

AUSTRALIA'S NEW MONTHLY

JULY 1971

40¢

electronics TODAY

**\$1000
DESIGN
CONTEST**

**COMPUTERIZED
DRAWING**

**VIDEO CASSETTES:
FULL REPORT**

**MILLION-VOLT
MICROSCOPE**

**DISTORTION
IN SPEAKERS**

**4 MORE
PROJECTS**



SOMETHING

IN A

SPEAKER SYSTEM

'U.L.M.C.'

NEW

SONY research makes the difference with "Ultra Linear Magnetic Circuit"*



Long research by SONY has now resulted in a revolutionary new speaker system. Each new SS-7300 speaker unit incorporates "U.L.M.C." ("Ultra Linear Magnetic Circuit") which eliminates the inseparable distortion common to conventional speakers.

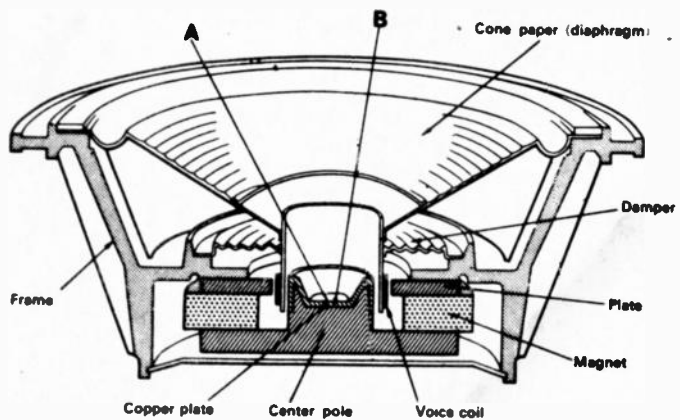
The three-way system comprises 12" cone-type woofer, 5" cone-type mid-range and 1" dome-type tweeter.

The superior sound of SS-7300 with its distortionless hi-fi sound will surpass anything you have heard before—with a perfect blend of tonal balance and harmonic accuracy. In deluxe walnut enclosures with elegant cloth.

Sounds good with your amplifier . . . even better with a SONY TA-1144.

* SONY research has successfully decreased distortion by noting that the voice coil in conventional speakers acts as transformer and causes distortion.

The "Ultra Linear Magnetic Circuit" ("U.L.M.C.") uses two advances: A. Special "DISHED" pole piece to lower centre pole permeability. B. Copper coating to short undesired self-generated flux. These ensure that harmful self-generated E.M.F's are reduced in the voice coil. Never before used in conventional speaker units, "U.L.M.C." assures maximum tonal quality with minimum distortion.



Newly developed "Ultra Linear Magnetic Circuit"

SONY

Distributed by:

JACOBY MITCHELL

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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 SS-7300 Speaker System.
NAME.....
ADDRESS.....
STATE.....

JMS/27-71EA571

electronics TODAY

JULY 1971

Vol.1 No.4

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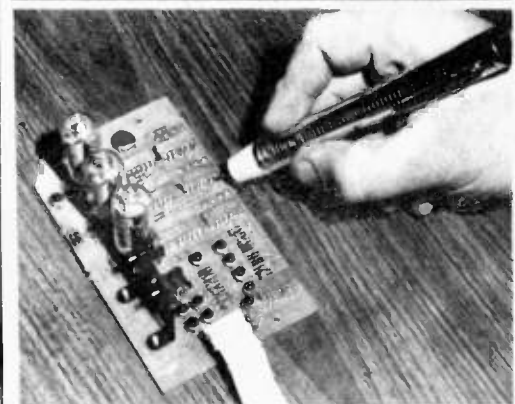
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COVER: New graphic arts computer produces three-dimensional drawings from
orthographic plans (subject here is an electric car). Report, pages 42-43.



