solenoid contacts ensures that the SCR does not latch on if triggered by transient noise.

ENGINE-OIL



Ingeniously simple unit from Plessey monitors engine usage and indicates when to change oil.

Fig. 1. Voltage drop across cell increases sharply at end of cell time period.

The most beautifully engineered car ever made was the Bugatti Royale. Engine capacity was 13 litres and the huge car would accelerate smoothly from 3 m.p.h. to 125 m.p.h. in top gear.

Only seven were made – specifically for Heads of State or other top-ranking VIPs all of whom had to be personally approved by Ettore Bugatti.

One of these vehicles was located in post-war Europe by Charlie Chayne, now vice-president of General Motors. The Royale had covered less than 5,000 miles and had been stored for 15 years.

Its engine was worn out – a wreck. All bearings had disappeared and the crankshaft and cylinder walls were almost worn away – after 5000 miles.

In England a fleet of Bedford trucks used exclusively on a London-Scotland schedule complete nearly a million miles between engine overhauls. Another fleet of identical vehicles, used for stop-start coal deliveries to private homes in London, require major engine overhauls every 6000 miles.

The reason? – Corrosion.

It is acid build-up and subsequent corrosion that wears out engines used infrequently or for short distances; corrosion, caused by condensation on cylinder walls of acid products of combustion at coolant temperatures of less than 70°C.

Every time an engine is started and stopped, acid products condense on the cold cylinder walls and eventually dilute the oil in the sump.

In normal vehicle the oil will become hot enough to boil off these acid products. If not, the acid content increases, etching away as it does. It wrecks Bugattis and Bedfords alike.

But what of taxi-cab owners, police vehicles, long-distance hauliers, milk vendors? Their usage patterns are far from average. When should they change engine oil?

An ingeniously simple unit from Plessey may well be the answer.

MONITORS ENGINE USAGE

Called the Sentry 7 car service 'computer', the unit monitors the number of times the engine is started, the engine running time, and the total time since the previous oil change.

The unit monitors these three parameters, which are 'weighted' by predetermined amounts, maintains a running total of these amounts, then – when a pre-set limit is reached – indicates that an oil change is due.

THE 'E' CELL

Heart of the device is an 'E' cell which is an electro-chemical timer manufactured by the Bissett-Berman Co. of Los Angeles. It is a small tube about an inch long and ¼" diameter. It contains an anode and a cathode immersed in an electrolyte. The anode has a plated coating of silver that is slowly transferred to the cathode when an electric current is passed through the cell. The rate of transfer is proportional to both current density and time.

Whilst a coating of silver remains on the anode the voltage drop across the 'E' cell is less than 10 mV, but when all the silver has been transferred to the cathode the cell resistance rises sharply and voltage drop increases to 800 mV (Fig. 1 shows this in graphical form).

Thus, by applying voltages to the cell which are proportional to the factors causing wear, the cell will record these factors by a proportional transference of deposited silver from the anode to the cathode terminal.

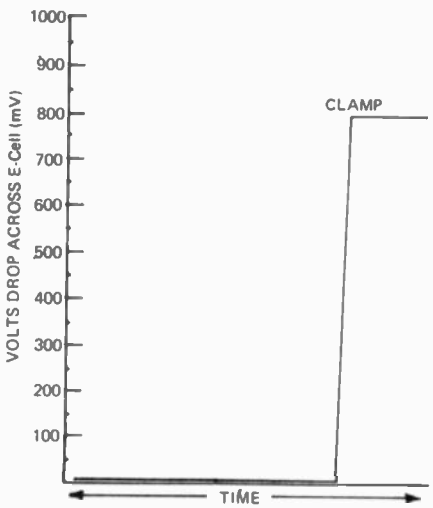
HOW UNIT IS CONNECTED

These voltages are taken from three different sources.

One connection is taken directly from the battery. This checks the total number of hours since the previous oil change (at which time the 'E' cell is also replaced).

The second connection is taken from

MONITOR



the primary side of the ignition system to indicate engine running hours, whilst a third input from the starter switch indicates the number of times the engine is started.

The manufacturers describe the Sentry 7 as a 'real time, on line computer'. This seems a rather grandiose title for one diode, one transistor and five resistors, but the Sentry 7 does work in 'real time', is 'on line' and certainly computes. The circuit of the complete unit is shown in Fig. 2.

When the ignition key is turned to start the engine, a relatively heavy current (1.10 mA) flows through R1 and the 'E' cell. Once the starter is released and the engine is running, cell current from the ignition primary system flows into the 'E' cell via R2. (this current is approx. 2 μA). A further input is taken directly from the vehicle battery to provide a record of 'total time' since the previous oil (and 'E' cell) change.

The unit's two indicator lights are operative only when the starter motor is in use. Both lights are 12 volt, but the Oil Change indicator has a much higher wattage rating than the Oil OK light.

As Fig. 1 illustrates, the 'E' cell has low internal resistance until the applied current has transferred the anode silver deposit to the cathode. When this point is reached the internal resistance increases sharply; this defines the expiry time of the 'E' cell and the necessity to change the oil.

Until this expiry point, the cell's low internal resistance effectively clamps Q1 base to zero potential. Q1 is thus non-conductive.

OIL CONDITION SHOWN DURING STARTING

As the starter is operated, both lamps will be energized via D1 and the starter switch – but as the current available to illuminate the Change Oil light is limited by the much lower rating of the Oil OK light, only the latter will emit light.

When the 'E' cell finally reaches its expiry time its internal resistance rises suddenly, thus removing the clamp from the base of Q1.

Thus, next time the starter motor is used Q1 will conduct, shorting out the Oil OK light and applying full current through the Oil Change light.

When the oil is changed the 'E' cell is reset. As the electrolytic plating process is reversible, this is just a matter of reversing the polarity of the cell.

The Sentry 7 unit does not perform any mechanical or chemical tests on the engine oil. Nevertheless a very large number of samples, checked both physically and by the Plessey unit, showed quite conclusively that the indirect method of measurement is extremely accurate.

There is not much that we can do about that Bugatti – but there are many fleet owners and private motorists around who should be looking very hard indeed at this ingeniously simple and effective device.

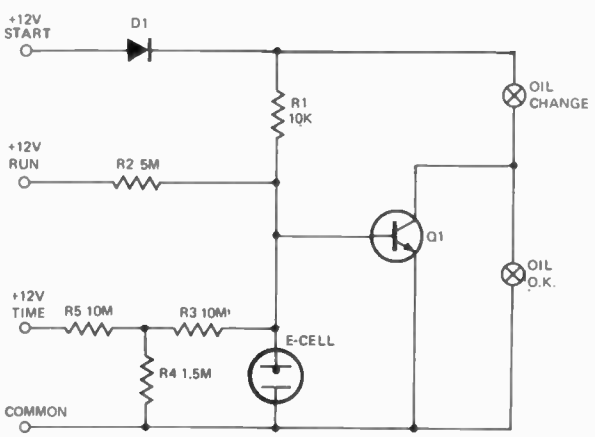
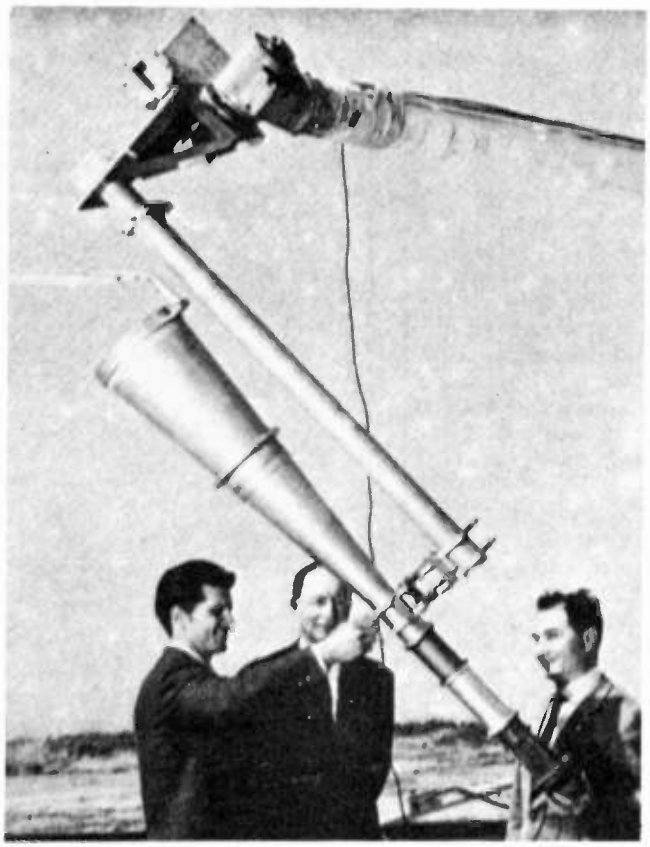


Fig. 2. Ingeniously simple circuit of the Sentry 7 oil monitor.

INTELSAT IV
voice of 77 nations



Close-up of horn antennas of Intelsat IV.

THE FIRST of the new Intelsat IV commercial communications satellites was launched from Cape Kennedy, Florida, on January 25.

The 1500 lb. satellite was boosted into orbit by NASA's Atlas/Centaur combination which has so successfully launched all the Surveyor lunar spacecraft, and the recent Mariner probe to Mars.

The new satellite can carry 9000 telephone circuits simultaneously, or 12 colour television channels, or a combination of telephone, television, digital data and other forms of communications traffic.

Although this is the largest commercial satellite, the U.S. Defense Department's Tactical Communications Satellite, orbited in 1969, is known to carry 10,000 telephone channels.

TECHNICAL DETAILS

Unlike the Soviet Molniya ('Lightning') communication satellites, which revolve circumferentially around the globe, Intelsat IV is in synchronous orbit. It is positioned 22,300 miles above the Atlantic, at 24.5° West longitude, where it serves as the primary relay for satellite communications in the Atlantic area.

Intelsat's electrical power is provided by a mosaic of 42,250 photo-voltaic cells covering the revolving cylindrical shell. The cells provide 570 watts to run the 12 receiver/transmitters.

A further bank of 2772 cells charges two nickel-cadmium batteries which maintain power during solar eclipses.

Like Intelsats I to III, Intelsat IV is spin-stabilized – but, in order to focus the directional aerials onto the earth, the entire communications system is counter-rotated.

Earth and sun sensors located on the exterior of the satellite synchronize the rotating assemblies.

A new feature of Intelsat IV is the antenna assembly, which now containes two transmit horns and two independently steerable 127 cm. spot beam reflectors. These are steerable in 0.1 degree steps from a ground control station. The beam is actually shifted by moving the reflector whilst the feed horn remains stationary. The angle of the spot beams is only 4.5° and they cover a region on the ground 1000 to 1500 miles in diameter.

These steerable antennas can direct spot beams to selected areas of the world. For example, one beam could be aimed at the Eastern United States and the other on Western Europe, providing these areas with maximum user capacity.

Orbit of a spacecraft is influenced by the non-sphericity of the earth and by the changing positions of the sun and moon. It is therefore necessary to provide an inbuilt manoeuvring system, to enable positional correction to be made from the ground control station.

Pairs of axial, radial and spin-up thrust assemblies accelerate the satellite in any required direction. The power source is hydrazine monopropellant which is decomposed into ammonia, hydrogen and nitrogen to provide the thrust energy.

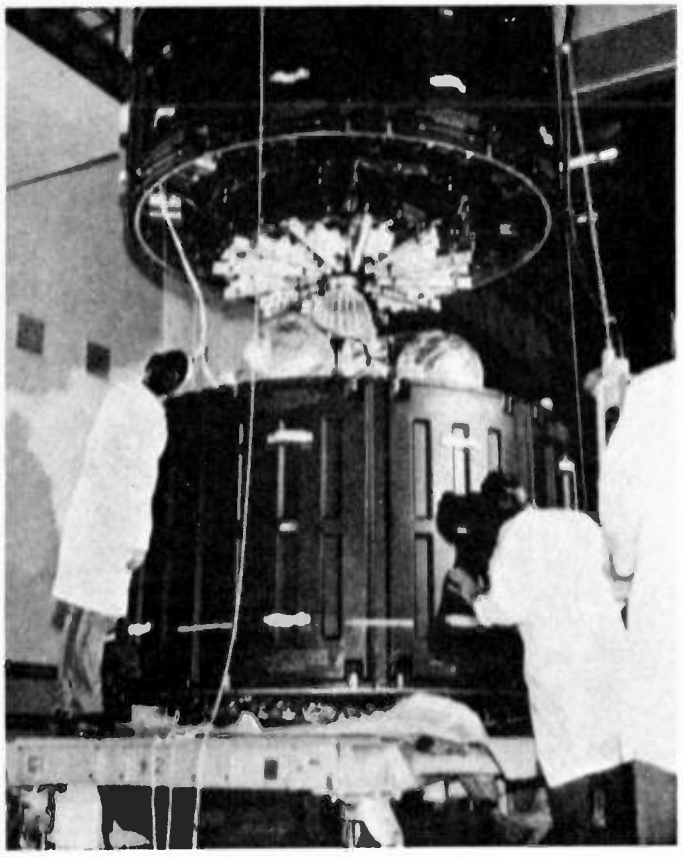
FUTURE PROGRAMME

Two more Intelsat IVs will be launched later this year to cover the Pacific and Indian oceans, and a further four satellites will complete the network.

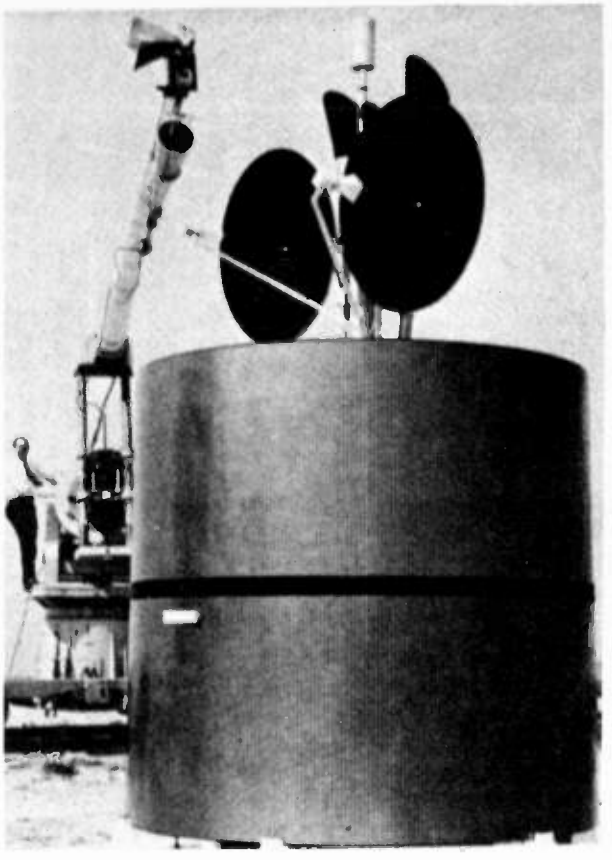
Between them, seven Intelsat IVs will quadruple the total capacity of all previous communications channels – including satellites as well as cables – across the Atlantic, Pacific and Indian oceans.

Cost of each satellite is approximately $13½ million, plus a further $16 million for launching – a sum which, Intelsat is confident, will be more than recovered in revenue.

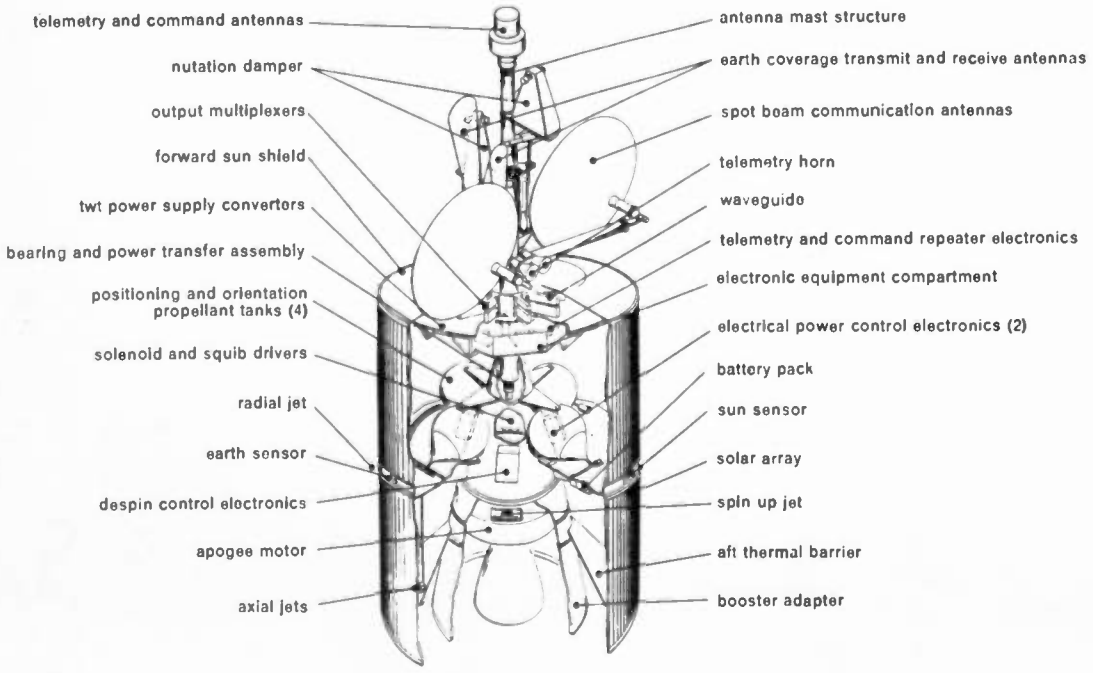
The Intelsat satellites are owned by a consortium of 77 countries and managed by the Communications Satellite Corporation of Washington, D.C. ●



With sensitive solar cells clad in protective metal covers, engineers at Hughes Aircraft Company carefully fit together the top and bottom halves of a full-scale thermal model of the Intelsat-IV communications satellite during thermal testing. The satellite was equipped with more than 300 sensors to record temperature variations during the test which simulated the heat and cold to be encountered in orbit.



Antenna test – A full-scale model of the huge Intelsat-IV communications satellite looms in foreground while an engineer conducts an antenna range test to verify radio frequency patterns of the horn antenna (mounted on boom).



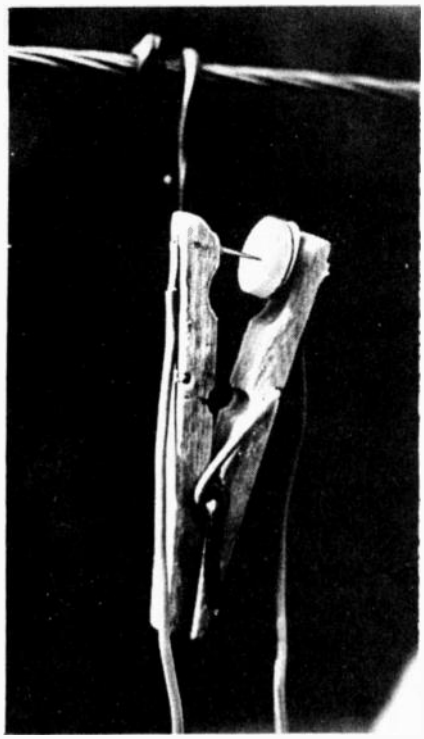
Intelsat-IV components

10-cent moisture alarm

ET PROJECT

By Ursula Simpler

An engineer has been defined as someone who can do for ten cents what others can do for ten dollars. By this standard, our hitherto unknown contributor must be regarded as at the pinnacle of her profession – for she has done just that.



Vertically suspended hygroscopic transducer features disposable actuating element.

YOU MAY THINK WE ARE KIDDING – AND SO WE ARE. BUT THIS DEVICE REALLY WORKS.

COMBINING a career as a carpet designer with that of a housewife with seven enuretic children is in itself difficult.

When these are combined with a neurosis about whiteness, you can imagine my state of tension on washdays.

Always, continuously overshadowing the anticipation of that one perfect wash, was my – perhaps neurotic – fear of rain.

Is it – could it be – raining? . . . Every few minutes I would rush outside, despite a cloudless sky, just to calm my fears.

No wonder I took ten aspirins every washday.

Then one day, whilst munching my ninth aspirin, the thought struck me, in all its blinding simplicity:

"Aspirins dissolve!"

Surely here was a principle that could be further exploited. Here was the basis for a simple rain detector.

Aspirins dissolve! So simple if it worked.

First I checked a number of aspirins from different batches, to establish that their solubility time was reasonably uniform.

The result was even better than I had hoped.

A perfect Gaussian distribution! (Fig.1). The standard deviation (SD = $\sqrt{\frac{\Sigma d^2}{N}}$) was less than 5%.

I next clamped an aspirin tablet between two spring-loaded contacts and checked the dry resistance. This I found to exceed several thousand ohms.

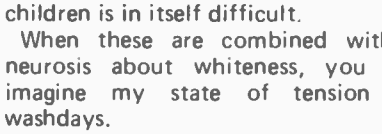
Then I placed the assembly outside in the rain. To my delight the effect was even better than I had hoped.

Not only did the tablet dissolve, thus allowing the contacts to close, but the hygroscopic inertia of the aspirin performed an integrating function. $\Delta t/\Delta p$, as the most enuretic of my boys put it (he never did understand calculus).

There was just one problem – the response time of a standard aspirin was a little too slow. A colleague, however, pointed out that μfined aspirin dissolves 2¼ times faster, and this provided the exact response time I required.

I now had a simple moisture transducer – open circuit when dry, closed circuit when wet.

Next I connected the unit across my front doorbell. It worked perfectly.



Alternative self contained alarm.

Admittedly, it was difficult to tell whether it was raining, or one had an unusually persistent caller (or both), but the saving in cost compensated for the occasional ambiguity.

The unit is still in use. Reliability is excellent, running costs depend upon how often it rains but seldom exceed 2 cents per week. How little to pay for peace of mind!

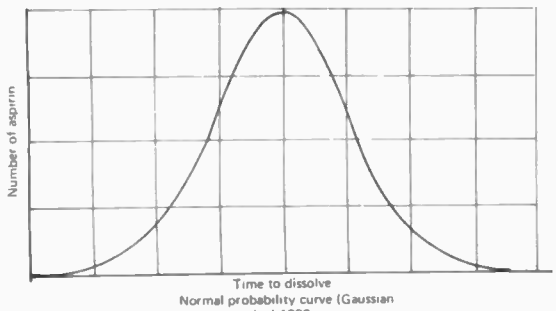
(In case you wonder about that word enuretic, it means prone to bed-wetting. –Ed.)

SPECIFICATION

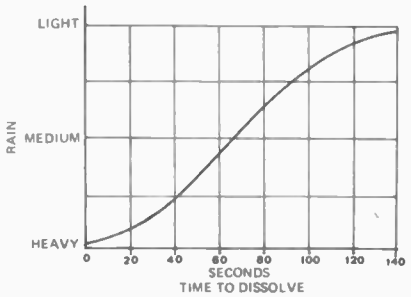
Input voltage	2 - 12 volts ac/dc
Response time	<30 seconds
Consumption	
(electrical)	<1mA
(pharmaceutical)	1 aspirin per alarm
Dimensions	2¾" x ¾" x 5/8"

PARTS LIST

1 clothes peg
2 drawing pins
1 bottle of aspirins (μfined).
Assorted screws, wire, etc.



Normal probability curve (Gaussian Distribution) of 1000 aspirins



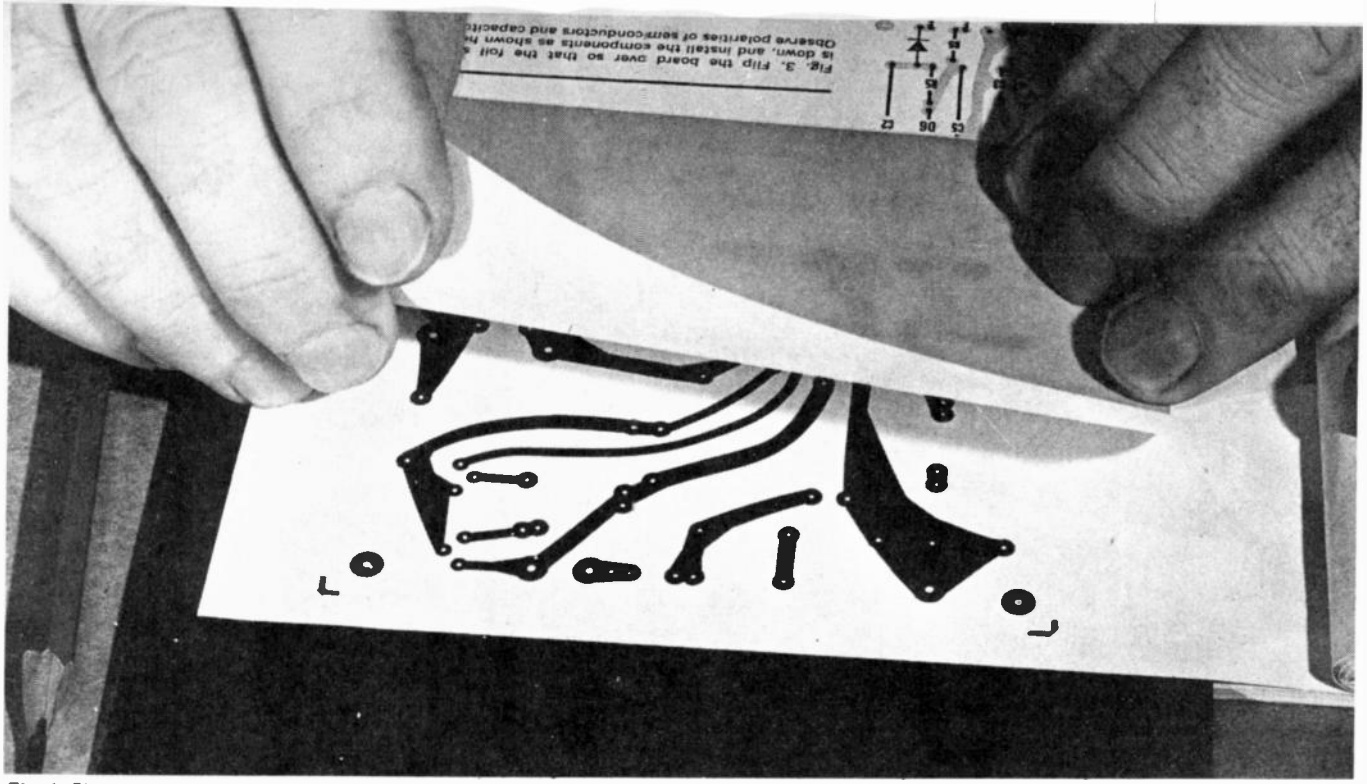
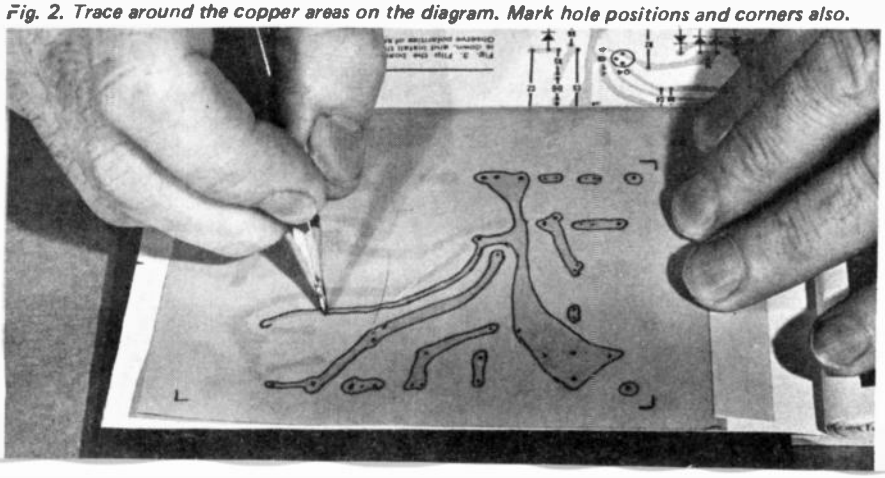


Fig. 1. Place the Letrafilm over the diagram.

Easier way to make your own P.C. boards

Now you can do away with all the fuss and bother of conventional printed circuit preparation, says A. J. Lowe

Fig. 2. Trace around the copper areas on the diagram. Mark hole positions and corners also.



At last! Here's a quick, clean method of preparing printed circuit boards for etching – and it's for the home constructor.

Photographic methods are fine if you want to produce a large number of identical boards, but far too slow, expensive and involved for the 'one-off' man who simply wants to make one board – usually from a diagram in a magazine.

The standard method, for the experimenter, involves the use of tracing paper, carbon paper, and a resist paint. Sure, it works – but those who have used it know how hard it is to get narrow clean-edged lines with paint. Sometimes the paint is thin and porous and lets the etchant through, and sometimes it runs across narrow gaps, leaving short circuits to be cleaned up later. Sometimes the paint is thick and hard to manage. Besides, it takes ages for the paint to dry.

This new method requires no tracing paper, no carbon paper, no paint, no brushes, no solvents – and you can have a printed circuit board ready in an hour or so.

It depends on the use of a cut-out colour film used in the graphic arts field, called LETRAFILM. Made by the manufacturers of the widely-used Letraset stick-on letters, it is obtainable from artists' shops and drawing office supply houses.

Letrafilm is a thin sheet of film available in a range of 50 colours, tacky on one side and 'toothed' on the other. The tacky side is backed with a translucent paper support. The toothed side can be written or drawn on with ease. The film is quite impervious to etchants and so makes

Fig. 3. Separate the Letrafilm from its backing support.

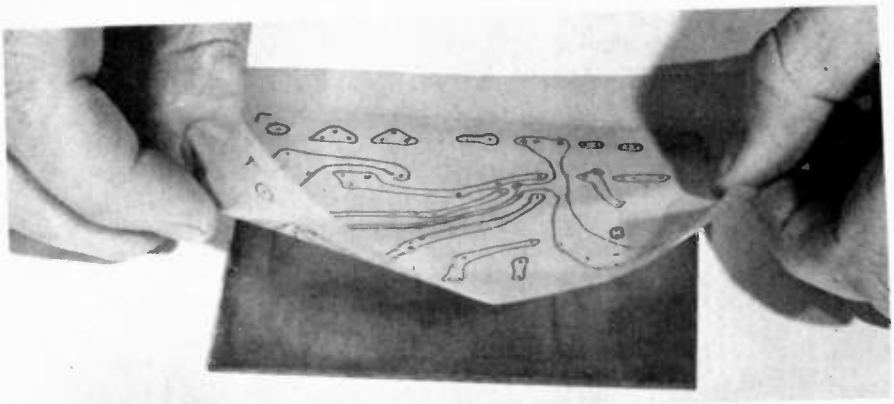


Fig. 4. Place the film down on the copper side of the p.c. board.

Fig. 5. Press the film down gently.

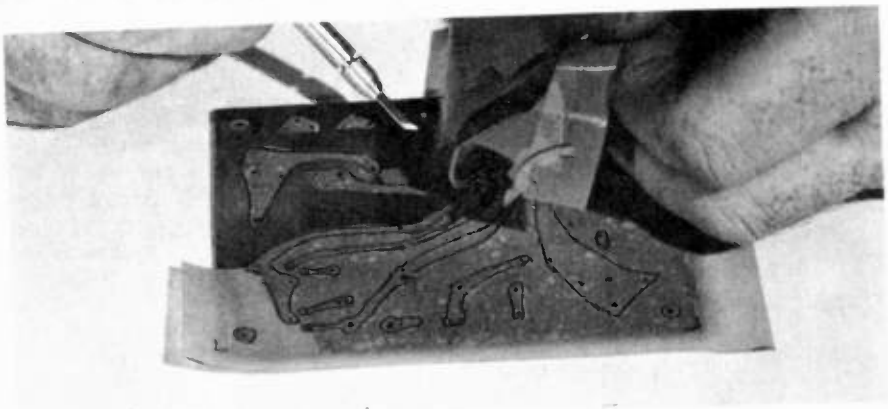


Fig. 6. Cut around the copper areas with a sharp craft knife.

Fig. 7. Remove the unwanted film, leaving film over the areas where copper is to remain.

Easier way to make your own P.C. boards

an ideal resist. It is available in sheets 10" x 15" and is quite inexpensive. Only a few cents' worth will cover the typical printed circuit board. A light colour, such as pale yellow, is ideal for this application.

Here's how to use it:

1) Cut a piece of Letrafilm, complete with its backing, about 3/8" or so larger all round than the printed circuit board.

2) Place a sheet of aluminium, or phenolic board, or even printed circuit board, below the diagram of the printed circuit. This gives a hard support for the next few operations.

3) Lay the Letrafilm over the diagram (see Fig. 1) and hold it down at one side with sticky tape. It will be found that the diagram can be seen quite clearly through the Letrafilm.

4) Trace around the copper (i.e. black) areas in the diagram with a pencil. (Fig. 2), making sure that the corners of the board are marked as well. The position of holes for the component leads should be marked with a pencil dot. This is another advantage of this method over the paint method, in which hole positions have to be gauged later.

Many diagrams prepared professionally, using stick-down circles and lines, have lots of fine curves and indentations where none is really required. There's no need to follow unnecessary detail and it may be eliminated as tracing proceeds. (See article on printed circuits in May issue of ELECTRONICS TODAY.)

5) Remove the Letrafilm from the diagram and carefully separate the film from its backing sheet (Fig. 3).

6) Lay the film, tacky side down, on to the thoroughly cleaned copper surface of the printed circuit board, using the corner marks as a guide (Fig. 4).

7) Press the Letrafilm gently down on to the printed circuit board. (Fig. 5). Do not press too hard, as this will make later removal of the unwanted film portions unnecessarily difficult. Small air bubbles need not be squeezed out.

8) Cut around the pencilled outlines of the copper areas with a sharp craft knife (Fig. 6). This process is much easier than painting, and quicker — and clean sharp lines are automatic.

Do not, at this stage, do anything about the dots marking component lead hole positions.

9) When cutting is complete, carefully peel away the *unwanted* film

from the board – that is, the film which does not cover areas where copper is required. This is done by gently lifting the film at one corner and easing it back. It will break as you progress, but that's no disadvantage (Fig. 7). Watch that none of the 'islands' lifts, due to bad cutting along the pencil lines. If one does lift, press it back and cut around it once again.

10) When all the unwanted film has been lifted, lay a sheet of paper over the board and press down firmly all over it. This bonds the film to the wanted copper so that it acts as an effective resist (Fig. 8). Make sure that no air bubbles are near the edge of an island. In the middle they don't matter.

11) Etch the board. This can be done in your usual etching bath. For those who have never made a printed circuit board before, an effective etching solution is 4oz. of ferric chloride dissolved in 10oz. of hot water. This will etch a typical board in 20 to 30 minutes. Protect your eyes and hands – the solution is corrosive.

12) When etching is complete, remove the board from the etching bath and wash it clear of etching solution under running water. Dry the board by dabbing it with a rag.

13) With a scriber, mark the positions of the holes for component leads by pressing through the film into the copper (Fig. 9). The pencil dots already made (see introduction 4 above) give the positions.

14) Remove the remaining Letrafilm. This can be peeled and rubbed off (Fig. 10).

15) Clean away any residual adhesive from the film by cleaning the board with an abrasive domestic cleaning powder and, if needed, some steel wool. The board is now clean and ready marked for drilling (Fig. 11).

16) To prevent the copper oxidising, it should be sprayed with a special printed circuit board lacquer. Alternatively – and much more cheaply – it can be brushed with a rosin solution (one lump of rosin dissolved in a little methylated spirit). This makes a first-class flux and maintains the shiny look of the board.

Well, there it is – a simple, clean, efficient and quick method of doing-it-yourself and, at the same time, saving many dollars. ●

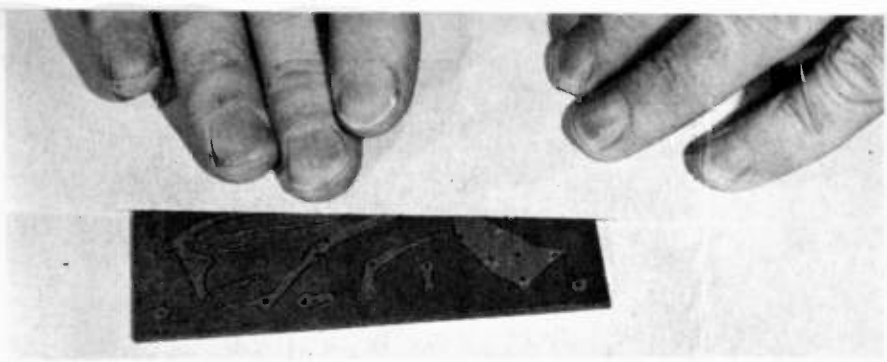


Fig. 8. Press down hard, to bond the remaining film to the board.

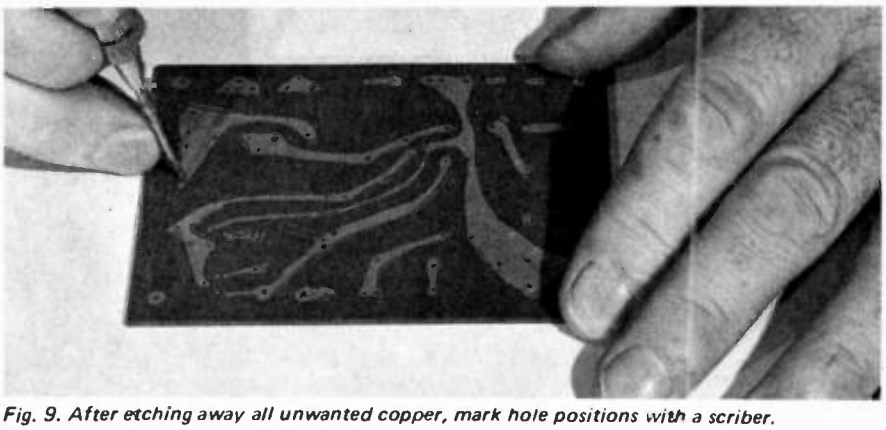
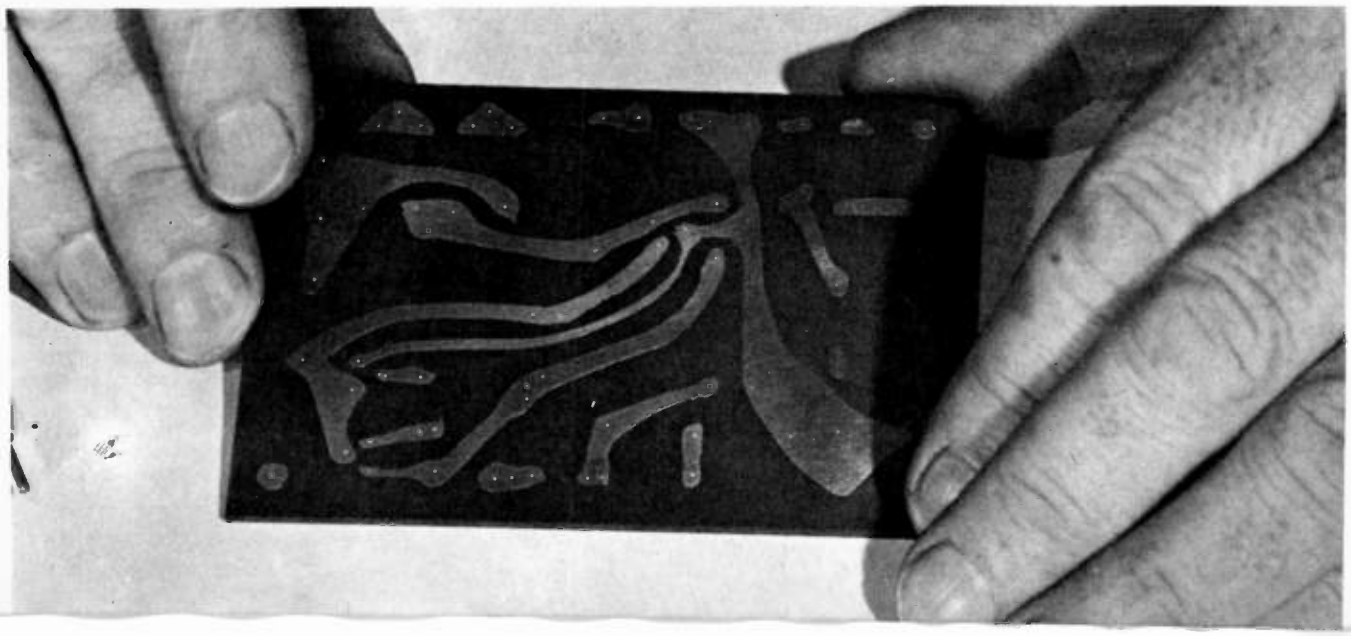


Fig. 9. After etching away all unwanted copper, mark hole positions with a scriber.

Fig. 10. Remove remaining film from the board.

Fig. 11. The board, cleaned and ready for drilling.



This new instrument from Keithley provides current regulation of ± 0.005% over a very wide range

ULTRA-STABLE CURRENT SOURCE

AN accurate, regulated dc current source can be as useful in the laboratory or on the test bench as a regulated voltage supply.

Keithley Instruments have introduced the Model 225 Current Source which provides a predetermined amount of current that will not vary more than ± 0.005% of full range, despite a wide variation of operating conditions. Applications include four point resistivity measurements, stable current supply for cryogenic investigations, photomultiplier current source, Hall effect studies, etc. The instrument is extensively used in the U.S.A. for semiconductor development work. The most likely users will be electrophysicists.

The manufacturers claim that the Model 225 will automatically establish any output terminal voltage necessary to maintain the chosen output current, from 10^{-7} to 10^{-1} amperes, within the compliance voltage range, which may be selected from ± 100 volts. If the voltage necessary to maintain the desired current level exceeds the chosen compliance limit, the unit automatically changes its operating mode from constant-current to constant-voltage, thereby protecting voltage-sensitive loads. A light on the front panel signals that this has occurred.

For making precise dynamic measurements, an external ac signal generator can be used to modulate the current output by means of a transformer-coupled input on the rear panel. Applying a 10-volt rms sinewave at a frequency of 50Hz would produce 40% modulation peak-to-peak, decreasing to 8% modulation at 500Hz. This arrangement of superimposing modulation on a precise dc bias can simplify measurement of forward current-voltage characteristics and other parameters of semiconductors.

An output current range switch on the front panel selects milli-, micro-, or nano-ampere ranges. Output current value within these ranges is selected by means of three decade switches, which provide a 3-digit in-line display of the value selected. The unit has a resolution of 0.02% provided by a vernier trim knob.

A polarity selector switch on the front panel eliminates the nuisance of changing leads to reverse output polarity. This bipolar output feature makes floating unnecessary in many applications, but when desirable the output can be floated up to 500 volts above ground.

Stable to 0.02/, output current provided by the Model 225 is regulated to within 0.005% of full range, from no-load to full-load on the 10^{-1} to 10^{-6} ampere range, and ± 0.05% on the 10^{-7} ampere range. A noise level less than 0.01% of full range reduces the possibility of extraneous signal generation.

APPLICATIONS

The Model 225 is of value wherever constant, well-regulated currents are necessary and makes measurements of component or circuit electrical characteristics easier. It can be used in semiconductor investigations, Hall effect studies, four-point probe resistivity measurements, and as a stable current source in the cryogenics laboratory.

In semiconductor investigations, the unit is particularly applicable to tests of diode forward characteristics, life tests of transistors and diodes, and to zener diode testing. It can also be used for evaluating reverse breakdown characteristics of diodes, by setting it to supply enough voltage to induce avalanche breakdown, at a controlled current low enough to prevent damage.

Production-line testing, especially when it involves comparative measurements, can be performed with the unit. With a known, unvarying input current available, the often bothersome task of making resistance measurements is reduced to a simple matter of taking voltage readings. It permits sorting of components according to voltage data with only a single test.

The precise regulation of the Model 225 can eliminate the uncertainties involved in using voltage sources for testing and sorting resistors, relays, meters, and similar devices. Accidents are eliminated because it supplies only the voltage needed to pass the desired current through the device under test, and never goes above the maximum set on the compliance voltage control.

The instrument lends itself to varied applications in checking out incoming precision components for production use. It is claimed to be capable of maintaining the high order of accuracy necessary, for example, for calibration of precision reference diodes. Or it can be used in sorting zener diodes according to both dc voltage characteristics and dynamic impedance, with only a single test and no adjustments, even on a production line basis.

The makers state that the basic simplicity of the Model 225 and the ease with which it can be operated make it suitable for routine applications as well, even those conducted by relatively untrained and inexperienced personnel. Current output and voltage limits can be pre-set with the output switch in stand-by position, before the load is connected. When an overload occurs, output current automatically returns to its set value after it is removed. ●

VALUE PACKED QUALITY MULTIMETERS

$34.50

AS-100D/P. High 100,000 Ω/Volt sensitivity on DC. Mirror scale. Protected movement.

AC/V	: 6V 30V 120V 300V 600V 1,200V (10,000Ω/V)
DC/V	: 3V 12V 60V 120V 300V 600V 1,200V (100,000Ω/V)
DC/A	: 12μA 6mA 60mA 300mA 12A
OHM	: 2kΩ 200kΩ 20MΩ 200MΩ
db	: —20 to +63db
Audio Output	: 6V 30V 120V 300V 600V 1,200V AC
Battery	: Internal
Approx. size	: 7½" x 5½" x 2¾"

$17.00

CT-500/P. Popular, medium-size, mirror scale. Overload-Protected.

AC/V	: 10V 50V 250V 500V 1,000V (10,000Ω/V)
DC/V	: 2.5V 10V 50V 250V 500V 5,000V (20,000Ω/V)
DC/A	: 50μA 5mA 50mA 500mA
OHM	: 12kΩ 120kΩ 1.2MΩ 12MΩ
db	: —20db to +62db
Approx. size	: 5½" x 3⅜" x 1¾"

$51.75

370W/P. Bench model. Overload-Protected.