OBJECT: TO SAVE LIVES

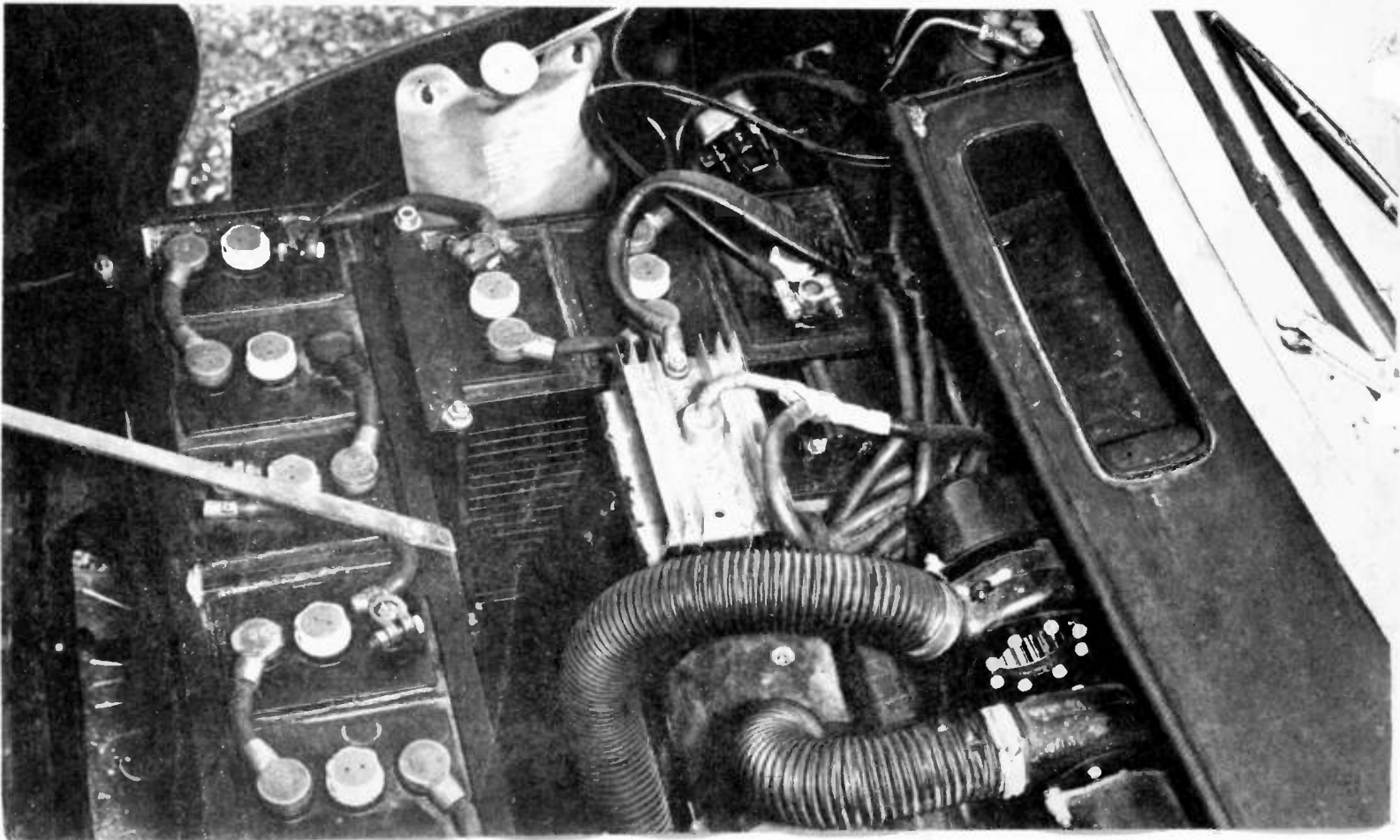


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STOP PRESS

Despite denials by British Leyland following the article on electric cars published in the April issue of ELECTRONICS TODAY, the factory IS going ahead with its electric car project: this pilot model is being evaluated right now in preparation for production. A full report on it appears in the next issue of our companion magazine, MODERN MOTOR, due out in the first week of July — and the August issue of ELECTRONICS TODAY will feature a technical assessment of the vehicle.



security~ fancied or factual?



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DOES a section of Australia's security industry think it has a monopoly on electrical know-how? And that none but the cleverest of criminals can disable their 'security' systems? Our April issue contained an article describing the more rudimentary systems in common use. This upset some members of the industry so much that complaints were made at ministerial level.

But these complaints did not come from the major security companies, nor from the police.

They came from companies whose principals, in 1971, still seriously think that adequate protection is a handful of switches and a type 3000 relay.

Their type of protection is just about as secret as today's date, and can be by-passed by anyone with a pair of side-cutters, six feet of wire and a rudimentary knowledge of electricity.

There are hundreds of thousands of people in Australia with this knowledge — and, obviously, some of them are criminals.

Security installations remain in use for many years. Unless they are thoroughly up-to-date when installed, what protection can they offer in ten years' time?

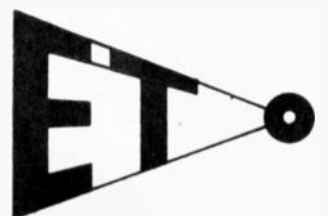
For the criminal is also updating his technique.

The more responsible security companies are well aware of this problem, and their equipment and installations reflect this awareness. But, whilst good equipment is not expensive if measured against the protection it affords, it does cost more than primitive types of installations.

If, you buy the cheapest installation you can find, don't be surprised if it is beaten.

Today's criminal doesn't need **ELECTRONICS TODAY** to tell him how to do it.

Just a secondary school education.



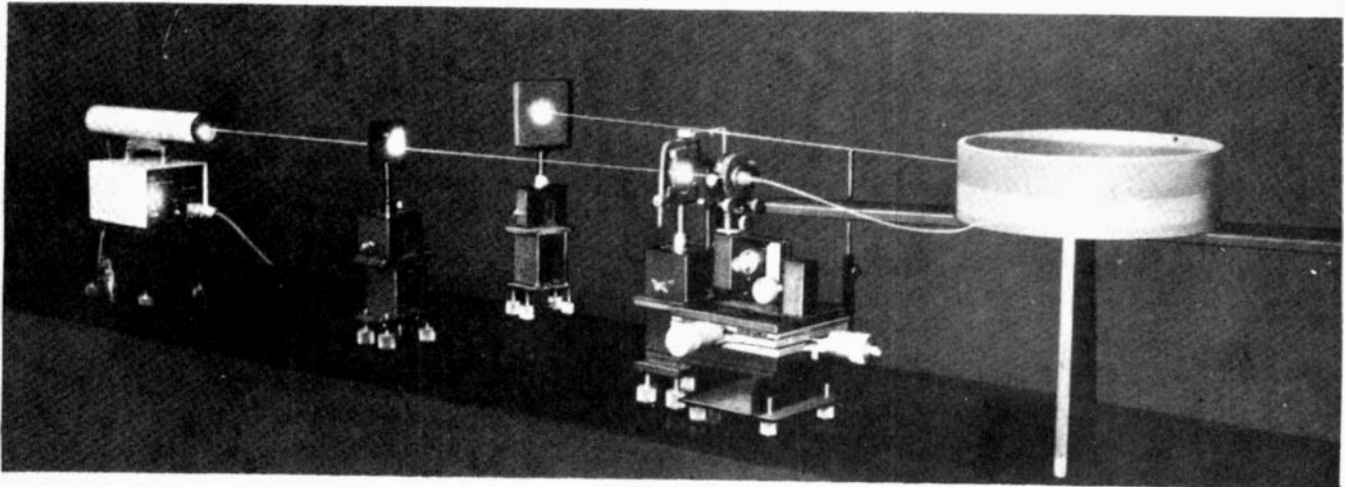
OPTICAL KNOTS

TYING LIGHT BEAMS IN KNOTS

Guiding the laser beams around corners may well be one of the keys to the next generation of communication systems.

A new technique currently under development by NEC in Japan employs a low-attenuation light-focussing fibre with a refractive index decreasing parabolically toward the periphery.

The result is an optical transmission line, carrying laser beams in any direction it is bent.



EFFICIENT YELLOW LED

An experimental light emitting diode has been developed by the UK based Phosphor Products Co.

Efficiency is high, 100 ft-lamberts being produced at 5,800 angstroms from less than five milliamps per square centimetre.

Problems? — only one — current devices require a 100 volt supply instead of the one or two volts for 'conventional' LEDs.

QUANTITATIVE MOLECULAR EVOLUTION

Many scientists (and editors!—Ed) doubt generally accepted explanations for the evolution of life on the grounds of statistical improbability.

Support both for and against these views was presented recently by Manfred Eigen, director of the Max-Planck Institute for Physical Chemistry.