AC/V	: 2.5V 10V 50V 250V 500V 1,000V (4,000Ω/V)
DC/V	: 0.5V 2.5V 10V 50V 250V 500V 1,000V (20,000Ω/V)
DC/A	: 50μA 1mA 10mA 100mA 1A 10A
AC/A	: 100mA 1A 10A
OHM	: 5kΩ 50kΩ 500kΩ 5MΩ 50MΩ
db	: —20db to +62db
Approx. size	: 7" x 5¼" x 3⅛"

PEAK

$11.95

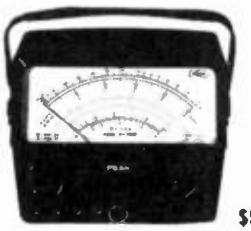
200-H. 90° quadrant meter. Pocket size.

AC/V	: 10V 50V 100V 500V 1,000V (10,000Ω/V)
DC/V	: 5V 25V 50V 250V 500V 2,500V (20,000Ω/V)
DC/A	: 50μA 2.5mA 250mA
OHM	: 60kΩ 6MΩ
Capacitance	: 100pF to .01μF .001μF to .1μF
db	: —20db to +22db
Audio Output	: 10V 50V 120V 1,000V AC
Approx. size	: 4½" x 3¼" x 1⅛"

$21.50

M-650/P. Plastic dial cover. Mirror scale. Overload-Protected.

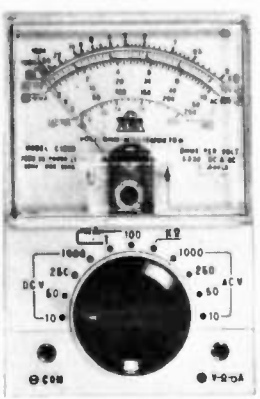
AC/V	: 6V 30V 120V 300V 1,200V (15,000Ω/V)
DC/V	: 3V 12V 60V 300V 600V 1,200V (50,000Ω/V)
DC/A	: 30μA 6mA 60mA 600mA
OHM	: 16kΩ 160kΩ 1.6MΩ 16MΩ
db	: —20 to +63db
Approx. size	: 5¼" x 3½" x 1¼"



$55.00

A-10/P. Giant 6½" Meter. Inbuilt signal injector. Overload-Protected.

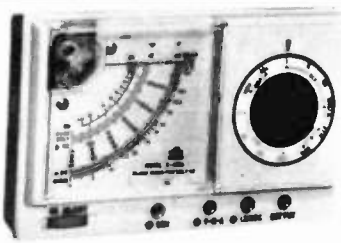
AC/V	: 2.5V 10V 50V 250V 500V 1,000V (10,000Ω/V)
DC/V	: 0.5V 2.5V 10V 50V 250V 500V 1,000V at 30,000Ω/V 5,000V (10,000Ω/V)
DC/A	: 50μA 1mA 50mA 250mA 1A 10A
AC/A	: 1A 10A
OHMS	: 10kΩ 100kΩ 1MΩ 100MΩ
db	: —20 to +62db
Signal Injector	: Blocking oscillator circuit with a 2SA102 transistor
Approx. size	: 6⅘" x 7⅘" x 3⅗"



$6.75

MODEL C1000 is the ideal low cost pocket meter.

AC volts	: 10V 50V 250V 1,000V (1,000Ω/V)
DC volts	: 10V 50V 250V 1,000V (1,000Ω/V)
DC current	: 1mA 100mA
OHMS	: 150kΩ
Decibels	: —10db to +22db
Dimensions	: 4¾" x 3⅛" x 1⅛" 4¾" x 3⅛" x 1⅛"



MODEL C1051/P $13.75 and **MODEL C1052/P** $18.95 pocket size scale and protected movement.

	Mod. C1051/P	Mod. C1052/P
AC volts	: 6V 30V 300V 1,200V (10,000Ω/V)	6V 30V 120V 300V 1,200V (15,000Ω/V)
DC volts	: 3V 15V 150V 300V 1,200V (20,000Ω/V)	0.6V 3V 15V 60V 300V 1,200V (30,000Ω/V)
DC current	: 60μA 300mA	30μA 3mA 30mA 300mA
Resistance	: 60kΩ 6MΩ	6kΩ 60kΩ 600kΩ 6MΩ
Decibels	: —20db to +17db	—20db to +63db
Audio Output	: as AC.V.	as AC.V.
Dimensions	: 4¾" x 3⅛" x 1⅛"	4¾" x 3⅛" x 1⅛"

AVAILABLE WHEREVER QUALITY ELECTRICAL TESTING EQUIPMENT IS SOLD

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*ALL PRICES INCLUDE SALES TAX.

LOGIC IC POWER SUPPLY

ET PROJECT

Simple, adjustable power source for digital ICs.

DESIGNED around a simple IC voltage regulator, this power supply provides an adjustable power source for experimenting with the more popular digital ICs. Cost of the parts is around $15 – less those you already have in your 'junk' box!

Anyone wishing to experiment with low-cost digital ICs is immediately faced with a power supply problem. Low-cost RTL devices require around 3.6 V, while the very popular TTL devices require around 5V. In the research laboratory there is always a range of suitable power supplies, but this is not usually the situation for the beginner wishing to experiment with digital ICs.

This project describes the construction of a basic power supply mounted on a printed circuit board. Additional refinements such as output voltage and current meters, variable current limiting and other circuiting refinements can be added to the basic module.

VOLTAGE REGULATOR IC

The heart of this power supply is the SGS L123 integrated circuit precision voltage regulator.

The L123 is a monolithic voltage regulator constructed on a single silicon chip, using the planar epitaxial process. The device consists of a temperature compensated reference amplifier, error amplifier, power series pass transistor and current limit circuitry.

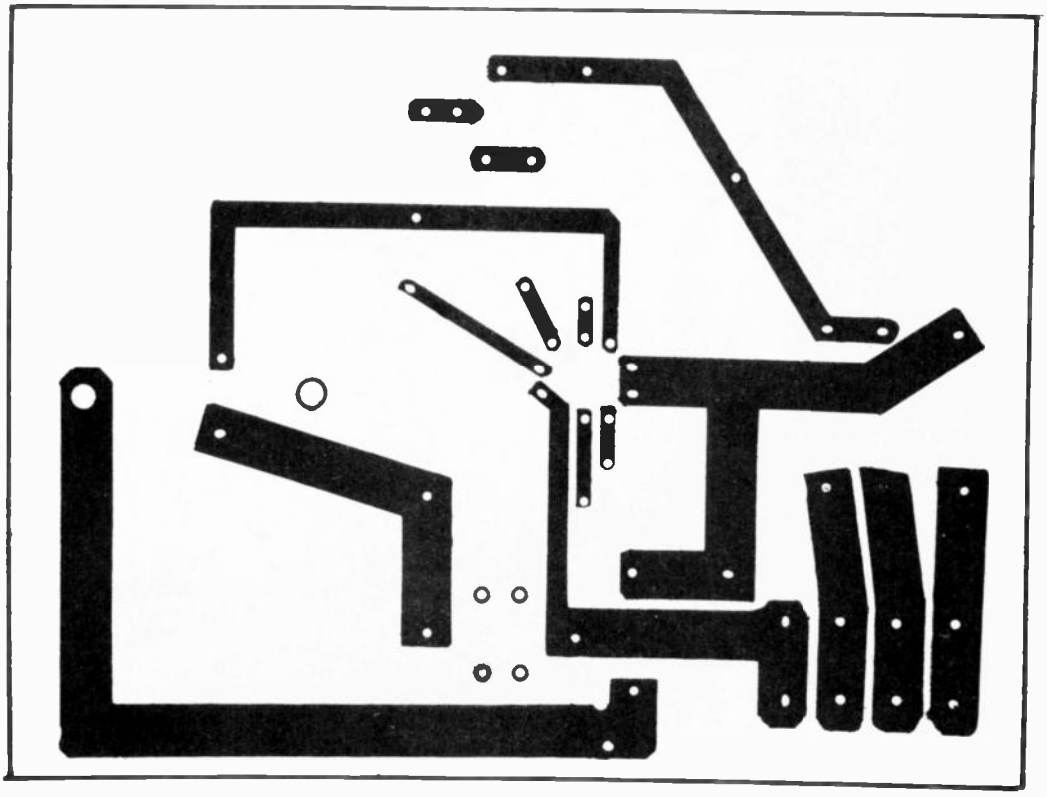
Additional external npn and pnp pass elements may be used when output currents exceeding 150mA are required. Provisions are made for adjustable current limiting and remote shut-down. In addition to the above, the device features low standby current drain, low temperature drift and high ripple rejection.

The L123 is intended for use with positive or negative supplies, as a series, shunt, switching or floating regulator. Applications include laboratory power supplies, isolation regulators for low level data amplifiers, logic card regulators, small instrument power supplies, airborne logic card regulators, small instrument power supplies, airborne systems and other power supplies for digital and linear circuits.

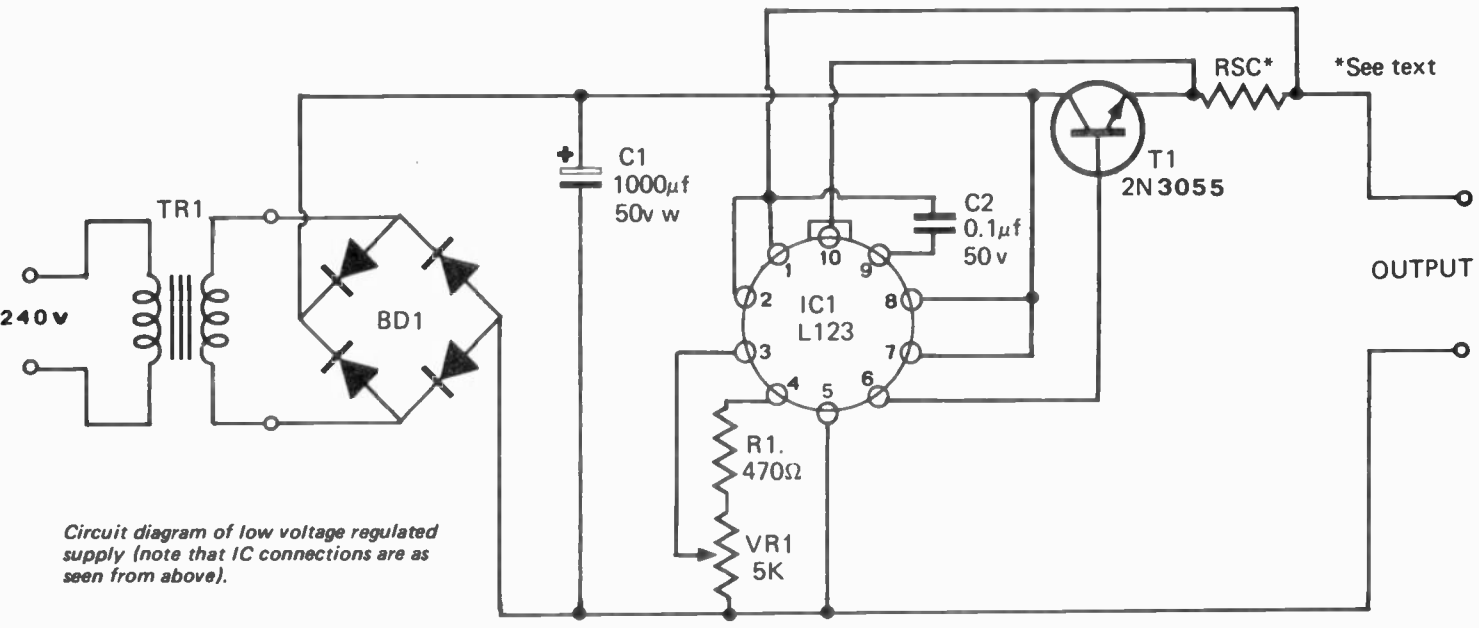
CONSTRUCTION

Our unit was built on an epoxy glass board. The construction is not critical and could be built on matrix board, or by any other method available to the experimenter.

The L123 may be soldered directly into the circuit; however, excessive heat must be avoided, or the internal connections to the chip will be damaged. Recommended maximum load temperature during soldering is 300°C for 60 seconds.



Foil pattern for logic power supply (actual size).



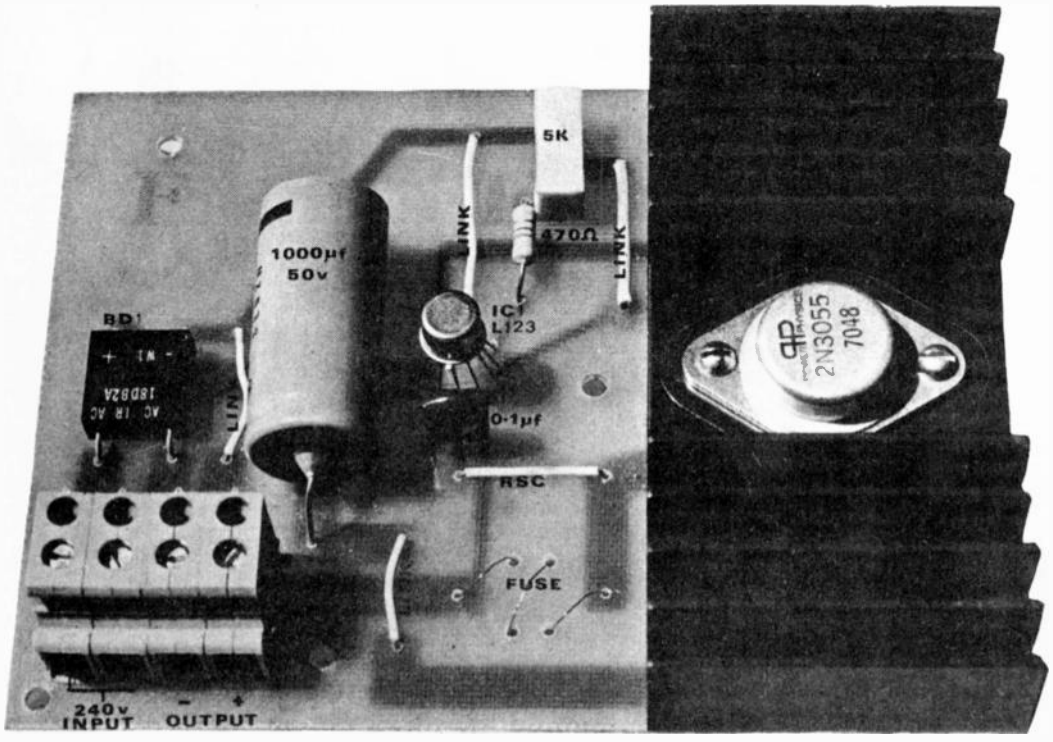
Circuit diagram of low voltage regulated supply (note that IC connections are as seen from above).

The following procedure is recommended, to ensure operation first time and to avoid mistakes which might result in damage to the IC.

1) Mount the bridge rectifier on the board. Observe the connections carefully. Apply the ac voltage from the transformer secondary to the input of the bridge and check the output dc with a multimeter. Disconnect the ac.
2) Connect the 1000 µf capacitor Cl across the output of the rectifier bridge (observe polarity).
3) Connect the L123 and associated components as shown in the schematic. Do not, however, make

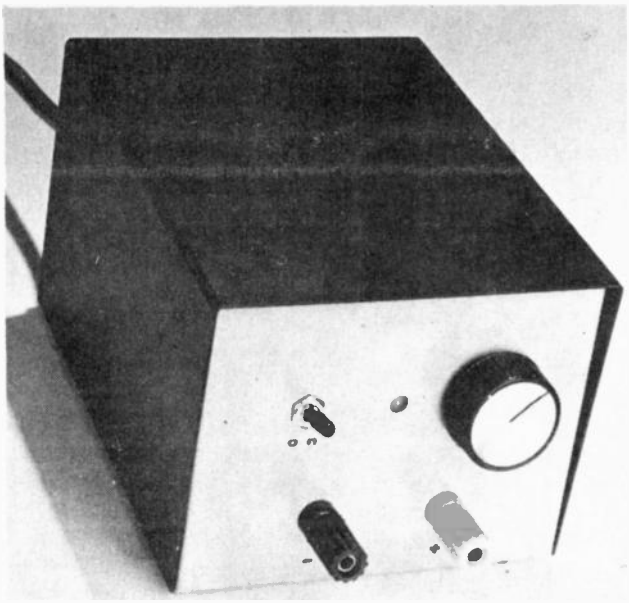
PARTS LIST FOR 1.5 AMP LOGIC POWER SUPPLY

TR1	– Any transformer with a secondary output between 9.5 volts and 32 volts rated at 2 Amps or more.	VR1	– 5000 ohms wire wound 'helitrim' or standard potentiometer (see text)
BD1	– IR 1.8 Amps bridge rectifier (or equivalent).	C2	– 0.1 µV ceramic capacitor
C1	– 1000 µf 50 VW electrolytic	T1	– 2N3055 transistor or equivalent.
IC1	– SGS L123 integrated circuit regulator	RSC	– See text.
		Connector	– Phoenix 1X 6KDS printed circuit mounting connector (or equivalent).



Layout of components on circuit board.

LOGIC IC POWER SUPPLY



any connection to the power transistor TI at this point. Check all connections carefully. Temporarily short together integrated circuit leads 1, 6, and 10 to test the voltage regulator part of the unit.

4) Testing. Connect a multimeter between V—and Vout (pins 5 and 6 on the integrated circuit) and switch on the power. Adjust the setting on VRI and the output voltage should follow. You should be able to adjust the voltage to any value between 1 volt and 7 volts by varying VRI.
   If you are satisfied that all is in order, switch off the power and remove the temporary short from integrated circuit leads 1, 6 and 10.
5) Now mount the power transistor TI and install the heatsink on the board. Connect TI as shown. Insulate TI from the heatsink if there is any chance that the heatsink will accidently touch the negative rail.
6) RSC is the load sensing resistor for overload protection. In our prototype we used a short length of resistance wire, cut to length to limit the current to the desired value.
   You can, of course, short this resistance and rely on the internal resistance of your experimental circuits to limit the current.

TYPICAL VALUES FOR RSC

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

The maximum current is determined by the power dissipation of the 2N3055 and the associated heatsink. For most experimental applications a limit of 1 amp is usually adequate.

ALTERNATIVE COMPONENTS

VRI. In the prototype we recommend the use of a Beckman Helitrim, which is a low-cost multiturn trimming potentiometer. This enables the experimenter to set his output voltage precisely. A single turn wire wound potentiometer may be substituted if this fine control is not required.

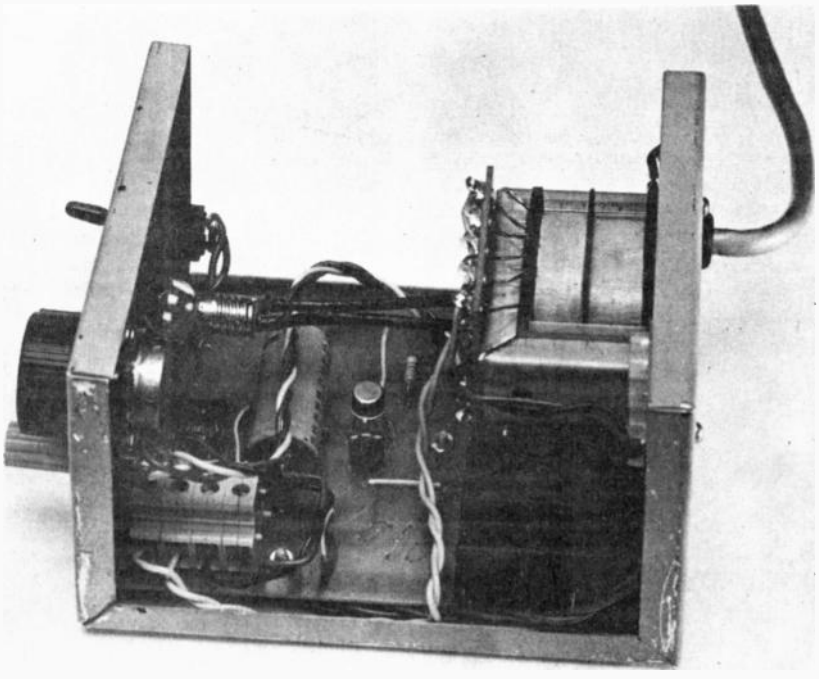
A screwdriver adjustable potentiometer was selected because it was felt that most experimenters would only require one specific voltage most of the time. If your application requires frequent voltage changes, a panel mounting potentiometer should be used.

RSC. An interesting alternative is to substitute a 20 ohms, 5W wire wound potentiometer so that the current limiting can be continuously varied. With this feature the user can start his experimenting with a very low current limit and increase the current when his circuit is operating correctly.

TRANSISTOR TI. We have selected the 2N3055 transistor because it is readily available and can be used to carry currents of 15A at 115 W dissipation. If lower currents are required, a smaller npn transistor can be substituted.

INCREASED RIPPLE REJECTION

The L123 has a typical ripple rejection of 74dB, which is more than adequate for most applications. However, by additional filtering at the non-inverting input (pin 3) the ripple can be substantially reduced. A typical performance, using a 4.7 μf capacitor across the non-inverting input and Vref, is around 86dB. ●



RIGHT: As described in the text, an externally mounted potentiometer can be used. Our own prototype unit was assembled in this form.

SPECIAL OFFER FOR THIS PROJECT

SGS L123 integrated circuit regulator — $3.55 including sales tax and postage. From Warburton Franki Ltd., 372 Eastern Valley Way, Chatswood, N.S.W. 2067.

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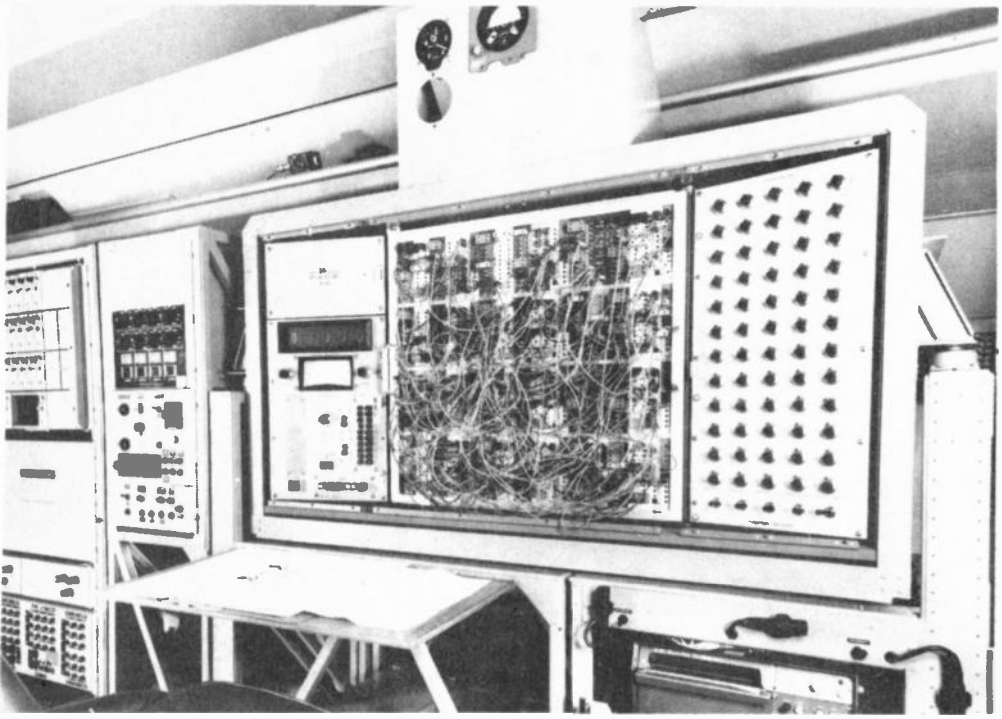


Airborne analogue computer is main control centre of blind landing unit

By O. B. ST. JOHN
Superintendent of the Blind Landing Experimental Unit, Royal Aircraft Establishment.

THE ROUTINE USE of automatic landing techniques, although not yet in widespread operation, has reached the point where some of the more advanced airline operators, flying into major airports, are daily gaining valuable experience.

In other words, the practical feasibility of automatic landing – with the attendant advantages of improved safety and regularity of operation in bad weather – has been demonstrated. But much still remains to be done in terms of gaining further operational experience before enough confidence is acquired safely to penetrate the worst visibilities during landing.

PIONEERING RESEARCH

The development of automatic landing for civil aviation owes much to the pioneering research of the Blind Landing Experimental Unit (BLEU), now part of the Avionics Department of the Royal Aircraft Establishment at Bedford, set up at the end of World War II with the express purpose of providing the Royal Air Force with an all-weather operating capability.

In the late 1950s, BEA (British European Airways) – shortly afterwards followed by BOAC (British Overseas Airways Corporation) – were sufficiently encouraged by BLEU's progress to adopt a forward-looking policy of designing-in an automatic landing capability on their new aircraft, the Trident and VC 10.

As a result, both airlines have fleets which regularly perform fully automatic landings in passenger-carrying service. The Tridents have been doing this for some years now, well ahead of any other passenger aircraft, and the flight control equipment is fitted 'in triplicate' in order to have the reliability to land safely, eventually in near-blind conditions. Tridents are currently performing some 250 automatic landings per month in service.

Clearly, present-generation automatic landing systems have satisfactory and safe performance – but this does not mean there is no need for further improvements. In particular, there is need to widen the environment under which automatic techniques are practicable, if the safety and consistency associated with them are to be fully exploited.

The flight path of the automatically landing aircraft is disturbed both by wind and turbulence, and by any interference existing on the radio guidance beam. Better flight control systems would enable 'autoland' to function satisfactorily in higher wind conditions and on radio beams of poorer quality, or those subjected to more interference than is presently acceptable.

A new flight test facility has been acquired and developed by BLEU for helping to speed up the realisation of better control systems in next-generation civil aircraft. To explain the philosophy behind this facility, which is called a Versatile Autopilot (VAP) and is installed in a Comet III B jet transport at Bedford, we must first realise how the original development of automatic landing was managed.

Following a comparatively simple theoretical mathematical design of the system, practical implementation, for testing purposes, consisted of fitting an aircraft with suitable guidance sensors – such as a radio beam receiver, radio altimeter and compass – together with a standard 'off-the shelf' automatic pilot. The guidance sensors were then connected to the autopilot, with appropriate modifications to circuits in the autopilot black boxes.

This approach, although successful, was painfully slow – especially when flight experience indicated further modifications to the black boxes were required. Each stage of modification would take weeks or even months, involving tedious work with a soldering iron to the maze of wires inside the boxes. The advent of the Versatile Autopilot does away with these long delays between successive stages of development.

The heart of the VAP is an airborne analogue computer to which a variety of inputs can be fed. Outputs are to either the autopilot servos (directly moving the flying controls), or to the human pilot's command instruments. The input sensors consist of a number of radio aids, together with a self-contained inertia navigator.

The mathematical relationship between inputs and outputs can now be precisely controlled and varied in a

BLIND LANDINGS

matter of hours rather than weeks or months, thereby speeding up the rate of understanding and development enormously. Physical realisation of the mathematical relationships is by means of plug-in leads between the various computer units.

A number of particular practical experiments have already been successfully made with this new aid.

INSTRUMENT LANDING SIGNAL

To make autolanding a widespread civil airline practice, it is essential to reach international agreement regarding the form of ground guidance aids to be used, thereby making airborne and ground equipment compatible on a worldwide basis. Such agreement has been reached through the International Civil Aviation Organisation (ICA)), and the universally accepted radio aid is the Instrument Landing System (ILS).

This consists of two beams – one in azimuth (localiser), defining the extended runaway centreline, and the other in pitch (glide path), defining the ideal approach path at three degrees to the horizontal. Not only is ILS internationally acceptable, but for economic reasons it is likely to be the mainstay for automatic landing for many years to come.

The radio technique employed by ILS (in the VHF/UHF – Very High Frequency and Ultra High Frequency) is such that on average its guidance quality is good, but it is nevertheless potentially susceptible to various interferences.

One source of interference arises from the reflections generated by one aircraft taking off from a runway and overflying the localiser transmitter while a second aircraft is approaching and using the localiser signal. The effect is similar to that seen on a television screen when an aircraft flies close – there can be serious interference to the signal for a few seconds.

In the case of ILS, this interference can be very large if the landing aircraft is three miles (five kilometres) or less behind the taking-off one. In practice this will not jeopardise the safety of automatic landing in blind conditions, since by using suitable Air Traffic Control procedures adequate clearance between adjacent aircraft can be guaranteed, thereby eliminating the problem at its source.

Even the latest blind landing techniques pioneered by the Royal Aircraft Establishment at Bedford, in southern England, had the disadvantage that echoes or ground obstructions could cause a bending of the beam which guides the aircraft. Now the Royal Aircraft Establishment has invented a gyroscopic device incorporating an analogue computer which automatically straightens the flight path, should bending occur, so completing the effectiveness of the system.

For the first few years of bad-weather operations this expedient will be perfectly acceptable; but later, as more aircraft become fitted for such operations, the requirements for large separations during landing will have a slowing-down effect on traffic flow.

One solution is to introduce a new guidance aid, less susceptible to interference – but an alternative approach is to try to make the flight control system equally less susceptible. This is where the Versatile Autopilot comes in useful.

EN-ROUTE NAVIGATION

Some long-range aircraft – such as Boeing 747 and Concorde – will be fitted with multiple inertia navigators for en-route navigation. Such devices are entirely self-contained in the aircraft and consist of a platform (stabilised in space by high-accuracy gyroscopes) on which are mounted sensitive instruments (accelerometers) for sensing changes in the direction and magnitude of speed.

Present-day inertia navigators can tell the pilot where the aircraft is to an accuracy of a few miles (kilometres) after a trans-oceanic journey of 3000 miles (4828 kilometers). This is quite adequate for flying the comparatively open spaces across the oceans – but, by itself, it is obviously not accurate enough to blind-land the aircraft on a runway which is only about 150 feet (45 metres) wide.

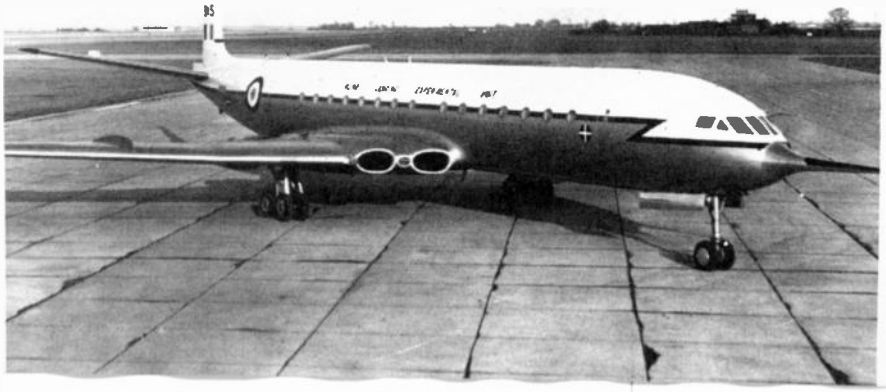
However, the ILS localiser is a good average measure of where the aircraft is for landing, despite its short-lived aberrations due to the effects of possible interference. By combining the best features of both ILS and inertial guidance (long-term accuracy of the former and short-term of the latter) we should be able to get combined information for landing that is better than from either navigation source independently.

With this principle in mind, BLEU made an experiment in flight – following ground simulator tests – mixing airborne ILS localiser and inertia navigator information in the VAP and then feeding the combined navigation information into the autopilot servos. This mixed automatic landing system was then tested in conditions with overflying aircraft interference and compared with the more conventional ILS only landing system.

Results were very encouraging, indicating that inertia mixing could indeed virtually eliminate the disturbing effect of ILS interference, even when the conditions of interference were more severe than would be expected in realistic heavy air traffic conditions.

Other experiments are now being carried out with the powerful research tool provided by the Versatile Autopilot, including an assessment of the advantages of inertia mixing in the pitch (glide path) part of the autolanding system. ●

Experimental system is fitted in Comet III B.



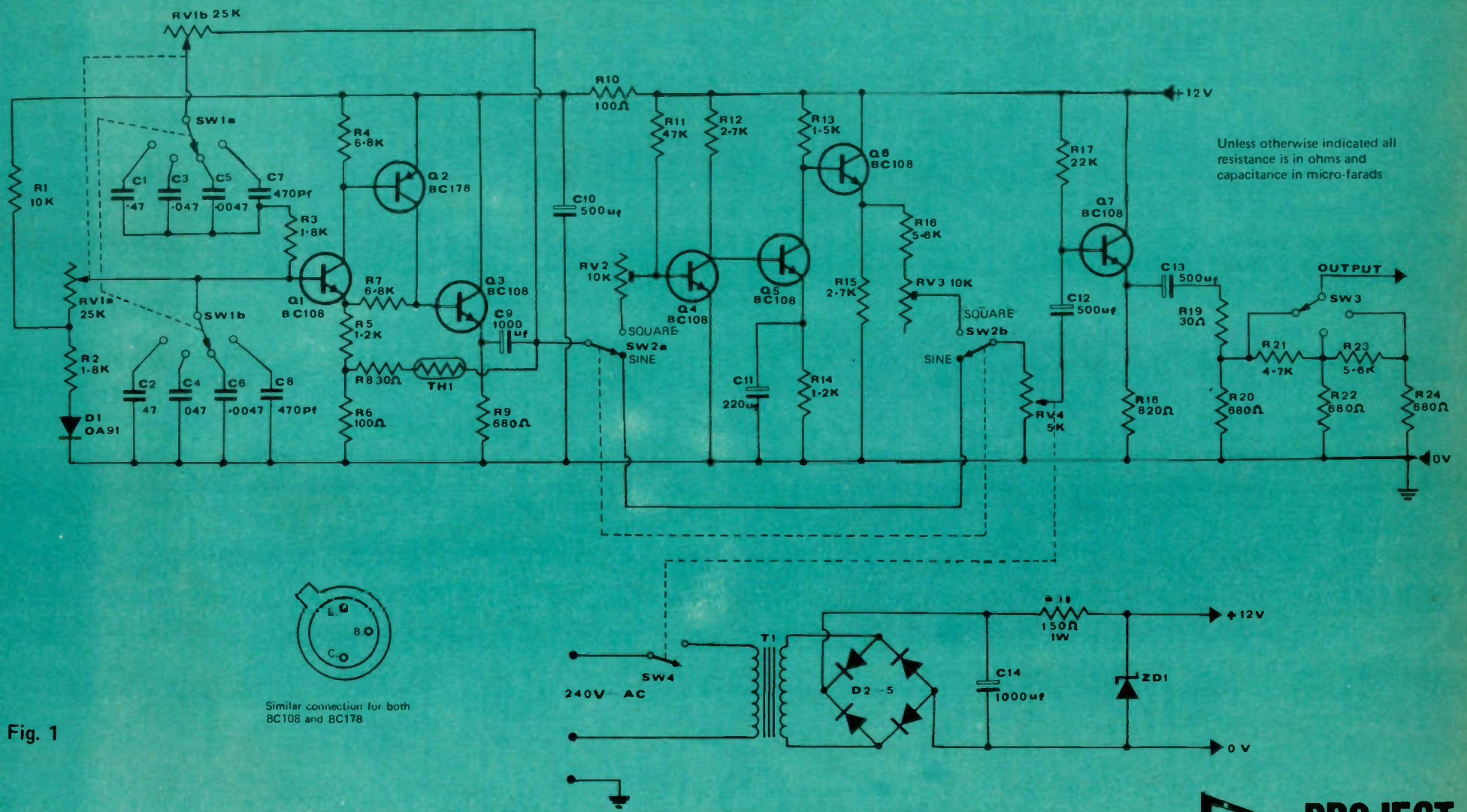


Fig. 1

ET PROJECT

Audio Signal Generator

THIS ARTICLE gives all necessary data for constructing a reliable, stable audio signal generator which covers frequencies from 15Hz to 150kHz in four switch-selected ranges.

Both sine and square wave outputs are provided. Sine wave amplitude is one volt rms, square wave amplitude is one volt peak, adjustable by both fine and coarse attenuators in the emitter follower output stage.

The generator uses a total of seven silicon transistors, six of which are npn types and one a pnp type. The Wien bridge oscillator (Q1, Q2, Q3) is a slightly modified version of the well-known Mullard circuit which uses fixed capacitive elements and variable resistance elements in the bridge and includes a thermistor to ensure constant amplitude output. The modifications to the original Mullard Wien bridge circuit have been made to accommodate transistors readily available in Australia.

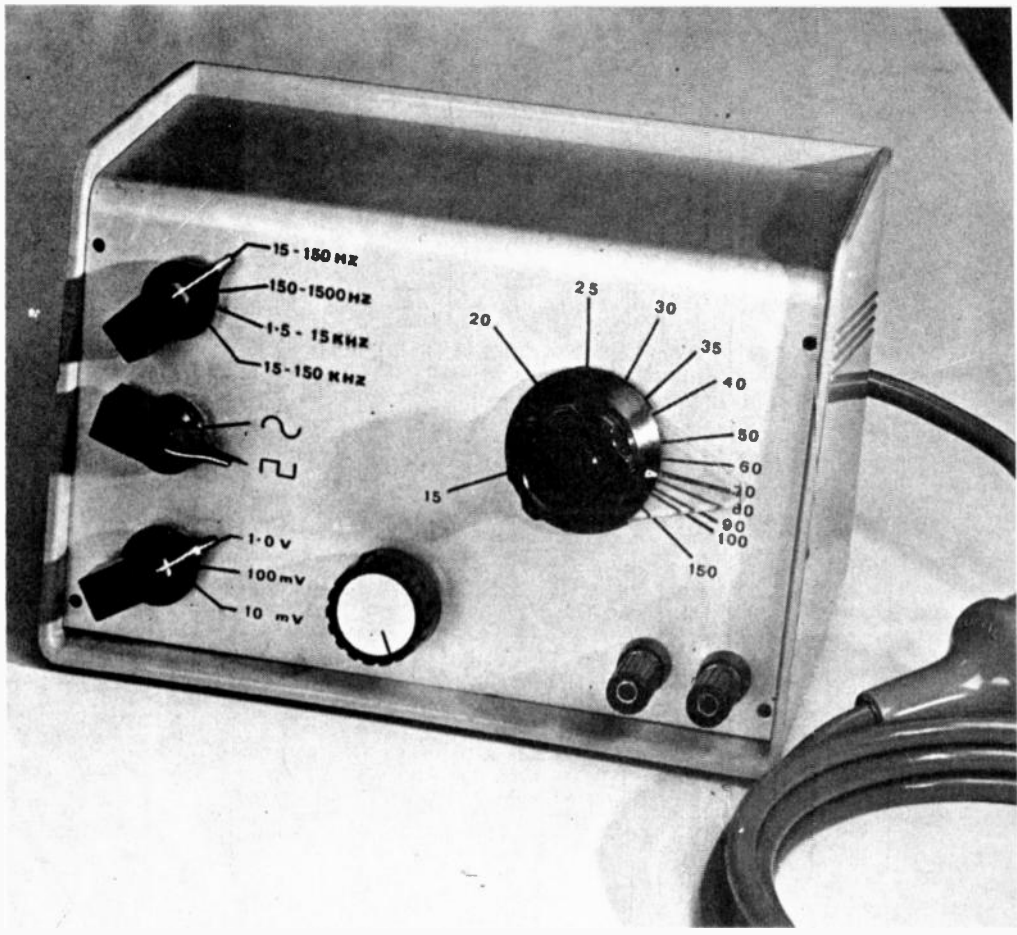
The full circuit is shown in Fig. 1.

Frequency is varied by the ganged potentiometers RV1a and RV1b; these form the resistive elements of the bridge. Constant amplitude output is ensured by the thermistor TH1 in the feedback loop to the emitter circuit of Q1.

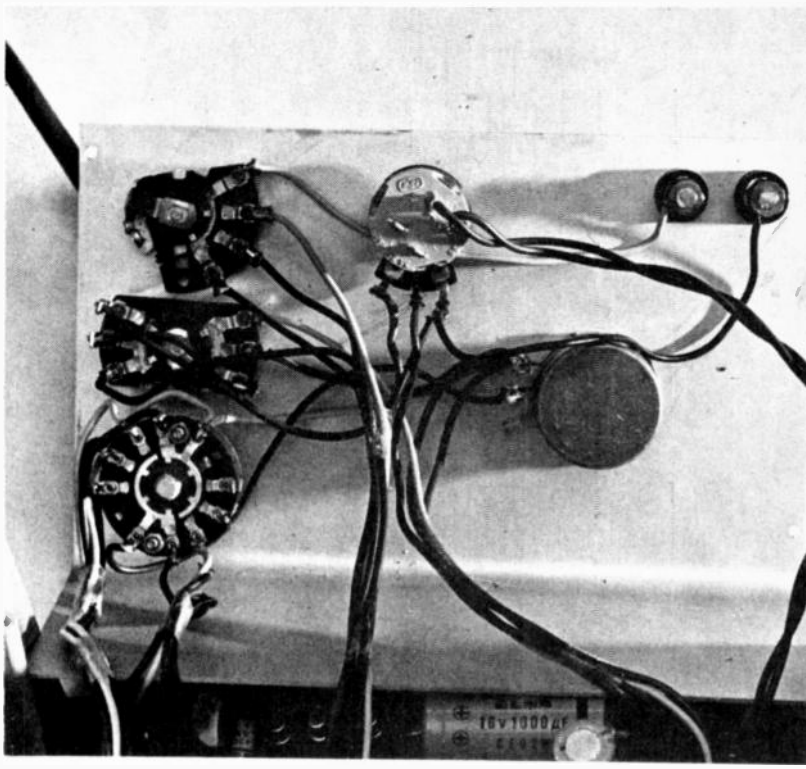
The npn/pnp pair Q1 and Q2 form a high gain amplifier which is coupled to the npn emitter follower Q3.

For sine-wave output the signals are taken via SW2a and SW2b, and the fine attenuator control VR4, to the base of emitter follower Q7. The output of Q7 then goes via the switched attenuation circuit (SW3, R21, R22, R23, R24) which can be used to adjust the sine-wave output to a maximum of 1 volt, 100mV, or 10mV rms.

For square-wave signals, the sine-wave output from Q3 is taken to Q4 and Q5, which together form a

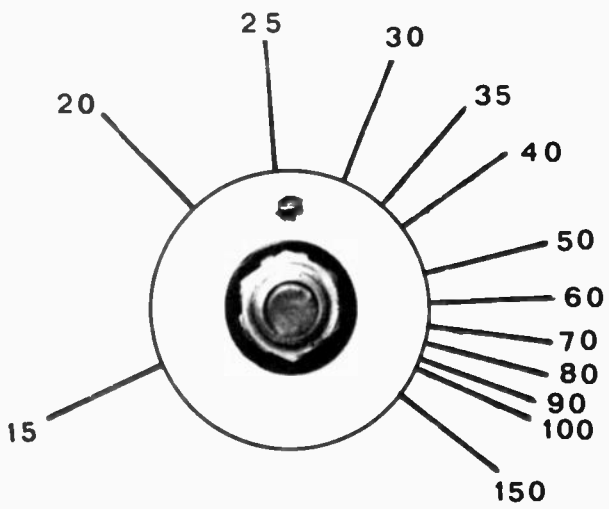


Our completed unit



Front panel wiring details.

Fig. 5. Calibration scale (full size)



Simply constructed audio signal generator provides adequate performance for home and shop use.

Audio Signal Generator

PARTS LIST

R1	–	Resistor 10k ½ watt 5%
R2	–	" 1.8k " " "
R3	–	" 1.8k " " "
R4	–	" 6.8k " " "
R5	–	" 1.2k " " "
R6	–	" 100Ω " " "
R7	–	" 6.8k " " "
R8	–	" 30Ω " " "
R9	–	" 680Ω " " "
R10	–	" 100Ω " " "
R11	–	" 47k " " "
R12	–	" 2.7k " " "
R13	–	" 1.5k " " "
R14	–	" 1.2k " " "
R15	–	" 2.7k " " "
R16	–	" 5.6k " " "
R17	–	" 22k " " "
R18	–	" 820Ω " " "
R19	–	" 30Ω " " "
R20	–	" 680Ω " " "
R21	–	" 4.7k " " "
R22	–	" 680Ω " " "
R23	–	" 5.6k " " "
R24	–	" 680Ω " " "
R25	–	" 150Ω 1 watt 10%
RV1 (a/b)	–	Dual gang potentiometer 25k linear
RV2	–	Potentiometer preset 10k linear
RV3	–	" " " " "
RV4	–	Switch potentiometer 5k linear
C1	–	Capacitor – metallized 0.47 µf, 15 volt
C2	–	" – " 0.47 µf, " "
C3	–	" – " 0.047µf, " "
C4	–	" – " 0.047µf, " "
C5	–	" – " 0.0047µf, " "
C6	–	" – " 0.0047µf, " "
C7	–	Capacitor – metallized 470 pf, 15 volt
C8	–	" – " 470pf, " "
		(silver mica capacitors may be used for C7 and C8).
C9	–	Capacitor – electrolytic 1000 µf, 16 volt
C10	–	" – " 500 µf, " "
C11	–	" – " 220 µf, " "
C12	–	" – " 500 µf, " "
C13	–	" – " 500 µf, " "
(Note C10–C13 are single ended type capacitors)		
C14	–	" – " 1000 µf, " "
D1	–	diode – OA91 (or equivalent)
D2-5	–	diodes EM401 (or equivalent)
ZD-1	–	zener diode BZY96, 12v., 1 watt (or similar)
Q1	–	Transistor BC108
Q2	–	" BC178
Q3–Q7	–	Transistors BC108
TH1	–	Thermistor type STC type R53
T1	–	Transformer 240 volt to 12 volt 150 ma (Ferguson type PF 2851 or similar)
SW1 (a/b)	–	Switch rotary, two pole, four way
SW2 (a/b)	–	Switch rotary, two pole, two way
SW3	–	Switch rotary, single pole, three way
SW4	–	(rear of switch pot. RV4)
PC ET-006	–	Printed circuit board
Case	–	ATC type plastic case
Various	–	Output terminals, connecting block, mains cable and plug, control knobs.