Manfred Eigen has calculated the possibilities of creating a 100 residue protein from the 20 or so amino acids. He found that the creation of any specific protein by random selection would take no less than 10^{130} attempts; a number so vast that the resultant molecules would fill 10^{27} universes.

Eigen therefore postulates a theory of qualitative molecular evolution in which each specific protein is assembled

stage by stage — with each stage being checked by some overriding control mechanism before proceeding to the next.

By this method a specific protein can be created in about 2000 attempts.

In essence Eigen says that for molecular evolution to be statistically feasible, selection must have taken place at molecular level before any recognisable structure existed.

Eigen states that for molecular evolution the conditions required are: autocatalytic reactions, (enzymes catalysing their own formation by 'positive feedback'), self-replicating molecules and an external energy source.

There is also a critical level of instability, — a balance between 'information content' and mutability. If the system is too stable no change can take place — or on the other hand if it is too unstable the result is molecular chaos.

Hence the belief in the original interaction between protein and nucleic acids — for the former cannot support a change by itself, whilst the latter is prone to excessive mutation.

PHOTOGRAPHING THROUGH LEAD

Highly radioactive material can be photographed through lead shielding

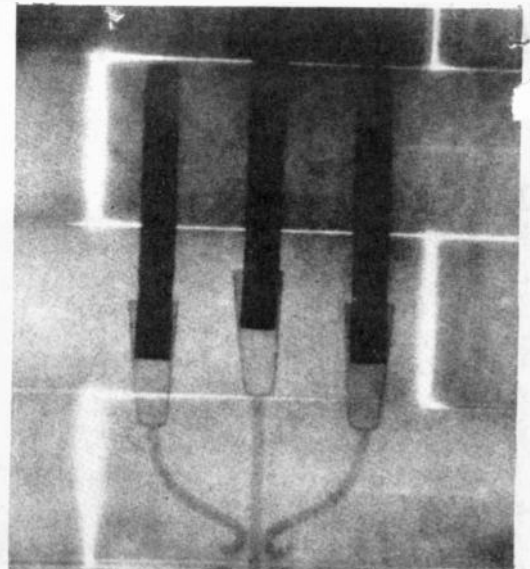
by utilising thermal neutrons instead of X-rays.

Unlike X-rays, thermal neutrons are absorbed by light materials rather than heavy ones, and as the detection method is insensitive to the gamma radiation emitted by radioactive objects, no film fogging problems are encountered.

The technique is finding increasing use in the explosives industry where its ability to penetrate steel and lead casings, yet clearly indicate the lighter explosive filling, is invaluable.

Other applications include the study of composite boron filament materials, and medical research.

This thermal neutron radiograph showing wax candles in steel holders was taken through a four-inch-thick lead-brick wall!



SILCRON



Since its introduction less than two years ago, SILCRON — the "vital statistics" turntable, has been acclaimed by audio enthusiasts all over Australia. What are the reasons for SILCRON's success? There's a simple answer. Look at the SILCRON "vital statistics"!

- Precision engineering throughout
- Belt drive
- Two speeds — 33 $\frac{1}{3}$ and 45 rpm
- Patented lightning-fast speed change
- Wow and flutter less than 0.04%
- Sealed-for-life 12 pole synchronous motor
- Dynamically balanced 12" diameter cast aluminium platter
- Anti-static mat supplied at no extra cost
- Only 3 moving parts
- National sales and service facilities
- Last but not least — SILCRON is only \$44.50!

See the SILCRON turntable at franchised Simon Gray dealers in all states. *Listen* to it; as SILCRON is virtually silent you will probably hear *nothing*. And that's why SILCRON will not affect the most sensitive cartridges and tone arms.

Ask for your demonstration today!

*The Silcron turntable, as illustrated, also shows base and tone arm; these are optional extras.

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

Please send me all the facts about the "vital statistics" of the SILCRON turntable.

NAME _____

ADDRESS _____

POSTCODE _____

50 ST 871



Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth St., Melbourne, Vic. Tel. 63 8101 • Telex: 31804
Sydney Office: 33 Victoria Ave., Chatswood, N.S.W. Tel. 49 4882
Canberra Office: 75 Melongate Mall, Pyebridge, A.C.T. Tel. 95 0820
Adelaide Office: 81 Yasca Rd., Seachow, S.A. Tel. 99 3107

INTERSTATE REPRESENTATIVES:

N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801

Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. 58 1422

Tas: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel. 2 5322

W.A.: Athol M. Hill Pty. Ltd., 613-615 Wellington Street, Perth. Tel. 21 7861



The Vital Statistics Turntable!



aquarius 4



Mounted in the heart of the Aquarius 4 enclosure an 8-inch wide range transducer is directed upward into a radial horn. This radial horn spreads the sound waves through a 360° horizontal radial diffraction slot. High frequencies emerge in a 360° vertical plane from a 2-inch driver separately loaded by a radial horn located on the upper rear panel of the Aquarius 4. These right angle dispersion patterns interact with each other to provide an immense sound stage that belies the modest dimensions of the Aquarius 4 itself.

Striking by its very simplicity, the Aquarius 4 blends harmoniously with almost any decor. Its clean, unencumbered styling and exciting sound quality makes the Aquarius 4 an ideal choice for those who desire sound reproduction without compromise, but find themselves limited for space in their listening room.

specifications

Low frequency transducer: 8-inch high compliance radial horn-loaded driver

Power capacity: 25 w continuous RMS *

Frequency transition bands: 8-inch wide range driver operates up to 8000 Hz, high frequency driver operates from 3000 Hz to beyond the range of human audibility.

Available finishes: Hand-rubbed Oiled Walnut or Satin White

Dimensions: 40" x 10" x 10" deep

Impedance: 8 ohms

Call your JBL dealer for a demonstration.

QUEENSLAND: Brisbane Agencies, Brisbane 2-6931

WEST AUSTRALIA: Leslie Leonard & Co, Perth 21-5067

VICTORIA: Keith Abernethy Stereo, Melbourne 663-1615

Allans Music, Melbourne 63-0451; Southern Sound, Melbourne 63-8237, 97-7245; Douglas Trading, Melbourne R3-9321

N.S.W.: Instrol Hi Fi, Sydney 29-4258; Convoy Technocentre,

Sydney 357-2621; Glen-Dor Hi Fi, Sydney 97-2709;

Autel Sound Systems, Sydney 89-0663

SOUTH AUSTRALIA: Truscott Electronics, Adelaide 23-3024

NORTHERN TERRITORY: Phitzners Music Salon,

Darwin 3801

*NOTE: Power capacity has no direct relationship to the rated power of the amplifier used. The Aquarius 4 can deliver full-bodied performance when connected to an amplifier rated at only 10 watts output. The use of larger amplifiers permits a greater margin of reserve power for effortless handling of momentary musical transient sounds. These loudspeaker systems may be connected to the most powerful amplifiers available if desired, with little danger of overload.

ears



front

or left, or right, or anywhere in
the room.

This is Aquarius, from JBL...
Environmental sound. A stereo
loudspeaker system specifically
designed for home listening. To
bring sound out of its corner.

Sound in the round.

Aquarius 4. For people who are
just a little rich or determined
to own the finest in sound
equipment.

Quality, and it looks it. JBL is for
when you're there.