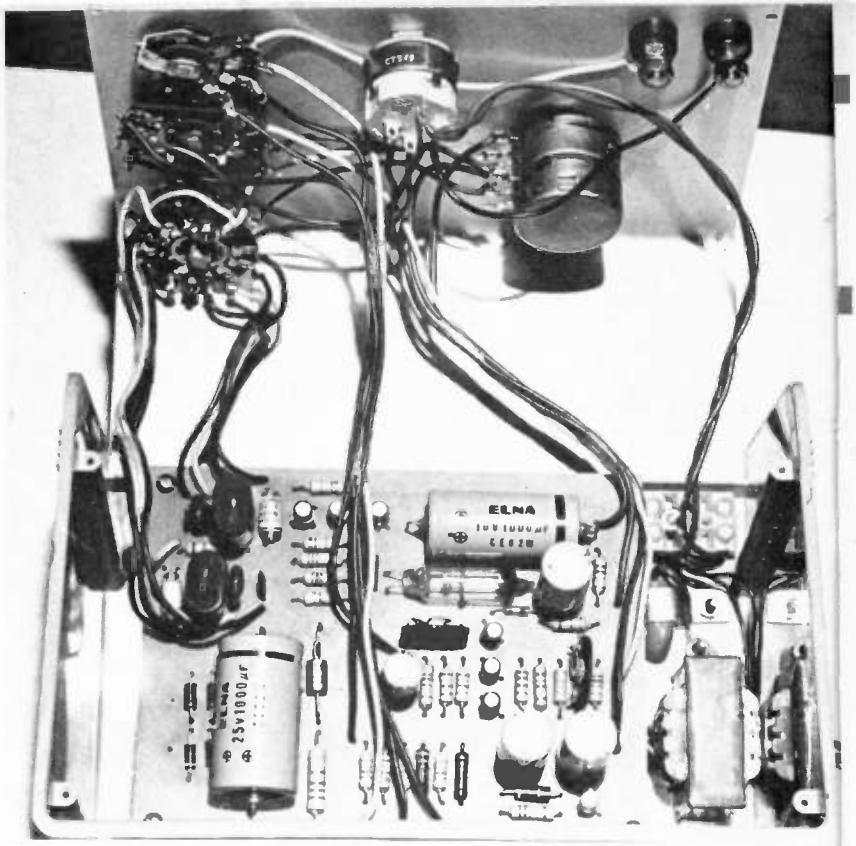
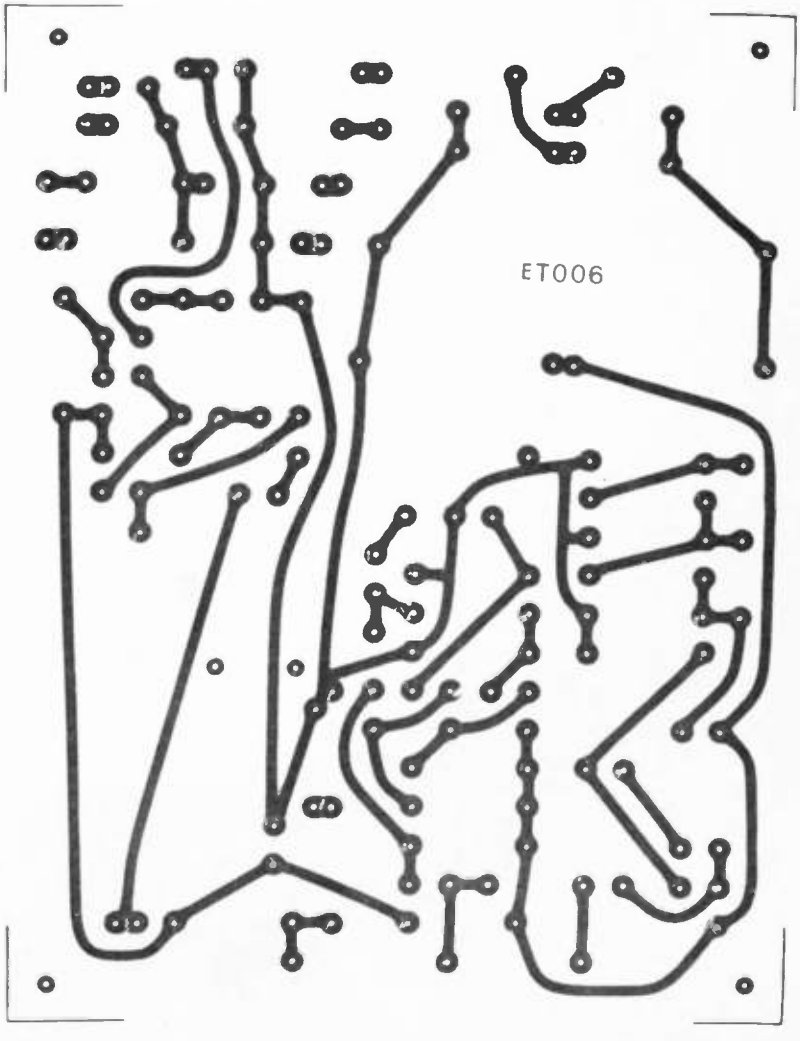


Fig. 4. General layout of components, in our final version we found it was desirable to us screened signal leads between the circuit board and the panel mounted switches.

Fig. 2. Foil pattern – full size



Audio Signal Generator

squaring amplifier. The pre-set potentiometer RV2 is used to set the mark-space ratio to 1:1. The squared signal is then taken from the emitter follower Q6, through pre-set attenuator RV2, and then to the output transistor Q7.

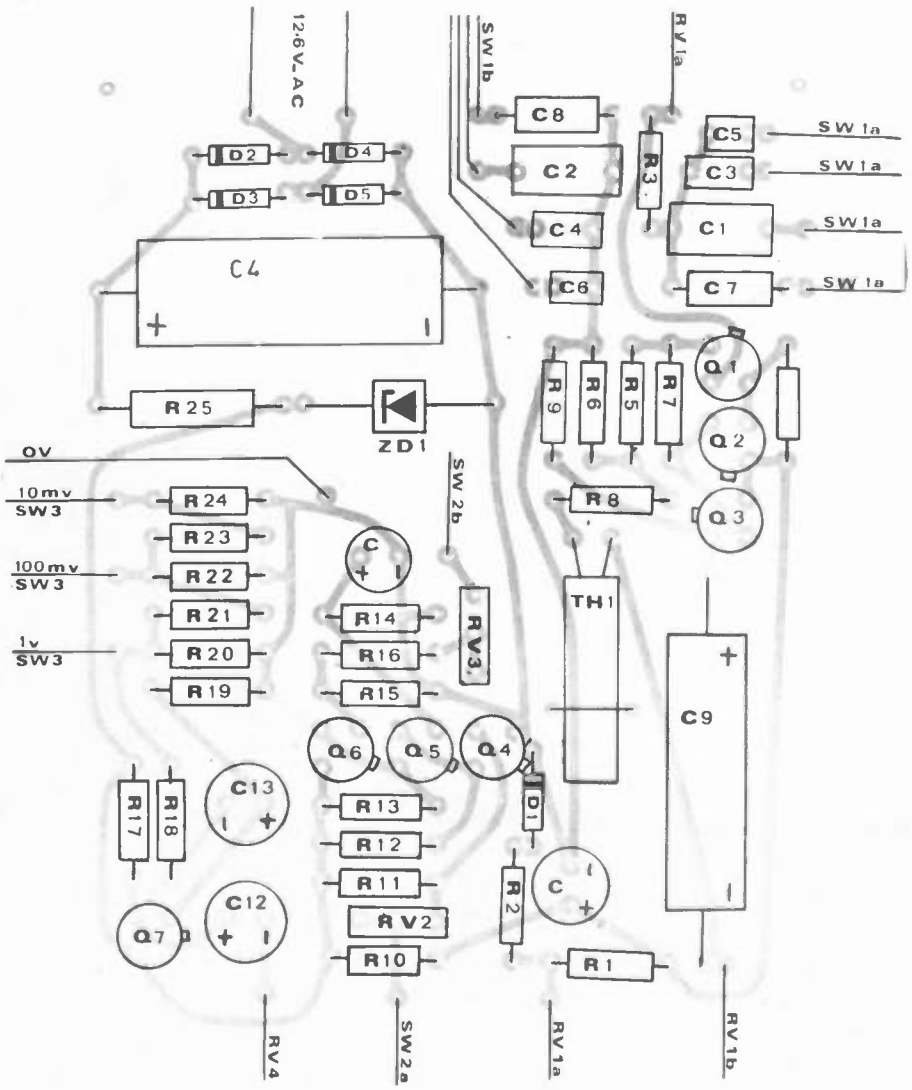
The preset potentiometer RV3 is adjusted to produce a maximum square-wave output of 2 volts peak-to-peak. The coarse output attenuator will reduce this to either 200mV or 20mV peak-to-peak. Each of three output levels (both sine-wave and square-wave) is then steplessly variable from zero to maximum by means of RV4.

A circuit for a 12 volt power supply has been included in Fig. 1. However, if the generator is used infrequently or for short periods, it can be operated from a 12 volt battery. Current drain is less than 30mA.

Our prototype unit was built on a printed circuit board the foil pattern of which is reproduced in Fig. 2. The layout of components is shown in Fig. 3; compare this with Fig. 4, which is a photograph of the completed unit.

Frequency range 1:	15Hz – 150Hz
Frequency range 2:	150Hz – 1,500Hz
Frequency range 3:	1,500 Hz – 15,000Hz
Frequency range 4:	15,000Hz – 150kHz
(range 4 will in fact extend beyond 150kHz)	
Output variation:	Less than ±1dB from 15Hz – 150kHz.
Distortion:	<1%
Output impedance:	600 ohms.
Sine-wave output:	0-1 volt (rms)
	0-100mV (rms)
	0-10mV (rms)
Square-wave output:	0-2 volts (peak-to-peak)
	0-200mV (peak-to-peak)
	0-20mV (peak-to-peak)
Square-wave mark/space ratio:	nominally 1:1
Square-wave rise time:	less than 1 μsec.

Fig. 3. Position of components on the printed circuit board.



If desired, the unit can be assembled on Veroboard. The layout of components is not too critical, although we have found that it is necessary to use screened leads from the oscillator board to the output level switch, and from the output level switch to the output terminals.

It is essential that, metallized capacitors be used for C1, C2, C3, C4, C5 and C6. Silver mica capacitors may be used for C7 and C8 (470pF). DO NOT use ceramic capacitors.

The frequency range scale illustrated in Fig. 5 will prove accurate enough for most audio work, providing 2% tolerance capacitors are used for C1-C8. If greater accuracy is required, the unit must be checked against another oscillator of known accuracy.

The output waveform should, if possible, be checked with an oscilloscope to verify that a good sine-wave is being obtained and that the square-wave is uniform. The mark-space ratio of the square-wave output should be set to 1:1 by the pre-set potentiometer RV2 and the peak-to-peak output level by RV3. If no oscilloscope is available, RV2 and RV3 should be set to mid-range.

If an audio frequency voltmeter is available, the sine-wave output should be checked from 15Hz to about 100kHz to ensure that reasonably constant output is maintained.

The output signal should remain constant within ±1dB up to 100kHz or so, but there may be changes in level whilst changing frequency. The envelope stability (or the time taken for the amplitude to stabilize after a change in frequency) is mainly a function of the quality of the dual ganged potentiometer.

Performance of the prototype unit is detailed above. ●

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REALISTIC DX150A RADIO RECEIVER

WE TEST A POPULAR JAPANESE MULTI–WAVE RECEIVER

OVER the past decade the terms Hi-Fi, Professional, Studio, and Transcription have been bandied about freely by the commercial world as catchwords tacked on to the description of a new piece of equipment to enhance its image in the eyes of the intending purchaser.

This practice has been less common with radio receivers, where changing international standards, and the trend to fixed channel operation, have led to crystal controlled receivers and transmitters with stability that was unheard-of a little over two decades ago.

When examining the Realistic DX 150A multi-wave receiver, we were nonplussed by the term 'Communications Receiver' which the manufacturers' leaflet claims for the unit. Most communications receivers incorporate double or triple frequency conversion, and a host of technical features which this receiver does not claim to possess.

Today short-wave reception is as important as ever – notwithstanding satellites and coaxial cables, it still carries a significant portion of the worlds' communications. Because of the shift in emphasis, short-wave circuits are being used more by the newly-developing nations, for propaganda broadcasting by most nations of the world, and – as always – by amateurs.

The main attributes of a communications receiver can be generally defined as sensitivity, selectivity, stability, and ease and accuracy of tuning. Whilst there are undoubtedly plenty of other factors, these have been our yardstick – and, with the increased crowding of the bands and the snowballing electronic pollution of radio waves, these factors are now more important than ever.

DESCRIPTION OF UNIT

The Realistic DX 150A is a four-band single conversion receiver covering the range 535kHz to 30 MHz. Appearance is neat and attractive, with the main slide rule dial flanked by the band-spread dial on one side and an accurate S meter on the other.

The front is a solid aluminium extrusion in silver and black, with controls placed below the dial. These are, from left to right: phone jack, band spread, BFO pitch, AF gain, band selector, antenna trimming capacitor, RF gain, and main tuning. Secondary controls are provided by four switches: anti-noise limiter (on-off), mode switch (AM – SSB/CW), automatic volume control (fast-slow) and operate (receive-stand by). Rear connections are provided for a balanced or unbalanced antenna, a dc/ac switch and socket input, and a stand by control for working with a transmitter.

The case is solidly made from 18G matt-grey steel panels and is provided with a 2-metres-long mains cable ready for use. The unit is supplied with an 18-page owner's manual intended for beginners in the radio field, with a circuit diagram at the back in small print.

The main circuitry is separated into three sections. First, the main tuning capacitors are placed above the chassis and are operated through a smooth, positive cord drive system without any trace of backlash. The bandspread also uses a cord drive system, equally well-made. The RF circuitry is positioned under the chassis, with good shielding provided between the banks of coils, whilst the trimming and padding capacitors for each coil bank are located above the chassis, so adjustments can be made without introducing problems of stray capacitance.

The main semi-conductors are either

REALISTIC DX150A RADIO RECEIVER

silicon FETs or silicon planars. The only germanium transistors used are the final output transistors and the power supply regulation transistor. The circuitry is novel and consists of a cascade type front end using FET transistors for the RF mixer stage, followed by a conventional 3-stage 445 kHz IF incorporating one ceramic filter and 3 small single tuned IF transformers for narrow bandwidth. Whilst such bandwiths are suitable for short wave, they limit the performance on the broadcast band (a true communications receiver would offer at least two choices of bandwidth).

The AVC circuitry uses an amplifier stage to provide fast and slow control characteristics, and the CW stage incorporates a product detector to facilitate SSB reception. The power supply incorporates a simple regulator supply with a single transistor and zener diode, whilst the audio circuit incorporates a transformer-driven single-ended push-pull circuit capable of over 1 watt audio putput power into speaker or phones.

TEST PROCEDURE

The tests to which we subjected the receiver were aimed at evaluating its overall performance, as well as its suitability for communication or amateur use.

The basic receiver sensitivity is fair, almost meeting the stated 10dB signal-to-noise claimed for a 2μV signal. The signal-to-noise ratio figures were as follows:

AM Frequency	Signal/Noise at 2μV	Signal/Noise at 1μV
1.8 MHz	13 dB	7 dB
4.0 MHz	8 dB	4 dB
5.0 MHz	12 dB	5 dB
10.0 MHz	11 dB	5 dB
15.0 MHz	10 dB	5 dB
20.0 MHz	8 dB	4 dB
25.0 MHz	9 dB	5 dB

In the SSB mode the signal-to-noise ratio at 10MHz is 18dB at 2 μ V input and 14dB at 1 μ V input, whilst the noise factor at 10MHz is 5, which is quite good for a receiver of this general class.

Selectivity was found to have the following figures:

– 6dB points at 5kHz bandwidth
– 40dB points at 25kHz bandwidth
– 60dB points at 35kHz bandwidth

These were in exact agreement with figures stated in the book.

The image rejection ratio, measured at 10MHz with an image of 10910kHz (2 x 455kHz, I.F. frequency), was 40dB, which is about all that can be expected from a single conversion receiver. The AGC becomes effective from 10μV and holds the signal within 5dB from 15μV input up to 100mV input.

The S meter, checked on the AM mode on the fast or slow with RF control at maximum, provided the following figures:

S_1	1·2μV input
2	2.0μV input
3	3.2μV input
4	4.5μV input
5	6.3μV input
6	8.0μV input
7	10.0μV input
8	12.0μV input
9	14.0μV input
9 + 10	45.0μV input
9 + 30	400.0μV input

This result was good and would readily allow the use of the S meter for signal strength assessment.

Stability was reasonable, showing a positive drift of 200Hz per hour at 10MHz after a 2-hour warm up. This was better than many more expensive receivers we have tested. In tuning the receiver at the higher frequencies it was found that the desired frequency could be 100kHz out, due to parallax errors on the main dial. The need for either a crystal calibrator or more accurate dial calibration is essential if this sort of error is to be avoided.

Calibration of the final tuning dial (bandspread dial) is not close enough for either amateur or communication requirements, both of which seem to need accuracy approaching 1kHz calibration points these days.

The tuning system is quite smooth and positive in its operation, but it does have other limitations. First of these is the interaction between the Radio Frequency gain and the Audio Frequency gain, which both affected the tuning whilst either was being adjusted. Whilst not confirmed, we believe this was due to inadequate power supply regulation.

The second problem was the proximity of the external phone jack to the fine tuning control. When the phones plug was inserted in the jack, it was difficult to use the control.

During tests out of Sydney we found that the receiver had numerous spurious heterodyne whistles through both the C and D bands. One in particular, on 14100 kHz, would prove annoying when using the 14MHz amateur band. These spurious whistles were products of the HF oscillator/mixer, as they remained unchanged by replacing the aerial with a resistive termination at the antenna input.

The provision of a speaker in the cabinet has definite drawbacks and causes microphonic problems at moderate to high listening levels. Even with an external plug-in speaker this problem is still evident, but is fully obviated by using phones. The cause of the microphonics was traced to the rigid mounting of the tuning capacitors on the front panel assembly.

This receiver is suitable for short-wave listening by the beginner. Its stability is good enough for amateur SSB or short wave broad unit *listening*. The BFO is adequate for smooth CW and SSB reception. The frequency calibration falls short of the basic requirements of amateur or communications reception, but with the addition of a crystal calibrator it could be made to accommodate, even if laboriously.

Whilst the DX 150A receiver offers a performance comparable to the better amateur receivers of the early fifties, the state of the art and the greater technical requirements needed today place it at a disadvantage when compared with a full-fledged communications receiver. ●

MEASURED PERFORMANCE

Actual frequency range	Calibrated range
Band A 520kHz to 1.6MHz	535kHz to 1.6MHz
B 1.48 MHz to 5.6MHz	1.5MHz to 4.5MHz
C 4.32 MHz to 13.5MHz	4.5MHz to 13MHz
D 12.3MHz to 30.9MHz	13MHz to 30MHz

Minimum sensitivity at 2μV signal expressed as a signal to noise ratio: 8 dB.

Selectivity at	
5kHz:	– 6dB
25kHz:	– 40dB
35kHz:	– 60dB

Audio Output: 1.45 watts at 5% distortion into 8Ω.
Power consumption at 240 volts: 6.5 watts.
Dimensions: 14 1/8" wide x 7" high x 9¾" deep. Weight: 13.8lb.
Number of transistors: 16 Number of diodes: 12.

who needs 40 watts r.m.s.?

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These two fine British speaker systems are representative of the Wharfedale range; you can hear them all at your franchised Simon Gray dealer. When you do, listen for the *musical transparency* that identifies Wharfedale — for this intangible quality is the *reason* for Wharfedale's international success.

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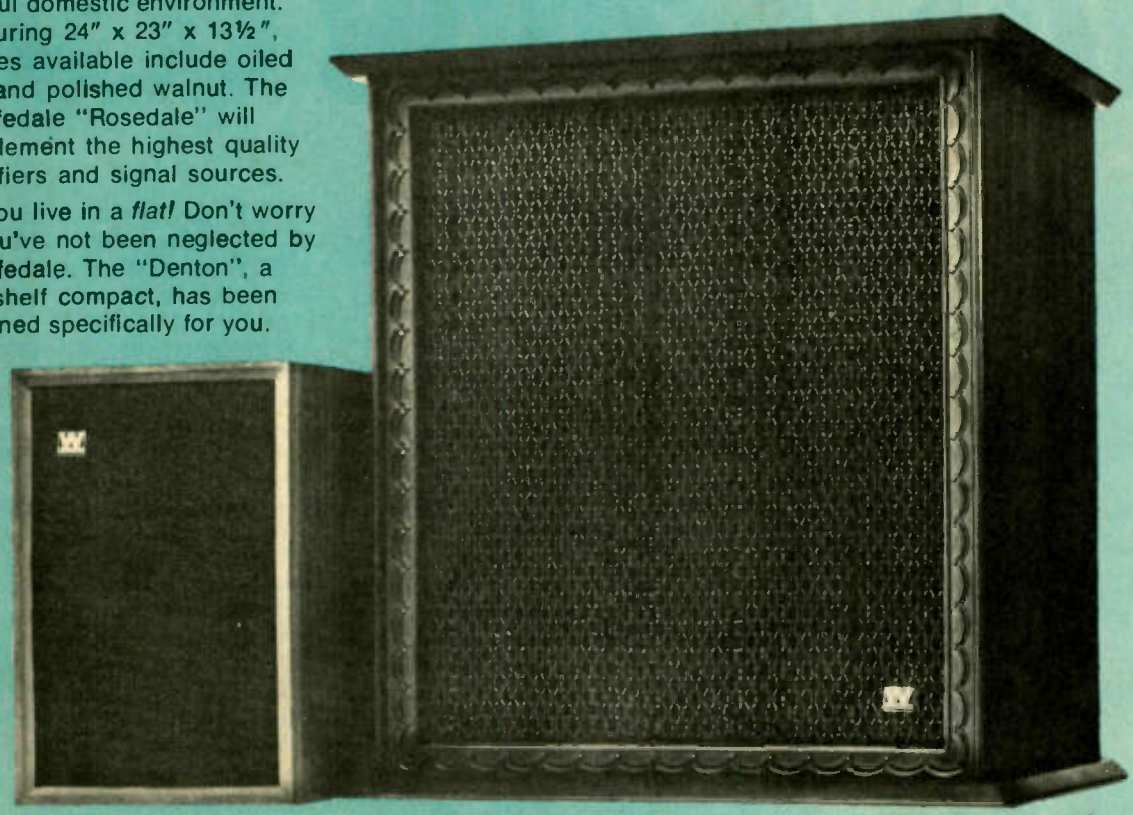

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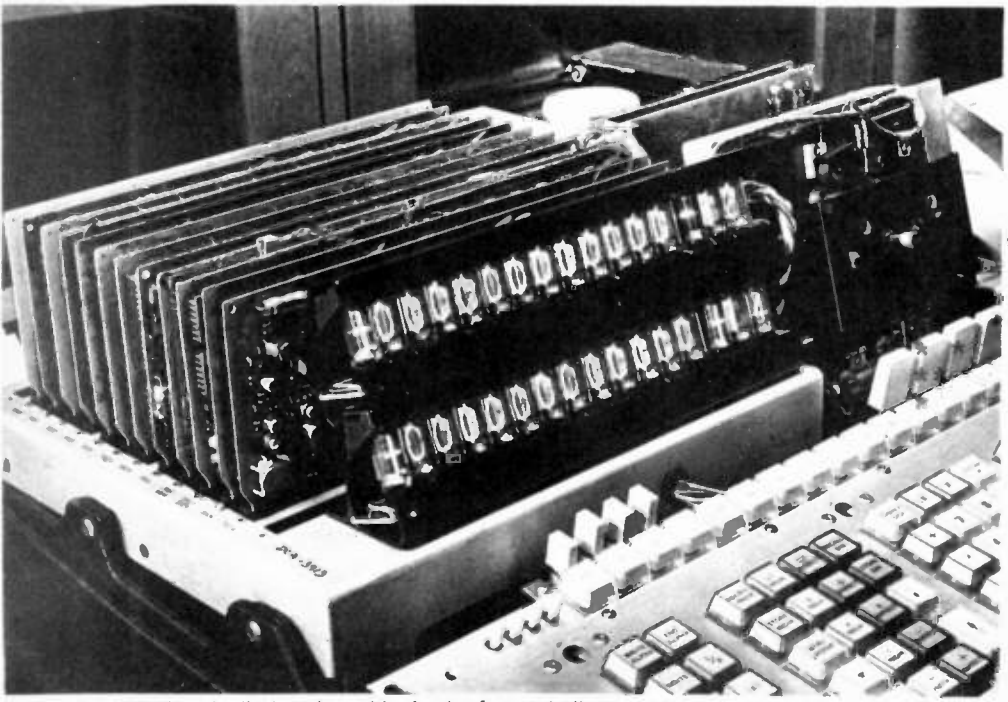
WHARFEDALE

WANG 700B COMP



Readout is displayed on this bank of neon indicator tubes.

An in-depth assessment by
MURRAY G. WOOD B.Sc., M.E., LOUIS A. CHALLIS B.E., M.I.E. (Aust)

BEING familiar with new tape recorders coming complete with a demonstration tape, we weren't surprised that the Wang 700B computer/calculator also came complete with a demonstration magnetic tape.

But, whilst a tape recorder can talk to you through speakers, the Wang has to present its patter through the associated Wang/IBM Selectric typewriter, which is an optional extra.

We fed the calculator its tape — which, surprisingly, is a 1.7/8 inches/sec. 'compact' cassette — and lo and behold the story started to unfold:

"Hi, I am the WANG 700 COMPUTER/CALCULATOR, the most powerful and flexible unit available. I can be used as a calculator or be programmed. I have an incredible memory and I am very versatile, in fact I can do many tasks that one would normally have a time sharing terminal for . . ."

A good sales gimmick — but how come a calculator with a name like Wang is manufactured in the U.S.A.?

Answer: Dr. Wang is the man who did the initial development work and subsequently took out patents for the

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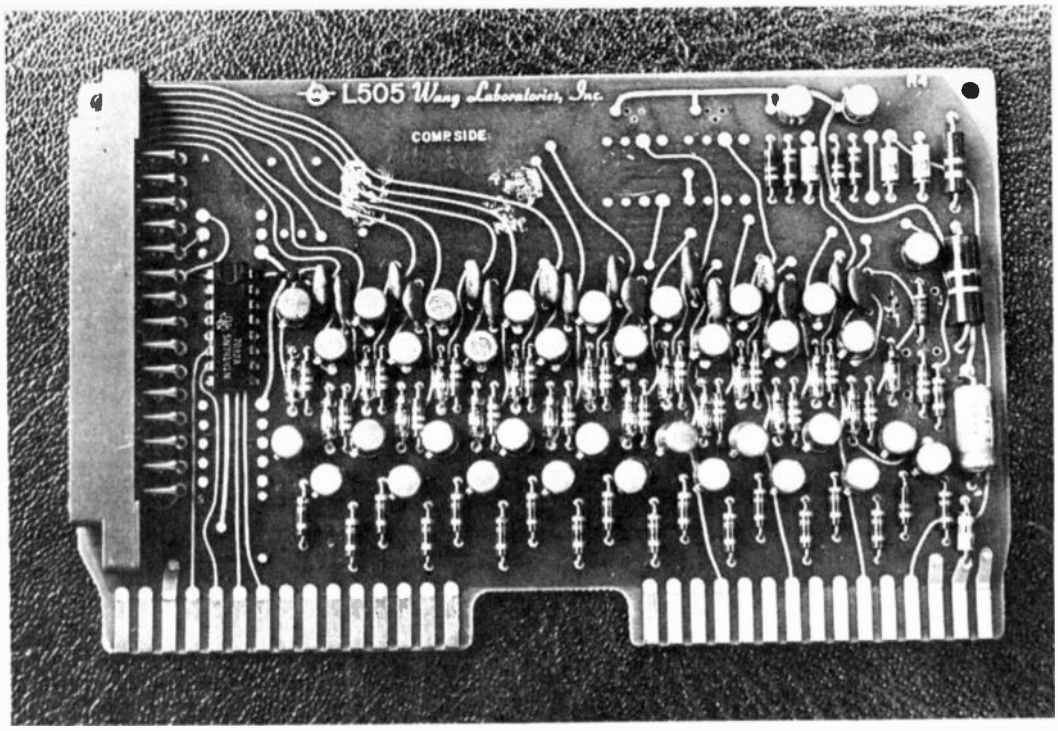


They say a ballpoint pen is capable of writing four great novels — in the right hands. Similarly, the Wang calculator's performance is limited only by the skill of its handler.

Plug-in circuit boards simplify maintenance and fault-finding.

UTER/CALCULATOR

read/write ferrite toroidal core matrix memory system. This memory system is the basis of the fast random access memory systems in most modern computers. After taking out the patents, it appears somebody else infringed them — and in the subsequent litigation Dr. Wang collected something like U.S.$9 million in damages.

Dr. Wang still earns considerable revenue from this patent, and others that he holds — but it was the $9 million that he first collected which enabled him to set up the Wang Laboratories.

Through Wang Laboratories, Dr. Wang was able to attract an enthusiastic group of research workers whose backgrounds varied from Ph.D's in mathematics and electronics to a graduate in Pharmacy, who is a software specialist.

These researchers have developed a number of new techniques which, for instance, facilitate the generation of logarithms, antilogarithms and other mathematical derivatives by a simplified sequence of operations.

Because the Wang Laboratories have developed these simplified techniques to compute such difficult functions very rapidly and efficiently the machine is capable of using its 'read only' memory more economically — which results either in a saving of costs or in increased computing power.

Having given you a background, let us look at the computer/calculator — which is what this review is concerned with, anyway.

SMALL BUT POTENT

As can be seen from the photo, the Wang 700B is a small machine measuring 23" deep by 19" wide by 9" high.

Whilst the average non-computer-orientated user would describe the 700B as a desk-top computer, the technical description of the machine is a *programmable calculator*. The distinction being the actual capability of the machine to accept programme material in a user-oriented language or a machine-oriented language. The Wang calculator — in common with other calculators — requires that the user, as distinct from the machine, keep track of where the data is.

As an example, consider the following simple computation of the roots of the quadratic equation:

$$A x^2 + B x + C = 0$$

The results of the equation are given by

$$X_1 = (-B + \sqrt{B^2 - 4AC}) / 2A \quad (1)$$

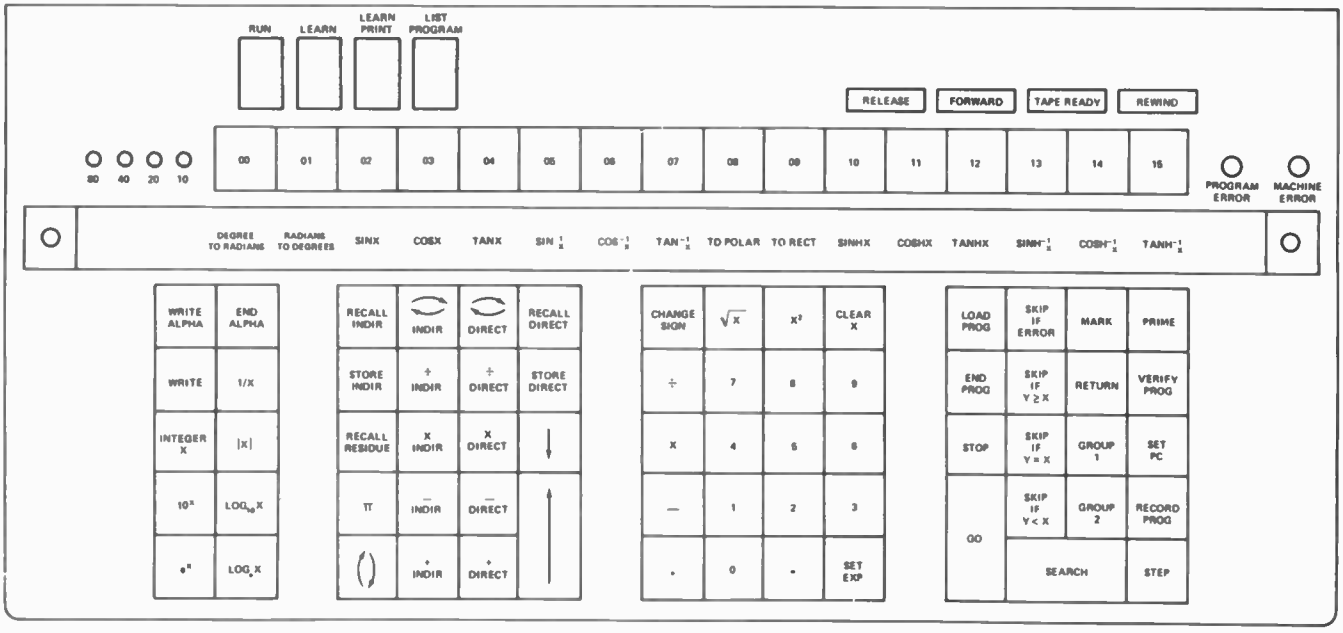
$$X_2 = (-B - \sqrt{B^2 - 4AC}) / 2A \quad (2)$$

A computer would essentially only require the values of A, B and C and the equations (1) and (2) whilst the Wang Calculator would require the instructions shown on the programme sheet.

The obvious question is — why cannot a calculator like the Wang 700 use similar methods of programming? The reason is that a full-size computer with a user-oriented language uses a considerable percentage of its memory to store the information it requires to convert to and from machine instructions, and instructions that the user readily understands. While this is feasible and worthwhile on a computer with a large amount of storage, on a machine with limited storage this is not practicable.

SNOOPY, the dog from the 'Peanuts' comic strip, played out on Wang calculator.

WANG 700B COMPUTER/CALCULATOR



Keyboard layout of Wang 700B.

The addition of two quantities stored in the memory in registers 001 and 002 of the Wang computer would require the use of the following instructions:

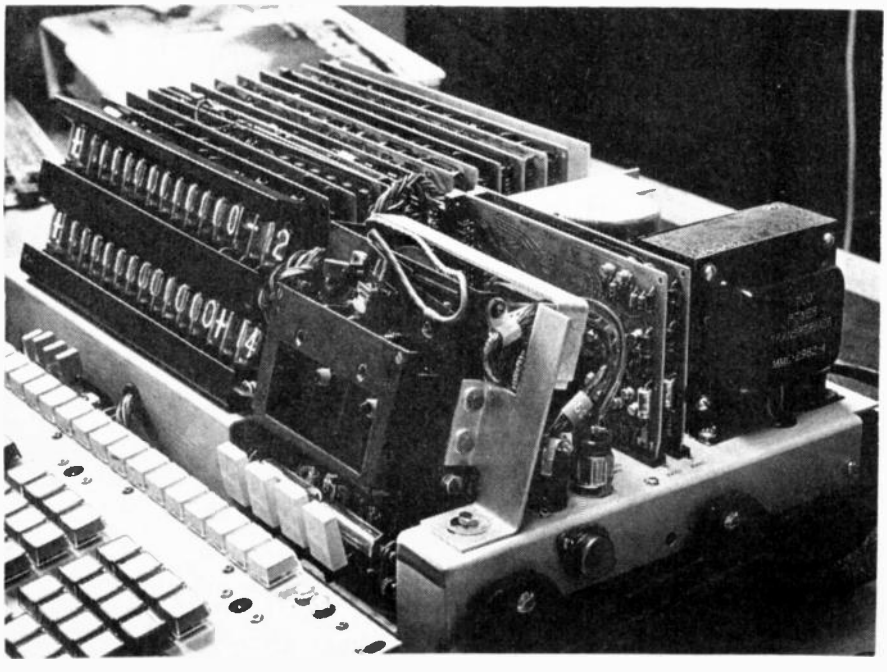
RECALL DIRECT
REG 001
+ DIRECT
REG 002
RECALL DIRECT
REG 002

The number appearing in the X register (the contents of which are displayed or printed) is the sum of the contents of the two registers. The machine stores the instructions as a numerical code in the ferrite core memory.

The above segment of programme would be stored in core as pairs of hexadecimal numbers, as follows:

04 05
00 01
04 00
00 02
04 05
00 02

Programming in machine language is harder at first than the programming in a user-oriented language such as FORTRAN, but with practice it becomes easy. Many experienced programmers often prefer to programme large computers in machine language rather than in a user-oriented language because it allows greater control of the programme, combined with a saving of core storage.



Programmes are stored on tape cassettes. The cassette drive mechanism can be seen in corner of machine nearest camera.

PERIPHERALS INCREASE VERSATILITY

The Wang calculator has many peripherals which can be used to increase its versatility.

These include a typewriter, a graph plotter, and a drum memory. These features provide many of the facilities of a large computer while maintaining the flexibility inherent in a small computer.

When using a large-size computer, one must usually forego the ability to control its operation at the time of execution of a programme. This is primarily due to the cost of computer time and the reluctance of computer operators to allow the users to play with their machines.

The ability to examine the intermediate results, and decide whether further computation is necessary, is a very useful feature of small computers. At any

pre-programmed step it is possible to perform manual computation and then allow the machine to continue.

A question that is often asked regarding desk-top computers or programmable calculators is 'Why use the programming facility for one-off jobs rather than perform the computations directly on the keyboard?' The advantage of such programming is that it is often possible to check your calculations, using a simplified example. The programme will then compute the correct answer for the actual or real problem where the answer is not so readily checked.

As a simple example, suppose that one wishes to compute the product of two phasors given in rectangular co-ordinates. Using the programme supplied in the *trig* pack, it is easy to convert the data to polar co-ordinates, multiply the magnitudes and add the phase angles, convert to rectangular co-ordinates and read off the results. It is, however, even easier to write a simple subroutine on the end of the *trig* pack (just in core), which then only requires the selection of one key and the entry of the four pieces of data required. The answer will appear in the X and Y register *NIXIE* display in a fraction of a second. A simple check with (2,0) and (0,3) should give the result (6.0). One can then assume that the desired product will be correct.

The Wang calculator is one of the most versatile computing machines we have seen. The functions available on the keyboard allow many of the commonly required functions to be obtained directly – these include: x, INTEGER x, π, $\log_{10} x$, $\log_e x$, $\sqrt{x}$, 10^x, e^x, $\frac{1}{x}$, x^2. In addition to these there are also logical functions which enable the machine to omit the instruction immediately following the logical function; these include: SKIP if $Y \geq X$, SKIP if $Y = X$, SKIP if $Y < X$, SKIP IF ERROR.

The flexibility of the machine is greatly increased by the use of two-step instructions. These are generated by the use of two keys rather than one. 20 of these two-step instructions allow movement of the decimal point, while the remaining 11 are less commonly required instructions. For example, WRITE ALPHA, SKIP IF ERROR is the two-step command for SKIP if $Y < 0$ and WRITE ALPHA, GO generates $180/\pi$.

A further set of commands is provided for operating the typewriter or any other output device used with the calculator. The typewriter used with the Wang calculator is an IBM Selectric or 'golf-ball' machine. The typewriter is 2" higher than a normal Selectric typewriter. The additional 2" contain the electronics and relays required to drive the typewriter from the calculator. With this system, any of the typewriter functions which are available manually are also available under calculator control – yet the typewriter is still capable of being used as a standard machine.

One of the features which really appealed to us was the programme storage capability. The programmes are stored on standard compact cassettes. Wang do not recommend that ordinary cassettes be used, but we tried some of our standard ones and experienced no trouble.

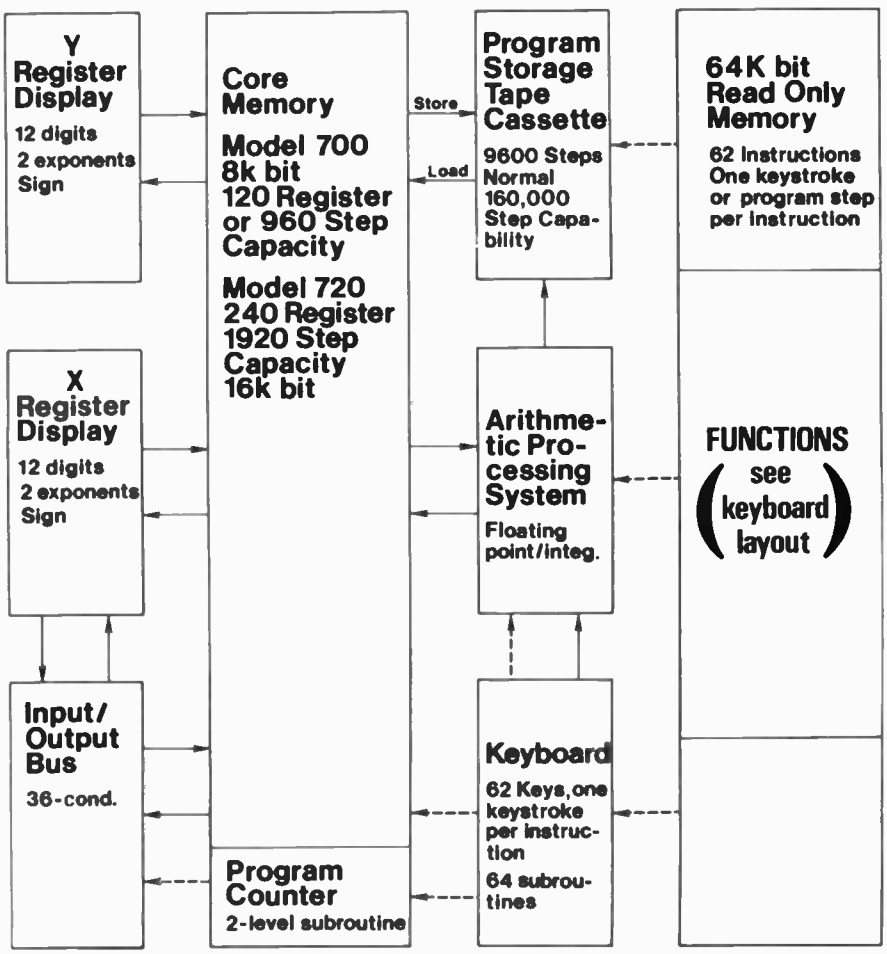
Using the cassettes, either data and programme storage, or just programme storage, can be obtained. The calculator records onto the cassette until it reaches an END PROGRAM instruction. On playback it once again stops when it reaches an END PROGRAM instruction on tape. With this capability it is possible to write extremely long programmes which are fed into the calculator in sections. Each programme is identified by a 4 digit number, generated by adding numbers corresponding to the programme instructions together. This verification number, while not unique, is unlikely to be duplicated by two different programmes.

Using this verification number, it is possible to tell whether the correct programme has been loaded, or whether the programme has been correctly loaded.

The only limitation with the machine is the amount of data storage available *within* the machine. With no programme, a total of 120 data registers are available. Two data registers are required to store 16 programme steps, or any fraction of 16 programme steps.

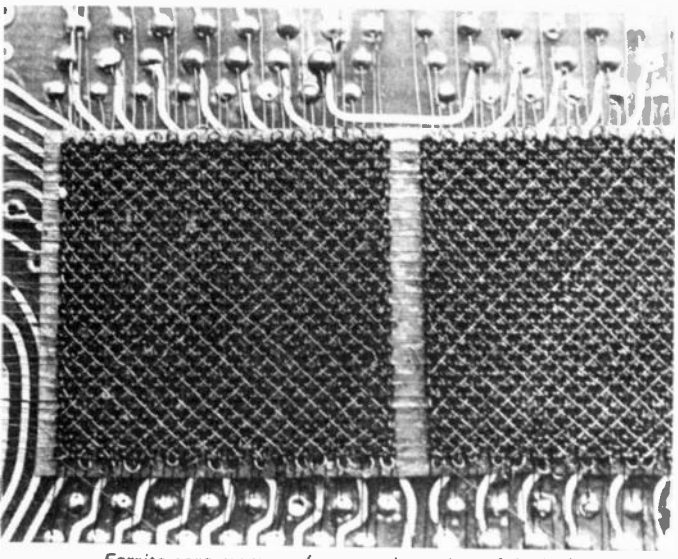
Another useful feature available on the Wang 700 is the RECALL RESIDUE key. This key gives the user the option of double precision arithmetic for addition, subtraction and multiplication. By recalling the residue, a total of 24 significant figures can be obtained.

The limitation of the double precision mode on the Wang 700B is that double precision is not obtainable directly with any of the special functions, and it is doubtful whether sufficient space is available in the core to generate double precision functions.

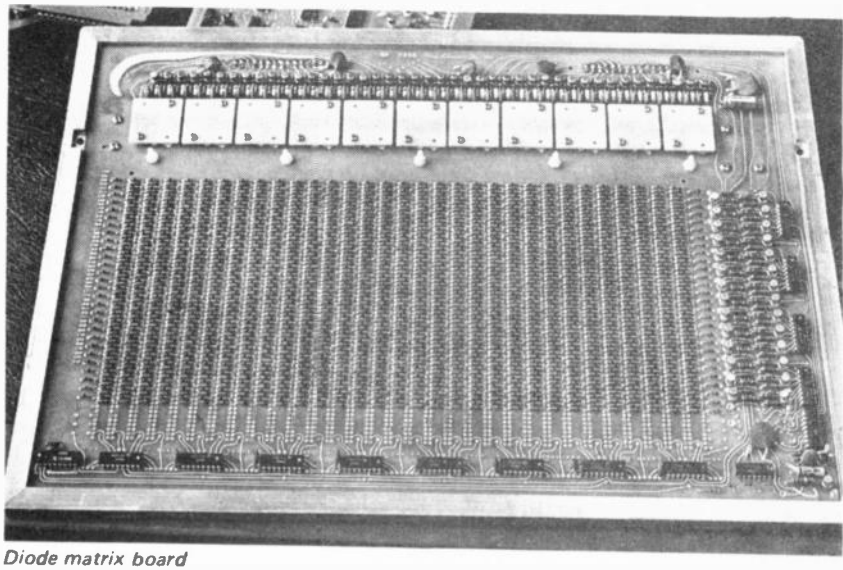


Block schematic diagram of Wang 700 series calculators.