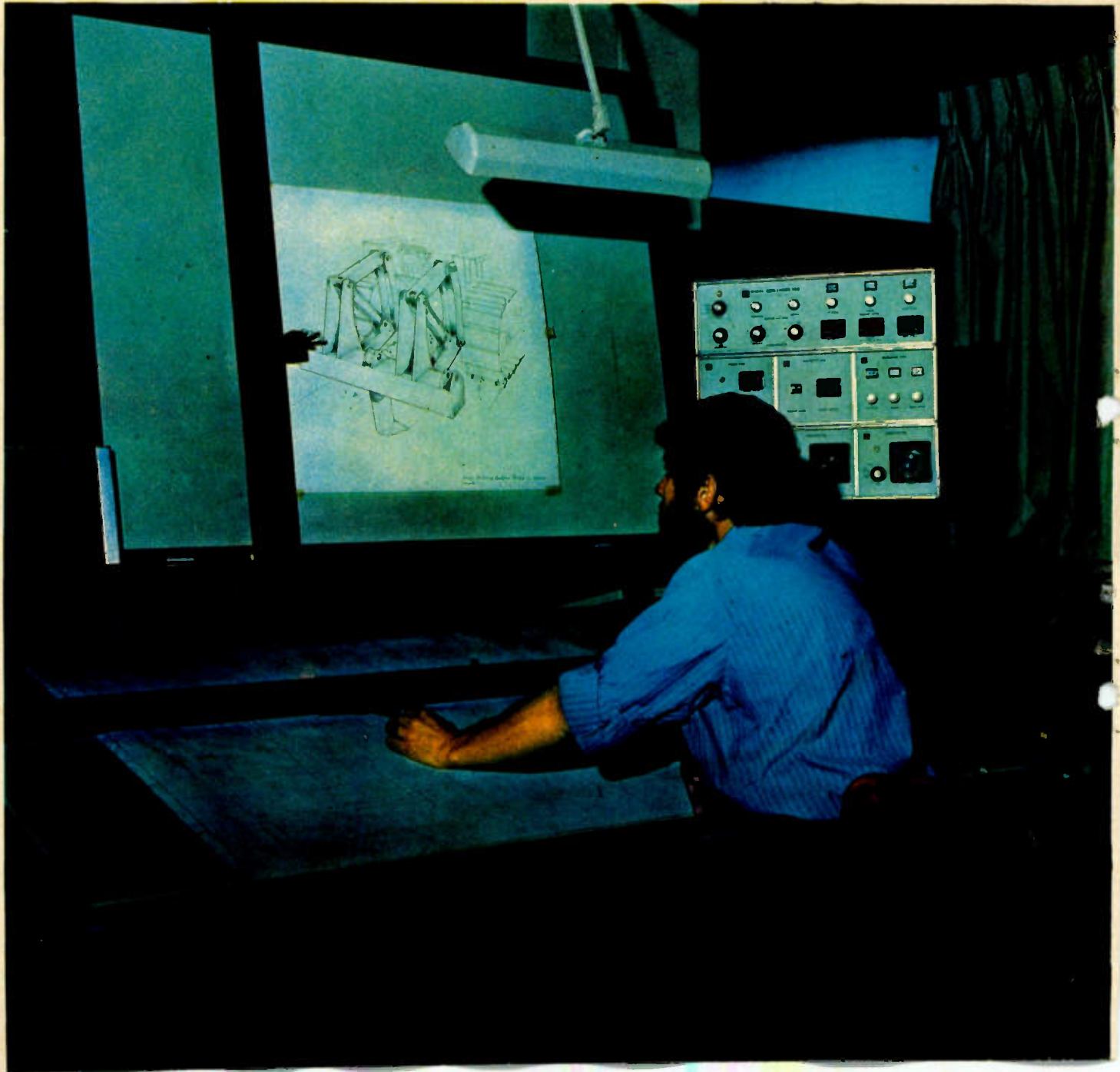
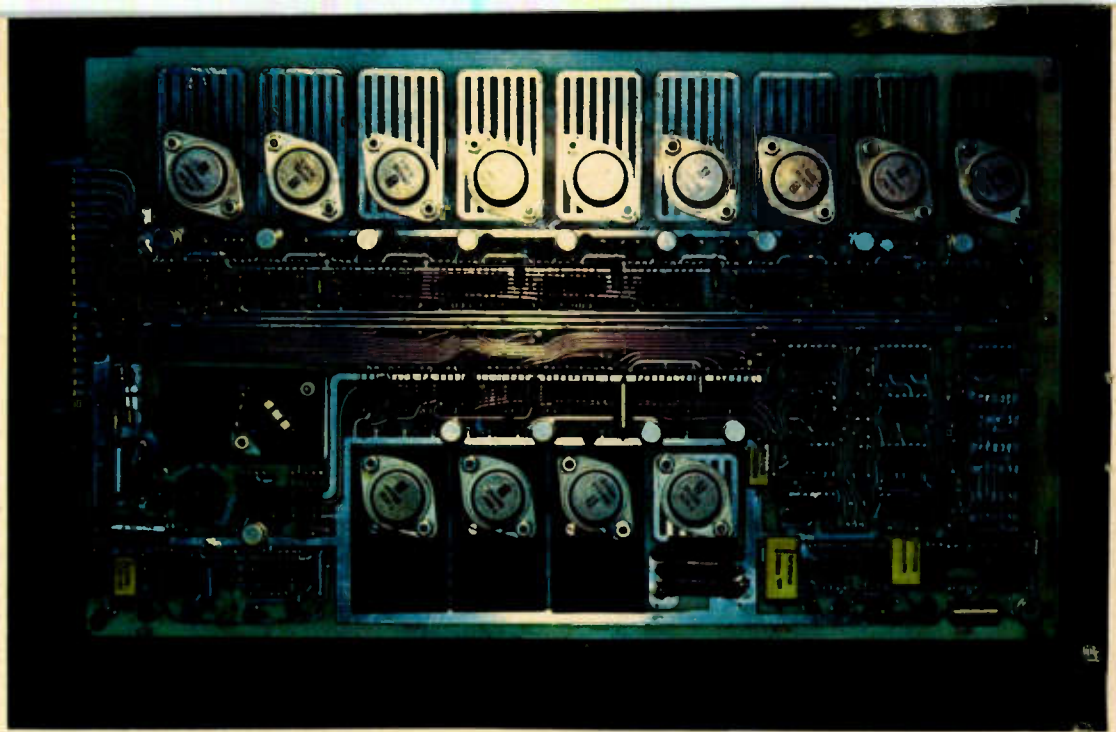
AURIEMA (A/ASIA) PTY. LTD.,
549 Pittwater Road,
Brookvale 2100
Phone 939-1833