WANG 700B COMPUTER/CALCULATOR



Ferrite core memory (approx three times full size).



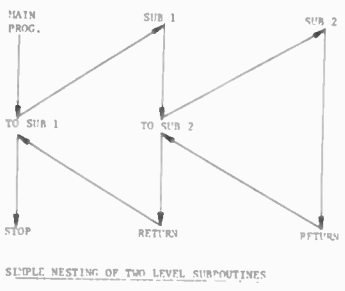
Diode matrix board

TEST PROGRAMMES

To describe the capabilities of such a machine is very difficult without finding out its limitations. We therefore tried a few programmes to test its flexibility.

The first ones we tried were mostly to solve existing computational problems. We did, however, try some standard programmes just to see how flexible the Wang is. We found that the calculator was particularly good at 'Noughts and Crosses' and in most cases the games were drawn.

Among the more useful exercises we tried was a task of analysing vibration data to determine corrective treatment. Such an analysis would not normally be worthwhile, but in this particular case we had approximately 10 sets of measurements and 4 sets of operating conditions to compare. Each set of measurements consisted of 30 1/3 octave bandwidth vibration components. This amount of data is very difficult to compare and assimilate. We therefore predigested the information on the Wang 700 and worked on the output data which it supplied.



ABOVE: Simple nesting of two level subroutines.

This technique would have resulted in a considerable saving in time, had we been more expert in using the machine. Even though the programming took longer than would normally be the case, the analysis was still far quicker than it would have been without the machine.

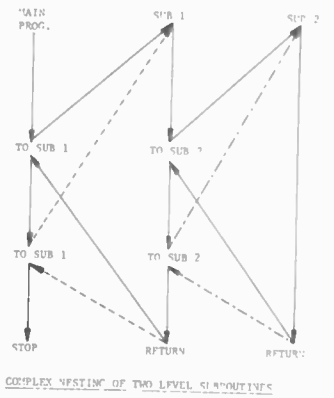
The second major programme we tried was analysis of acoustical data from a transmission loss measurement. This data is in the form of a histogram containing the probability distribution of a given sound pressure level on each side of the partition in each of 18 1/3 octave bands. Each histogram has the range divided into 12 increments. This data must then be processed in the following way:-

I The mean sound pressure level on each side of the partition must be determined for each 1/3 octave.

II The differences in each 1/3 octave must be computed.

III A frequency dependent term must be computed and added to each result.

IV The resulting numbers must be combined in an iterative manner to provide a single figure.



RIGHT: Complex nesting of two level subroutines.

This computation, even when carried out with an adding machine, usually takes 4 to 5 hours. Using the calculator, it was possible to programme the machine in under 1 hour and compute the results in the final required form in 15 minutes.

SUMMARY OF SPECIFICATIONS

Direct keyboard operations.

Arithmetic: addition, subtraction, multiplication, square, square-root.

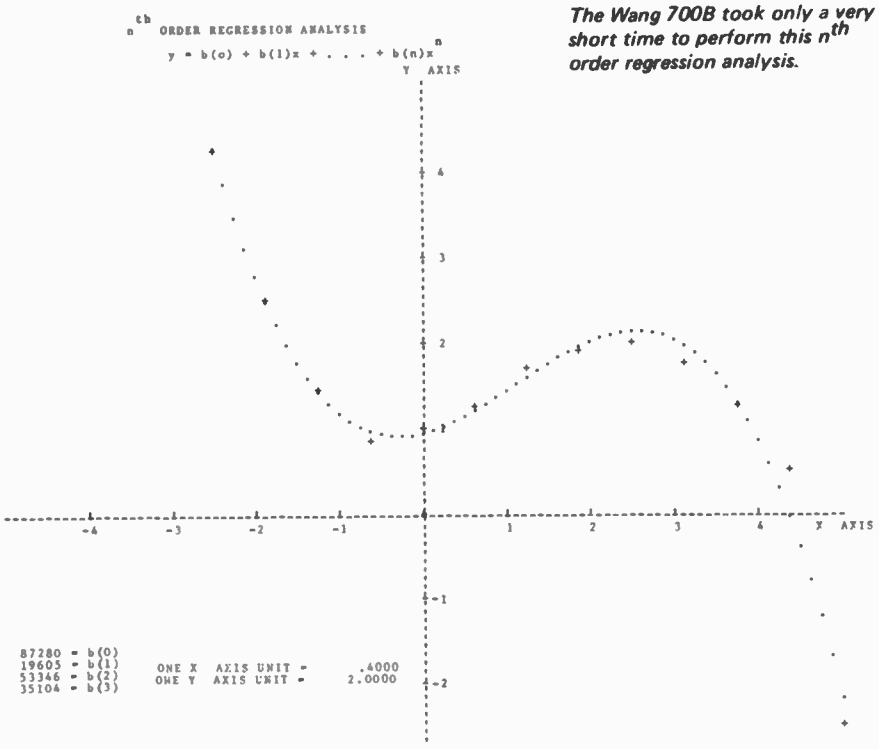
Logarithmic: e^x, 10^x, $\log_e x$, $\log_{10} x$

Miscellaneous: INTEGER X, X!, π, $\frac{1}{x}$

Available on Trigonometric Pack (supplied on cassette) as single key operation.

Degrees to Radians
Radians to Degrees
Sin x
Cos x
Tan x
$\sin^{-1} x$
$\cos^{-1} x$
$\tan^{-1} x$
Rectangular to Polar
Polar to Rectangular
Sinh x
Cosh x
Tanh X
$\sinh^{-1} x$
$\cosh^{-1} x$
$\tanh^{-1} x$

Available on Statistics Pack as single key operations (supplied on cassette).



The Wang 700B took only a very short time to perform this n th order regression analysis.

The only criticism we had of the Wang calculator was a relatively minor one. The readout of the programme is in the code stored in the core. While this is adequate, it is very difficult for the new user who has to translate it step by step and, even when used to the machine, it is difficult to 'debug' the programme without decoding it first.

But this is a minor weakness in a machine which appears to be head and shoulders above others in the same price range.

We agree with 'Playboy', which in one of its recent articles recommended the Wang 700 calculator as the ideal gift for the man-who-has-everything.

LAST PAGE OF RESULTS OF TRANSMISSION LOSS CALCULATIONS

FREQUENCY 4000 HZ	
POSITION	
1	44.0
2	43.0
3	42.1
4	43.3
5	43.7
6	42.9
7	43.2
8	44.9
MEAN NOISE REDUCTION	43.20
TRANSMISSION LOSS	43.29
FREQUENCY 5000 HZ	
POSITION	
1	44.3
2	45.0
3	44.1
4	44.9
5	44.7
6	44.2
7	45.1
8	44.7
MEAN NOISE REDUCTION	44.62
TRANSMISSION LOSS	37.70
SOUND TRANSMISSION CLASS	32.0

Mean, Variance and Standard Deviation
Normal Distribution
Inverse Normal Distribution
X^2 Test
X^2 Distribution
Error Function
Binomial Distribution
Factorial
Linear Regression
Gamma Function
Negative Binomial Distribution
Poisson Distribution
Random Number Generator

In addition to these functions, it is possible to prepare your own tape which can contain up to 64 simple key-operated functions.

FORMAT: Fixed or Floating Point.

SPEED: Times for completion of the following operations:
Add, subtract in 300 m/sec.
Multiply, divide in 5 m/sec.
Square 6 m/sec.
Square root 8 m/sec.
Sin, Cos, Tan 250 m/sec. on all trig functions.
$Log_{10}x$ 8 m/sec.

INPUTS: Keyboard, optionally, drum memory, and output of analogue to digital convertor.

OUTPUTS: 701 typewriter, 702 plotting output writer, drum memory, compact cassette and 2 Nixie displays.

PROGRAMME INSTRUCTIONS
Conditional branching 12 'SKIP IF' statement.
Unconditional branching 'MARK' and 'SEARCH' statement.

Labroutines: 5 level subroutine nesting.

Stop: to allow operator to enter data, display results or make decisions.

Pause: produces 0.5 second pause for display of intermedial results in programs.

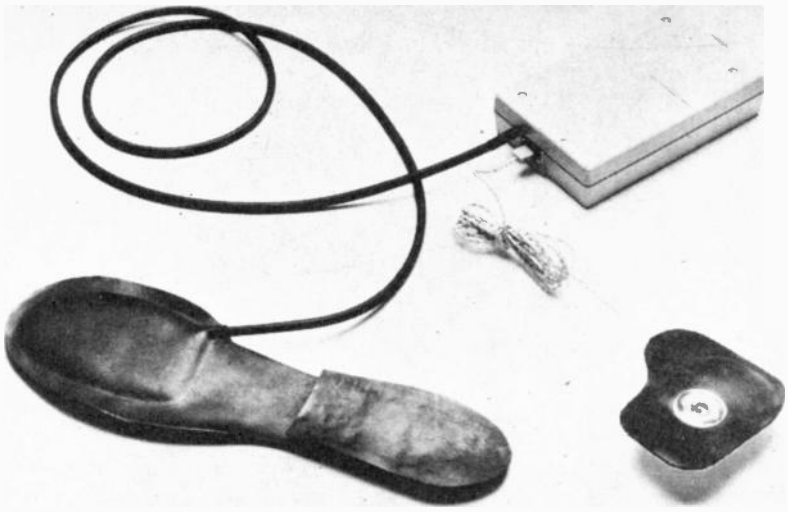
Direct addressing: allows a storage register to be specified directly.

Indirect addressing of registers: allows a storage register to be specified by computation or by entry of a number into div 'Y' register at time of execution of program.

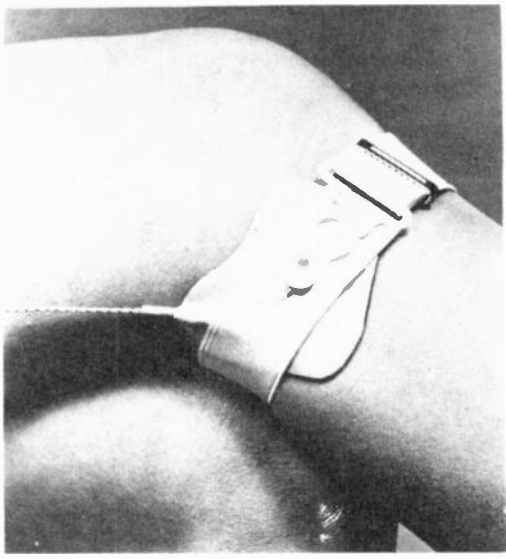
Recall Residues: Toroid core memory. 2 display registers and 120 storage register with capacity of 960 instruction (a total of 8K bits).

MEMORY: Read only memory containing 88K bits for control by the control processing unit.

ACCESSORIES PROVIDED
1 pre-recorded cassette containing the trigonometric and the plotistical package.
1 blank cassette.
Programme reference book containing programmes used in several scientific fields.
Reference manual.



Complete kit consists of a rubber inner sole with small air chamber (left), connected by a tube to a pneumatic switch in a pulse generator (top right) which in turn is connected to an electrode (bottom right).



The electrode is fastened to the patient's leg by a strap and connected with the pulse generator on the patient's belt.

Stimulator helps handicapped walkers

electronics in Medicine

WHAT is so unusual about wiping your feet on the doormat or walking normally? Nothing – unless you happen to be hemiplegic.

As a result of certain nervous disorders or brain damage, the muscles which should lift the foot when walking fail to function. The disability, known as hemiplegia or 'dropfoot', causes the sufferer to continue standing on his sound leg until the affected foot is safely on the gound. The resulting unstable, dragging gait is both slow and tiring, even when using a walking stick.

Research into methods of overcoming this disability suggested that a solution might be to apply electrical stimuli to the nerve, causing the peroneal muscle of the affected leg to contract at the right times. W. T. Liberson, of Hines, Illinois, U.S.A., carried out field experiments using a portable electronic muscle stimulator with a mechanical switch placed under the heel of the affected foot. A number of patients seemed to develop an improved gait.

Subsequently J. Vredenbregt, of the Institute for Perception Research, and J. J. van Leeuwen, of the Rehabilitation Centre at Eindhoven (Holland), examined this method but encountered timing problems. They noticed that the beginning and the end of the swing phase of the affected foot coincided with the instants when the patient's weight was placed on, and withdrawn from, the ball of the unaffected foot.

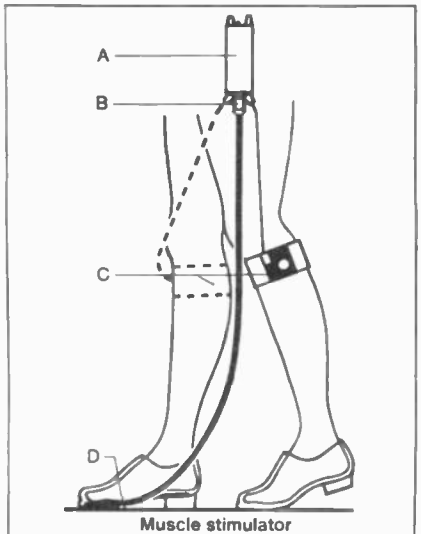
So they placed a switch on the sole of the foot, near the ball of this foot. This was only a partial success. Normal walking was possible in many cases on hard level ground, but the vulnerable mechanical switch wore out rapidly.

Vredenbregt then developed a rubber inner-sole containing a small air chamber, connected via a tube to a pneumatic switch. The inner-sole is placed in the shoe, the air chamber fitting under the ball of the foot. When the body weight rests on the inner-sole, the switch actuates a stimulator.

The stimulator, which fits on a belt round the patient's waist, generates a 50 Hz rectangular pulse of 0.6 ms duration, with a maximum amplitude of 100 V. These pulses stimulate the nerve concerned via a combined active and passive electrode on the patient's leg.

This system has proved highly reliable, and the switch operates on any kind of ground without damage – an essential factor in promoting the confidence of the user.

Results of tests with 65 hemiplegic patients showed that all had an improved gait when using the device. It is an unexplained physiological fact that, after 3 to 6 weeks training, 55 of them walked almost normally or showed considerable improvement even without the device. Children, hemiplegic from birth and therefore never having learned to walk normally, have also shown promising results after 4 to 5 months. ●



Muscle stimulator
A. generator B pneumatic switch
C. combined electrode D insole

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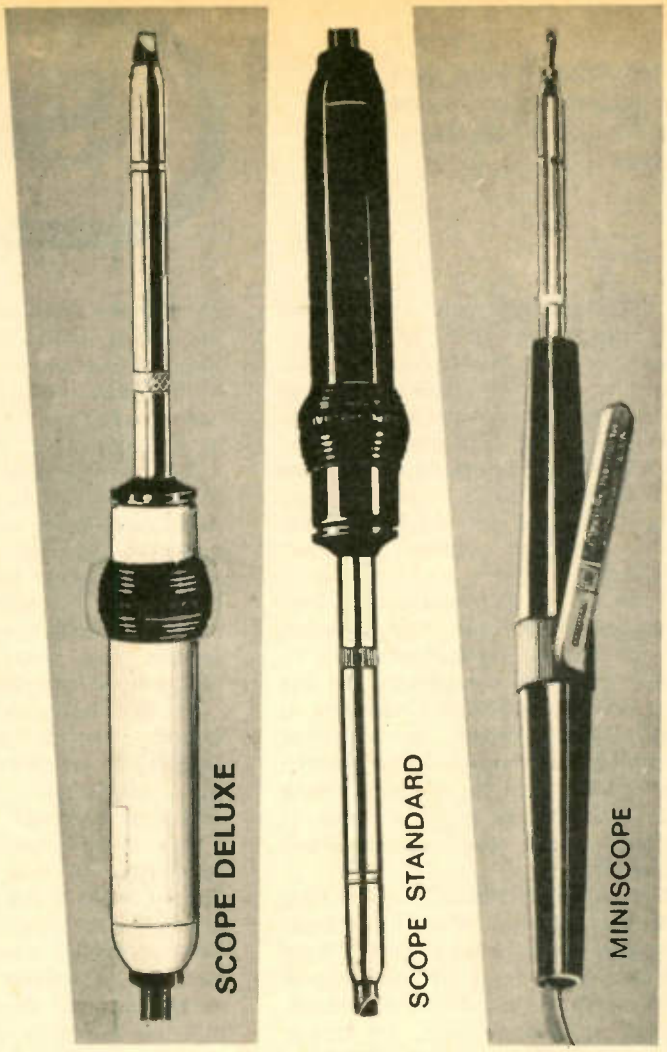

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ET

Latest four-channel tape recorder to reach Australia is the Akai 1730 SS. Here are the details . . .

SURROUND

LAST MONTH one of the largest importers of high-fidelity equipment in this country, Akai Australia, arranged a special function for the key people in the audio field to view their latest products — the Akai Model 1730-SS Surround Stereo tape recorder, the 1730-SS Surround Stereo tape deck, and the AA-6100 Solid State Surround Stereo pre-main amplifier.

These are the first production units of a commercial range of four-channel tape recorders to reach Australia.

Akai of Japan consistently led the field in developing new concepts in tape recorder design, so it is not surprising that they have again beaten their competition in releasing a new and well-designed product range of surround-stereo tape recorders and accessories.

Although the standard range of Akai tape recorders use the cross-field head principle, these new recorders have returned to a form of conventional head system — but with a difference. Instead of pressure pads, the tape is held against the heads by tape tension — and whilst this practice is a little unconventional, it has been used before and used successfully.

The 1730-SS and 1730D-SS mark a completely new approach to recorder design for Akai. First, they are based almost completely on the use of integrated circuits for all major circuit sections, from preamplifiers to main amplifiers — and, secondly, Akai have rationalised their approach in the design of the two machines to make them as simple and as inexpensive as possible.

The reasons for this are quite straight forward. The market is limited for such machines, and many people may be frightened away from surround-stereo if prices are not kept down to a reasonable level.

LACK OF TAPES

The main problem, however, lies in the basic concept of surround-stereo itself and, more particularly, in taped surround-stereo. Whilst the majority of owners of tape recorders beg, borrow, buy or steal material which they themselves record — usually from records — very few, except possibly Americans, buy prerecorded tapes. It is our observation that most prerecorded tapes are not comparable in quality with the same material recorded on records, because of the high-speed multiple recording techniques used by tape manufacturers.

The four-channel surround-stereo tapes currently available are particularly poor, with little choice of subjects and a quality so mediocre that a mere amateur could safely claim them to be his own work. Worse — there is no such thing as four-channel records to copy, or even a four-channel cartridge.

All this leads up to a situation whereby the tape recorder owner is deprived of suitable material which he can himself copy — so what, then, is he supposed to use?

This is obviously far from satisfactory — and whilst Akai are acutely aware of the problem, the firm which was responsible for innovating the concept of demonstration tapes has yet to release their own for surround-stereo! We are led to believe that this is exactly what they will do, as without suitable material, offering a range of content to suit all possible tastes, the market will reject this expensive development.

AKAI'S DEMONSTRATION

Surround-stereo is still in its earliest stages of development. The demonstration which we witnessed impresses us with the problems of application rather than with the technical quality of the article offered.

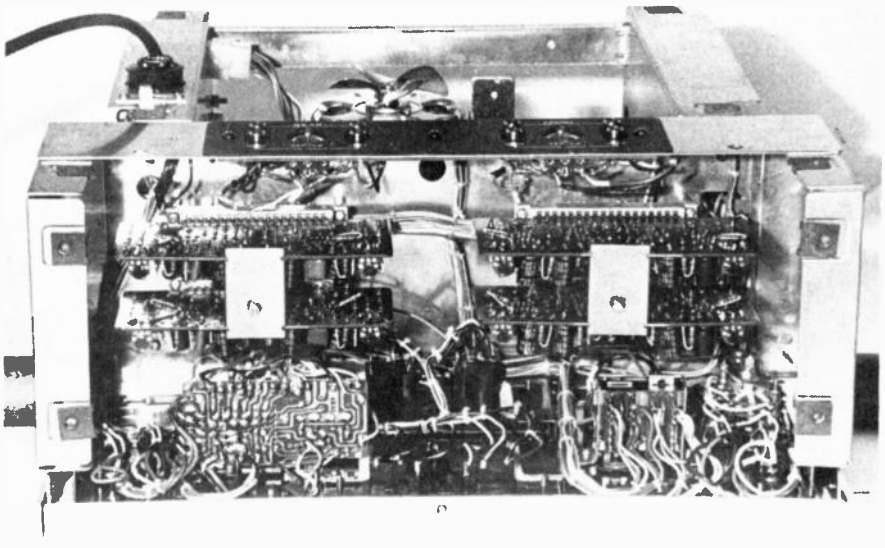
Not that the quality was lacking — far from it. We believe that this is possibly one of the best tape recorders yet produced by Akai, but we are concerned that this development has so far preceded the all-important material needed to justify its viability.

Although Akai have developed and promoted the concept of the cross-field head over the last ten years, and have used this technique almost exclusively, the new four-channel stereo tape recorders have reverted to the conventional principle of a normally biased record head. While most recorders use pressure pads to provide the positive pressure of the tape against the heads, the Akai four-channel recorders have adopted a very simple system which has been used with success in many high-quality tape recorders.

The heads are so arranged that the friction of the supply spool provides the tension on one end of the tape and the capstan drive on the other end. Correct placement of the heads is all that is needed to ensure just the right pressure on each head.

In the present circumstances, it's a good thing for Akai that their new four-channel recorders are almost

Main recording and playback circuits are on plug-in boards housed in bottom of chassis.



SOUND

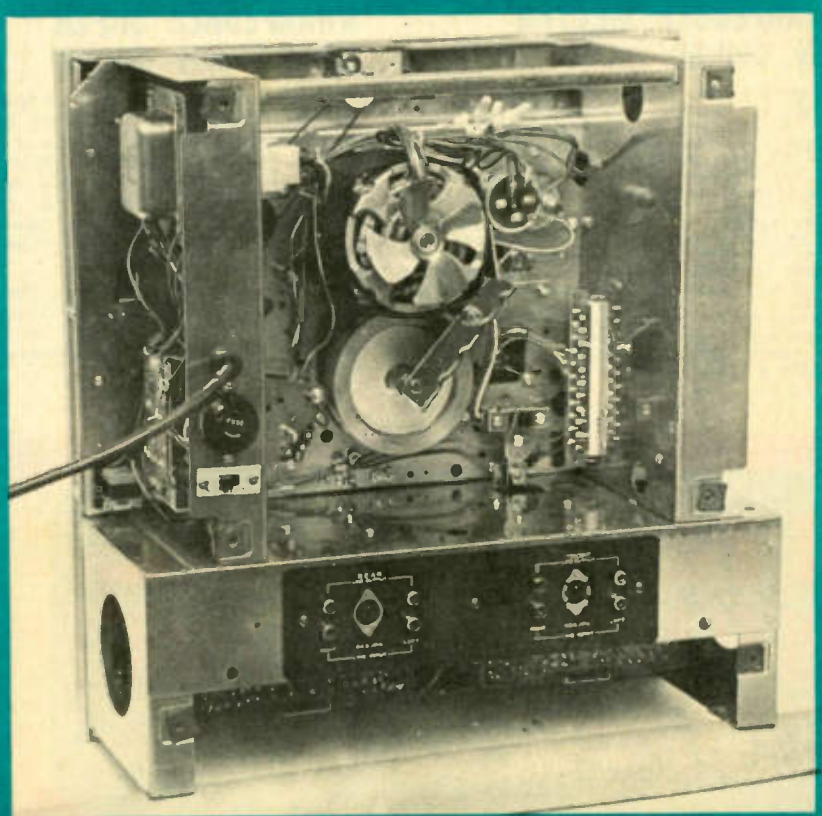
competitively priced with most two-channel stereo systems and perform very well as conventional two-channel stereo.

Time will tell whether the promise of four-channel material to come will be sufficient inducement to the owner of a two-channel system to make the change to a four-channel recorder – but newcomers to the field could choose to spend a few more dollars on four-channel equipment in the first place, and so be ready for any developments that may follow.

As with the early days of two-channel stereophonic sound, it is hard to foresee where the future lies. There's always an element of risk in any attempt to create a need in order to create a market where neither previously existed.

Four-channel stereo could become universal, or it could die out quietly. Meanwhile the whole range of four-channel equipment is becoming available with the leaders like the Akai machines, the conversion kits and the pseudo-four-channel equipment. Only when the programme material becomes available in sufficient quantity to cater to the tastes of a large cross-section of the population, with a quality that meets the exacting requirements of the more particular, will we find out whether the four-channel stereo is here to stay.

The release was arranged as a trade afternoon at the offices of Akai Australia, in which the demonstration was set up under conditions which, regrettably, could not show off the tape recorders to their best advantage. This was possibly worthwhile, because it was a classical example of what problems are liable to arise in public and private demonstrations: as usual, most of 'Murphy's Laws' held good and 'what could be expected not to go wrong' did go wrong.



TOP RIGHT: Sound level from each of the four channels is checked by its own VU meter.

RIGHT: Open layout of chassis provides easy access for servicing of components.

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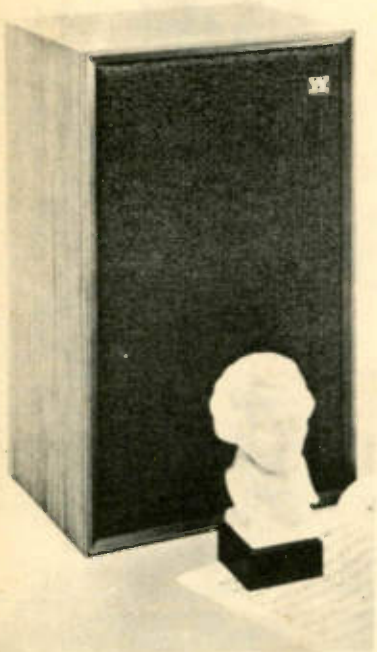

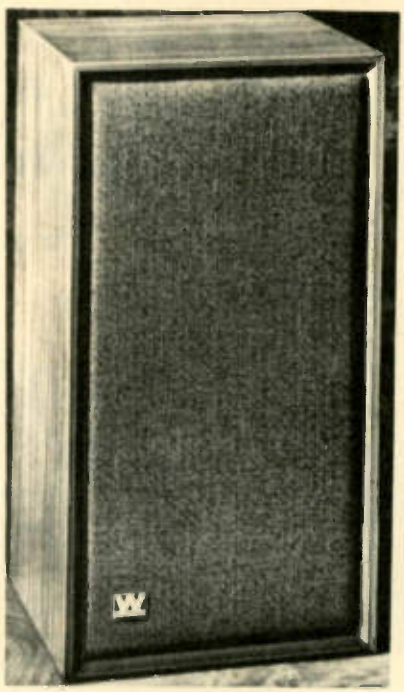

WHARFEDALE MELTON only $90.00

The Melton gives you the advantages of big speaker systems in a compact cabinet. Using the new Unit 4 speaker kit, a clear, firm bass response is achieved from the wide-spectrum 12in. bass unit and the acoustiprene low mass tweeter gives smooth treble performance. The electrical cross-over unit links bass and treble speakers at 1,500 Hz and it is at this point that each speaker is designed to roll-off mechanically. The result is smooth response from 45 Hz to 17,000 Hz. Power handling capacity is 20 watts R.M.S.
The new Instrol enclosure kit, in Teak or Queensland Maple, is exactly to Wharfedale specifications and measures 24¼in. x 14¼in. x 11¼in.

WHARFEDALE SUPER LINTON only $49.00

Using the ever-popular Wharfedale Unit 3 kit, this system gives full-blooded bass response, astonishing for the size of the cabinet. Frequency response of 40 Hz to 17,000 Hz is achieved with an 8in. bass/mid-range unit that has a 4in. cast ceramic magnet weighing 3½lb., together with a treble pressure unit. Power handling capacity is 15 watts.

The Instrol enclosure kit is according to specifications laid down by Wharfedale and measures 21in. x 11½in. x 9½in. The kits are available in Teak or Queensland Maple.

WHARFEDALE DOVEDALE 111 only $128.00

The new Unit 5 speaker kit by Wharfedale contains the 12in. bass, 5in. mid-range and 1in. tweeter that enables Dovedale to give the smoothest performance ever produced. The new Instrol enclosure kit is exactly to Wharfedale specifications . . . all timber parts are precision cut, fit together smoothly . . . panels are best-quality veneered in selected Teak or Queensland Maple.
Check the following features:

● Three-way system for only $135.00 ● Unique Cross-over system ● 40 Hz to 20,000 Hz without any audible peaks.

● Power handling capacity of 35 watts R.M.S. ● Cabinet size 29½in. x 17in. x 11½in.

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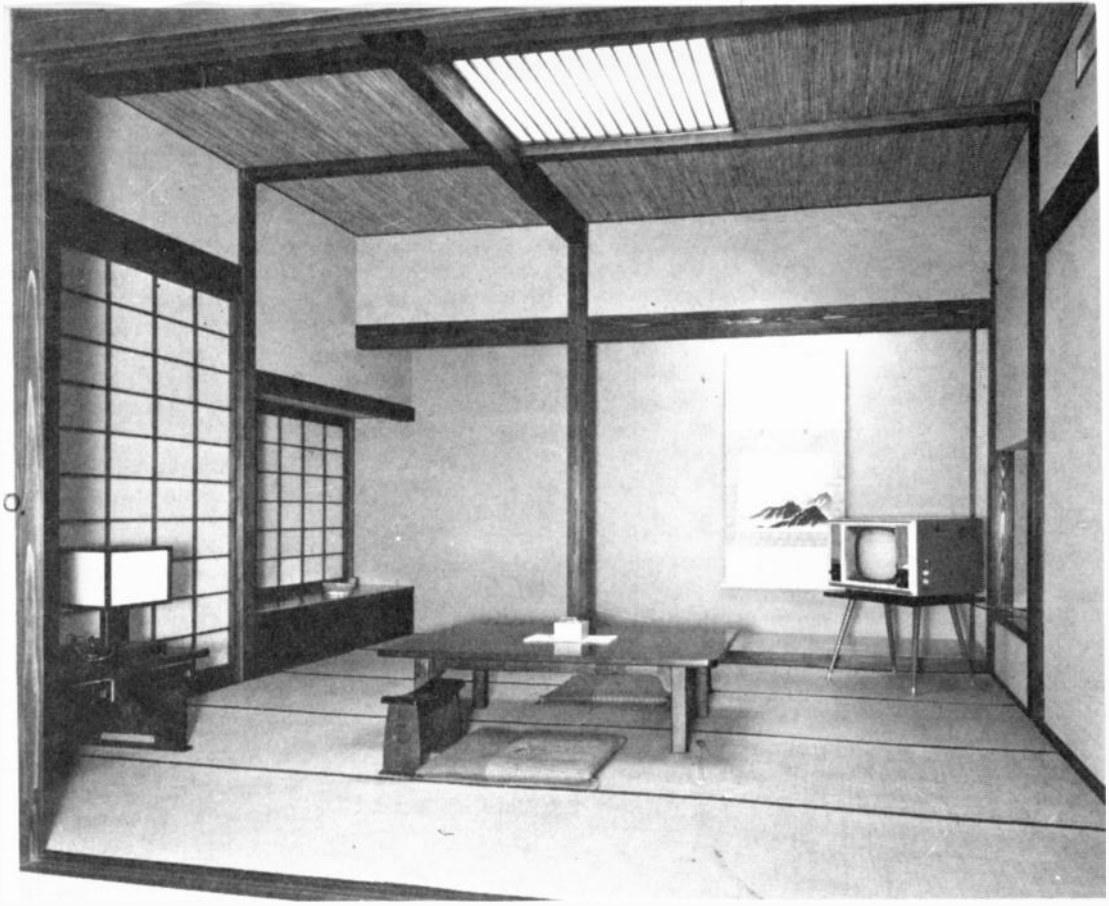
Do Japanese speakers really sound different from most others? We asked one of our testing consultants to investigate this often-voiced opinion. Here is his report.



Typical living-room in a traditional Japanese home. Acoustically transparent building materials and sparse furniture result in a shorter reverberation time than would be experienced in a similar-size Western type room.

SOUNDS OF THE ORIENT

AT A RECENT trade function, a friend floored me with the question: "Why do Japanese loud speaker systems sound different from those manufactured in other countries?"

While I was trying to digest this, he continued: "Is it because Japanese speakers are designed for Japanese houses, which are quite different from ours?"

By this time I was looking for a doorway to slip through, for I knew I couldn't answer those questions. Never having seen a Japanese house, I was starting to wish I hadn't accepted that invitation to the trade night.

Luckily, a Japanese face appeared on the other side of the room, accompanied by someone I recognised. Taking charge of a situation which had appeared hopeless, I led my tormentor over to the new arrivals and got him to repeat his questions.

The Japanese gentleman turned out to be Hajime Uchida, of the Pioneer Electric Corporation, Tokyo – and he at least had some original thoughts on the subject, together with facts and figures to back them up.

The ensuing conversation proved most interesting and helped to crystallise my thoughts, on a subject to which, frankly, I hadn't previously given much attention.

First, do Japanese speaker systems in fact sound differently from those manufactured by other nations?

The answer is unquestionably yes – and the reason has been stated by some to be the result of the initial design philosophy which resulted in the speaker systems being designed to meet the acoustical requirements of the Japanese market.

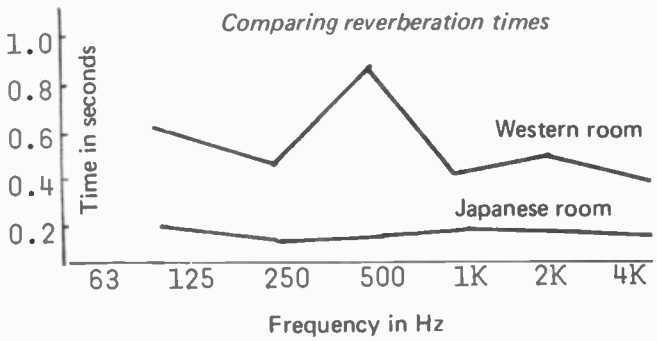
DIFFERENT ACOUSTICS

There is no doubt that the average Japanese house has acoustical characteristics very different from those of the Western (or, more particularly, the Australian) house, but I have yet to be convinced that this is the primary cause of the different speaker sound.

The first acoustical difference between Japanese and Western houses is in the reverberation time (the time taken for multiple reflections of the sound wave to die away). The second, which is associated with the first, is due to the type of furnishings in the Japanese house.

The third difference is in the type of music most popular in Japan – but, as with the first two differences, the influence of Western culture is starting to tell and all these differences are being slowly reduced.

Comparing reverberation times



The accompanying graph shows that, while the traditional Japanese house has a short reverberation time, the Western house – and most certainly the Australian house – is more *live* and far more demanding of speaker performance as far as room coloration is concerned.

Room acoustics are almost as important as the

SOUNDS OF THE ORIENT

performance of the speaker, particularly at the low frequency end of the spectrum.

The typical Western house has four brick or brick-and-plasterboard walls. Where windows are installed, these are generally of reasonable size, with less than half the window area open. Although our floors are generally wood (or sometimes concrete), they are covered with carpets which only offer a reasonable absorption above 1kHz, and the ceilings are always reflective. Our taste in furniture has changed, and whilst we used to go for well-padded armchairs of massive proportions (which offered great acoustical absorption), today small open-frame chairs are more in favour.

Because our rooms are small, with physical dimensions not conducive to the proper reproduction of sounds below about 100Hz, our speakers have an even harder task to provide satisfaction. Western style Japanese rooms are even smaller.

By contrast, the classical Japanese house is constructed with wooden wall frames. These are covered by large areas of paper which is acoustically transparent, and there is usually little furniture.

Whereas the Western house may typically have a reverberation time ranging between 0.5 and 0.75 seconds, the Japanese house has a reverberation time ranging between 0.2 and 0.3 seconds.

This reverberation time is equal to that of a small broadcast studio, and consequently the Japanese room acoustics play little part in determining the performance of the speakers used.

It is at the low frequency end of the spectrum that the main differences occur between Japanese speakers and those designed elsewhere.

Whilst the majority of Japanese speakers have performances which appear to be between critical and overdamped in the region below 100 Hz, most other speakers have either slightly rising response, or a sometimes deliberate peaking response. The reasons for this are often associated with speaker box panel resonance and are usually deliberate.

DIFFERENT SPEAKER DESIGNS

Most Japanese speakers sold in Australia are either fully sealed enclosures or flat arrays suitable for wall mounting. Neither of these systems offers particularly good bass performance. By contrast, most of the newest speaker systems sold or developed in the U.S.A., including the bookcase types, are vented enclosures or use a passive radiator, which is more or less equivalent to a vented enclosure. Either of these approaches provides an enhancement of the low frequency performance and meets the requirements of the current vogue in music where we find an increasing use of drums, electric organs and electric guitars.

Over the past three years we have tested a number of Japanese speakers and generally find that they do not sound the same as speakers made elsewhere.

In laboratory testing of vented enclosures and sealed enclosures of the same size, it has been quite obvious that the speakers with the best bass content or efficiency have usually incorporated either a tuned port or a passive radiator. The majority of Japanese speakers have been sealed enclosures – and, surprisingly, there is no consistency in the range produced by any one manufacturer.

Pioneer speaker systems are nearly all sealed enclosures, with groups of speakers arranged for either a multi-amplifier system or with internal cross-over networks.

Akai, who used to specialise in baffle mounted speakers, now also produce mainly sealed enclosures – with the exception of their smallest speaker enclosure, which is based on a folded horn.

Sansui, however, offer vented enclosures – and generally, for a given size of cabinet, they are able to produce a slightly better low frequency response than some of their competitors.

COMPARING FOUR SPEAKERS

We decided to test three of the latest Japanese sealed enclosures available on the Australian market, together with one American system, to check out whether things had changed since our last major testing programme was carried out.

For our test we took four representative speaker systems from the many that we listened to. These were:

- A set of Sansui SP 3000 speaker systems.
- A set of Pioneer CSA 700 speaker systems.
- A set of Akai SW 170 A speaker systems.
- A set of J.B.L. 'Professional Series' control room monitors.

Although the price differential is marked between the American-made J.B.L. equipment and the Japanese system, internal volumes are fairly comparable.

Prices, and main characteristics, are tabulated below.

Brand	J.B.L.	PIONEER	AKAI	SANSUI
Model	4310	CSA 700	SW170	SP 3000
Volume (cu.ft.)	2.3	2.7	2.7	2.8
Price (each)	$400	$250	$281.50	$239
Weight (lb.)	57	37.2	35.3	45
Impedance (Ω)	8	8	8	8
No. of speakers	3	3	6	6
Diameter of largest speaker:	12"	12"	15"	15"

The purpose of these tests was not to prove that one speaker system was bad or another good, but rather to show the difference in frequency response which can result from differences in design philosophy.

As can be seen from the accompanying measurements of frequency response, there is a considerable difference in the respective performances.

The majority of Japanese speaker manufacturers have apparently embarked on a 'gimmick war'.

Thus the majority of new Japanese speaker systems costing above $200 seem to contain increasing numbers of speakers whose dimensions are out of all proportion to the size of the cabinet. Rather than improving the performance of the system, it has been our observation that the contrary is just as likely to happen.

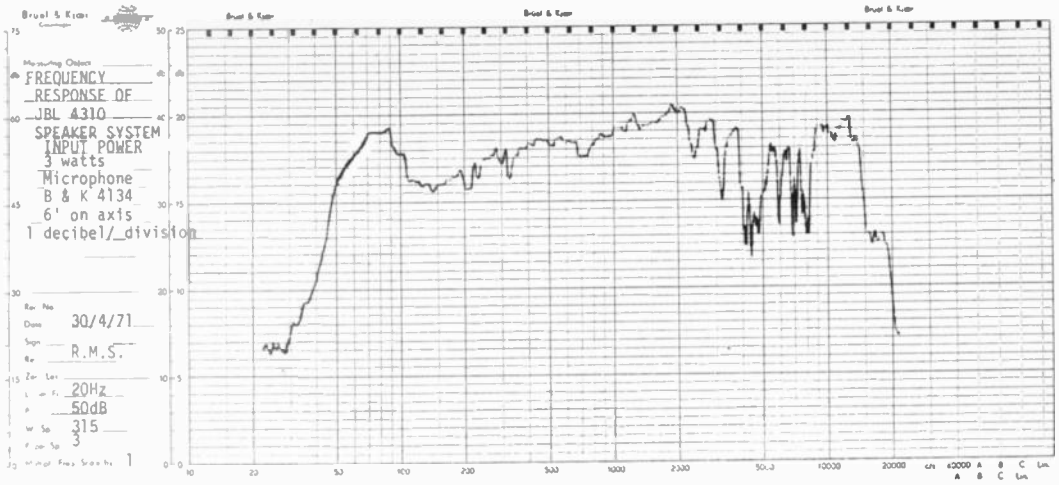
Whilst the low frequency performance is much improved over previous Japanese speakers we have tested, it is clear that the addition of a 15" speaker in a cabinet designed for a 10" speaker does nothing for the performance even if the cabinet is vented, and serves mainly for advertising purposes.

Similarly, a large number of high frequency speakers in a unit offering moderate performance can hardly be justified. To our mind, the money would have been better spent on a three-speaker system with better speakers. As is evident from the performance of the Pioneer speaker system, a three-unit system at the same price can offer better performance.

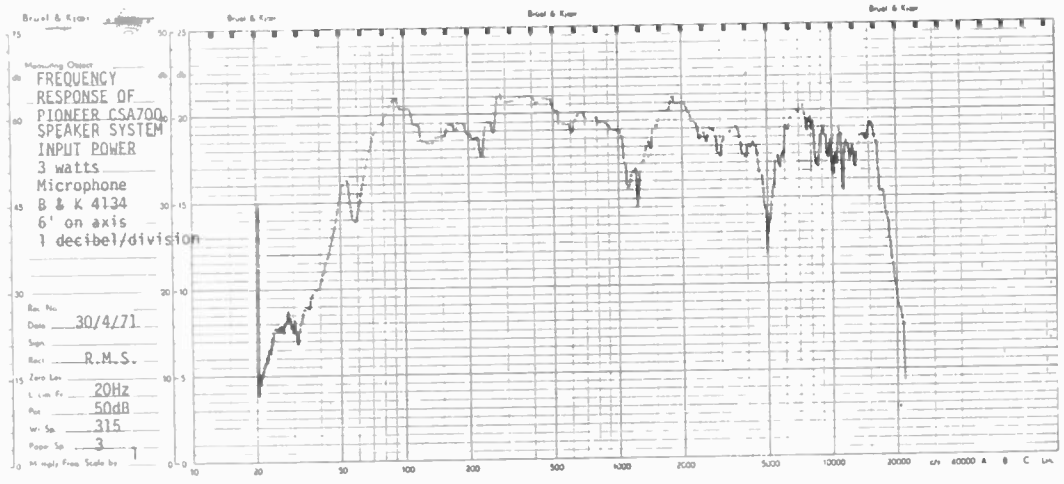
The results of our investigations of speaker performance have only confirmed what we originally thought. Japanese speakers *do* sound different from European or American speaker systems – but it is more likely that this is the result of the design or marketing philosophy than because of Japanese room acoustics. ●

Frequency response curves of the four speakers tested. Note the difference in response below 100 Hertz between the three Japanese speakers and the JBL system used for comparison.

JBL



PIONEER



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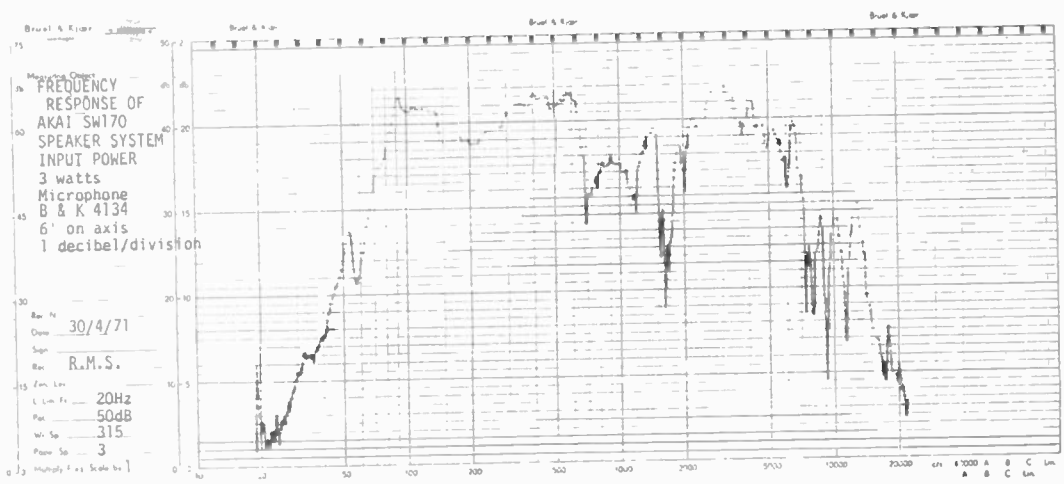

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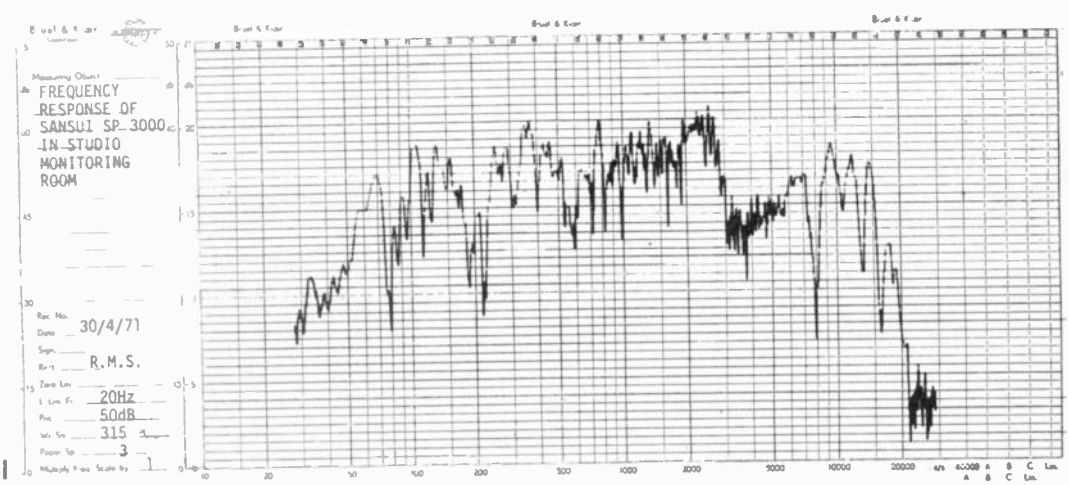


Ancient and modern. Etonians in traditional College garb learn to use their newly-acquired Marconi-Elliott 903 computer.

Electronics in Education

ANOTHER SCHOOL COMPUTER

A Marconi-Elliott 903 medium-sized, low-cost British computer has been installed at Eton College, the famous Buckinghamshire public school. Pupils are using the 903 to learn what computers are, what they do, and how to make them do it.

By operating it themselves, in conjunction with a paper tape punch and reader and on-line teletype providing the necessary input/output facilities, the boys are becoming familiar with technical terms and programme writing, and are gaining knowledge of order and instruction codes.

This computer is also being used at the College to perform complex astronomy calculations, to process examination marks, and for the correlation of examination entries.

COMPUTER MARKS EXAM PAPERS

Multiple-choice examination papers are being marked by a computer in Britain's Enfield College of Technology.

The candidates' completed papers are processed by a commercial card punching agency. The punched cards are compared by the computer against a correct master card. Each candidate's score is then compiled on magnetic tape.

Sceptical teachers were silenced when, compared to manual marking, the computer increased accuracy ten times, reduced costs to one-third, and halved the processing time.

PSYCHOLOGY: NEW APPROACH

The Department of Psychology at the University of Melbourne has recently purchased a PDP-11/20 computer from Digital Equipment Australia Pty. Ltd. which will increase the scope of its experiments and make possible more meaningful results.

Main uses of the computer will be in studies in perception, learning and thinking. The computer will also be used extensively in the scoring and interpretation of tests, and as a major aid in training students in properly conducting tests of ability and personality.

Because there are large variations between people, it is often necessary to conduct psychological experiments on large numbers of subjects for reliable results to be achieved. The computer at the University of Melbourne enables many subjects to be tested at the same time and under identical conditions. This procedure eliminates possible variations in the results caused by differences in test methods, and speeds up the overall test programme.

Specific applications envisaged by the Department include studies of reaction time, where the computer monitors the responses of subjects to varied sequences of visual or auditory test stimuli. Responses such as bodily movements and physiological data such as heart rates can be monitored while the computer controls the projection of slides on a screen. These experiments can provide invaluable information about personality traits and behaviour under stress.

Another planned application, in social psychology, is the simulation by the computer of a second person. Studying the social relationship between the subject and the simulated person enables human behavioural models to be tested for validity. In the area of education, the computer will greatly assist the evaluation of various programmed teaching techniques.

The PDP-11/20 purchased by the University of Melbourne has 4096 16-bit words of core storage. With four levels of priority interrupt that permit any number of separate peripheral devices to be attached at each level, the computer is ideally suited for monitoring a wide variety of experiments in the behavioural sciences.

COMPUTERISED EDUCATION

The University of Illinois has installed a Control Data 6400 super-scale computer system for research and development in the use of high-speed computers as teaching and learning tools.

The CDC 6400 is to be used to continue development of PLATO (Programmed Logic for Automatic Teaching Operations), which designates the Computer-Based Education (CBE) system as well as the overall programme at the University of Illinois.

Computer-assisted instruction retrieval terminals, located in classrooms, connect directly to the central 6400 for lesson material presentation and information feedback. The system has about 1000 terminals but is designed to handle 4000 when fully expanded.

The University says that since 1959, the PLATO programme has been committed to exploring educational possibilities, and engineering and economical problems associated with the introduction of modern high-speed computers to the educational process.

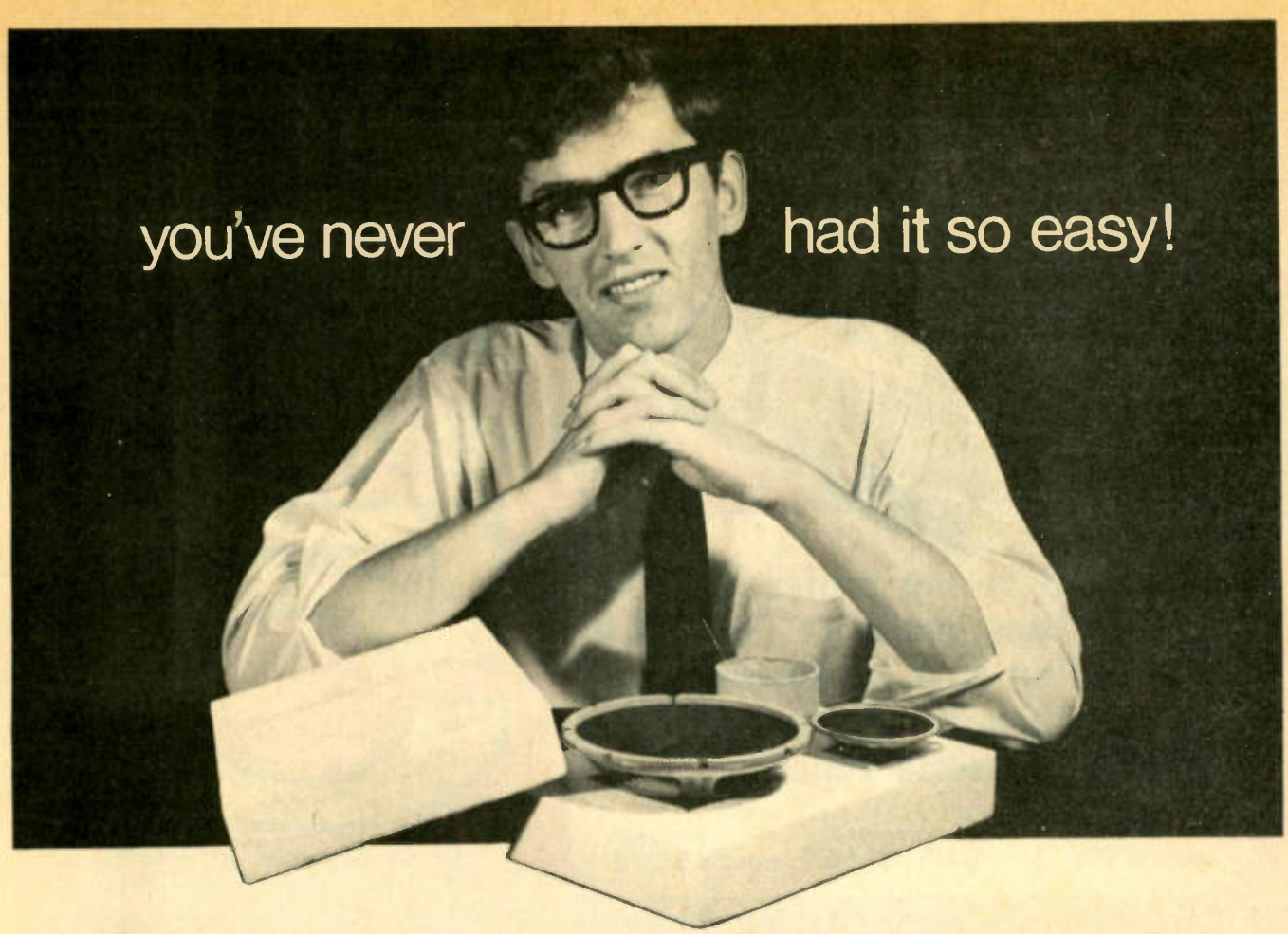
In the last decade numerous groups at other universities, research centres and corporations have engaged in studies to utilise computer techniques for instruction, believing that the computer could resolve the conflict between the demand for mass education over a large period of the human lifespan, and the demand for more individualised instruction.

PLATO proceeds on the premise that existing technology, while valuable for research, has made no significant economical or practical contribution to the nation's educational programme. Among approximately 75 projects under way, PLATO is one of few that have included research and development programmes in all aspects of systems design for hardware and software innovations and teaching strategy.

University officials point out that several key features of the 6400-PLATO system capture the enthusiasm of teachers and students alike and provide a base for determining the effectiveness of lesson material, teaching strategy and methods of presentations.

The interactive nature of instructional media holds the interest and totally involves students of all ages and grade levels. The student proceeds at his own pace and has a wide choice of alternatives in teaching strategy and method of presentation. Information feedback allows students to ask various questions and provides teachers with detailed descriptions of student progress – a powerful tool for lesson evaluation and modification.

Teachers can prepare, edit or modify lesson material at any student console, at any location, while other student consoles are in use. Lessons prepared elsewhere may be modified at any participating site, to fit the particular needs of a specific class.



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

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

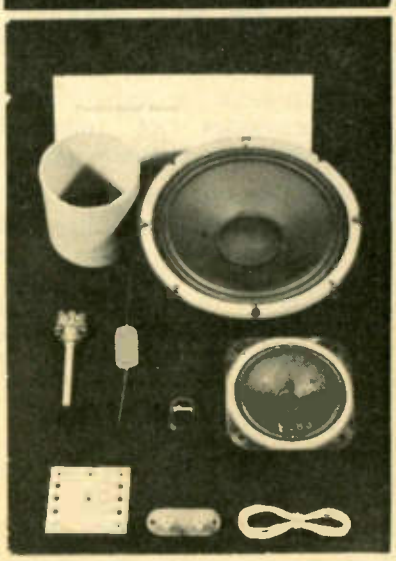
C60 Woofer

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

C3GX Tweeter

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

kit components



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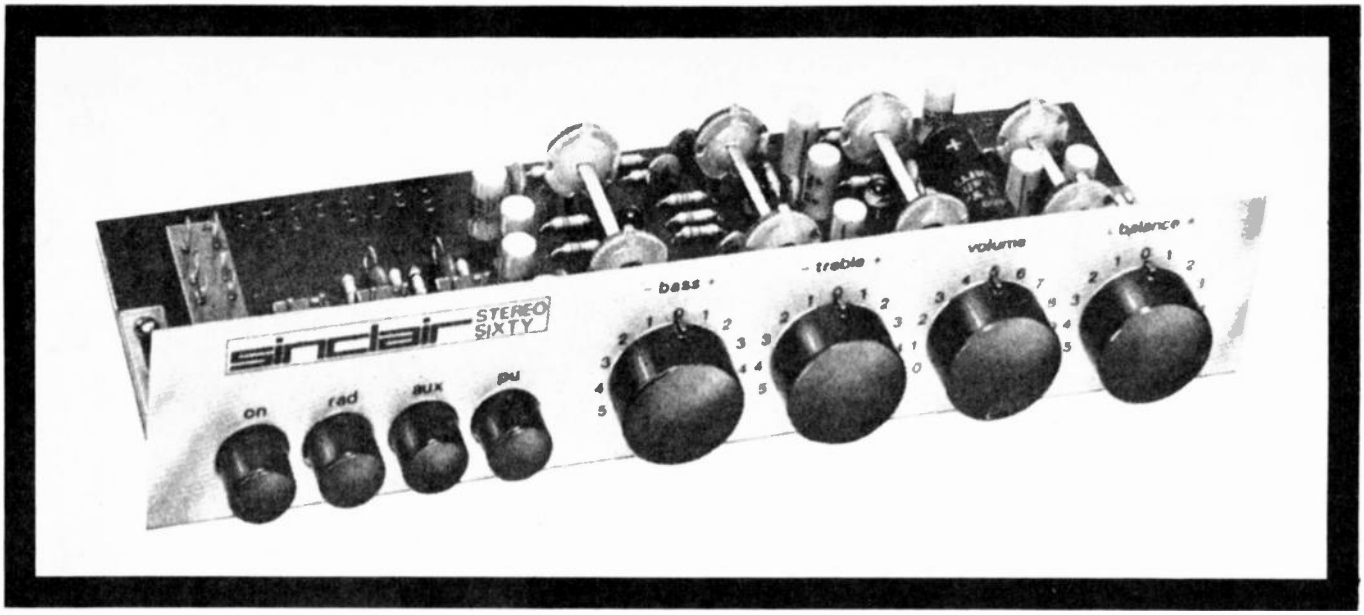


Measuring noise in amplifiers

Totally accurate descriptions of amplifier noise must relate both operating frequency and source resistance. This article, by the technical staff of Princeton Applied Research, explains the technique.

A VARIETY of techniques have been used to measure and specify the noise characteristics of amplifiers. One of the best-known and certainly the simplest technique is to short the amplifier input to ground and measure the rms voltage appearing at the output over a specified bandwidth. This value is then divided by the gain of the amplifier and the resultant figure is specified as 'noise referred to the input'.

This method is probably satisfactory where a comparison of a number of amplifiers is to be made and the proposed operational bandwidth of the amplifiers is known.

If an accurate description of amplifier noise is to be determined, it is necessary to realize that amplifier noise is a function of both operating frequency and source resistance. The 'noise referred to the input' technique disregards the fact that source resistance exists in every application. This source resistance may vary from several tenths of an ohm, for devices such as thermocouples, to many megohms for photomultiplier tubes or vibrating capacitors.

In order to specify completely the noise performance characteristics of any amplifier, the designer must measure the noise at a number of different frequencies and source resistances. To accomplish this type of measurement the following test circuit can be used.

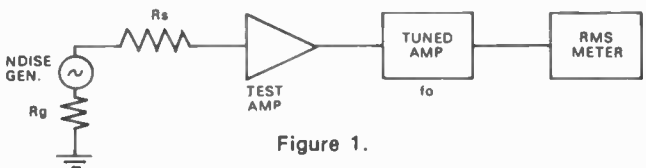


Figure 1.

A calibrated white noise generator (equal power per unit bandwidth) is set for zero output and the source resistance (R_S) is inserted into the circuit. The tuned amplifier is adjusted to the desired centre frequency. Under these conditions the reading on the rms meter is read and recorded. The noise generator output is then increased from zero until the rms meter reads 1.4 times its former value. (Noise power adds directly but noise voltage adds vectorially, so 1 mV of noise equals 1.414 mV of total noise.) At this point the calibrated front panel meter of the noise generator reads the total noise due to the amplifier plus the source resistance in volt-$Hz^{-\frac{1}{2}}$.

By varying the source resistance while maintaining the centre frequency constant the total noise as a function of source resistance can be determined. By varying the centre frequency while maintaining the source resistance constant, total noise as a function of frequency can be determined.

Once the entire frequency range and source resistance range of the amplifier have been measured, the data must

Measuring noise in amplifiers

be reduced for presentation in a relatively straightforward way. One method is to calculate the noise figure for each frequency and source resistance combination for which data has been recorded.

The noise figure relates the amount of noise being added by the amplifier to the amount of Johnson noise inherent in the source resistor. Johnson noise is an rms voltage generated in a resistor due to random electron motion present at any temperature above absolute zero. It can be calculated from the following equation:

$$E_n = \sqrt{4KTR_SB_N} \qquad (1)$$

where:

- E_n = rms noise voltage within a bandwidth of measurement.
- K = Boltzmann's constant = 1.38×10^{-23} joules/Kelvin.
- T = Absolute temperature in Kelvins.
- R_S = Resistive component in the impedance across which the voltage is measured.
- B_N = Bandwidth across which the noise voltage is measured.

$$\frac{E_N}{\sqrt{Hz}} = 1.28 \times 10^{-10} \sqrt{R_S}$$

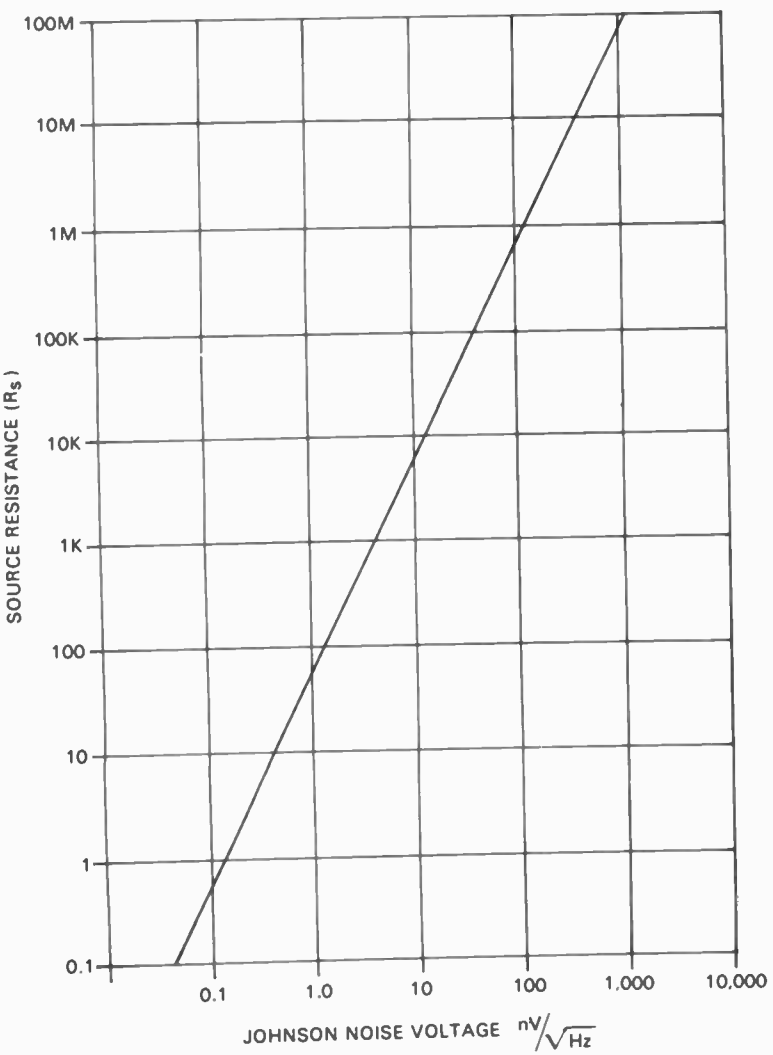


Figure 2.

For any given source resistance operating at room temperature the Johnson noise per root-hertz is:

$$\frac{E_n}{f^{1/2}} = 1.28 \times 10^{-10} R_S^{1/2} \qquad (2)$$

This equation is plotted in Figure 2 for source resistances over the range of 0.1 ohm to 100 megohms.

Since the theoretical noise of the source resistance is now known and the total of this noise plus the amplifier noise has been measured, the noise figure can be calculated from the following equation:

$$NF = 20 \log 10 \frac{\text{Johnson noise + Amplifier noise (measured)}}{\text{Johnson noise (calculated from Equation 1)}} \qquad (3)$$

The three variables of frequency, source resistance and noise figure can best be shown by plotting the contours of constant noise figure on full logarithmic frequency vs. source resistance scales. A typical set of noise figure contours for a low noise preamplifier is shown in Figure 3. As can be seen, this noise figure specification completely describes the noise performance of the amplifier for every source resistance and frequency combination over which it was designed to operate.

Noise figure controus are extremely useful because of the variety of information which they can provide. Noise figure contours can be used as follows:

1. SELECTION OF THE PROPER PREAMP – When the source resistance and operating frequency are fixed by experimental limitations, the contours of several preamplifiers can be compared to determine the proper instrument for minimum noise. For example, an experiment may be set up in which a modulation frequency of 104 Hz is fixed because a mechanical light chopper is used. A particular infrared semiconductor detector is also being used which fixes the source resistance at 80 kilohms. Since neither of these parameters can be varied, an experimenter could review the noise figure contours of all available preamplifiers to find the one which would provide the lowest noise figure and hence the lowest noise performance.

2. DETERMINING OPTIMUM FREQUENCY AND SOURCE RESISTANCE – If a particular preamplifier is already available, the experimenter may be able to design his experiment so that the source resistance and frequency appear at the lowest noise figure point on the contour. Assume, for example, that the PAR Model 113 Preamplifier was available and the experimenter had relatively wide latitude on frequency and source resistance. From the Model 113 noise figure contour shown in Figure 3 it is evident that, with an operating frequency of 100 Hz and a source resistance of 5 megohms, a noise figure of less than 0.05 dB would be realized. The experimenter would then try to arrange his equipment to provide this combination of source resistance and frequency and thereby obtain the lowest noise possible.

3. APPROXIMATING MINIMUM DETECTABLE SIGNAL – An amplifier cannot usefully amplify signals which are below its own internal noise level. Since noise figure contours provide complete information on internal amplifier noise, they can readily be used to determine the minimum signal one can expect to detect when using a particular amplifier. As mentioned earlier, the noise figure relates total amplifier noise plus Johnson noise to

Johnson noise alone. The Johnson noise from a given source resistance can be obtained from Figure 2. The amplifier noise plus Johnson noise can be calculated by solving Equation 3 for this value as follows:

Johnson noise + Amplifier noise =

$$\text{Johnson noise} \times 10^{\frac{NF}{20}} \qquad (4)$$

Noise Figure (dB)	$10^{\frac{NF}{20}}$
0.05	1.006
0.10	1.012
0.20	1.023
0.50	1.059
1.0	1.122
3.	1.414
6.	1.995
10.	3.162
15.	5.632
20.	10.0
30.	31.62

If it were necessary to calculate the minimum detectable signal of the Model 113 Preamplifier at 1 kHz and 10 kilohms source resistance, the following procedure would be used:

1. From Figure 2, the Johnson noise for the 10 kilohms source resistance is approximately 12 nV-Hz$^{-\frac{1}{2}}$.
2. From the noise figure contour (Figure 3), the noise figure for this source resistance and frequency is 1.0 dB.
3. From Table 1, for a noise figure of 2 dB, $10^{\frac{NF}{20}}$ is 1.222.
4. From Equation 4, the Johnson noise plus amplifier noise is

$$12\ \text{nV-Hz}^{-\frac{1}{2}} \times 10^{\frac{NF}{20}} = 12\ \text{nV-Hz}^{-\frac{1}{2}} \times 1.122 = 13.5\ \text{nV-Hz}^{-\frac{1}{2}}$$

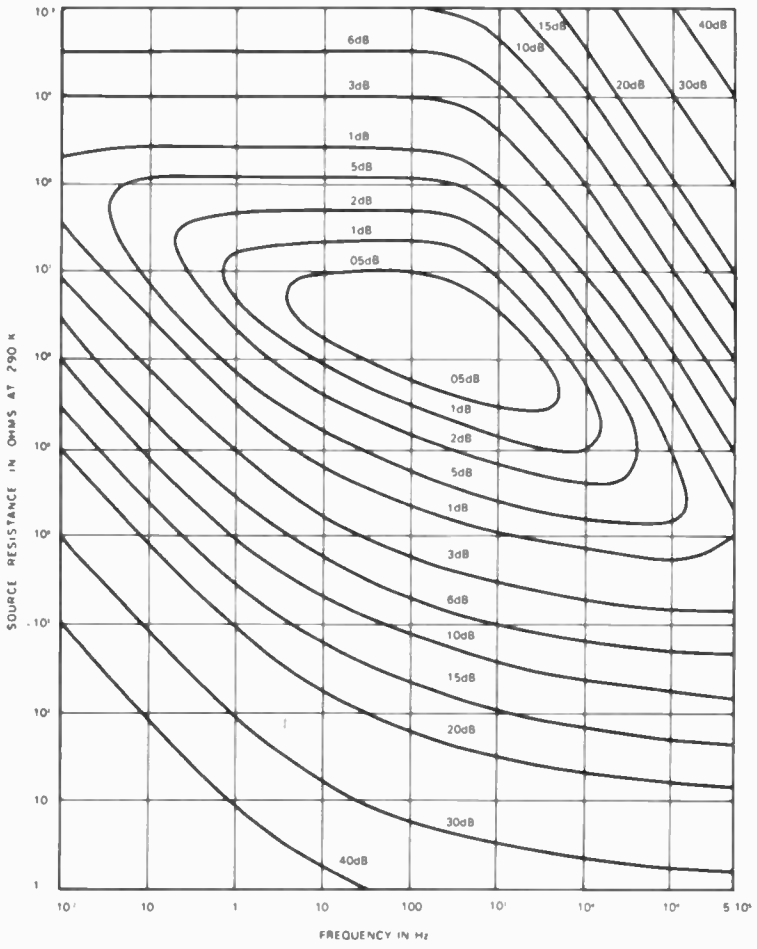
This is the level of signal at which the signal-to-noise ratio will be unity. If the signal bandwidth were 1 Hz, then the actual noise would be 13.5 nV rms.

4. DETERMINING EQUIVALENT INPUT NOISE RESISTANCE (Re) – This specification is used to define amplifier noise in terms of a resistor whose Johnson noise is equal to the amplifier noise at a given frequency. For example, if one wanted to find the 'equivalent input noise resistance' for a Model 113 Preamplifier at a frequency of 1 kHz, he would follow the 1 kHz ordinate to the lower 3 dB noise figure contour. The source resistance on the abscissa (5 kilohms) would be the 'equivalent input noise resistance'.

To summarize, noise figure contours offer an extremely useful tool in evaluating the noise performance of amplifiers for use in low-level signal processing. In addition to describing completely the noise performance of an amplifier over its entire operating range, they provide the researcher with the information necessary to determine the ultimate performance of his system.

For those who wish to obtain further insight into the measurement and specification of noise, we recommend the following references:

1. IRE Standards on Methods of Measuring Noise in Linear Two Ports – H. A. Haus, et al – Proceedings of the IRE, January 1959.
2. Representation of Noise in Linear Two Ports – H. A. Haus, et al – Proceedings of the IRE, January 1959.

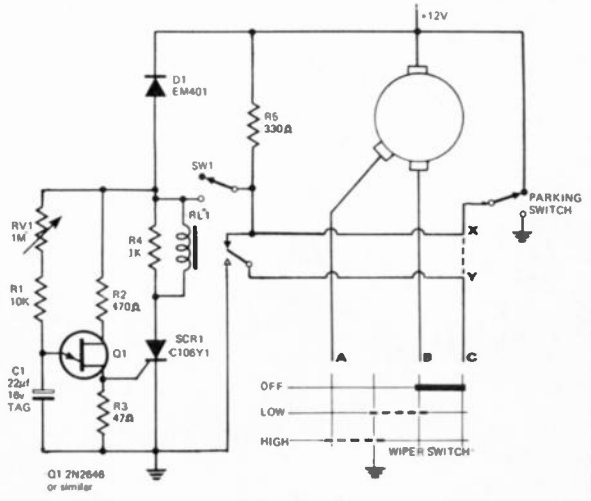


Typical Noise Figure Contours

Figure 3.

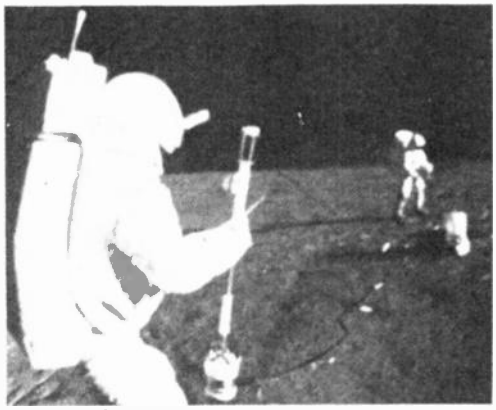
VARI–WIPER PROJECT – MAY ISSUE

Fig. 2. The identification letters A, B, C, X and Y referred to in the text were omitted from the circuit diagram. The amended circuit is shown.

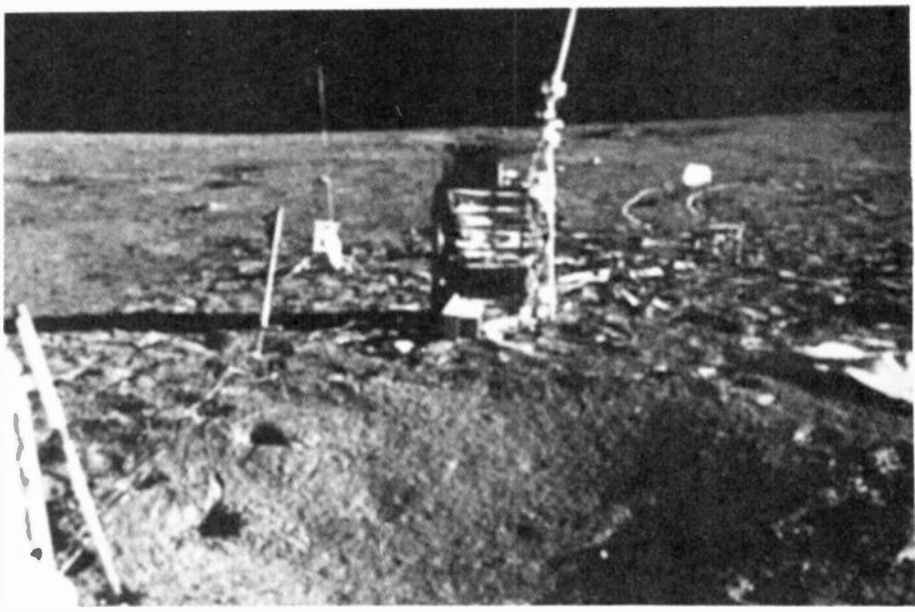


Apollo 14 Experiments

electronics in Space



Ed Mitchell uses the 'Thumper' in the Active Seismic Experiment. Commander Alan Shepard can be seen in the background.



Telemetry transmitter and nuclear-electric generator are seen in this photograph taken on the lunar surface. The grenade launcher is marked by a flag. Behind the launcher is the Charged Particle apparatus. A corner of the equipment trolley is visible in the immediate foreground.

FORMER test pilots Alan Shepard, Ed Mitchell and Stu Roosa doubled as scientists during the recent Apollo 14 moon mission.

They conducted a number of experiments, both on the lunar surface and during their return flight to earth.

Many of the experiments on the lunar surface sought to investigate the composition and structure of the moon. These included the positioning of a unit called the Passive Seismic Experiment, which monitors moonquake phenomena such as frequency of moonquakes, measurement of azimuth and distance to epicentres. It also records the frequency and location of lunar meteorite impacts.

Power for this experiment is provided by a radio-isotope thermo-electric generator.

This generator is similar to that used on Apollo 12. Four pounds of plutonium -238 is used for the radio-isotope source. This creates heat as it decays, and the resultant heat is converted into electrical energy by a bank of lead-telluride thermo-electric converters. Power output of the generator is approximately 65 watts.

Data from the passive seismic experiment (amongst others) is radioed back to earth via a telemetry transmitter which is also powered by the nuclear-electric generator.

Seismography

The astronauts performed two experiments using electronic refraction siesmographs. In this technique shock waves are caused to travel through the surface and subsurface under investigation. The time taken for the shock waves to travel through various paths to a number of spaced geophones is accurately measured by starting and stopping a digital clock. This indicates shock-wave velocity in the various strata through which the wave has travelled, providing a guide to the density and type of strata.

First the astronauts laid out three geophones, together with the lightweight grenade-launcher intended to fire four projectiles. Firings were to be controlled from earth, some time after the astronauts' departure.

After laying out the geophones and grenade-launcher Shepard and Mitchell generated a series of shock-waves, using the 'Thumper'. This is a long hammer-like device which uses explosive charges to thump the lunar surface. The shock-waves thus generated are picked up by the geophones. This experiment provided information about strata to a depth of 75ft.

The subsequent experiment using the grenade-launcher operates in a similar fashion, but the greater distance travelled by the shock-waves provides information about strata to a depth of 1500 ft.

Further seismic data was provided by the impact of the third stage of the Saturn rocket upon the lunar surface. This section, weighing nearly 14 tons, smashed onto the moon at a speed of 4500 mph. Geophones left by the earlier Apollo 12 mission picked up the subsequent shock-waves, which continued for three hours and extended some 20 miles below the lunar surface.

It had been hoped to obtain data to a greater depth than this, but unfortunately the impact occurred 90 miles closer to the geophones than the total 193 miles originally intended.

Subsequent to the astronauts transferring to the command module, the discarded lunar module was aimed at the lunar surface about 40 miles from the Apollo 14 site, providing calibration data for both Apollo 12 and 14 geophone stations.

Some 100 lb. of soil samples were brought back to earth. Preliminary analysis shows that the rocks are quite different from the basalts found by Apollos 11 and 12. The Apollo 14 samples are ten times richer in radioactive potassium, thorium and uranium. This suggests that the moon may be considerably older than previously thought.

Despite some setbacks, the Saturn/Apollo combination has proved its reliability. More and more emphasis is being placed on the scientific aspects of space exploration. This report outlines some of the experiments carried out during the recent Apollo 14 mission.

Solar Wind Composition Detector

Similar to the devices used by the Apollo 11 and 12 missions, this apparatus is a sheet of pure aluminium foil supported by a stake.

Whilst cosmic rays pass through the foil, solar wind particles embed themselves to a depth of several hundred atomic layers. After exposure for 25 hours the sheet was rolled up, sealed, and brought back to earth.

Portable Magnetometer

This instrument was carried on the astronauts' equipment transporter. It measures variations in the lunar magnetic field and thus helps determine the location and strength of the lunar magnetic sources.

Charged Particle Lunar Environment Experiment

Used to measure the energy of solar protons and electrons reaching the lunar surface, it also provides information about solar flares and characteristics of the earth's magnetic field.

Supra-Thermal Ion Detector

This instrument measures the flux, energy, velocity and mass of positive ions at the lunar surface. It is connected to a Cold Cathode Ion Gauge which, by measuring the pressure of neutral particles, indicates the lunar atmospheric pressure. The two instruments also detect lunar volcanic processes.

Laser Ranging Retro-Reflector

This consists of 100 fused silica reflector cubes forming a passive reflector for earth-based laser beams. The experiment gathers data about the earth's rotational rate fluctuations, axis wobble, and of the moon's size and orbit. A similar apparatus was used by the crew of Apollos 11 and 12.

In-Flight Experiments

Four experiments conducted during the return flight investigated the effects of zero gravity on various processes.

Electrophoretic Separation

This effect is produced by passing an electric current through a mildly acid or alkaline liquid containing organic molecules. The molecules will move through the liquid at speeds determined by the nature of the molecules.

The process is used on earth or the preparation of pure vaccines, etc. Problems of convection flow and sedimentation are believed to be due to the earth's magnetic field, and the Apollo 14 experiment was to determine whether a zero G environment would overcome the difficulties.

The experiment was conducted by placing three tubes inside a small container fitted with an observation port.

One tube held human haemoglobin, a second tube contained salmon sperm DNA, whilst the third contained a mixture of red and blue organic dyes.

A colour camera mounted on the observation port photographed the separation of each sample.

Convection Flow

A second experiment studied the convection flow of liquids and gases in a zero G environment. Samples of pure water, sugar solution, and carbon dioxide were heated and photographed.

Liquid Flow

The third experiment has a bearing on in-flight refuelling and fuel storage of space vehicles.

This was a simple experiment in which the behaviour of two sets of coloured liquids was filmed whilst they were pumped from one tank to another via baffles of various types.

Composite Casting Experiment

This involved the casting of various materials in a zero G environment.

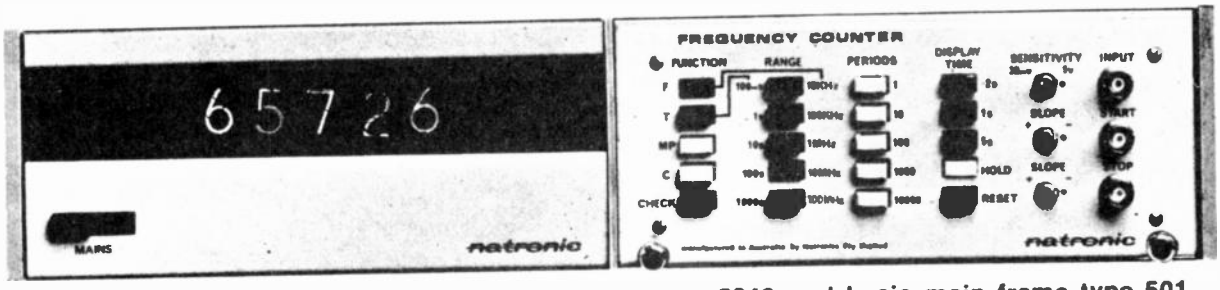
Several metals, fibre-reinforced materials and crystals were heated in a small furnace. The object was to obtain truly homogenous castings. This is very difficult on earth as the gravitational field causes sedimentation.

Future Experiments

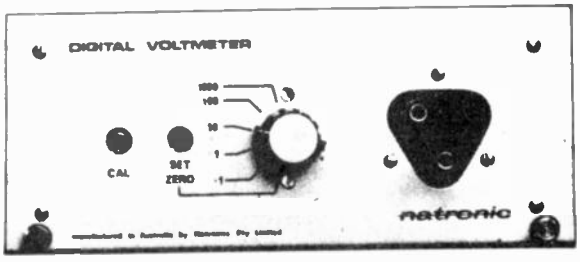
In 1967 NASA commenced to train a number of scientists. So far none of these scientists/astronauts has flown on a mission — but now that the basic soundness of the Saturn/Apollo system has been reasonably well proven, we can expect to see the scientific aspects of the space programme taking greater prominence.

There are many terrestial problems that may well be solved by the use of space. Who will be the first to establish a lunar ball-bearing factory? ●

TWO FOR THE PRICE OF ONE



Frequency counter plug-in module type 5040 and basic main frame type 501



DVM plug-in module type 50410

Modular construction enables the Natronic 500 series of digital instruments to be used for accurate and repeatable measurement of a large number of variables. The instruments are constructed as a basic main frame with interchangeable plug-in modules.
Frequency counter plug-in module type 5040 and basic main frame type 501 combine to form a 100MHz frequency counter with facilities for period timing and event counting.

DVM plug-in module type 50410 and basic main frame type 501 combine to form a highly accurate integrating digital voltmeter. Principal features of the instrument include excellent zero stability, 0.02% accuracy maintained over a wide temperature range and good rejection of common and series mode interference.

A main frame with both plug-ins available for what you would normally pay for one instrument.

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IRH THE EQUIPMENT DIVISION OF IRH INDUSTRIES LIMITED

ELECTRONIC FUEL INJECTION -how it works

HIGH traffic density – particularly at congested points in city areas – requires an extremely accurate regulation of the amount of fuel according to the varying operating conditions of the engine.

An electronically controlled petrol injection system, developed jointly by Bosch and VW, is claimed to reduce exhaust transmission by increasing engine efficiency.

Every combustion process requires air – or, more precisely, oxygen from the air. The amount of air just needed for complete combustion of a fuel is called the stoichiometric air/fuel ratio. For petrol engines it is 14:1.

If the fuel component of the ratio is higher, some fuel is wasted and, furthermore, the wasted fuel appears as harmful contaminants in the exhaust gas. If the amount of fuel is smaller than the correct amount, power drops off and the engine temperature rises.

The function of the electronically controlled petrol injection system is thus to maintain theoretically correct fuel metering despite varying operating conditions.

CONTROL SYSTEM

The 'brain' of the system is an electronic control unit that constantly monitors engine requirements and environmental conditions. It uses this data to determine and control the optimum air/fuel ratio at all times.

This small computer, built on a printed circuit board, contains about 250 components with 30 transistors and nearly 40 diodes.

A simplified schematic drawing of the system is shown in Fig. 1.

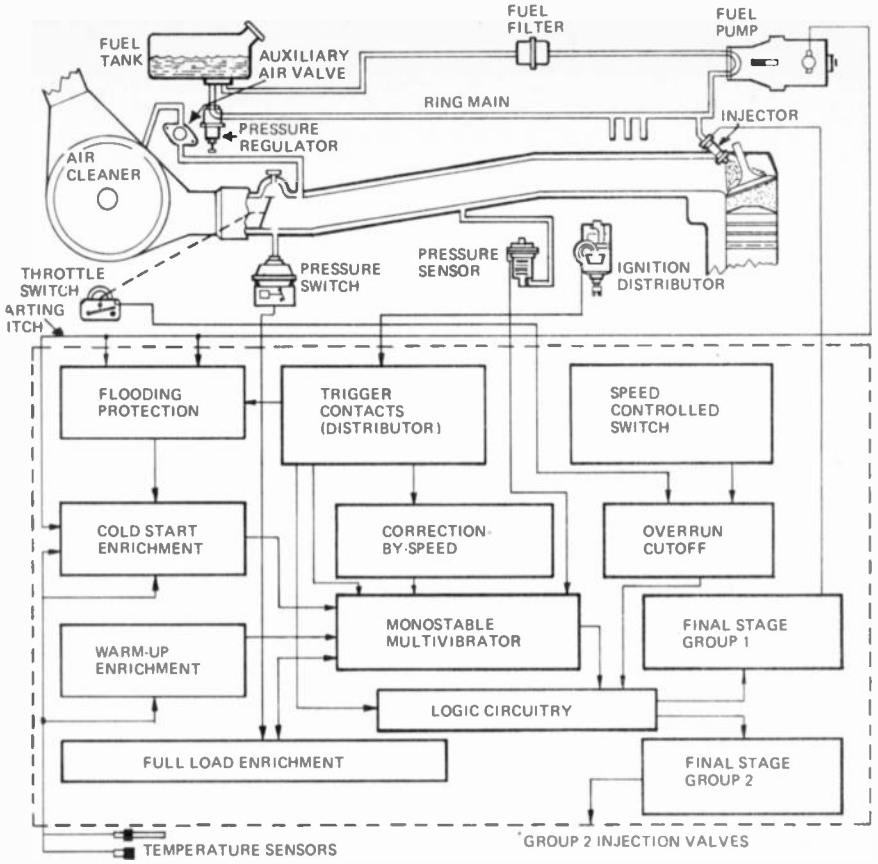

Fig. 1. Schematic drawing of fuel injector system.

OPERATION

Fuel is pumped from the tank into a ring main for distribution to all injection valves. A pressure regulator maintains a constant 28 psi in the ring main by allowing excess fuel to flow through the regulator and back into the fuel tank.

Electromagnetic injector valves in the inlet manifold are opened and held open by a pulse from the electronic control unit. This pulse varies in width from 2 to 10 milliseconds. The pulse width is governed primarily by engine speed and load conditions.

IGNITION DISTRIBUTOR

The distributor is equipped with the usual contact breaker points and normal centrifugal and vacuum advance. In addition two non-adjustable trigger contacts, spaced 180° apart, have been provided in the lower part of the housing.

Signals from these trigger contacts are used in the control unit by a speed-controlled switch, the flooding-protection circuitry, and a monostable vibrator circuit.

Load condition information is furnished to the control unit in the form of a voltage signal from the pressure sensor located on the intake manifold. Other factors such as information from the cold-start circuit, the warmup enrichment circuit, the full-load enrichment circuit and the correction-by-speed circuit combine with the pressure sensor signal to establish the output pulse duration of the multivibrator.

When the control unit receives a trigger signal from one of the trigger contacts, the multivibrator switches to the unstable state for the appropriate time period determined by operating conditions. The output pulse is gated in the logic circuitry with the trigger signal and a signal from the overrun cutoff circuit.

Gating of the multivibrator pulse with the trigger signal excludes unwanted injections that could be triggered by contact bounce. The signal from the overrun cutoff circuit has no effect, except when the throttle valve is closed and engine speed is above 1800 rpm.

Under these conditions, a signal is generated that inhibits the gate and cuts of fuel to the engine. As engine speed drops to 1250 rpm, the signal changes to enable the gate to switch on the fuel again so that a smooth transfer to idling operation is assured.

The logic circuitry also determines which final-stage amplifier is to receive the pulse from the multivibrator. The final-stage amplifier for group 1 drives the injectors for cylinders 1 and 4, while that for group 2 drives the injectors for cylinders 2 and 3. Each injector group has a separate trigger contact in the distributor. ●

ENCEL BRINGS YOU GREAT VALUE AND QUALITY IN 4-TRACK TAPEDECKS — AUTO/REVERSE MARLUX 407 — ONLY $425.00!

The Marlux 407 has all the features that make a great recorder—push-button solenoid control of tape motion, hysteresis synchronous capstan motor, supply and take-up reel motors for smooth tape spooling, electrical speed change, tape tension control for standard and thin base tape, etc.
American High Fidelity Magazine reviewing Marlux 407 enthusiastically says—"the unit offers high performance and versatility in a well-engineered and handsomely-styled open reel format aimed at the serious home tape enthuslast. Especially notable are its low wow and flutter, low distortion, excellent signal to noise ratio, absolute meter accuracy and smooth extended response. Thanks to its careful engineering and construction it is a pleasure to use and to listen to."

"Stereo Review" Magazine was equally enthusiastic. "A carefully thought out and well-made machine. In an A-B comparison of input and output signals, virtually no difference could be heard between them at 7½ ips." Marlux 407 offers 4 heads which allow reverse play, plus off-tape monitoring. Frequency response—30-20,000 Hz @ 7½ ips; 40-16,000 Hz @ 3¾ ips. Two speeds—7½ & 3¾ ips; re-wind or fast forward time—less than 60 seconds for 1,200'.

As the magazine "Audio" says in its review—"Marlux 407 is certainly a lot of tape machine for the money. It would make a fine addition to any good quality stereo system, bar none!"
At the Encel price of only $425.00 it is outstanding value!*

MICRO QUALITY CARTRIDGES.

With replaceable diamond stylii. Those coded "e" have elliptical stylus. Those coded "/5" or "/7" have 5 mil and 7 mil conical stylii respectively. Stylii are interchangeable within the two ranges without the use of tools.

3100/e—Encel price $26.50. A top-quality magnetic unit approved for use in broadcasting stations throughout Australia in systems that meet the Australian Broadcasting Control Board standards.

3100/5—Encel price $21.50.

3100/7—Encel price $19.50. A ruggedly constructed unit giving high quality performance.

2100/5—Encel price $15.50.

2100/7—Encel price $12.50.

MICRO MDP-3 DUST BUG.

Cleans recordings automatically ahead of the stylus. Weighted base requires no fixing. **Encel price $4.50.**

MICRO MSB-1 SHOCK ABSORBERS.

Eliminate or minimise turntable baseplate feedback (50-200 Hz). Suit all turntables. **Encel price (per set of 4) $12.50.**

RENOWNED STAX SR-3 STEREO HEADPHONES.

(with SRD-5 adaptor)

World's finest electrostatic headset. HI-Fi News review states, "response is very smooth, with no obtrusive peaks or colouration . . . a sense of realness about the sound . . . comfortable to wear for extended periods. They are by no means expensive and are probably better than any other headphones at present available, certainly better than any we have tried."

Australian Hi-Fi in a recent review says: "We performed comparison tests between Stax headphones and our monitor speakers and decided that our monitor speakers will have to go! These headphones offer a performance, which, while not perfection, is the nearest thing to it which we have yet experienced in either speakers or headphones."

Encel price $76.50*

Note: Ask for copies of reviews from authoritative technical journals on all items marked*.

All prices quoted include Sales Tax.

LOOK AT ENCEL'S UNBEATABLE PRICES ON FAMOUS MICRO EQUIPMENT

MICRO MR-211 TURNTABLE.

A 4-pole hysteresis, synchronous, outer-rotor motor and feather-touch selector gives positive 33⅓ and 45 rpm. Static balance S-shaped tone arm, fully compensated, accepts standard ½" mounting cartridges. Oil-damped lift. Baseplate silver finished, mounted in wooden base with plastic cover. **Encel price $149.00.** (Cartridge of your choice extra.)

MICRO MR-111 TURNTABLE.

Engineered for high-quality reproduction. Vibration-free belt drive: 33⅓ or 45 rpm. Baseplate matt black. High-precision tone arm and hydraulic lift. **Encel price $72.50** (Cartridge, tinted acrylic lid and base extra.)

EE113A

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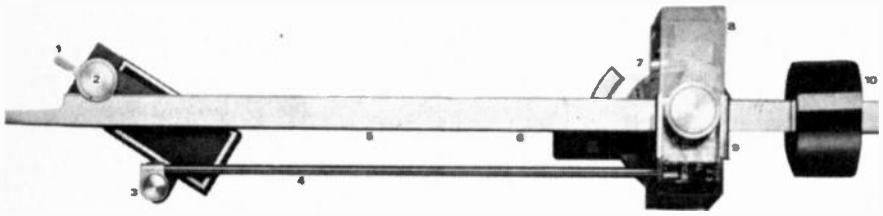
AUDIO NEWS

SOUNDS OF SONEX '71



Garrard's pivoted cartridge tracking arm.

1. Cartridge angle adjustment. 2. Pickup head pivot. 3. Control link pivot. 4. Control arm. 5. Low resonance pickup arm. 6. Stylus force adjustment (under arm). 7. Gimballed pivots. 8. Rigid acrylic pickup housing. 9. Magnetic bias compensation device and adjustment. 10. Brass counterbalance weight.

Britain's Sonex '71 exhibition, held at London Airport from March 31 to April 4, once again had a quota of salesmen convinced that people buy hi-fi by the decibel.

Fortunately they were fewer than in previous years – but is there really no way that the organisers can persuade them otherwise?

An interesting amplifier from JVC featured four separate channels, each with its own VU meter.

The amplifier can be used as a 4 x 10 watt unit, a 2 x 20 watt unit, or – by using what the makers call a 'Sound Field Composer' – it can be made to create four-channel stereo effect from two-channel sources.

Garrard's new Zero 100 turntable is claimed to have a tracking error of less than 90 seconds of arc.

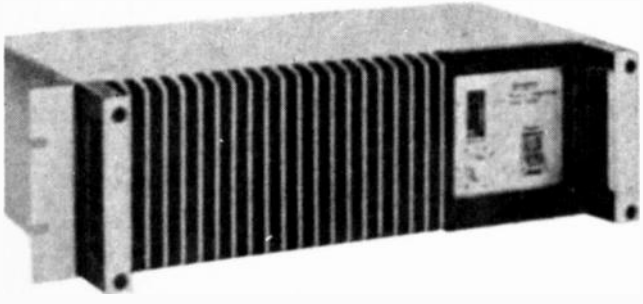
This is achieved by pivoting the cartridge above the stylus tip and continuously changing its orientation as the pick-up arm moves towards the centre of the record. The technique ensures that the centreline of the cartridge is maintained tangentially to the groove. Distortion is claimed to be reduced.

Grampion were showing what at first appeared to be a large heat-sink but on closer inspection turned out to be a 100 watt amplifier.

Radford demonstrated their SC 24 pre-amp and PA 50 main amplifier; the latter was claimed to have a total harmonic distortion of less than 0.01%.

Two speakers that could only have been conceived by Salvador Dali were shown by JVC. 'Shown' is the operative word, for these devices were made in the form of pictures. The sound emerged between the picture and the frame.

One trusts that purchasers with a penchant for Palestrina will not go for a Picasso picture!

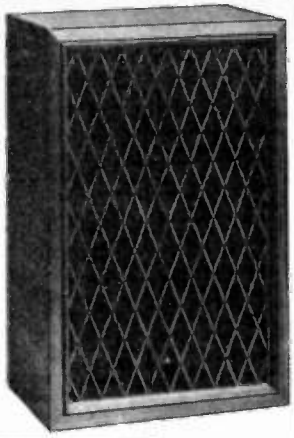


Left – 100 watt amplifier from Grampion.

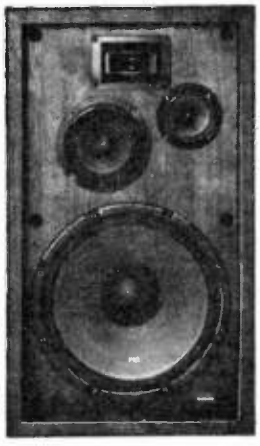
Below – JVC 4 channel integrated amplifier.

sound ideas from...

PIONEER



CS-63 DX

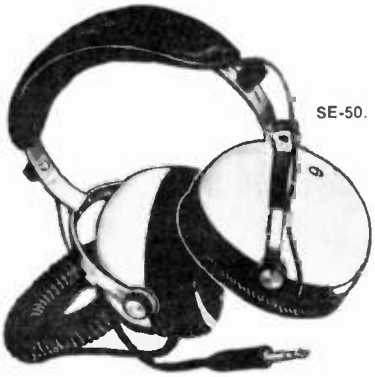


CS-77A

Superb Hi-Fi speakers to suit every application. In cabinets, unmounted or complete kits.

CS-63 DX 4-Way 6-Speaker System 15" Woofer; two 5" mid range; Horn Tweeter; 2 Horn super-tweeters; 20-20,000 Hz; 80 Watts.

CS-77A 4-Way 4-Speaker System. 12" Woofer; 5" mid-range; 3" cone tweeter; multi-cellular horn supersonic tweeter; 25-20,000 Hz; 65 Watts. Removable grille.



SE-50.

Headphones for personal listening. Perfect sound without fatigue.

SE-30. 20-20,000 Hz, 8 ohm, 0.5W per channel.
SE-50. 20-20,000 Hz. Separate tweeter and volume controls. 8 ohm, 0.5W per channel.

PL-31D 4

Advanced belt-drive turntables engineered for minimum wow and flutter.

PL-31D 4 pole hysteresis motor. Wow and flutter less than 0.1%. Cartridge; PC-35 induced-magnet type. 10-25,000 Hz.

T-6600

Stereo tape decks and tape recorders. 'Professional' 4 track recorders with every conceivable feature.

T-6600 Auto-reverse Tape Deck. 50-15,000 Hz±2dB. S/N ratio less than 55dB.

SA-900

Stereo amplifiers, tuners and receivers featuring minimum harmonic distortion.

SX-770 Tuner Amplifier. 20-40,000 Hz±3dB. 15W R.M.S. per channel into 8 ohms. Harmonic distortion less than 0.8% at rated output. Multiple inputs including mic.; multiple outputs; filters, etc.

SA-900 Amplifier. 20-50,000 Hz±3dB. 50W R.M.S. per channel into 8 ohms. Harmonic distortion less than 0.08% at rated output. Multiple inputs, outputs, filters, etc.

Stereo systems to suit the most demanding listener. Every component matched for perfection in sound. The items illustrated are only a small part of the WORLD'S LARGEST RANGE OF HI-FI AND NOTHING BUT HI-FI.

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AUDIO NEWS

WIDE RANGE TAPES

A new range of high-performance recording tapes is being imported to Australia from Japan's TDK Electronics Company by Convoy International Pty. Ltd.

The new SD tapes can be obtained in both reel-to-reel and cassette form.

The makers claim a usable frequency range from 30 Hz to 20,000 Hz, combined with an improved signal-to-noise ratio, and say that this is primarily due to their use of special fine-particle oxide.

A full test report on this tape will appear in next month's ELECTRONICS TODAY.

HIGH-QUALITY CERAMIC CARTRIDGE

A new type of ceramic piezo-electric pick-up cartridge, intended for high-quality stereo reproduction, is the ACOS 14.

The cartridge can be used with magnetic cartridge amplifier inputs with RIAA correction, or in high impedance amplifier inputs.

Tracking weight is 2-5 grammes, and static compliance is 17 x 10^{-6} cm/dyn (vertical) and 20 x 10^{-6} (lateral).

Stereo separation is claimed to be at least 20 dB at 1 kHz.

Full details from Amplion (Australasia) Pty. Ltd., 29 Majors Bay Road, Concord, N.S.W. 2137.

FM BROADCASTING

An American expert on educational radio – Bill Giorda – will be the guest speaker at the Music Broadcasting Society's Annual General Meeting.

Since Mr. Giorda's remarks about the current situation in educational and cultural broadcasting in the U.S.A. – and the latest technical advances in frequency modulation broadcasting – will be of general interest, non-members are invited to attend.

The meeting will be held in the Teachers' Federation Building (9th floor), 300 Sussex St., Sydney, on Monday, June 28.

TAPE RENTAL CLUB

A new service for audio fans is offered by the Trade-a-Tape Stereo Club, formed recently by Consolidated Promotional Enterprises Pty. Ltd. – major backers of the Odyssey Rock Festival, held at Wallacia (N.S.W.) last January.

With headquarters on the ground floor of the Expressway Arcade at 122 Arthur Street, North Sydney, the club intends to supply its members with 8-track stereo cartridges, which are very popular in America but scarce in Australia. Hire-purchase of the necessary stereo equipment will be included in the package-deal agreement, which works out as follows.

The initial joining fee of $40 will entitle the member to free installation of the stereo equipment – the choice including two leading brands of car stereo, two brands of portable units, and one unit for homes.

For $15 per month, members will be able to listen to ten tapes of their choice, returning these and replacing them with others whenever they wish (this works out at a rental figure of $1.50 per tape per month).

After three years the member will own the stereo equipment, plus ten tapes of his choice. Presumably, if he wishes to continue his membership, he will then pay a lower rental on tapes, since he will then have paid off his stereo outfit.

At a later date Consolidated Promotional Enterprises intend to offer franchises for the formation of Trade-a-Tape Stereo Club branches in other cities, on much the same basis as the Colonel Sanders Kentucky Fried Chicken franchises and similar enterprises.

SIMON GRAY EXPANSION

With the opening of new offices and showrooms for its N.S.W. branch on May 3, the Melbourne-based Simon Gray organization concludes several weeks of hectic interstate office activity.

The new Sydney premises are at 53 Victoria Avenue, Chatswood. Recently the Canberra office of Simon Gray moved to 25 Molonglo Mall, Fyshwick, and a new branch office was opened in Adelaide.

Jim Olsen has been appointed manager for S.A., and the office is situated at 81 Yacca Road, Seacliffe.

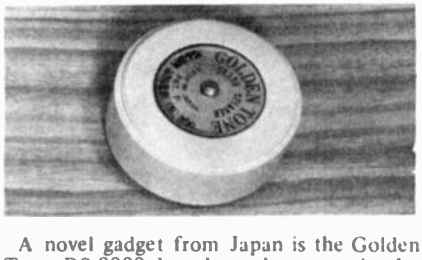
NEW BOSE SPEAKER

A new speaker from the Bose Corporation – the 501 – uses an integrated woofer/two-tweeter combination, balanced for direct and reflected sound.

The new speakers cost approximately two-thirds the price of the very successful 901 series, but are in no way intended to replace them.

Enquiries to W. C. Wedderspoon, 193 Clarence St., Sydney, N.S.W. 2000.

'PIN-UP' SPEAKER



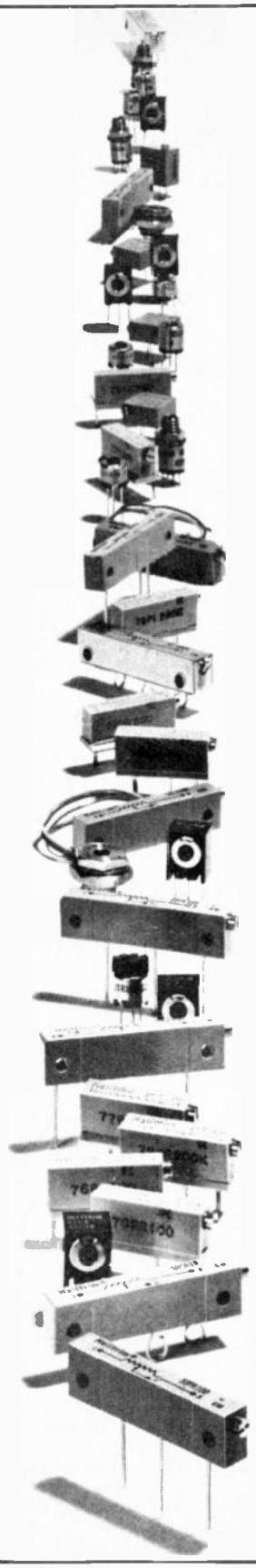
A novel gadget from Japan is the Golden Tone DS-8000 board speaker – a circular transducer, approximately 3½ inches in diameter.

It can be screwed onto any convenient flat surface – directly on the wall or ceiling if desired.

The manufacturers' brochure claims it reproduces "hi-fi sounds within 16Hz - 16,000 Hz of frequency range of flat" and "offers audio enthusiasts the outstanding hi-fi and stereo sounds that have not been reproduced by the convential speakers." The brochure also describes it as an "ideal sound reproducing surface-sound source, already over the period of speaker-box" – which we interpret as meaning that it will make conventional speakers obsolete.

A tryout convinced us that conventional speakers are in no danger of obsolescence – though reproduction is certainly better than one would expect from such a simple device, costing a modest $10 or so.

The endless line



It's a complete line – an endless line of Helitrim® cermet trimming potentiometers with a current field failure rate of only 0.08%.

And all have essentially infinite resolution. Plus a wide range of standard resistance values. And excellent setting and total resistance stability under a wide range of environmental extremes.

Helipot stocks almost 2 million trimmers in a wide range of models and values at 13 stocking locations. All to fit your every need–whatever it is. To fit your budget–list prices from $1.75.

For more details on "the endless line" of cermet trimmers, contact your local Helipot sales representative. He'll tell you all about cermet reliability, fill you in with all available test data and personally handle your Helitrim orders.

	MILITARY			HIGH TEMP.	GENERAL PURPOSE		
	Series 25, 58, 98 (RJ11 & RJ12)	Series 61 (RJ22)	Series 63 (RJ24)	Series 50	Series 62	Series 78	Series 76P, 77P, 79P
Resistance Range	10 to 2 meg Ω	10 to 1 meg Ω	10 to 2 meg Ω	10 to 2 meg Ω	10 to 1 meg Ω	10 to 2 meg Ω	10 to 2 meg Ω
Power Rating	1 watt @ +85°C	0.5 watts @ +85°C	0.5 watts @ +85°C	1.5 watts @ +125°C	0.5 watts @ +70°C	0.75 watts @ +70°C	0.75 watts @ +25°C
Operating Temperature Range	−65° to +175°C	−65° to +150°C	−65° to +150°C	−65° to +200°C	−25° to +125°C	−25° to +125°C	−55° to +105°C
Typical Setting Ability	±0.01%	±0.05%	±0.01%	±0.01%	±0.05%	±0.05%	±0.05%

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WF2233

COMPONENT NEWS

PROTOTYPE PRINTED CIRCUITS

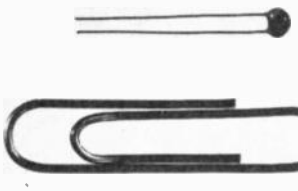
Tecnico Electronics have announced the establishment of a fast prototype service for runs of up to 20 printed circuit boards. This service covers photography, printing, etching, drilling, simple notching, tin plating, gold edge connectors.

Object of the service is to enable a designer to prove his circuitry quickly before going into quantity production. Preparation of artwork can also be undertaken, but this necessitates a slightly longer time for delivery of the finished boards.

The company foresees a wide demand for this service, not only for prototypes but also for small production runs.

Enquiries to Tecnico Electronics, P.O. Box 12, Marrickville, N.S.W. 2204.

CERMET MICRO-RESISTORS



Plessey Ducon have been appointed Australian distributors for Riverohm micro-resistors, manufactured in Japan by Fuji Industry Co. Ltd.

These are probably among the smallest resistors available for their rating. They have a power rating of 1/16 watt, a diameter of 3 mm. (approximately 1/8 inch), and are fitted with radial leads suitable for direct mounting into printed circuit boards.

The resistance values available are from 33 ohms to 100 K ohms in the 5% or E24 series. The standard resistance tolerance is ±5%, the voltage rating is 100V DC, and they have a temperature range of -40°C to ±125°C, and a temperature coefficient of ±700 PPM/°C.

The manufacturers claim that high purity ceramic substrate with very closely controlled cermet resistance paste provides microminiature size with very high reliability. Identification, because of the 'grain of wheat' size, is by three-band colour coding to accepted standards, with heat-resistant insulating paints. The lead wires are soft copper, solder-plated for easy soldering.

Details from Professional Components Department, Plessey Ducon Pty. Ltd., P.O. Box 2, Villawood, N.S.W. 2163.

LOW-COST TANTALUM CAPACITORS

Soanar Electronics are now distributing a new range of ELNA tantalum capacitors which, they claim, cost little more than conventional aluminium equivalents.

The new capacitors are available from 0.1 µf to 22 µf.

Details from Soanar Electronics Pty. Ltd., 30 Lexton Road, Box Hill, Vic. 3128.

ENCAPSULATED REED RELAYS

A range of miniature encapsulated reed relays are available from IRH Components. The relays include both normally open and change-over configurations. They are ideally suited for printed circuit board mounting.

The coil is wound on a glass-filled nylon bobbin, and a magnetic screen is included as standard. The assembly is encapsulated in glass-filled nylon to provide environmental protection.

Details from IRH Components, The Crescent, Kingsgrove, N.S.W. 2208.

MINIATURE EDGE SWITCHES

The Professional Components Division of Plessey Components Group announces a new miniaturised range of edge switches known as the 33 Series – a smaller and more advanced version of the well-known Plessey 50 Series.

Economically priced, the switches are intended for both military and industrial applications in such fields as machine tool control, computer switching systems and instrumentation, and frequency setting arrays where read-out legibility and superior reliability are important.

A wide range of switching codes includes decimal, binary, and binary with complement, while multi-pole switching is achieved by coupling together a switch and up to four slave modules, with plain or marked drums.

Terminations may be for direct wiring, or for edge connectors, and are numbered to facilitate correct connections. Extended printed circuit boards are also available for mounting diodes or other miniature components. Gold-plated tracks on epoxy glass laminate, with precious-metal wiping contacts, ensure reliable operation.

The 33 Series has contact ratings of 100 mA at 50 Vdc, with a maximum current carrying capacity of 1A; temperature range is -20 to +70°C. The switch meets H5 to DEF 5011 climatic specification and life is given as not less than 10^6 indexing operations.

Commercial enquiries to Professional Components Division, Plessey Ducon Pty. Limited, P.O. Box 2, Villawood, N.S.W. 2163.

LIGHT-SENSITIVE ICs

A new range of optical couplers including both digital and analogue detectors are now manufactured in England by IPL.

These are not normal photodiodes or transistors but light-sensitive ICs which include sophisticated MOS circuitry, Schmitt triggers, clock generators, amplifiers, etc., to provide full system functions and eliminate most of the circuitry needed for photodiode/phototransistor detectors.

The C15 digital coupler uses the IPL 15 photo-switch family and features positive switching action – 10 kHz max. transmission frequency – TTL compatible – variable threshold control and total immunity to spurious signals below threshold.

The C16 is an analogue coupler of fixed sensitivity and contains, as well as the LED, a tiny ceramic substrate with a thick film resistor and a 1 mm. photodiode with integrated MOS amplifier. Three versions are available with different speed/responsivity figures.

Details from Teknis Pty. Ltd., P.O. Box 635, Crows Nest, N.S.W. 2065.

SLIDE POTENTIOMETERS

From Soanar Electronics comes a new range of 30 mm. slide potentiometers, available in all popular values (linear and logarithmic).

An unusual feature of this range is the warranty which extends to two years.

Details from Soanar Electronics Pty. Ltd., 30 Lexton Road, Box Hill, Vic. 3128.

PROFESSIONAL OPERATIONAL AMPLIFIER

SGS, (Societa Generale Semiconduttori) has added to its operational amplifier range a new device, aimed at the professional market.

Produced under the designation L147 B1, this new device consists of a pair of high performance operational amplifiers and is designed for applications where it is important to save on space, weight, or number of components. It is characterised by low power consumption, and isothermal layout provides excellent channel separation of over 120 dB.

Each of the paired amplifiers consists of two stages: a high-gain differential input stage and a high-gain driver with class AB output. Each output stage is protected against shorts to ground, or to either supply rail, by means of current limiting circuitry.

Internal MOS capacitors provide roll-off of 20 dB per decade (6 dB octave), ensuring frequency stability in all closed-loop applications. The L 147 B1 requires no external components for frequency compensation.

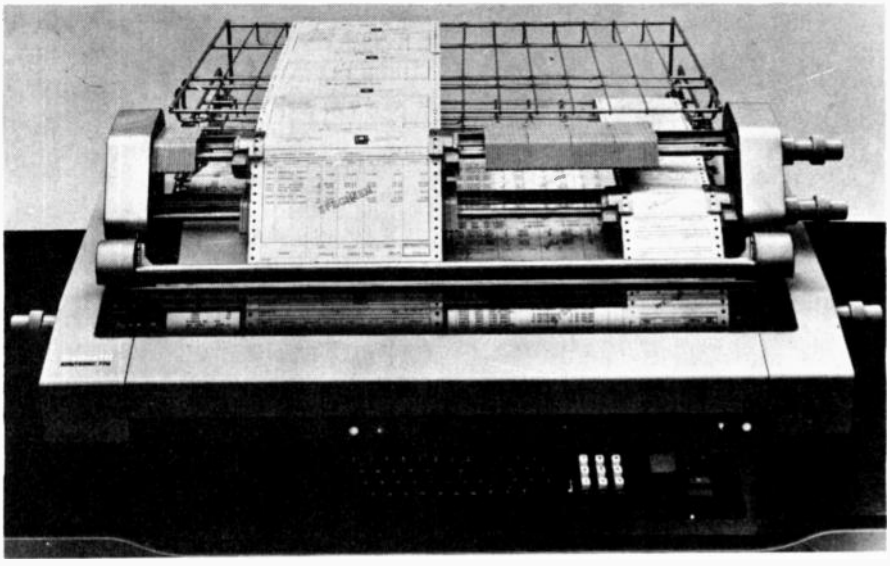
The high gain (typically 200,000) and wide range of operating voltages provide excellent performance when used as integrator, summing amplifier, and in general feedback applications.

High common mode voltage range and absence of 'latch-up' make the L 147 B1 ideal for use as a voltage follower. Furthermore, the device can be used with differential input voltage range of ± 30V. This device is encapsulated in DIP plastic package.

Details from Warburton Franki, P.O. Box 182, Chatswood, N.S.W. 2067.

EQUIPMENT NEWS

VISIBLE RECORD COMPUTER



THE OLIVETTI Auditronic 770 is a visible record computer designed to fill the gap between sophisticated accounting machines and large-scale computers.

The basic system has a capacity of 95,000 characters and is 'open-ended', allowing the addition of various peripherals if required. Devices like paper tape input and output, punched cards or magnetic cards can be added without reducing the 95,000 character capacity of the basic system. The 770 can also be used as an on-line terminal.

The Auditronic is equipped with a standard typewriter keyboard (upper and lower case), 96 character repertoire, a simplified numeric keyboard and a controls keyboard.

The printing mechanism consists of a mobile print unit which travels under programme control along a fixed 27" carriage, printing at 15 characters per second and spacing at 200 characters per second.

The print unit is capable of handling six individual accounting forms simultaneously – four of these forms can be the continuous stationery type. Under programme control, the Auditronic can perform high-speed routines involving a wide range of applications – invoicing, stock control, costing, payroll or estimating.

Programmes are recorded on magnetic tape held in interchangeable cassettes. They control not only the processing but also the flow of information through the system.

The 770 can be equipped with two cassettes, both housed in a small compartment at the rear of the machine. The cassette is unusual in that it incorporates its own transport mechanism, including read/write heads. Another feature is that both programme instructions as well as alpha-numeric data are stored on the magnetic tape. Thus a programme and its related data are held on the same tape. The actual length of the tape can vary, and so can the storage capacity. Normally a tape is divided into capacities of 13,860 characters, up to 55,000 characters. Programme instructions and data are recorded in seven-bit ISO code. The principal advantage of this method of storing programmes and data is that the user can build up an extensive library of programmes on tape.

The makers state that the Auditronic 770 is suitable as an overall management system for the medium-to-small business, as a system for decentralisation in large organisations, or as a system for off-loading larger computers.

The 770 is a computer designed to work in a way that is free of rigid procedure, to carry out in a single cycle all the necessary processing of an item of information, and at the same time to bring up to date the various situations that this information has to modify.

The magnetic tape, which is used for programming and storing both data and results, enables periodical, sectional or analytical processing to be done.

The Auditronic requires no air-conditioning and occupies very little space. Details from Olivetti Australia Pty. Ltd., 33 Riley St., Sydney, N.S.W. 2000.

TRACKING BY LASER

A LASER tracking system designed to monitor in-flight performance of aircraft during certification tests is being produced by Sylvania Electric Products Inc., of U.S.A. The system, which can track aircraft up to 60,000ft., will evaluate avionic, aerodynamic and acoustic performance of the DC-10.

In tests, a low-powered, infra-red laser beam from a mobile ground station, locks on, to a reflector mounted on the aircraft in flight. The reflected beam is picked up by sensing equipment in the tracker which determines precisely the speed, azimuth and elevation angles, and altitude of the aircraft.

Capable of 100 measurements per second, the system detects angular changes in the beam and provides results in digital form for direct readout or storage on magnetic tape for computer processing.

Details from Sylvania Electric Australia Pty. Ltd., 1 Lucas Rd., Burwood, N.S.W. 2134.

STABLE 500MHz COUNTER

NATRONICS' new Model 802 frequency counter is a highly stable, accurate and versatile instrument covering a frequency range of 0–100 MHz (dc coupled).

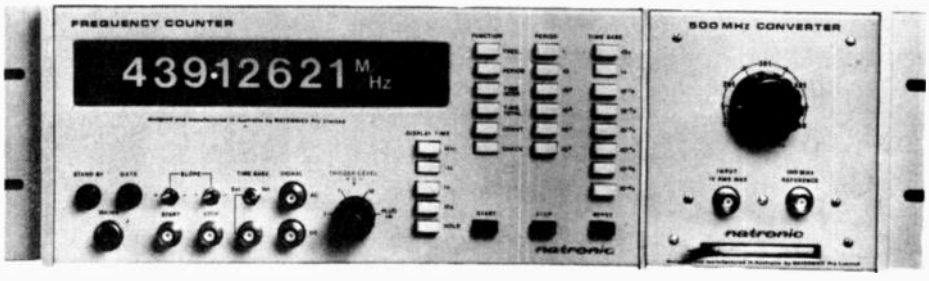
Measurements can be made of frequency, period, period average and frequency ratio. Frequency scaling is provided in decade steps to 10^8. All functions are selectable by push-buttons, or may be programmed from remote locations via a rear-mounted multi-way connector.

The instrument features eight-digit neon indicator readout. Display storage and selectable sample times are provided.

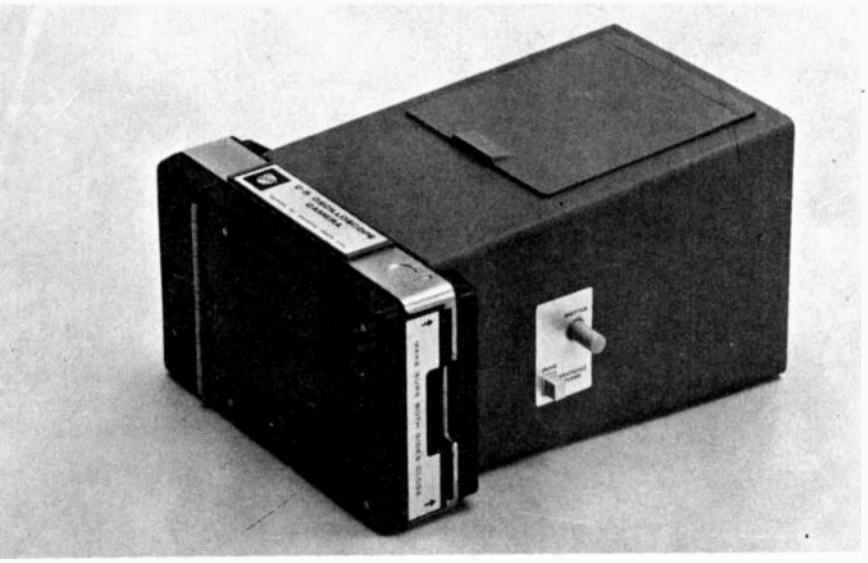
The basic reference for the counter is a 5 MHz crystal oscillator. A double oven with proportional temperature control, combined with automatic crystal drive control, is claimed to provide an oscillator stability of better than one part in 10^9 (typically three parts in 10^{10}).

A plug-in heterodyne converter is available to extend the measurement capabilities to 500MHz. Use of the heterodyne principle ensures that measurements using the converter maintain the same accuracy and resolution as the basic counter (in contrast to scaling techniques).

Details from Natronics Pty. Ltd., The Crescent, Kingsgrove, N.S.W. 2208.



TRACE RECORDING CAMERA



TEKTRONIX Australia Pty. Limited announces a new low-cost camera for photographing oscilloscope displays. The C-5 camera features fixed-focus and fixed-aperture design which simplifies waveform photography. The C–5 is mechanically compatible with all 5100-Series and 7000-Series oscilloscopes, 601 and 602 display units, 528 TV waveform monitor and 4501 scan converter. A mounting adapter is not required.

The C-5 has a 60 mm., f/16 (fixed) lens. Shutter speeds are 1/10, 1/25 and 1/50 second, plus Bulb and Time. The object-to-image ratio is 1:0.68, which allows recording 6½-inch CRT's on standard 3¼ x 4¼ Polaroid film. A permanently attached Polaroid Pack-Film accepts 3000-speed film which develops outside the camera in about 15 seconds.

A hinged door in the camera top allows viewing of the CRT without removing the camera. A graticule illuminator, powered by two 9-volt batteries, illuminates the graticule during part of the shutter cycle. It may be turned off when not required.

Details from Tektronix Australia Pty. Ltd., 80 Waterloo Rd., North Ryde, N.S.W. 2113.

CAPACITANCE DEVIATION BRIDGE

A BRIDGE for comprehensive checks on capacitors during manufacture and at batching and goods inwards stages has been introduced by Wayne Kerr Co. Ltd., of Surrey, England.

It reads directly the percentage deviation of capacitance from a pre-set nominal value and, simultaneously, the loss factor. Analogue outputs of both readings are available for recorders, control systems or batching mechanisms.

Built-in limit circuits can be switched-in to operate warning lights and give logic outputs of High, Low or Pass for a number of alternative acceptance limits. The makers state that, in addition to pre-set limits ranging from ± 10 to ± 1 percent on capacitance deviation, and 0.1 down to 0.001 on dissipation, continuously-variable controls are available for setting-up special limits, including asymmetric ones for capacitance.

The bridge can also be used for straightforward capacitance measurement to 4 or 5 significant figures, with an analogue output. Balance is maintained electronically.

According to the manufacturers, capacitance ranges (full-scale) are from 10pF to 1 MF; deviation from -10 percent to +10 percent and -1 percent to +1 percent; dissipation from 0 to 0.1 and 0 to 0.01. Measurements made at 1kHz.

Details from Sample Electronics (Aust.) Pty. Ltd., 9–11 Cremorne Street, Richmond, Vic. 3121.

POCKET TWO-WAY RADIO

A COMPLETELY new VHF, FM pocket-sized portable transmitter/receiver, the CUB Type 4B7, is now available from Plessey.

The fully transistorised CUBs are designed to provide a completely portable system or, alternatively, to be used in conjunction with a mobile/fixed station network. Excellent reception is possible at distances up to 20 miles from the fixed station.

Two versions of the CUB are available, the PB2 (low band) and PH2 (high band).

Controls or the top of the unit are the channel selector, and the combined volume control and ON/OFF switch. In addition two aerial sockets are fitted. A fixed-length wire aerial and an extending rod aerial are provided.

A miniature handset fitted with a press-to-talk switch is attached by a flexible lead and may be hand-held or attached to the coat lapel.

The CUB is powered by an internal rechargeable battery with an average operation duration of eight hours. Charging units are available as a standard two-battery configuration.

Rugged construction and highly dependable performance make the CUB transmitter/receivers ideal for all types of commercial and industrial applications.

Details from Plessey Electronics Pty. Ltd., 91 Murphy St., Richmond, Vic. 3121.

REMOTE BATCH TERMINAL DOES NOT DATE

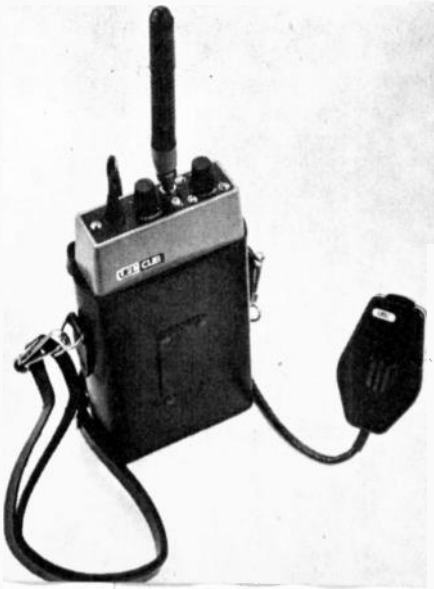
A REMOTE batch terminal can be made compatible with computer systems as diverse as IBM, Univac, CDC, or ICL, by means of a simple programme change.

Designed for remote batch processing, and for providing direct access to central computing units or bureaux, the terminal is said by its British makers to have superior advantage in keeping pace with technological advances through simple software routines, rather than hardware changes.

Software exists which enables the terminal to be programmed to operate on line to IBM 360, Univac 1108, CDC 6600 and ICL 1900 series. Transmission and reception is by telephone line with speeds up to 9600 baud having been achieved. The usual transmission speed, however, is 2400 baud.

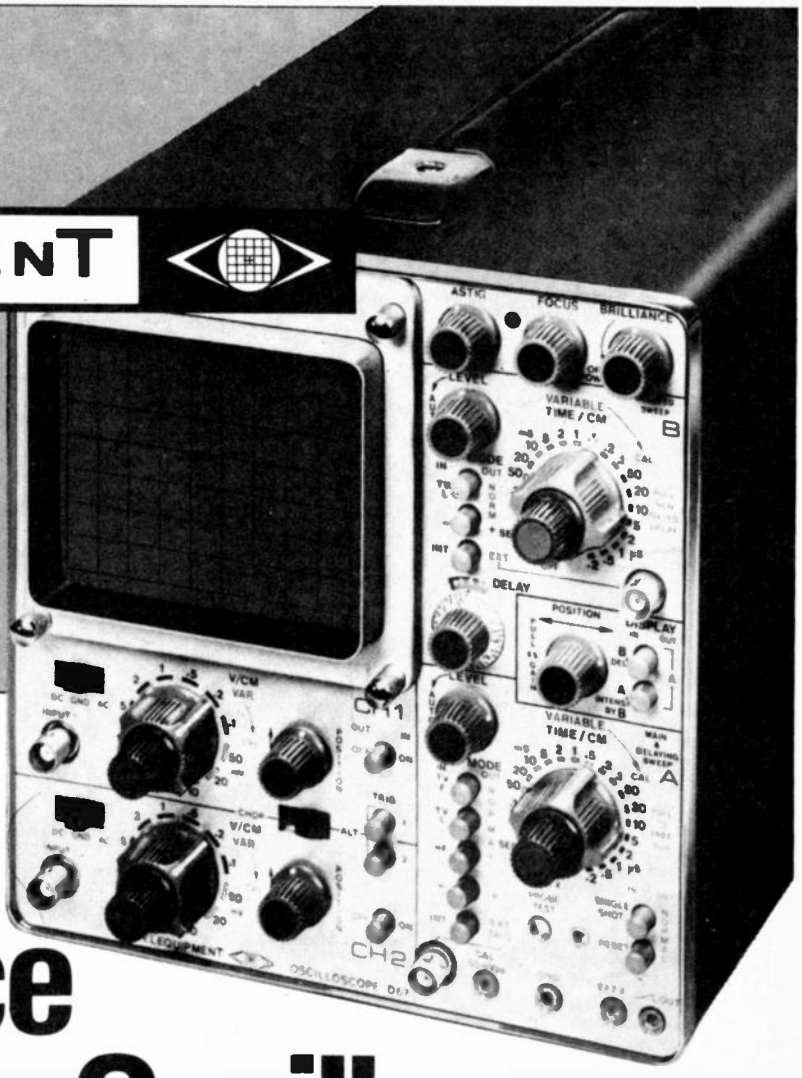
The basic terminal consists of a remote terminal controller with a 300 cpm card reader, a 300 lines per minute printer, and a communications coupler for the modem. With this equipment, the terminal may input and transmit data via a communications line to a central computer system, receive and output data from the communications line to the peripherals, and perform off-line functions.

Other peripherals can be added such as a teletype, video display unit, and card punch.



TELEQUIPMENT

NEW



D67 Dual-trace Solid State Oscilloscope

- **Dual Trace**
- **Bandwidth DC—25 MHz at 10 mV/cm**
- **Signal and Sweep Delay**
- **Large, bright 8 x 10 cm display**
- **3% Measuring Accuracy**
- **Small size—Light weight**

The D67 is a 25 MHz, all solid state dual-trace portable oscilloscope. An 8 x 10 cm mesh CRT provides a bright, clear display. The dual-trace vertical system displays either channel separately, adds channels algebraically, alternates between channels or chops between channels at 100 kHz rate. The delayed sweep feature permits close examination of any part of a complex waveform and also allows for accurate measurements of the time jitter in the input waveform. Solid state design, using FET input circuitry, provides minimum drift and fast stabilisation time.

Advanced Telequipment design and use of solid state circuitry throughout have produced an instrument of extra reliability and robustness ensuring long periods of operation without attention.

Price $793.00 (plus tax and duty if applicable).

3079A

Contact your Tektronix Field Engineer for further information.

Distributed by Tektronix Australia Pty. Limited
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VIC.: 25-27 Alma Road, St. Kilda 3182. Phone 94 0220
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EQUIPMENT NEWS

A multitude of routine jobs such as listings or media conversions can be run off-line, using: card reader to high-speed printer, ASR paper tape, ASR printer, or CRT display unit; ASR paper tape to ASR printer or card punch; ASR or CRT keyboard to card punch; and ASR keyboard to ASR paper tape.

The RTC has a repertoire of 39 instructions, including indirect address and 4k of byte-oriented high-speed core storage. A hardwired 32 byte read-only memory provides a software load routine. The RTC contains five registers designated as the Address Store, Location Counter, Memory Data, Accumulator and Function.

Instructions may consist of either single or double words, occupying one or two bytes in memory. Executive time per instruction is one to four cycles, with a 2 μ/sec cycle time.

Details from EAI-Electronic Associates Pty. Ltd., 48 Atchison St., St. Leonards, N.S.W. 2065.

LOW-COST CRYOGENIC ENVIRONMENT

A LOW-COST, variable-temperature insert that fits into most commercial helium storage dewars to provide an economical cryogenic environment has been announced by Tecnico Electronics, Australian distributors for Princeton Applied Research Corporation.

The PAR Model 157 Mini-cryostat has a sample area that provides an environment for variable temperature research from 2 to 300°K. The area's dimensions are 11.8 mm. in diameter by approximately 50 mm. in length. Overall operating costs are very low. This, combined with a relatively inexpensive initial cost, makes the Model 157 ideally suited for preliminary work on advanced cryogenic studies before large sums are committed for sophisticated systems.

Typical applications of the instrument include experiments on resistivity, magnetic susceptibility, thermoluminescence and carrier lifetimes.

Details from Tecnico Electronics, P.O. Box 12, Marrickville, N.S.W. 2204.

INCREASED PRECISION IN RESISTANCE THERMOMETRY

DESIGN features of a new ac bridge for resistance thermometry will be outlined to an international meeting in Washington this month.

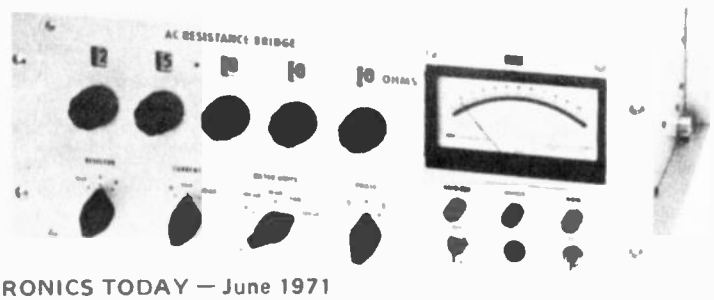
The bridge has been developed by A. M. Thompson and G. W. Small, of the Division of Applied Physics, CSIRO (Sydney) to meet a need for increased precision in temperature measurement and control. It is very stable and insensitive to the thermoelectric effects that cause trouble with dc systems of measurement.

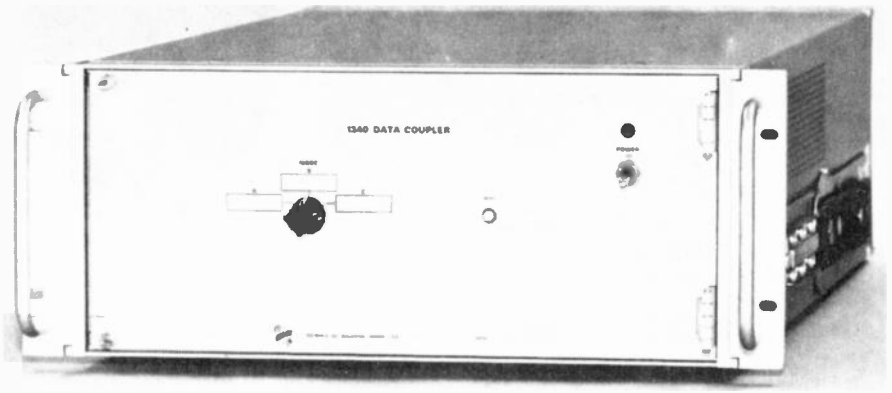
With a resistance range of 0–111 ohms and a linearity of 20 micro-ohms, the bridge, when used with a 25-ohm platinum resistance thermometer, covers a temperature range from –223°C to 1000°C with a resolution of better than 10^{-3} degrees Centigrade.

The bridge is balanced by operating five decade switches from which the resistance reading is obtained in conjunction with a direct-reading meter. There are also facilities for analogue recording which make it very suitable for following small changes in temperature.

In the laboratory the bridge has been used in precision measurements such as determining the melting and freezing curves of metal fixed points standards and the temperature distribution in the working zone of a water bath showing the effects of water flow patterns. The Division has brought the instrument to the stage where it is ready for manufacture on a commercial basis, and contact has been made with a number of interested Australian companies.

A paper describing the bridge and its behaviour will be presented in Washington at the Fifth Symposium on 'Temperature' its measurement and control in science and industry'.





MULTI-PURPOSE DATA COUPLER

ANNOUNCED by Tektronix Australia Pty. Limited – the R1340 Data Coupler, a multi-purpose instrument intended to interface a wide variety of digital measurement, processing and recording equipment.

The interface options presently available provide computer control, data logging and dot-by-dot waveform digitizing for instruments used in Tektronix automated measurement systems, as well as for other instruments having digital inputs and outputs.

The R1340 allows computer control in two different ways: (1) the computer can select predetermined programmes stored in individual programme cards or in the disc memory used with the programme control unit, or (2) the computer can store and manipulate the measurement programme directly through the programme control unit.

Data, such as measurement results, measurement address number, device type and serial information, may be logged on computer-compatible magnetic or paper tape without requiring a computer. Duplication of paper tapes is allowed without computer control with the combined tape reader/punch interface.

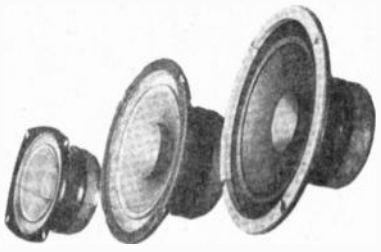
The R1340 operates with Tektronix sampling units to digitize waveforms for computer use. Waveform scanning is digitally controlled by the computer and may be incremented for sequential sampling or directly set to a predetermined position. While The R1340 is intended for repetitive signal conditions, one sample of a single event, such as the response of an integrated circuit under functional test, can be digitized.

Interface cards within the R1340 perform such functions as input/output level conversion, serial-to-parallel and parallel-to-serial format conversions, and temporary data storage in latching registers. A common TTL bus within the R1340 makes all data and control information available to each card where it is interfaced to a computer, other data source or data logger. Several input and output logic level choices can be selected.

Details from Tektronix Pty. Ltd., 80 Waterloo Rd., North Ryde, N.S.W. 2113.

"KALTRO" SPEAKERS

HIGH COMPLIANCE FULL RANGE SPEAKERS



- Powerful ceramic magnet combined with an acoustically suspended cone for remarkably low resonance and undistorted response over the entire audio spectrum.
- High quality cone to bring out the highs.
- Newly designed and epoxi-bonded voice coil for extra heavy program input.
- Compact size and shallow width make these speakers ideal for use with bookshelf type cabinets.
- Double Diaphragm suspension.

SPECIFICATIONS

	FR4	FR65	FR8
Nominal size:	4 inches	6½ inches	8 inches
Power Handling Capacity:			
rms.	4 watts	8 watts	10 watts
Program:	15 watts	25 watts	35 watts
Flux density: (minimum)	10,000 gauss	11,000 gauss	12,000 gauss
Sensitivity:	95 db/W	96 db/W	97 db/W
Voice coil impedance:	8 ohms	8 ohms	8 ohms
Frequency range:	65 16,000 hz	35 18,000 hz	30 20,000 hz
Weight	1¾ lbs.	2¾ lbs.	2¾ lbs.

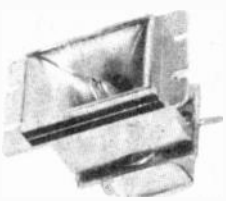
KALTRO FR-8A 8 INCH WOOFER

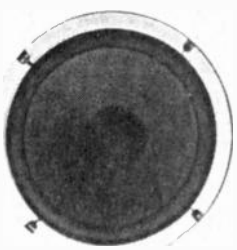
The KALTRO FR-8A is a special version of our FR-8 full range speaker which has been praised by many audio enthusiasts for its supreme tone quality and performance.

SPECIFICATIONS KALTRO FR-8A

Frequency Response 25-5,000Hz
Resonance Frequency 25-50Hz
Power Handling Capacity ..... 10 Watts rms.
Sensitivity ..... 27 db/W
Voice Coil Impedance 8 ohms
Flux Density Over 12,000 gauss
Baffle Opening ..... 6½"
Overall Depth 3¾"

We recommend use of the KALTRO FR-8A with the HTM-2 Horn Tweeter which has been especially designed for use with this woofer. Since the use of an adequate crossover network is desirable, we offer KALTRO MX31 or MX5.
Crossover Frequency 3000 cycles.





Frequency Response 30 Hz to 21,000 Hz

KALTRO Two-way speaker system assembly kit, model SSk-84 8" high compliance woofer + 2¼" dome type tweeter + dividing net work + instruction for building of cabinet.

Available from

RADIO PARTS GROUP

562 Spencer Street, Melbourne—329 7888
157 Elizabeth Street, Melbourne—67 1967
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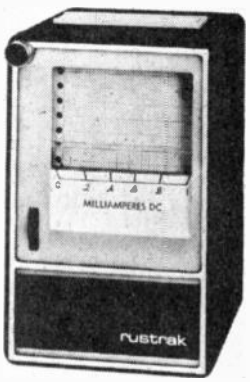
Or your local distributor.

THE rustrak PRIVATE EYE

Rustrak Miniature Recorders chart voltage, current, power, temperature, pressure, strain, events; or virtually any parameter that can be converted into an electrical signal.
Inkless, drywriting, rectilinear recording with wide range of sensitivities, writing and chart speeds.
Quick, easy chart review and re-wind. Sliding access window.
Rugged die-cast aluminium case in epoxy suede-like charcoal gray finish.
63' chart roll — one month's supply at 1" per hour.
Portable or for panel mounting as a system component.
Accuracy ±2% of full scale.
Only 5⅝" high, 3⅝" wide, 4⅛" deep. Weighs 3½ lbs.
Combine any two functions on one chart in our new Dual 300 Series.



Model 288

TECNICO ELECTRONICS

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2 High Street, Northcote, Vic. 3070. Tel. 489 9322
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TE5932

TRIO

9R-59DS

COMMUNICATIONS RECEIVER

PRICE: FOR/FOA SYDNEY: $178.50

- 4 BANDS COVERING 540 Kcs. TO 30 Mcs.
- TWO MECHANICAL FILTERS ENSURE MAXIMUM SELECTIVITY.
- PRODUCT DETECTOR FOR S.S.B. RECEPTION.
- AUTOMATIC NOISE LIMITER.
- LARGE TUNING AND BANDSPREAD DIALS FOR ACCURATE TUNING.
- CALIBRATED ELECTRICAL BANDSPREAD.
- "S" METER AND B.F.O.
- 2 MICROVOLTS SENSITIVITY FOR 10 dB S/N RATIO.

Weston electronics PTY LTD
(A unit of Teddy Mitchell Holdings Ltd)
376 EASTERN VALLEY WAY, ROSEVILLE, 2069.
Cables and Telegraphic Address: 'WESTELEC' Sydney. Phone: 40 1212

Please forward free illustrated literature and specifications on Trio equipment.

Name .....
Address .....

TD

EQUIPMENT NEWS

EDDY CURRENT DETECTOR

A PORTABLE flaw detector which uses eddy currents to locate surface flaws in ferrous and non-ferrous metal components can be either mains-operated or powered by nickel/cadmium rechargeable batteries.

The manufacturers state that cracks can be detected under oxide or paint films, using one or other of a variety of probes which are available for different materials and duties, including the examination of bores down to 3/16 in. diameter.

In operation, a high-frequency alternating current is passed through a small coil wound on a ferrite rod (the probe) attached to a suitable handle. The end of the probe is tracked across the metal surface, the alternating magnetic impulses inducing eddy currents in the metal which are sensed by the probe.

When the probe crosses the line of a crack or surface flaw, the steady pattern of eddy currents is affected, causing a change in voltage indicated on a panel-mounted voltmeter and indicator lamp. There is also provision for an external lamp, a buzzer or a pen recorder.

Standard probes are available for different types of work, but others can be supplied for special needs.

Complete with batteries, probe, test block and detachable front cover, the instrument, called the Richmond Eddy Current Flaw Detector, weighs about 13 lb., case dimensions are 12½ in. x 8½ in. x 9½ in.

Details from Burmah-Castrol Industrial Ltd., Special Products Division, Burmah-Castrol House, Marylebone Road, London N.W.1., England.

MULTI-FUNCTION POLAROGRAPH

A LOW-COST polarographic analyzer, the Model 174, has been introduced by Princeton Applied Research Corporation.

The new multi-purpose instrument brings the techniques of pulse, differential pulse and current-sampled polarography within the reach of every laboratory. It permits sensitivities for metals in the 10^{-8} molar range and comparable sensitivities in organic systems.

By using the latest in solid-state integrated circuitry and new packaging concepts, P.A.R. has produced an instrument which is as sensitive as previously available pulse polarographs selling for five times the price.

The instrument incorporates a ± 80 volt potentiostat for 3 electrode operation and has current sensitivities as high as 20 nanoamps full scale. It also features variable pulse amplitude for differential pulse polarography, and provides scan rates from 0.1 to 500 millivolts per second. Plug-in circuit boards permit quick, easy service.

By adding a P.A.R. lock-in amplifier, phase-sensitive AC polarography may also be performed with the Model 174. This instrument can be used with most laboratory X–Y or strip chart recorders.

Details from Tecnico Electronics, P.O. Box 12, Marrickville, N.S.W. 2204.

IN–CIRCUIT/OUT–OF–CIRCUIT TRANSISTOR TESTER

COMPLETELY portable and requiring no external power source, RCA's WT-501A tests transistors both in-circuit and out-of-circuit, tests both low and high power transistors and has NPN and PNP sockets to allow convenient transistor matching for complementary symmetry applications.

Three colour-coded test leads are provided for in-circuit testing. Special low-impedance circuitry is claimed to ensure the testing is reliable.

The instrument tests transistors for dc beta from 1 to 1000, collector-to-base leakage (ICBO) down to two microamperes, and collector-to-emitter leakage (ICEO) from 20 microamperes to one ampere.

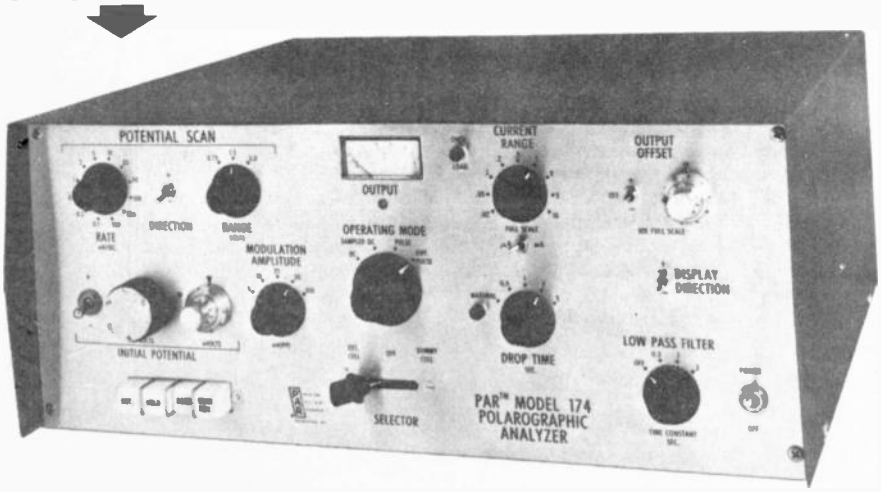
Collector current is adjustable from 20 microamperes to one ampere in four ranges, permitting most transistors to be tested at their rated current level.

Power transistors can be tested with Ic up to one ampere. A dc forward current transfer ratio curve can be plotted.

The instrument can also test the relative in-circuit dc current gain of a transistor.

The WT-501A is a convenient device for checking the front-to-back ratio of diodes. An important feature is stated to be the ability to check the diode at an appropriate current level.

The instrument is available in Australia through AWA, P.O. Box 96, North Ryde, N.S.W. 2113.



EQUIPMENT NEWS

NEW LOCK-IN AMPLIFIER

KEITHLEY Instruments Inc., have recently released their new Model 840 Autoloc lock-in amplifier.

The Model 840 can be operated either as a wideband lock-in or as a tuned lock-in. It automatically tracks frequency and keeps the signal phase shift constant when frequency changes.

Using optional plug-in filter cards, the 840 Autoloc Amplifier is claimed to be capable of detecting signals 140 dB below the noise level. That's equivalent to recovering a signal buried in noise that has a magnitude of 10 million times the signal.

Other features of the signal channel also contribute to versatility. The 840 offers a choice of either differential or single ended input to accommodate a wide variety of signal sources and eliminate ground loops. Sensitivity is variable either by varying the early stage (ac) gain or by varying the post-demodulator (dc) gain. This permits the user to optimize the lock-in for high rejection characteristics – useful when small signals are obscured by large amounts of noise – or permits him to optimize for high output stability – useful when small changes in large signals hidden by noise must be observed.

The reference channel accepts virtually any waveform in the automatic mode. Second-harmonic operation is obtained by turning a knob. Full phase control, including switched 90° steps, is provided.

Items such as second-harmonic operation, variable ac and dc gain, differential input, choice of wideband or tuned operation, built-in time constants for all practical values, full phase control, 0.003%/°C zero stability, ac amplifier output monitor, are included.

Details from Warburton Franki Ltd., Box 182, Chatswood, N.S.W. 2067.

INDUSTRIAL EVENT RECORDER

THE AUTOVISOR, manufactured by F.C. Robinson & Partners, provides an automatic record, on one chart, of the periods of operation of up to 20 machines or processes. The chart moves at a speed applicable to the machine or process being monitored. Electrically operated pens are actuated by the closing of external contacts.

The pens use no ink and require no attention.

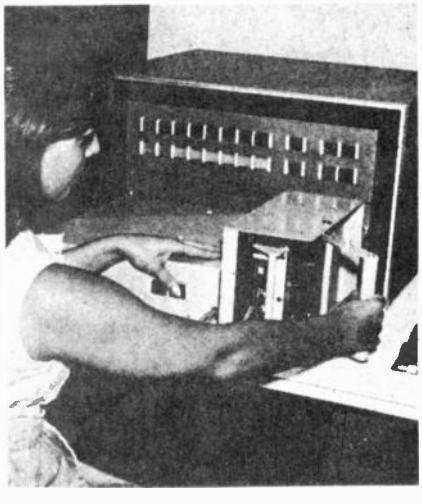
The Autovisor is said to be invaluable for preparing records of machine operating times, machine stoppages, times of morning start, processing time and sequences, periods during which pressures, humidities and temperatures are within predetermined limits, heat treatment periods, flow of liquids, engine tests, life tests – and, in fact, the frequency and duration of any random occurrences.

Full details from Natronics Pty. Limited, The Crescent, Kingsgrove, N.S.W. 2208.

COMPUTER–CONTROLLED TEST SET

A new computer-controlled test set performs 25 intricate tests on newly-produced communications equipment within one minute. Previously, without the computerized device, a skilled technician needed 20 minutes to do the same job.

Called system 250, the computer-controlled device was developed by Lenkurt Electric Company, Inc., a subsidiary of General Telephone and Electronics Corporation. It is estimated the high-speed system will save Lenkurt 9000 man-hours and more than 80,000 dollars in production costs during its first year of operation.



For the initial test, the printed circuit board is inserted into a holding fixture on the test set and contact pins are locked against the components to be tested. Console lights then signal whether the card has "passed" or "failed" the test.

RECORDINGS... CLASSICAL

J.S. BACH — A Musical Offering. Concentus Musicus (Vienna), directed by Nikolaus Harnoncourt. Telefunken SAWT-9569. Stereo.

The 'Musical Offering' remains a remarkable feat of contrapuntal complexity only surpassed by the 'Art of Fugue'. Using one theme (and a difficult one for development), Bach composes a series of canons, three fugues and a trio sonata, all totally different from one-another both in construction and tonal structure.

This performance by the Concentus Musicus of Vienna is to my mind as close as possible to Bach's intentions – in the instruments used, phrasing and tempi. The work is essentially an exercise in counterpoint', – certainly there are extra-musical allusions contained within the work (the ascending modulations of the last canon upon the royal theme symbolising the rising king's glory is one) but its main feature is contrapuntal complexity. This is how Harnoncourt treats the work.

It would perhaps be hard to improve upon this performance. The phrasing by each instrumentalist is beautiful throughout (the finest I have heard from this group) and control over their instruments as to pitch, timbre and bowing is remarkable. They display far greater control than certain groups using *modern* instruments. Trills and ornaments are faultlessly executed, giving the work a delightful freshness. Mention must be made of the superb harpsichord work by Herbert Tachezi.

The theme itself is finely phrased and the six-part fugue (a great test not only for keeping the subject distinct but also sustaining interest in the counterpoint) reveals a mature sense of style and a remarkable understanding of the work. The sounds of the instruments used are of great beauty and fascination, and they blend well with each-other. The lines of counterpoint are outstandingly transparent – it seems just as easy to follow any one part as it is to follow a voice of a fugue played on a Baroque organ. The trio sonata is excellently performed and each line, though completely independent, is clearly distinguishable – yet no one part dominates.

Balance of instruments is excellent throughout and sound is remarkably clear. The disc comes with brief notes on the music, the circumstances concerning composition and the instruments used.

A fine rendering – C.W.

DEBUSSY — 'Debussy': La Mer, Nocturnes. Concertgebouw Orchestra, conducted by Eliahu Inbal. Women's Chorus of the Netherlands Radio and Television. Philips SAL3798. Stereo.

Debussy is not at all easy to do. His music is not just langours and coloured mists. It has precision-finish sliding panels, bands of streaming energy, beautifully formed modal tunes, a kind of rarefied ethereal passion and a feeling of rapt contemplation. Karajan, for one, while perhaps trying to avoid over-emphasising the obvious, was unable to make 'La Mer' sound like Debussy. At times he might have been conducting Bartok, at others Stravinsky.

This is the best interpretation of 'La Mer' I have heard since that of Boulez (CBS), and it is almost its opposite. Boulez' 'La Mer' is a little faster than usual and is a classical articulation, matchless in its strength, subtlety and clarity, of the music as music. Inbal's is slower than usual, and he seems more concerned than Boulez with a poetic evocation of specific sea images and impressions. He succeeds through intensity and conviction, as well as a fine control of tricky rhythms and forces moving, as it were, in slow motion.

Indicative of the differing approaches is the way the two men have balanced their orchestras: Inbal with strings in the foreground, Boulez favouring the woodwinds. Halfway through the first part, the lower strings emerge from brief silence with a peculiarly deliberate grace; tense, measured and fluent. In Boulez' treatment they have the quality of lacquered spring steel rhythmically unwinding. Inbal directs them, after the tension of their first ascending phrase, into a playful stacatto treatment. The one is musically astonishing, the other brings to mind the play of waves under a light breeze.

Boulez gives you, finally, through the formal beauty of the music, a kind of maritime essence. Inbal gives you poetic experience from moment to moment. His interpretation is not entirely without fault. Some of the glorious melodies are stretched at his slow tempo into formlessness. The spectacular passages in the second and third movements have not the strength and clarity Boulez finds in them. Rather a slight overfullness, deliberation, heavyness even – though the climax is an impressive achievement on any terms, raging indeed like the sea.

Equally impressive is the opening in which the orchestra stirs to shivering intense life, as though on a cold bright morning; a slow wind seems to pass over everything, and one can easily see the ocean exquisitely ruffled and glistening, the seagrasses bowing and trembling.

Surface noise becomes obtrusive at times during 'La Mer' – but the 'Nuages' piece from Nocturnes is pretty well spoiled by rumbling, as well as a loud swishing sound. The performance, a fine one, is practically written off by these mechanical faults. The surface mysteriously clears for 'Fetes' and 'Sirenes' and both are splendid performances: the one rich and dazzling, the other quite rapturous in its strange remote way.

Apart from surface noise, the recorded sound often has a hollowness which might suggest transfer from an earlier pressing. Generally, though, it is clear and full. – J.C.

BIZET — Carmen. Soloists, with Chorus and Orchestra of the Theatre National de L'Opera, Paris, conducted by Fruhbeck de Burgos. HMV SLS 952/3. Stereo.

With the exceptions of Berlioz, Debussy and Ravel, French opera composers have in general not been well-served, whether live or on record. A number of French operas (by Massenet, Gounod) are on record, even more than once, but these discs do not present performances which are enthusiastic or idiomatic.

The fact that French opera is very seldom staged outside France, and there apathetically, states clearly enough the root of the problem: most performers don't like French opera – which is perhaps also to say that most listeners do not either.

One would think that Bizet's 'Carmen' would be an exception to this state of affairs – it is the most recorded and performed French opera – but where we can usually speak of at least enthusiastic performances of Verdi, Puccini, even Monteverdi, we cannot seem to say the same for Bizet's 'Carmen': it never comes to life.

There is certainly, in the case of this French opera, no lack of trying. This recorded set makes the third 'Carmen' HMV has put out in the last 12 years or so, and once again one is forced to say this is *not* the 'Carmen' we have been waiting for. A pity, since this recording has seen fit to restore the long-lost Act I Pantomime and the Duel Scene from Act III, as well as the original dialogue. If anything, this new set does prove that the dialogue enhances the dramatic atmosphere of the whole opera and is the version to have in future. Artistically, however, it must be ranked lower than either of the earlier HMV sets (Beecham, Pretre) and even the RCA (Von Karajan).

The blame must be placed on conductor Fruhbeck de Burgos. It was perhaps thought that this eminent Spanish conductor might just inject the score with the right Iberian flavour to make the opera take fire. But de Burghos seems self-conscious about anything Spanish that might be in this score; his reading is indistinguishable from that of any slightly more than competent *maitre*.

There are disconcerting moments (Micaela's aria) when de Burgos seems either eccentric or merely undecided about tempo and phrasing. But it is the general lacklustre attitude of the conductor that prevents Grace Bumbry's Carmen from becoming a characterization. Or it may also be that Bumbry herself is not quite taken by the part. Only one member of the cast seems to enjoy her role and sings well, and that is Mirella Freni as Micaela.

With one important exception, the rest of the cast is at least adequate, and I must say that Eliane Lublin (Frasquita) and Vioric Cortez (Mercedes) do the card scene very well. The exception is Jon Vicker's Don Joes – painful, nasal, and very vocally unfocused. Along with Mario del Monaco's version (Decca), it is the worst Don Jose I have heard in some time.

The speaking actors are not above ordinary; they, too, seem to be apathetic about the whole affair, and Carmen's *Ton*

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epinglette . . ." (No. 5) is dreadfully hammy.

To be completely fair about this production, let me conclude by saying that the Urchins' Chorus *(Les Petits Chanteurs a la Croix de Bois)* is superb. For once someone has seen fit to get a children's chorus that sounds like it has boys in it – and when they sing along with the rest of the chorus, at the beginning and the end of the opera, they achieve the very simple but ingenious setting of scene that Bizet intended.

Recording – as usual with a lot of Angel HMVs these days – is rather constricted, with distortion terribly frequent. Pressings are rather unsatisfactory, too.

For those in search of a 'Carmen' I would recommend their getting any of the following versions, although I must say I cannot recommend any wholeheartedly.

HMV ASD-331-3 preserves Beecham's very Gallic and fine conducting of the score. It does not have very much of the fire, however. De los Angeles' Carmen is sensitive, well sung, but not the gypsy of either Merimee or Bizet. Once again, HMV has cast the wrong Spaniard for 'Carmen': Senora de los Angeles is Catalan, and I'm afraid that she and Beecham are far from comprehending what an Andalusian gypsy is like.

Herbert von Karajan (RCA LDS-6164) presents a 'grand' opera performance – not, of course, the *opera-comique* Bizet intended. It is ponderous at times but usually exciting enough. This recording has the most luscious Carmen on records (Leontyne Price), a fine Escamillo (Robert Merill), and the usual inadequate Don Jose (Franco Corelli). But, once again, Price is not Carmen: one could mistake her for any other grand opera heroine.

It is strange that all the Carmens in history can be divided into two groups: the first, vocally superb but with non-Carmen characterization (or none at all); the second, vocally harsh but closer to the Carmen the composer must have intended, and certainly more like the true-to-life gypsy. In this second group we can place Maria Callas' protrayal of the role.

No-one can deny that Callas' voice on HMV SAN 143-5 is unbeautiful, but her characterization of the role is the closest to the ideal Carmen I have heard. Even the fact of the quality of her voice lends support to her conception of the role. I will only cite one instance in this recording, and I invite all directly to compare all other versions to that of Callas. In No. 16 Carmen proposes to dance for Don Jose. Callas' rendition of this scene, especially the variety of vocal colouring with which she injects each 'Taratata!' is quite superb.

Georges Pretre conducts with a lot of drive and interest, and Nicolai Gedda's Don Jose, while not as good as his previous one with de los Angeles, is nevertheless better than anyone else's. This recording, however, shares along with the de los Angeles recording rather disappointing Micaelas and Escamillos.

In sum, I would recommend Callas' performance above the rest, despite shortcomings in the general production. Otherwise, I'd much rather have the old (mono only) RCA recording by Fritz Reiner (LM-6102). That had superb and really quite fiery conducting, matched with a (by this time) vocally coarse Carmen by Rise Stevens – but a true Carmen, and a classic one at that. – J.A.

DEBUSSY — Pelleas et Melisande. Soloists, Royal Opera Chorus and Orchestra (Covent Garden) conducted by Pierre Boulez. CBS 72845/7.

With his usual sharp-clear approach, Boulez dissects and illustrates Debussy's phenomenal virtuousity as well as the newness of his approach to sound. I feel, however, that while such an approach benefits 'La Mer', it hardly does 'Pelleas'.

To borrow a literary frame of reference, Boulez is too 'cool, dry and sophisticated' for this score. Too often one feels he is indulging in his surprise of 'how clear, how modern' Debussy is, in much the same way as some newly-adult reader might exclaim in appreciation of Rimbaud – 'How really clear after all . . .'.

Boulez' approach to this particular score is indeed fashionable, and we will perhaps have to wait a number of years before people will be willing to acknowledge its very real poverty. In scene after scene, Boulez extracts the dazzling effect, which now also seems to have little to do with this symbolist drama. In no other version have I heard a more hard *'Mes longs cheveux descendent'* (III,1), completely devoid of mystery.

As in the first Ansermet recording, one could well understand people who said the music was superb but the text something one could hardly take seriously. Even more so than Ansermet, Boulez ignores the basically French idea that in order to have true clarity one must have shade. It would be wrong to under-estimate this performance: it is brilliant, and just that. Logically – but, from another viewpoint, paradoxically – Boulez is most successful in the more Wagnerian preludes.

Boulez' singers take their cue from the master: they sing very well, with little mystery. Even more seriously than the orchestral aspects of the score, vocal possibilities are restricted by the Boulez attempt to rescue 'Pelleas' from the realm of 'pale poetry': his achievement is certainly hard, but hardly less pale. How sentimental everything sounds in this reassuring glitter!

Incidentally, much has been made of Boulez' casting of Pelleas with a tenor and Yniold a treble. I dare say, the first is hardly original – the majority of recordings give the role of Pelleas to a tenor, and to the sort of tenor that really contrasts with Golaud's baritone; Boulez nullifies his attempt by casting George Shirley as Pelleas, but Shirley's voice is rather baritone in quality. Yes, Yniold is certainly more sensibly sung by a treble, but here again this much-heralded innovation is hardly new. Once again I must say that singing from everyone is very well done, with special credits to Yvonne Minton (Genevieve) and Anthony Britten (Yniold).

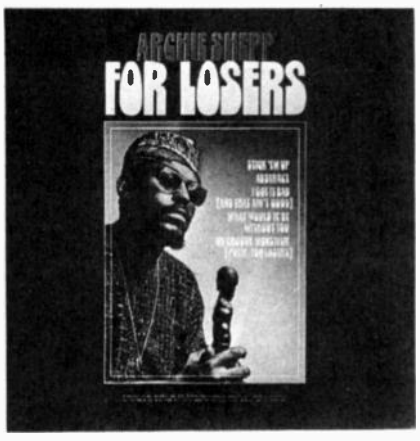
Despite the fact that Debussy's Pelleas has, I think, been the most successful presented French opera on records, I regret to say that there are no extant versions which are more than merely acceptable. Aside from this Boulez performance there are the two Ansermet readings, both of which I find preferable in atmosphere to this one, but not by much.

If one is willing to search around, one might come up with the old Desormiere (HMV) or Fournet (FPIC) performances, both wonderful but now deleted. But be on guard for an even finer performance – like the two preceding, also in old-style monophonic – but a recording which preserves the finest Melisande to be heard (Victoria de los Angeles).

Even a cursory comparison with Boulez' Melisande (Elizabeth Soederstroem) reveals the difference between a fine singer and a great one. Hearing de los Angeles, one realizes how useless all this fuss about 'pale poetry' is: one must get singers who have an affinity for the opera. This recording (ably conducted by Cluytens) also has the excellent Golaud of Gerard Souzay; the entire cast is, in fact, unusually strong. The Cluytens recording, oddly enough, is available and only on a Toshiba import – but it is THE 'Pelleas' to have. – J.A. ●

RECORDINGS... JAZZ

REVIEWERS:
John Clare, Dick Hughes



ARCHIE SHEPP — For Losers. Impulse AS-9188. Stereo. Stick 'em Up, Abstract, I Got it Bad, What Would it Be without You, Poem for Losers. Personnel includes Cecil Payne, baritone; Cedar Walton, piano; Jimmy Owens, trumpet; Leon Thomas, Chinalin Sharpe, vocals: Joe Chambers, drums.

It is not unusual for Archie Shepp to play rhythm and blues, 'free' jazz and an Ellington standard on the one recording, as he does here; I feel certain that he is more concerned with expressing himself through the whole spectrum of Black American music than he is with staying in the forefront of any experimental movement.

However, his very individual and often eccentric imagination asserts itself no matter what he plays. There are two rousing rhythm and blues tracks. 'Stick 'em Up' has a marvellous shouting vocal by Leon Thomas, good tenor by Shepp, and 'Abstract' has a nice clean solo by Jimmy Owens and a dirty roaring one by Shepp which includes a couple of beautifully placed high notes and displays his extraordinary rich, dark sound to perfection.

There are two immaculate and strong blues ballad performances in which Shepp still refuses to be pinned down by the orthodox context, while treating it with deep respect and playing in a manner which should please all lovers of the Webster-Hawkins school of tenor playing. Chinalin Sharpe, who sings on 'I Got It Bad' sounds remarkably like Billy Holiday. I don't doubt that this emulation is a reverent one, but am not sure that I see the point of it.

'For Losers' begins with trombone and reeds dividing between them a Latin rhythm slightly reminiscent of Bill Russo's 23 degrees North 82 degrees West with sharp driving cymbal work from Joe Chambers. The band generates such a rumbling, strong satisfying feeling here that the two bursts of abandoned neo-African chanting, probably by Shepp, could well have been unpremeditated The figure is transferred to the piano which becomes the timekeeper (as on the recent 'Black Gipsy' on 'America'), allowing the drummer to play out of time occasionally in purely textural passages, or concentrate on polyrhythms and unexpected explosive accents.

Shepp solos on soprano, and it is on this instrument that his debt to Ornette Coleman is most obvious, though it manifests itself in certain timbres and general concepts rather than specific ideas. Shepp is almost as original on this instrument as he is on tenor, and presents almost as rich a range of inflections and tonal variations. He gets an enormous open groaning sound down low and can play, if he chooses, with a stinging oboe-like sound in all registers – but for his lyrical phrases (these in general contour similar to Coleman's) he gets a ripe bright yellow sound, which in rare quiet moments becomes languid and exotic without ever losing that compelling buzz. The humorous quality that often pervades his tenor work is absent, and for that reason his soprano is generally more searing, even harrowing, in its intensity.

There follow two free blowing sections quite distinct in feeling. This second section resolves itself into a limpid background for Miss Sharpe, who sings the 'Poem for Losers' in a kind of jazz recitative drawing heavily from 'Lady Sings the Blues'.

A two-note figure is repeated slowly against a scale-like piano figure in fast twelve/four for the time, and Shepp solos continuously on soprano. I thought that this went on for too long.

Sound is generally excellent. The true characteristics of the different instruments are reproduced and stereo separation is intelligently arbitrated. However, there are a few awful surface crunches at the beginning of two tracks on my copy. – J.C.

JIMMY WITHERSPOON — 1969 Monterey Jazz Festival. Vedette VDS 214. Ain't Nobody's Business, When I Been Drinkin', Big Fine Girl, Good Rocking Tonight, No Rollin' Blues.

Jimmy Witherspoon is the master of the glorious, towering bellow, and he sure does roar out here with great heart. The two long slow rollers – 'Nobody's Business' and 'When I Been Drinkin' – have singing as good as you'll ever hear from him, I think.

This is not surprising, for the band accompanying him includes Coleman Hawkins, Ben Webster, Roy Eldridge and Earl Hines. The occasion was the 1959 Monterey Festival, and the musicians stayed on to accompany 'Spoon after completing their own set.

'Spoon's sudden opening roar on 'Aint Nobody's Business' is enough to stand anyone's hair up on their head, and the reaction from the crowd is immediate. In fact, their yells of encouragement throughout the record, as they anticipate the glorious rolling blues cadences, are almost as exciting as the music. At times they sound like a completely out-of-control gospel choir.

On this track the great men improvise an accompaniment with breathtaking ease and infinite tact, taking over from each other as though to secret signals, weaving counterpoint lines as though they were playing in a trance. Ben Webster oozes into the foreground – there is no other word for it – and breaks everything up without raising his voice. Earl Hines is the immovable rock on which it is all based, chiming out in the pauses great indestructible arpeggios.

The absolute peak of this marvellous session is reached on 'Drinking', when Coleman Hawkins opens up as I have heard him do only once or twice before. This solo is a burster, an outpouring of elemental force bearing a not-too-distant relationship to what Pharoach Sanders is doing these days. Never ever does it get out of control. It is as though the Hawk held a high-pressure hose in an iron grip, even letting it go at one point to flap and spout, then snapping it back into line. The crowd become literally hysterical.

Eldridge is the big disappointment. On 'Big Fine Girl' he crosses the thin line between his best playing and his out-of-control playing. He gets some admirable high notes from his trumpet, but then seems to get stuck in that register, unable to do too much there and unable to get down. The whole band is pretty rough on this track, as they are on the next, 'Good Rocking'. Both are largely a waste of time.

The final track, 'No Rollin' Blues', is a real good rocker, and the crowd are a treat.

Sound is good generally for a live recording. All the soloists come through strongly, including some pretty mad shouters in the audience.

I cannot recommend this strongly enough. Budget price. – J.C.

EARL HINES — Earl 'Fatha' Hines. Vedette VDS 207. Stereo.

This record consists of tracks from two rare sessions by the all-time great pianist. With him in Chicago in 1947 were Morris Lane on tenor sax, Eddie South on violin, Bob Wyatt on organ, and unknown guitar, bass and drums. With him in Los Angeles in 1954 were Gene Redd on trumpet (unknown to me, I must confess), Dickie Wells on trombone, Leroy Harris on alto sax, Jerome Richardson on tenor sax, bass clarinet and flute (listed only on flute), Paul Binnings on bass and Hank Milo on drums.

Neither session is listed on the Albert McCarthy – Dave Carey Jazz Directory. Neither session is among Hines' best.

Only three of the eight tracks are from the 1947 session – 'Blues for Garroway', 'Honeysuckle Rose' and 'Dark Eyes'. Curiously, Hines takes no solos on the 'Blues' or 'Dark Eyes' and plays only brief solos on 'Honeysuckle Rose'.

The unknown guitarist opens the 'Blues' with two excellent choruses which have overtones of Teddy Bunn and Floyd Smith. He plays singing single string work and gives way to Morris Lane, who comes in a bit like Ben Webster. The bass work is particularly

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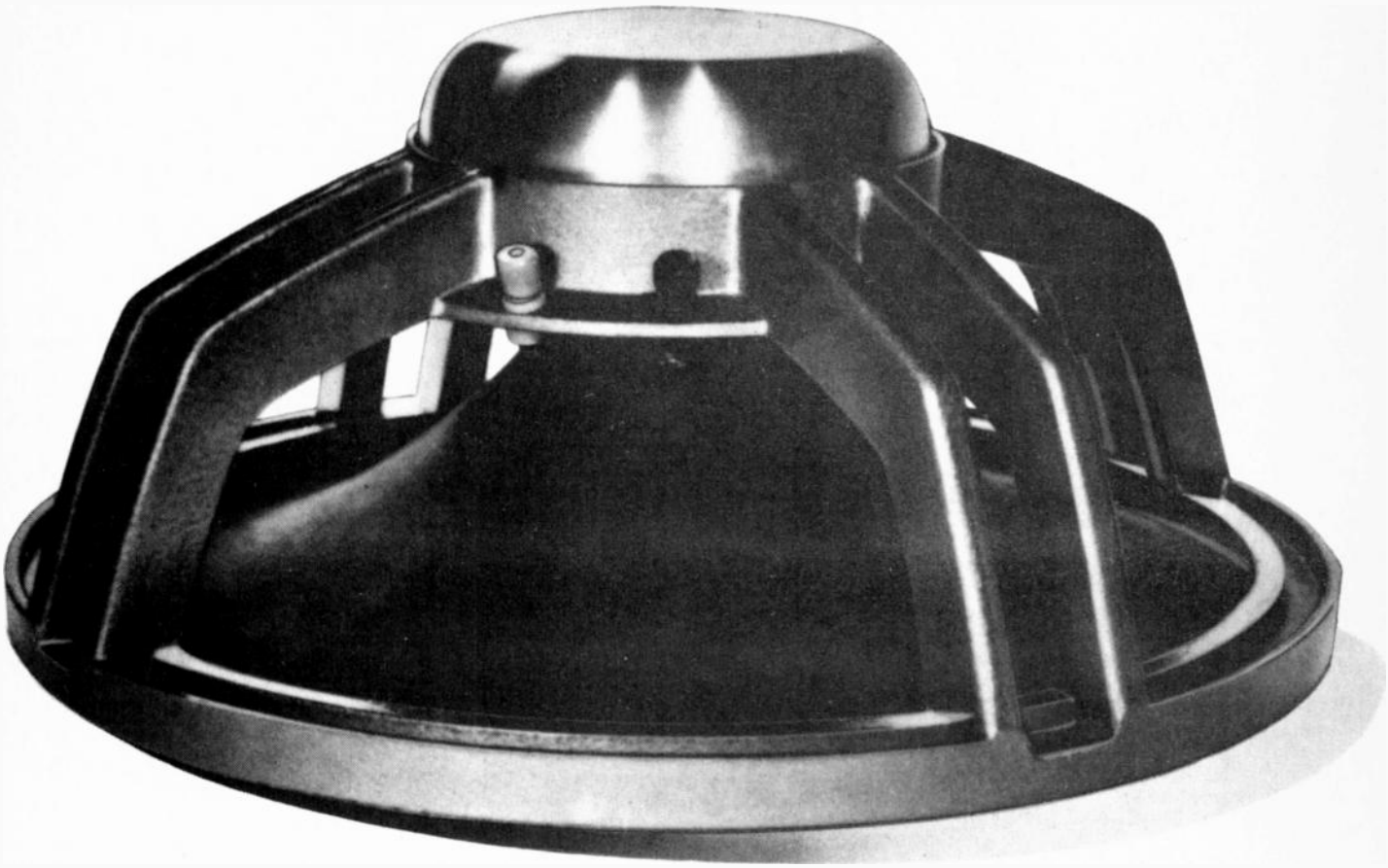

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JAZZ

good behind his two choruses, beyond which it's a pity he wasn't able to stretch himself. And more's the pity that Hines takes no solo.

Eddie South, one of the few first-rate genuine jazz violinists, opens 'Dark Eyes' with a quote from Sarasate, plays a chorus virtually straight, then swings gently with Hines feeding him superbly. In the third and last chorus Hines struts his tenths so effectively that, admire Eddie South though I do, I would have liked him to have dropped out on this one so that I could have heard Father at work.

Hines takes the first chorus of 'Honeysuckle Rose' fairly straight, with Bob Wyatt's organ and South's violin sighing behind him and toying with 'Tea for Two'. He plays in a Fats Waller style behind Morris Lane and takes out the final chorus after South's middle eight.

Happily, there's far more of Hines' piano on the Los Angeles session, which has three piano, bass, drums features – 'Nice Work If You Can Get It', 'If I Had You' and 'Humoresque'. The recording is very good, incidentally, and you can hear Hines gasp and chuckle at the end of 'Nice Work' – a fairly energetic workout over two-and-a-half choruses, but not so scintillating as the version from the PARIS ONE-NIGHT STAND Philips album he made in 1957.

Although 'Humoresque' is also favoured by two other great pianists (Art Tatum and Mary Lou Williams), I have always found it a dull and trite theme, annoyingly coy.

'If I Had You' is fair-to-average quality Hines ballad work. It lasts for only one-and-a-half choruses and Hines switches briefly to celeste in the last eight. Despite the presence of that mighty trombonist, Dickie Wells, the ensembles on the band tracks are rather tame. Remember the time – 1954; remember the place – Los Angeles. The pallid West Coast style was the 'in' thing in the mid-fifties and it even affected Hines a bit.

'Gone with the Wind' is a very low-key performance for Hines, and he plays some of his least characteristic piano in his solo. Jerome Richardson plays flute, and the overall feeling is that of high-class cocktail music.

'The Web', 'Hollywood Hop' and 'A Jumpin' Something' are much better. The opening phrase of 'Jumpin' Something' sounds a bit like 'Down By The Riverside'. Hines worries the piano after Dickie Wells' solo and the ensemble plays its best on the final chorus, with Gene Redd playing very good muted trumpet.

Hines plays his best orchestral piano on the last chorus of 'Hollywood Hop', cutting through the ensemble with a minimum of effort and a maximum of effect.

'The Web' is a minor-key piece which features Latin rhythms, Redd's muted trumpet and, I feel sure, Richardson on bass clarinet.

This is not a bad record, but it's certainly not Hines at his best. The muse just wasn't there. Recording quality is very good, but the playing time is short, with only 14 minutes 51 seconds for the first side and 15 minutes for the second. – D.H.

LIVE BLUES — American Folk Blues Festival. Scout (CBS) Sc S6. Stereo. Juke Boy Bonner, Earl Hooker, Carey Bell, John Jackson, Clifton Chenier, Magic Sam, Whistling Alex Moore.

Here is a pretty solid collection of blues performances recorded at London's Royal

Albert Hall in 1969.

The weakest tracks are to my mind 'Jumpin' with Juke Boy' – a routine boogie by Juke Boy Bonner on harmonica and guitar – and the two Clifton Chenier tracks (this is a personal quirk: his music is to me cheerful enough, but just plain boring on repeated hearings). The rest are all strong, and there is one track for which alone I would lay down the price of this LP: 'Across The Atlantic Ocean' by Whistling Alex Moore.

I don't think there are many stronger pianists, young or old, than the seventy-year-old Moore. He hasn't got much voice left, but his phrasing is always intriguing. His whistling is very simple, but amazingly broad and husky in tone, and it is saturated with the blues. Above all, he is a two-handed piano player of great facility and power. It must have been an inspiring thing to have heard and seen him on the night.

Where there are drums on this recording, they are played by Robert St. Julien, whose effectiveness varies from track to track. He adds nothing to Earl Hooker's fine 'Going Up and Down' but corny rock-and-roll triplets, and on Carey Bell's medley (with Hooker on guitar and Mack Thompson on bass) his fast oom-cha, oom-cha could well be dispensed with. This last has a very strong Bell vocal, and Bell leans hard into the beat with his roaring harmonica. On 'Up and Down' he gets into some fine interplay with Hooker's guitar.

Juke Boy Bonner redeems himself with 'Running Shoes'. There are no drums here and it tromps along quite diabolically. John Jackson's 'Poor Boy' also gets along some without percussion. Jackson's nasal old-time blues voice and sharp, singing guitar are haunting and satisfyingly authentic.

On Hooker's 'Blue Shadows Fall' the drummer's presence is certainly justified, rather he justifies his own presence. His approach here is much more 'modern' and, frankly, this is the only approach that really matches the rhythmic strength of a good blues group. Again, with Bell and Thompson, this is the kind of loping 'power-in-reserve' performance that wipes most of today's rock groups off the map.

Magic Sam's 'Easy Baby' rocks plenty too. Sam has a wide-ranging and rhythmic delivery similar in some ways to that of Ray Charles.

Sound is rough, but not muddy. There is no lack of impact, and it is true stereo. All in all, a good buy. – J.C.

MILES DAVIS — Miles Davis at Filmore, CBS G30038. Stereo, two-record set: 'Wednesday Miles, Thursday Miles, Friday Miles, Saturday Miles'. Chick Corea, electric piano; Steve Grossman, soprano sax; Keith Jarrett, organ; Jack De Johnette, drums; Dave Holland, bass; Arto Moriera, assorted percussion.

Each side of these two recordings is a continuous blowing session taped on a different night at the Filmore, which is most widely known as a rock palace. There is probably a bit of cutting and splicing – otherwise I am sure the sessions would not each have taken up exactly one side – but I can only detect it, or imagine that I can, in one spot.

This is not the most advanced jazz that it's possible for one to hear, but it is the most powerful and advanced use that's been made of elements of recent jazz and rock together.

Filmore is an extension of the previous album, 'Bitches Brew'. It brings what was being done on that album into sharper focus, and it uses it with greater freedom and force. Though there are fewer musicians, there are – perhaps not surprisingly – more things happening. Those who are not yet attuned to it may find it more cluttered and incomprehensible, but I know that there is a substantial audience able to follow and enjoy it with no trouble at all.

There is an unfortunate tendency to equate complexity with pretension, or with a denial of the emotional or sensual response. That lace of foam which spills over richly carpeted rocks on any headland is complex, yet most people experience it as pure sensual delight. I can only suggest that you shed as best you can all preconceptions, dance around, lie down, whatever you like, but listen: take a deep draught of this.

All else aside, Miles' blowing on every side must rank with the greatest in jazz in its largeness of concept, technical excellence and sheer emotional force. Around the time of his album 'Miles in the Sky' I fancied he had been listening to Freddy Hubbard, maybe Booker Little and even Don Cherry, though it's all unmistakably Miles. He has extended Hubbard's brilliant fragments into long jagged flashing lines ranging all over the horn, after which he might leave you space to digest what he has just done and listen to the amazing rhythm section, blat out a sudden two-note exclamation preceded by a grace note, or a short juddering valve trill, which threaten to crack the horn open as well as stiffening up the rhythm section in a salutory manner: landing just ahead of the on beat to throw everything forward and prompt the drummer to crack down harder on the off beat. He releases long pure screams in the upper register and croaks like a trombone down low.

Like Louis, like Diz and Roy, he fills you up.

Except for Steve Grossman, the other brilliant musicians do not take solos as such but improvise constantly around each-other, and it's amazing that they do not ever get in each-other's way. The whole thing constantly bubbles like hot springs, and it's shot through with terrific jolts of energy. What a great time they are all having, especially percussionist Moriera. There was something ominous about parts of 'Bitches Brew'. Dancing to it was often like boxing with a man who is moving around very fast, and who you know is always dangerous. This is pure joy.

The sound is exemplary for a live recording, particularly for music of this range and complexity.

Here, even more than in 'Brew', Miles has got a context in which he can combine the toughness flexibility and rhythmic variety of 'Miles in the Sky' with a voluptuous and hypnotic atmosphere, without simplifying his playing as he did on 'In a Silent Way'. – J.C.

Acoustic Research AR-3a speaker systems are important professional tools to composer/arranger Don Ellis.

Don Ellis creates music that ranges from the ancient sitar to a novel four-valve quarter-tone trumpet specially made for him. His work is well exemplified by **Electric Bath** (Columbia 9585), which was Album of the Year (1968) in **Down Beat,** placed second in **Playboy's** annual poll, and third in **Melody Maker;** the record was also nominated for a Grammy Award.

Mr. Ellis' high-fidelity system in his studio consists of an AR turntable, a Bogen-Lenco B62 turntable, an AR amplifier, a JBL 600 amplifier, a Koss Pro 600A headset, Revox and Crown tape recorders, and a pair of AR-3a speaker systems.

Mr. Ellis advises AR that the turntables, amplifiers, and tape recorders are all capable of highest-quality reproduction, so that making comparisons of different tapes and records can be done dependably with any of them. However, he finds that only AR-3a speaker systems are accurate enough to use in his work.

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WD7/FP

RECORDINGS... POP TRENDS

REVIEWERS:
John Clare, Kevin Wolfe

THE BEACH BOYS — Sunflower. EMI SOSL 8251. Stereo. Cottonfields, Slip on Through, This Whole World, Add Some Music to Your Day, Deidre, Got to Know That Woman, It's About Time, Tears in the Morning, All I Wanna Do, Forever, Our Sweet Love, At My Window, Cool, Cool Water.

This is a great party record, which means that it's not the Beach Boys at their most inventive. Either reissue stuff, or it represents a retrograde step on their part. The material alternates between heavily Beatles-influenced songs and early surfie rock-and-roll. There are some very humorous cliches in the backings. Apart from the obvious rock-and-roll riffs there are simpering strings on one track and French cafe music on another.

The recording has a cheap sound, sometimes depthless, sometimes over-resonant and hollow – but you can hear everything pretty clearly, separation is good, and I don't think it was ever intended to be listened to alone with the shades drawn. – J.C.

COLOSSEUM — Daughter of Time. Vertigo 6360017. Stereo. Three Score and Ten, Amen, Time Lament, Take Me Back to Doomsday, The Daughter of Time, Theme for an Imaginary Western, Bring out Your Dead, Downhill and Shadows, The Time Machine.

Colosseum's records to date have shown them to be an enjoyable but not over-exciting jazz rock group. On this recording they rely on big production numbers with extravagant orchestral backings. There is a general paucity of melodic invention, a banal, overblown quality in the orchestral writing, and the whole thing is monumentally boring. Drummer John Hiseman works hard to inject some life into the ponderous proceedings, but it's a losing battle.

Recorded sound is quite adequate. – J.C.

FOTHERINGAY — Fotheringay. SIL 933920 Stereo. Nothing More, The Sea, The Ballad of Ned Kelly, Winter Winds, Peace in the End, The Way I Feel, The Pond and the Stream, Too Much of Nothing, Banks of the Nile.

Fotheringay is an English group, and a very good one. Perhaps I should say *was* a group, because they have recently split up.

Their instrumentation comprises a 12-string guitar, acoustic guitar, lead electric guitar, electric bass, drums, and occasionally piano.

Basically they are a folk group which uses rock influences, and uses them very well indeed.

The lead singer is a girl – Sandy Denny – who also seems to write most of the material they do, sometimes in collaboration with Sydney singer Trevor Lucas. Sandy Denny's voice is perfectly suited to the material she sings, although I

have a slight quibble about her diction. Trevor Lucas gets in one of his own songs – The Ballad of Ned Kelly – and very good it is, too.

The backing and arrangements are brilliant. They never get so heavy that any instrument or strand of the arrangements is lost.

I urge you to listen to Fotheringay if you want to hear the perfect amalgam of folk and rock. I understand that this is their first and last record. I'm certainly glad that I have got it.

Recorded sound is ideal for their sensitive approach. Resonance has been used intelligently: it does not swamp the instruments' true characteristics. – K.W.

STAN GETZ — Marrakesh Express. MGM 2315 012. Stereo. Marrakesh Express, Raindrops Keep Fallin' on My Head, I'll Never Fall in Love Again, Both Sides Now, Without Her, Cecilia, Love Theme from 'Romeo and Juliet', Medley Because, Do You Know the Way to San Jose? Just a Child, The April Fools.

Getz, a talented jazz tenor sax player, here delivers a pretty straight melody line in some well-put-together, easy listening type arrangements. Most of his embellishments are of a pleasant but routine nature, though the odd turn of phrase shows that his jazz mind has not gone completely to sleep.

Production, by Beatles man George Martin, is faultless of its kind. On 'Do You Know the Way to San Jose' Getz gets some of the way into his Bossa Nova bag and there are few unseemly blasts from the brass – unseemly in the context of this record, anyway – and this is the only track that generates any heat.

All in all, very superior Muzak. The sound is very sharp and clear. – J.C.

DAVE BRUBECK — Dave Brubeck Quartet. Music for Pleasure A8209. Stereo. Audrey, Jeepers Creepers, Pennies from Heaven, Why Do I Love You?, Stompin' for Mili, Keepin' out of Mischief Now, A Fine Romance, Brother Can You Spare a Dime?

Brubeck, piano, Paul Desmond, alto sax; Bob Bates, bass; Joe Dodge, drums.

At the time this reissue was recorded (1954) Brubeck had his picture on the cover of Time magazine – in fact that cover was in turn reproduced on the original record cover – and he was being described by the experts at Time as "possibly the most exciting jazz artist at work today".

If I remember rightly, Time made much of Dave's intellectual approach. They were intrigued by his glasses. Dave did the college circuit. They loved those thoughtful pauses between chords, his concentration as he hovered over the keyboard, rather like a chess master, choosing a new chord just as its predecessor faded, filling with an occasional arpeggio while he pondered the problem of how to work in a little swinging Garnerish bit.

What does it sound like now? With Paul Desmond's alto lovely and limpid as always, but not at its most inventive, with one of the most negligible rhythm sections ever recorded, with Dave never straying far from the melody despite his ponderous deliberations, with the much-acclaimed 'contrapuntal' exchanges between Dave and Paul (the one merely echoing the other's phrase), it sounds like very pleasant background music.

It also sounds marvellously nostalgic. For the sake of nostalgia, I suppose, I decided against treating it solely as a jazz record – in which case I would have had to pull it apart. I can't imagine any less distracting, more thoroughly pleasant background than side two, which seems to have been recorded, or transferred from the old recording, with much more care than side one. I congratulate Mr. Hamlyn for releasing this recording.

On side one the sound is rather dull, recorded at a very low level, and the stereo effect is minimal. On both sides I found myself using the dreaded loudness contour – so help me, I'm commending it to you as background music. – in order to get more buoyancy into the bass. *(Fanatic! – Ed.)*

Incidentally, if you really want to hear some intellectual jazz, try Charlie Parker, Dizzy Gillespie and company. There were so serious that they felt obliged to act like clowns just to show they had a lighter side. I could be glib and say that Dave Brubeck felt obliged to act like a concert pianist to show

POP TRENDS

that he also had a serious side, his music being so lightweight, but I am sure that he sincerely believed that he was breaking new ground – just as he really believed, when he drummed out those stacatto parallel chords and a lock of his grey mane fell across his forehead, that he was really swinging as well as perspiring.

Brubeck is a good musician, though he was not at that time a good jazz musician, and he has played some very enjoyable music, as well as writing several first rate tunes. – J.C.

CAPTAIN BEEFHEART & THE MAGIC BAND — Lick My Decals Off, Baby. Reprise 6420. Stereo. Woe-Is-uh-Me-Bop, Japan in a Dishpan, I Wanna Find a Woman That'll Hold My Big Toe Till I have to Go, Petrified Forest, The Smithsonian Institute Blues (or The Big Dig), Space Age Couple, The Clouds are Full of Wine (not Whiskey or Rye), Flash Gordon's Ape, etc.

I have been reading about Captain Beefheart for some time in the overseas underground (overseas underground is what I said) press, and I had come to expect something so uncompromising, so far out that I couldn't possibly like it, though I would have to respect it.

It turns out that the Captain is doing little that black bluesman Howlin' Wolf hasn't been doing for years. In fact he gets some of Wolf's nasal, hoarse, growling vocal quality, and for that he should be commended. Sure there is a lot of broken time, etc. but that's just to make you seasick.

Beefheart's lyrics, where one can follow them (and it does get easier at each listening), are eccentric and often damned funny when combined with his bellicose delivery. The low-down piggish eroticism of 'Lick My Decals Off' is really very splendid.

Everything is funny, even when it's supposed to be serious. That's because it's still supposed to be funny. Ahem. The Captain has a singular gift. You've only got to look at some of the titles. The man's great, you must admit it. 'Space Age Couple' begins: "Come on, Space Age, flex your magic muscle!" and there is a line somewhere: "What's a new dinosaur like you doing in an old dinosaur's shoes?" which through repetition becomes "What's a new dinosaur doing in Dinah Shaw's shoes?" I'll pay that.

Although basically what the Magic Band plays is tough, high energy modern blues, with some Oriental and modern classical touches of collective improvisation in the style we've had to call avant-garde for the past ten years or so, so people will know what we are talking about.

It's all only far out if you haven't been listening to jazz and blues most of your life, which most of these underground dummies haven't.

Sound is fine. Very intelligently balanced – but then it was produced by Captain Beefheart, who is obviously a man of good sense. – J.C.

JAMES BROWN — James Brown's Greatest Hits. Polydor 2310 015 Stereo. I Got You (I Feel Good), Think, Ain't That a Groove Part I & II, Papa's Got a Brand New Bag Part I & II, And I Do Just What I Want, Baby You're Right, It's A Man's Man's Man's World.

James Brown has given as a reason for not appearing at large pop festivals the certainty of his causing a riot. A friend of mine who saw Brown perform in New York assures me that this is no idle boast. Brown became a multi-millionaire before ever condescending to appear on television, or before a white audience anywhere.

A good deal of his dynamic act is lost on record, where he comes over as a good hard-working rhythm and blues shouter – perhaps screamer is the appropriate term – of little more than average ability.

This recording contains mainly reissues from a time when Brown and his band were working within the same band, the feeling is so close. There is even a tenor player of obvious ability constrained to play good old rock-and-roll solos, and making them interesting through sheer sound and attack, in the manner of Fathead Newman.

Brown suffers by contrast with Charles in this context. He lacks the variety of rhythmic feeling and vocal colour that Charles has at his command. Nevertheless, he's still pretty good. In the upper register his voice is as abrasive as a frayed steel cable, and it's amazing that he has been able to sing like this for so long.

The recording is definitely lo-fi, but on some tracks there is an impactive grainy sound. On others the band sounds as though it is playing at the bottom of a well. Stereo on most tracks is of the rechannnelled variety. As there's not much James Brown available in Australia, I suggest that you listen to this. – J.C.

SINATRA & JOBIM — Francis Albert Sinatra & Antonio Carlos Jobim. Reprise 1021. Stereo. The Girl from Ipanema, Dindi, Change Partners, Quiet Nights, Meditation, If You Never Come to Me, How Insensitive, I Concentrate on You, Baubles, Bangles and Beads, Once I Loved. Arranged and conducted by Claus Ogerman.

This is a re-release, undoubtedly timed to follow hard on the heels of Sinatra's retirement. As it was recorded only a few years ago, I can't imagine that there are many real Sinatra fanatics who have not got it.

However, there are no doubt many people who see Sinatra as just one of several good singers of whose recordings they may own four or five. For such listeners the highest quality music can have is to be pleasant – that's how it seems to me at any rate, for Sinatra is an exceptional interpretive artist, far more refined and at the same time more deeply moving than almost any other singer in his field. One is not to be blamed for missing things like this. Many people have always had to be too busy to get right into music.

This record is one of those which should satisfy you, should you be looking for fine interpretations, or simply for pleasant background. It is soft, soothing, yet full of tenderness and passion. Sinatra slips out of tune occasionally – easy to do, singing as softly as he is here – but the unique shape of his phrasing is always intact. On some tracks he is joined by Jobim, and their contrasting rhythmic approaches to the Bossa Nova are fascinating. On the introduction to 'Dindi' Sinatra gets that strange measured bleak quality he can sometimes produce – like a man inching across the face of a cliff in a harrowing wind.

There is nothing to say about the arrangements. They are unobtrusive, ideal. Sound is adequate, although the bass is rather hollow on some tracks. – J.C.

THE HEARTS OF SOUL — The Hearts Of Soul. Basart LBP 3007. Stereo. Pride Is No Match for Love, I've Just Lost Somebody, Fat Jack, Ev'rybody Goes for Joe, I Don't Want to Go on Without You, Out in the Streets, Turn, Turn, Turn, Don't Go Home, Sweetheart, Abraham, Martin and John, Ev'ryday Will Be Like a Holiday.

The Hearts Of Soul are three groovy-looking Indonesian girls who sing archetypal show arrangements in the fifties rock-and-roll mode. They are professional, but not especially good. They are backed by an unusually enthusiastic brass section.

Well packaged, good impactive sound, budget price. Good value, if you're looking for a bright party record. – J.C.

MELANIE — Melanie — Buddah 203028. Stereo. Tuning My Guitar, Soul Sister Annie, Any Guy, Uptown and Down, Again, Beautiful People, Johnny Boy, Baby Guitar, Deep Down Low, For My Father, Take Me Home.

Melanie's formula for success seems to be based on roughly equal parts of Edith Piaff, Nina Simone and Bob Dylan. Unlike her sources she is not a consistently good interpretive artist, not to my way of thinking at any rate. The wild fervour of her singing sometimes bears little relation to the lyrics. Towards the end of 'Tuning My Guitar' – a mildly mawkish exercise in self-adulation – her hysteria-level delivery led me to believe that she had been electrocuted by the instrument in question. Not so, for she plays an acoustic model.

You've guessed by now that I don't like her very much. So many things irritate me: her lapses into a cutey poie little goil's voice, her actressy (American school of pathos) way of saying 'huh' between every other verse, with no doubt a wistful ironic shrug of the shoulders. The girl writes her own songs and they are generally abysmal, each one a variation of the same emotional cliche: cloyingly poignant to the point of revulsion.

According to the cover notes Melanie would like you to know that she 'Thinks of you all the time, even if you're album-touchers.' It would give me great pleasure to tell her, on behalf of album-touchers everywhere, to get lost.

Putting myself as best I can in the position of an admirer, I would count this album as being not one of her best, but one which I would buy. Melanie's voice is recorded adequately, as is the orchestra which generally stays back at a respectable distance in largely neutral arrangements. Melanie's own guitar is up front, though without much presence, and she plays quite well. On 'Baby Guitar' an electric piano is used, and a nice rock feeling is built. – J.C.

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OMEGA:

(Continued from page 29)

single independent VLF fix. Each vessel carries a device described as a NAVDAC computer, programmed to make continuous position estimates from a variety of inputs – astronomical, satellite, radio, etc. – and using Kalman filtering techniques where the data are considered corrupt.

Prior to total submersion for running or station keeping, the vessel's inertial navigation systems are corrected by signals from the TRANSIT navigation satellites. Since these transmit on VHF in order to penetrate the ionosphere, they cannot penetrate the salt water to depths of more than a few inches – so the vessel must project an antenna above the sea's surface, which it may do from its own conning tower, or from a towed buoy floated toward the surface. Due to its mode of operation – the double integration process – and the inevitable drift of the best gyros, the inertial navigator's accuracy after about 12 hours' operation is degraded to about one mile, so that it requires updating several times at least in each 24-hour period.

In abnormal times, when submarines have to remain submerged and may not poke up so much as a cat's whisker above the water surface for fear of detection and destruction, there is no passive means whatsoever other than VLF signals available for this updating process, and correcting for drift in slow currents, etc.

ACCURACY OF OMEGA FIXED

The very requirement for submergence and immobility, on the other hand, places the submarine's navigator in the best possible position to evaluate OMEGA's propagation errors. The shape and area of the scatter diagrams arising from the plotting of a succession of fixes enable the various causes of propagation fluctuation to be recognised and successively eliminated, leaving only the basic system error. This was originally quoted as of the order of 2000ft. but is now reliably stated as lying between 300 and 600ft.

Confirmation is additionally available through the use of differential OMEGA, measurements being made by small surface ships scattered over the seas which determine their position accurately by satellite and measure the deviation of the VLF lines of position in their vicinity. This information is collected by satellite relay and rebroadcast to the submarines by their VLF links.

In July 1968, in reply to a question, a spokesman for the Pentagon said that the accuracy of OMEGA was 500ft. – a figure which local experts judged as too generous by far at that time.

Let it not be supposed that the formerly quoted accuracies are the ultimate attainable. The basic system error can be further reduced by such things as substitution of the hydrogen maser time standard for the caesium beam clock, and the use of faster and more accurate logic to improve the phase resolution.

Likewise, the VLF propagation model is being constantly improved; for instance, it has been shown that the product of the group and phase velocities in the earth-ionosphere waveguide is essentially constant, so that simultaneous measurements on several frequencies can be used to correct for part of the irregular phase shifts associated with solar activity. Thus 'composite' OMEGA grants an accuracy of two or three times that obtained by using the 10.2 kHz frequency alone, following sudden ionospheric disturbances.

It is not inconceivable that within the immediately foreseeable future the accuracy of an OMEGA fix will be comparable to that presently available from satellites – i.e., a few tens of feet.

This, then, is OMEGA – its potential, its limitations, what it does and how it does it.

Some politicians insist that it is solely a civil navigational aid, others that it is solely for military use. Neither claim is true.

We have provided you with the facts – the conclusions must be your own. ●

BOOK REVIEWS

DIGITAL ELECTRONICS FOR SCIENTISTS —

by H. V. Malmstadt, University of Illinois, and C. G. Enke, Michigan State University. Published by W. A. Benjamin Inc., New York, 1969. Hard covers, 6" x 9", 545 pages. Australian price $18.14.

As the title suggests, this is not intended for those without a good background of science or engineering.

The book provides a systematic introduction to digital circuits, concepts and systems that are basic to the new instrumentation-computation revolution. The goal is to lead the reader from the simplest discrete switching devices, such as semiconductor diodes and transistors, to the latest high-speed integrated circuits and digital instrumentation systems.

The complete gambit of digital electronics, from diode to digital computation and instrumentation, is covered in the first 364 pages. One would be quite entitled to think, looking at the subject index, that the book would be merely a type of digital encyclopedia. You know the kind of thing – you look up the item, and it tells you only what you already know – but this is not the case.

The subject matter is clearly and concisely presented, with an amazing amount of information packed into a few concise paragraphs. All necessary points are made in a minimum of words – hence the opening statement of this review that the book is not for beginners. One would need a very thorough scientific background to be able to absorb the material presented here without any previous knowledge of electronics.

Those who have been educated in electronics, however, but are perhaps a little lacking in digital techniques, would find this book a really excellent short course. The subject matter is right up to date, and I personally thought the book uniquely impressive for the completeness of its coverage.

Coming now to the last section of the work, covering some 180 pages, we find an excellent set of experiments. The experiments are keyed to the chapters of the book and are based on the Heathkit Digital Designer Equipment.

I am a firm believer in one experiment being worth a thousand words. Hence I am sure that anyone who performed all the experiments detailed in the book, in conjunction with reading the text, would finish with a very thorough knowledge of digital techniques.

Of course, a decided disadvantage is the fact that the experiments are built around a very expensive piece of specialised training equipment which is not readily available to everyone. But one can always improvise – and the experiments, by the manner of their presentation in the book, are very instructional even if not actually performed.

In general, then, the book achieves its authors' aim exceedingly well. Scientists, and engineers of other disciplines, will find this book unequalled as an introduction to digital electronics, and it is strongly recommended.

JACK DARR'S SERVICE CLINIC

No. 2. — First edition, 1971, published by TAB Books of America. Hard covers, 5½" x 7½", 169 pages. Australian price $9.95. Obtainable from Grenville Publishing Company, Sydney.

For many years Jack Darr has been the author of the "Service Clinic" section of the American Radio-Electronics magazine. In 1967 a collection of the best from these articles was published – and this was followed by the present volume, which picks up where the first one left off.

The book is presented in ten sections, the first of which generalises about service techniques. The next seven sections deal with various aspects of colour TV servicing – and this, in fact, is the main theme of the book. Following is a section on Test Equipment and Testing, and finally a general chapter on assorted stereo, radio and tape recorder problems, etc.

REVIEWERS: Brian Chapman, Collyn Rivers.

Presentation – as is to be expected – is in a free-and-easy conversational format. Each chapter opens with general comments on the theoretical and practical aspects of the topic, and this is usually followed by a selection of answers to questions from readers of the magazine. The book is thus easy to read and entertaining, but cannot be considered to be a serious text – nor is it intended to be. A good index at the end of the book, however, does enable one to find readily any reference required.

Television servicemen will find this book loaded with good hints on colour TV servicing problems – worth studying, so as to 'get in on the ground floor' when colour telecasting reaches Australia.

UNDERSTANDING AND DESIGNING WITH FETs — published by Motorola Semi Conductor Products; available (free of charge) to professionals only.

Too substantial to be classed in our 'New Literature' department, this book is basically a collection of seven application notes on the characteristics and uses of FETs, preceded by a short general introduction.

The collection gives the subject a thorough and complete treatment, and dispels the misgivings some people seem to have about the use of FETs.

Supply is limited, so those interested should move quickly to obtain the book. Request – to Motorola Semi Conductor Conductor Products, 37 Alexander Street, Crows Nest, N.S.W. 2065 – should be made on the applicant's Company letterhead.

AUDIO AMPLIFIER SYSTEMS — by M. D. Hall, C. Eng., A.M.I.E.R.E. Published by Elcoma Division of Philips (Box 2703, G.P.O. Sydney, N.S.W. 2001). 202 pages. Price $2.10.

This book contains design and constructional details of over 30 audio circuits, from low level amplifiers and control systems to large power amplifiers.

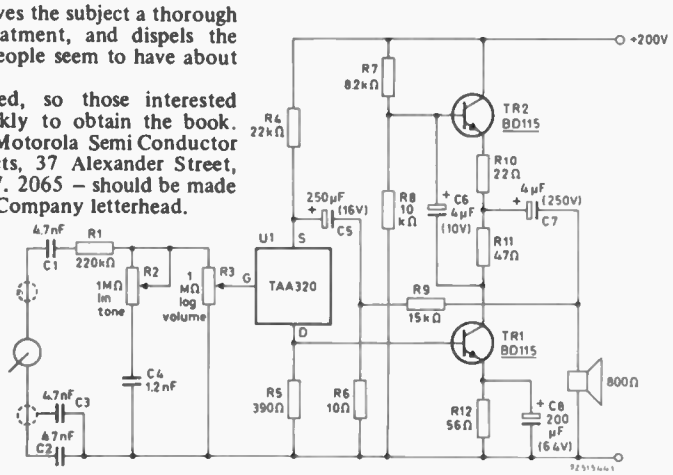
It includes practical details of a number of amplifiers based around readily available integrated circuits.

A section dealing with loudspeakers provides useful advice on the selection and housing of various types of speakers, and also includes a number of mathematical formulae not generally published in books of this nature.

The book would be invaluable to anyone contemplating building hi-fi equipment, and to those generally interested in the technical aspects of amplifiers and speakers.

It is certainly worth far more than its modest cover price.

Circuit diagram of four watt pick-up amplifier from 'Audio Amplifier Systems'.



NEW LITERATURE

CURRENT ISSUE of Inventus – journal of the Inventors' Club of Australia – includes an article outlining the University of N.S.W. Unisearch organisation, which is an organised technical service available to industry and commerce.

The journal also contains a full report on the 1970/71 Sebel Award, won by 23-year-old David Henderson's television receiver.

Obtainable from the Inventors' Association, 98 Ramsgate Rd., Sans Souci, N.S.W. 2219.

RECEIVED from Teknis Pty. Ltd. – Photain Controls' latest catalogue of burglar alarm equipment. Included are details of flush-mounting reed switches, pressure mats, alarm bells, infra-red beams, etc.

This range would be of particular interest to anyone currently building the ELECTRONICS TODAY intruder alarm.

Teknis Pty. Ltd., P.O. Box 635, Crows Nest, N.S.W. 2065.

DESCRIBED by the publishers as the Mapril issue, the Tasmanian-produced Electronic Experimenters' Bulletin contains an extremely interesting article on synchronous detection (phase-locked loops, etc.), a method of making your own circular slide rule, and – believe it or not – a recipe for mint chocolate.

This is a little-known journal which has a refreshing down-to-earth approach, of interest to radio amateurs and those who build constructional projects.

It costs 30 cents, contains 24 pages, and is published at two-month intervals.

(The mint chocolate recipe is great – Ed.)

Australian EEB, P.O. Box 177, Sandy Bay, Tasmania 7005.

A NEW HIGH in the field of technical literature is the Print Switch catalogue produced by the Plessey organisation.

Beautifully set out, the catalogue illustrates and describes the company's new range of printed circuit rotary switches intended primarily for prototype use.

Professional Components Division, Plessey Ducon Pty. Ltd., P.O. Box 2, Villawood, N.S.W. 2163.

CURRENT ISSUE of DC/E News, published by D. C. Electronics Pty. Ltd., contains details of a Daedalus airborne infra-red scanner being used by the University of Newcastle to collect evidence of pollution. The instrument detects and records variations in thermal radiation between polluted and clear water.

Also included are brief details of a range of rf filters, from simple by-pass units to multistage ladder type networks.

Obtainable from D. C. Electronics Pty. Ltd., 32-36 Smith St., Collingwood, Vic. 3066.

SIGNETICS Corporation have published a catalogue of their high-speed silicon gate MOS 2560 bit ROMs suited to 64 x 8 x 5 raster scan generation.

The ROMs, type 2513 and 2514, are DTL/TTL compatible, have access time of 450 n/sec (typ.) and have tri-state output.

Tecnico Electronics Pty. Ltd., Carrington Rd., Marrickville, N.S.W. 2204.

RECEIVED from Industrial and Medical Electronic Co. – a most interesting brochure describing an acoustical method of attracting schools of fish.

The brochure outlines a method developed by Prof. Tomija Hashimoto and now marketed by the Shimado Co. Ltd., of Tokyo.

Industrial and Medical Electronic Co., 288 Collins St., Melbourne, Vic. 3000.

FROM Plessey Rola comes a brochure describing their very wide range of loudspeakers and output transformers. Speakers vary in size from 100mW to 50W.

Plessey Rola Pty. Ltd., P.O. Box 5, Richmond, Vic. 3121.

1971 EDITION of the A. & R. Soanar Group's catalogue contains details of their range of Elna electrolytic and tantalum capacitors, Noble carbon potentiometers, TYK ceramic disc capacitors, Origin selenium rectifiers, KAO car radio generator suppressor capacitors, and I.T.T. silicon diodes.

The catalogue also includes details of the new A. & R. single phase bridge rectifier, which is rated at 25 amps if mounted on an adequate heatsink.

Soanar Electronics Pty. Ltd., 30-32 Lexton Rd., Box Hill, Vic. 3128.

A BROCHURE from Philips Industries describes their range of high-fidelity loudspeakers and outlines suitable enclosures.

Available from Miniwatt Electronics Division, Philips Industries Limited, Box 2703, G.P.O., Sydney, N.S.W. 2001. ●

Trade-a-Tape

GOT A CAR?

Ever thought about a car stereo? Expensive aren't they? Not only that, then you have to buy tapes at seven to eight dollars a piece. Car stereos are nice to have, but they sure are dear . . .

NOT ANY MORE

If you join our club, Trade-a-Tape Stereo will install in your car or home **absolutely free** an eight track car stereo or an attractive home unit complete with speakers and give you, also at no cost, **ten** eight track tapes of your choice. Your membership also entitles you to trade your tapes for only $1.50 a piece. All tapes, all brands, all artists. No strings, no hidden catches, no fine print. Your only cost ever is the tapes you trade.

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INPUT GATE

APPROACH TOO SIMPLE

Is it really necessary to show component layouts? The space would be better used for publishing more circuits. Surely most readers of ELECTRONICS TODAY can read circuit diagrams – R.J., Perth, W.A.

• See letter below.

NOT SIMPLE ENOUGH

Congratulations on your new magazine – an excellent job.

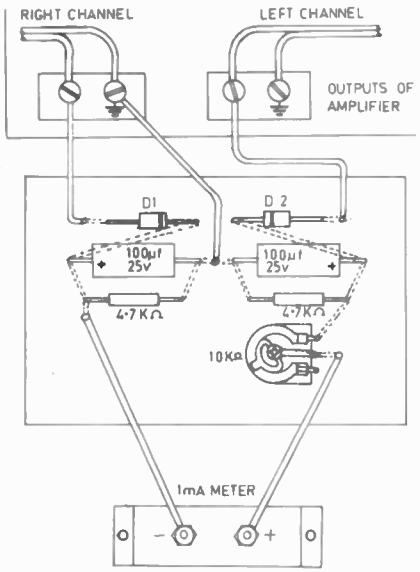
1. Editorial material nicely balanced by intelligent advertising.
2. Really good paper and layout.
3. Good typography, and type face is readable and very clear.

Your 'Simple Balance Meter' (May issue) is just what I want for my set-up. Player and amplifier in one room and speakers in another, no balance indicator on my Kenwood amplifier – the need for a balance meter is a real one. BUT your diagram is a schematic and, for me, hard to understand. Could you publish the diagram in photo form, as with other articles in the issue?

I really feel that your technical man tends to be a little intolerant of ignorance on the part of some non-technical readers (I am one of these, of 70 years, and electronics are to me a closed book).

However, you are publishing a fine magazine, and I hope you will be doing this for a long time to come. – E.W.F., Ringwood, Vic.

• The sketch below should help.



EH, WATT?

In your article 'How Many Watts?' (May Issue) you state that "Full orchestral sound reproduced at concert hall level in the average living room requires half an acoustic watt."

I think you are wrong – please quote your authority for this statement. – A.L., St. Marys, N.S.W.

• Certainly – 'Acoustical Engineering' by H. F. Olsen, P.524 (Van Nostrand, 1957). Many other standard works on acoustics quote the same figure.

TECHNICAL QUERIES

Will you be adopting the attitude of other Australian and overseas magazines towards technical queries? Unless the query specifically relates to a current project, they are just not interested. – A.S., Collingwood, Vic.

• Reader A.S. overstates the case. All technical journals receive these queries and, with few exceptions, answer them as far as they are able.

But many readers ask for an item of equipment to be designed specifically for them – and unless the item can form the basis of a constructional project, it just isn't on: the cost of preparing a constructional article – even a relatively simple one – may exceed several hundred dollars.

We welcome readers' letters and queries, but we cannot undertake to design 'one-off' equipment or work out modifications to a project, unless these are of sufficient general interest.

BURGLAR ALARM – 1

I have read the article in your May issue on the ELECTRONICS TODAY intruder alarm system. Will it be possible to purchase the equipment ready to fit to my home? – K. L., Gordon, N.S.W.

• We understand that several companies can supply this unit in kit form for home construction, but we have not yet heard of anyone producing it as a complete system

BURGLAR ALARM – 2

Your article on 'Electronic Watchdogs' (April issue) revealed the security industry's secrets. By explaining how to bypass micro-switches, magnetic reed switches and aluminium foil tape you told every criminal how to beat alarms.

Your statement that there are excessive false alarms is giving the industry a bad name. Alarms are very sensitive, naturally they will trigger if not properly adjusted – V. L., Camperdown, N.S.W.

• Micro-switches and aluminium foil are secrets? . . . And, with 97% false alarms, just who is giving the industry a bad name?

WATT RATINGS

I have recently purchased a (name deleted) amplifier rated at 250 Watts music power (IHF) when connected to 4-ohm speakers.

Your article 'How Many Watts?' makes me wonder what the rms power output of my amplifier is when connected to my 8-ohm speakers. – J.A.C., Kingsgrove, N.S.W.

• This amplifier rating business is becoming even sillier than the horsepower race. The IHF rating is measured at no less than 5% distortion; and when did you last see a 4-ohm hi-fi speaker?

Quoted power into 4 ohms is 250 Watts (IHF). This would be around 170 Watts into 8 ohms. Music power rating at a more realistic distortion figure would not exceed 150 Watts into 8 ohms.

Continuous power rating would be between 50 and 100 Watts peak-to-peak, or 12½-25 Watts rms. However, this amplifier's power output is quoted with both channels combined. Thus power output into conventional 8-ohm speakers is 6 to 12½ Watts rms per channel! ●

ASTRONICS IS PROUD TO SPONSOR

THE IMMIGRATION OF THE THIRD GENERATION WANG FAMILY DESK TOP PROGRAMMABLE CALCULATOR

100

We designed two versions, one for statistical applications with single keystroke results for $\sqrt{X}$, X^2, 1/X and integer X; another version for general scientific and technical applications which includes the statistical functions and adds $\log_e X$, e^x, and $\sqrt[3]{X}$—all available at the touch of a key. If you need certain other functions like sin, cos, arc sin and arc tan, you can add them. You can further calculate degrees to radians, radians to degrees, a^x EX^2, EX, EN, multiply-constant and divide-constant. These options are available with the six and fourteen register scientific modes respectively. On all statistical versions, you can add EX^2, EX, EN, multiply-constant and divide-constant. A simple key converts the storage registers to special function keys. But you add the functions as you need them, not buy them because they are built in.

Like a computer, Wang Series 100's are fully programmable, but without a complicated language required for computers. And Wang 100's have keys for the commonly used functions that necessitate a programme on mini computers.

500

The Wang 500 brings to the engineering and scientific user the optimum balance between manual and programmed calculator operation. The Wang 500 provides the ultimate in price/performance ratio in its price range. The self contained desktop unit consists of:

Display, keyboard, read-only memory (ROM), MOS memory, and optional tape drive and/or column printer.

DISPLAY

The full contents of the W register is displayed for both entries and results.

Decimal Settings: Display — automatic floating decimal point and scientific notation (the floating decimal point is automatically converted to scientific notation from $\geq +10 \cdot 10$ or $\leq +10^{-10}$).

Decimal Settings: Printer—floating decimal point, fixed decimal point from 0 to 9 decimal places and scientific notation.

KEYBOARD

Arithmetic: $+$, $-$, $\times$, $\div$, X^2, $\sqrt{X}$, 1/X

Logarithmic: LOGeX, $LOG_{10}X$

Exponential: e^x, 10^x

Miscellaneous: X $\rightleftarrows$ Y, Integer of X

Trigonometric Functions: (A switch is provided to permit input of either degrees or radians to the trigonometric keys.) SIN(X), COS(X), TAN(X), SIN^{-1}(X), COS^{-1}(X), TAN^{-1}(X). To facilitate special conversions, a DEGREES TO RADIANS and RADIANS TO DEGREES key is provided.

Special Two-Step Commands: π, pause ($\frac{1}{4}$ second), decimal shift 0 to 15 places right or left.

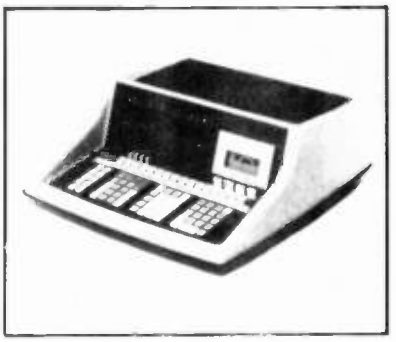
SPEEDS

Function	Approximate Speed
Addition/Subtraction	1.7ms
Multiplication/Division	12.0ms, 17.6ms
	12.0ms, 17.6ms
X^2, 1/X	44.4ms, 35.3ms
10^x, $\text{Log}_{10}X$	84.4ms
$\sqrt{x}$	61.8ms, 47.2ms
e^x, $\text{Log}_e X$	82ms to 238ms
Trigonometric Functions	5μs
Memory Read/Write cycle time	

MEMORY

The Wang 500 is available with three different memory sizes: 2,048 bits, 3,072 bits, and 4,096 bits. The memory is organised in the following manner: 2,048 bits as 16 registers and 64 programme steps; 3,072 bits as 16 registers and 192 programme steps; 4,096 bits as 16 registers and 320 programme steps. If required, the programme steps are available for use as extra registers utilising eight steps per extra register (e.g., the total registers available are 56 for the 4,096 bit machine).

700



The WANG 700A/B is the most advanced programmable electronic calculator on today's market. The following units are included in one self-contained desk top unit:

Display, Keyboard, Read only Memory (ROM), Core Memory, Tape Drive.

DISPLAY

Two rows (X & Y) are displayed.

Capacity: 12 digits, sign and decimal, 2 digit exponent and sign.

Decimal Setting: Automatic floating decimal point from 0 to $+10 \cdot 10$.

Automatically converted to fixed point from $+10 \cdot 11$ to $10 \cdot 98$.

KEYBOARD

Arithmetic: $+$, $-$, $\times$, $\div$, X^2, $\sqrt{x}$, 1/X

Logarithmic: LOGeX, $LOG_{10}X$

Exponential: e^x 10^x

Miscellaneous: X $\rightleftarrows$ Y, Integer of X

Standard TRIGONOMETRIC:

DEGREES TO RADIANS, RADIANS TO DEGREES, SIN(X), COS(X), TAN(X), SIN^{-1}(X), COS^{-1}(X), TAN^{-1}(X), RECTANGULAR TO POLAR, POLAR TO RECTANGULAR, SINH(X), COSH(X), TANH(X), $SINH^{-1}$(X), $COSH^{-1}$(X), $TANH^{-1}$(X).

Standard STATISTICS:

x, o, o^2 (ungrouped), x, o, o^2 (grouped) NORMAL DISTRIBUTION, INVERSE NORMAL DISTRIBUTION, X^2 STATISTIC, X^2 DISTRIBUTION, ERROR FUNCTION, BINOMIAL DISTRIBUTION, N!, LINEAR REGRESSION, GAMMA FUNCTION, NEGATIVE BINOMIAL DISTRIBUTION, POISSON DISTRIBUTON, RANDOM NUMBER GENERATOR.

SPEEDS

Function	Read/write cycle time Approximate Speed
Addition/Subtraction	300 to 500 microseconds
Multiplication/Division, X^2, 1/X	2 to 5 milliseconds
10^x, $\text{Log}_{10}X$	15 milliseconds
$\sqrt{x}$	25 milliseconds
e^x, LogeX	20 milliseconds
Single Variable Trig Functions	135 to 250 milliseconds
	2 microseconds

DOUBLE PRECISION

Up to 24-digit accuracy can be gained after $+$, $-$, $\times$. Remainder is displayed after $\div$.

MEMORY

The Wang 700A/B contains 120 data storage registers; or, as storage for 960 programme steps.

PERIPHERALS

Model 701 Alpha/numeric Output Writer, Model 702 Plotting Output Writer (requires 700B), Model 703 Paper Tape Editor, and a Model 704 Card Reader are available.

ASTRONICS

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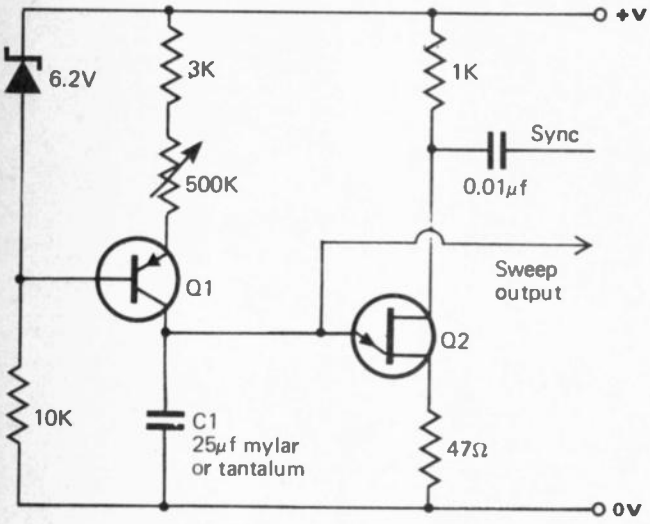
TECH-TIPS

LINEAR SWEEP GENERATOR

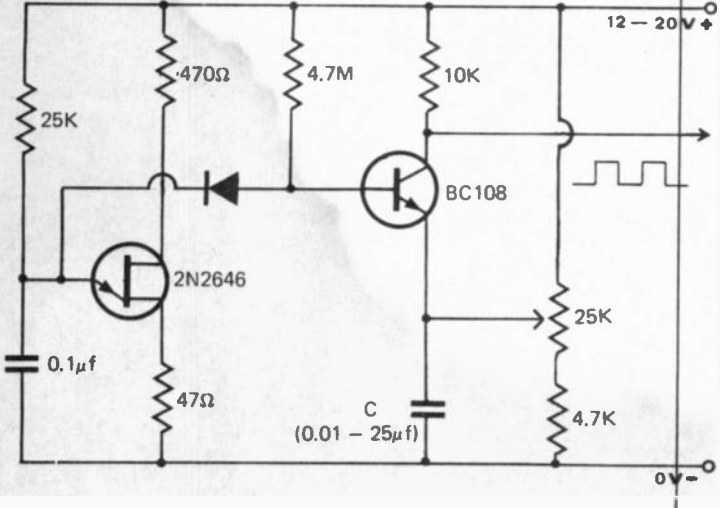


This circuit provides a linear time-base with a sweep time adjustable from a few milliseconds to over one minute.

The constant-current effect of emitter follower Q1 causes C1 to be charged at a constant rate.

The increasing voltage across C1 will be essentially linear (displacement error is less than 1%). The sweep is terminated when the increasing capacitor voltage reaches the peak valley point of unijunction Q2, when capacitor C1 will discharge through the current limiting resistor R1.

VARIABLE DUTY SQUAREWAVE GENERATOR



A variable duty cycle squarewave can be obtained from this unijunction circuit. The light loading imposed on the emitter timing circuit preserves frequency stability.

Faster rise and fall times can be attained by including bypass capacitor C. The value of this capacitor should be chosen to suit the pulse shape required.

CAREER OPPORTUNITIES

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Owing to expansion in our range of Electronic Calculators we require a young man to train as an Electronics Technician.
An equivalent to 3rd year of Electronics and Communications course would be desirable.
Experience in electronic calculators is not necessary.
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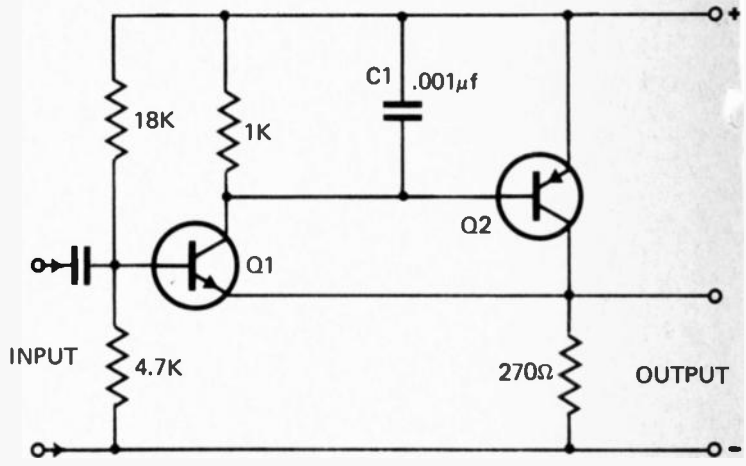
For more information on the Careers Opportunity Columns of Electronics Today (Advertising rate 76c per line) contact: — Sydney, Howard Jenkins or Terry Marsden, 26 2296; Melbourne, Clarrie Levy, 51 9776.

TECH-TIPS

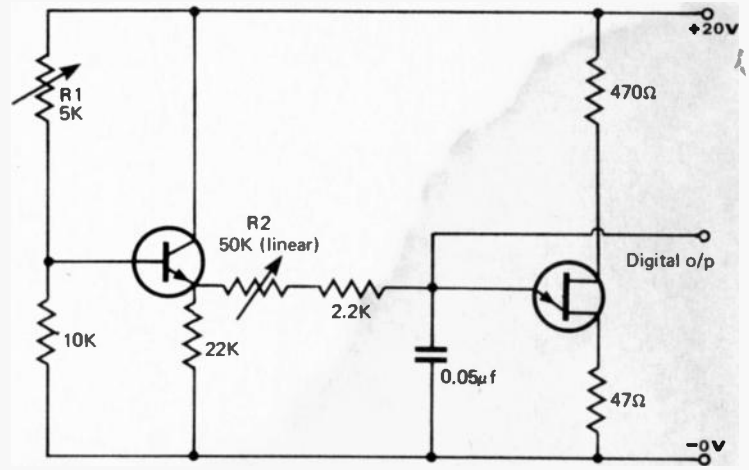
VERY LOW OUTPUT–IMPEDANCE



Output impedances as low as 0.05 ohm can be obtained by using this configuration.

Transistor Q1 is an ordinary emitter follower, assisted by Q2. Main load current is supplied by the collector of Q2. Transistor Q1 senses the difference between input and output voltage and regulates Q2 accordingly. C1 prevents oscillation.

SHAFT–POSITION DIGITAL TRANSDUCER



R2 is a low friction potentiometer used as angular position indicator.

A shaft angular-position to digital output transducer is shown in this circuit.

Rotating the angular position potentiometer R2 will provide a digital output varying from approximately 200 Hz to 2000 Hz.

The 5k trim potentiometer R1 provides a rate adjustment of a further 50%. This trim adjustment is independant of the main timing potentiometer.

READER INFORMATION SERVICE

For further information on Advertisers listed below complete the coupon/s stating information required including company and position held (if relevant). Cut out the coupon and post to:—

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ADVERTISERS' INDEX

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Phone 69 7281

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