JBL

news digest

RIGHT: This printed circuit component board is from a FACIT tape-punch. See article 'How to Make Measurements Automatically' - pages 20-24 this issue.

BELOW: Computer controlled drawing board converts orthographic drawings into three-dimensional form. Article on pages 42-43 explains how.



news digest

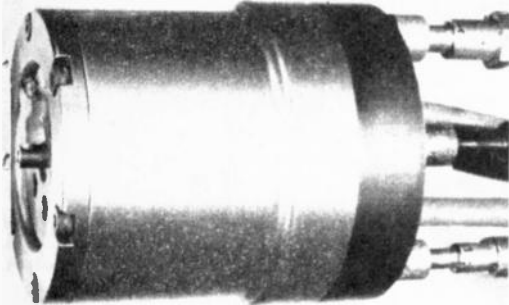
A BAG OF WORMS

'It's a real bag of worms' says Nobel Prize winner Willard Libby, about the results of recent investigations into the validity of carbon 14 dating techniques.

For the investigations, carried out by chemist John Anderson (and independently checked by the US Atomic Energy Commission) indicate that radioactive substances do not necessarily decay at constant rates unaffected by external conditions.

If Dr. Anderson's findings are sustained a lot of physics text books are due for hasty rewriting.

500,000 RPM



An ultra-high-speed motor designed to operate continuously at speeds up to 500,000 rpm has been developed by Japan's Hitachi Ltd.

The motor has been developed primarily for micro-calibre boring equipment used in the manufacture of printed circuit boards, fuel injection nozzles etc.

Externally pressurized air bearings eliminate rotational friction.

The 50 Watt unit is driven by an 8400 Hz supply.

LASER FIRE ALARM

A gallium arsenide laser beam is used to detect fires in a unique alarm system developed by Britain's Fire Research Station.

The laser beam is directed across the room, some inches below ceiling height, and is received by a photodiode mounted behind a matrix board in which the holes are roughly equal in diameter to the laser beam.

A fire will cause a temperature gradient in the room, this causes a refractive index gradient which in turn will cause the beam to be deflected downward.

The photodiode is capacitively

coupled to an amplifier and thus the unit will respond only to a fairly fast change in photo-cell light output. Movement caused by slow changes in ambient temperature or building stresses will not cause the alarm to operate.

THE SQUARE ROOT OF TWO

For reasons which escape us Dr. Jacques Dutka of Columbia University has calculated the square root of two, to one million decimal places.

The computer printout begins: 1.41421356237309504880168872 etc. etc.'

SCIENTIFIC SLEUTHS

British detectives are currently evaluating a number of scientific devices aimed at increasing their crime solving efficiency.

Systems include a holographic method of recording footprints — flux-gate gradiometers for locating buried guns and other metallic objects — and a unique method of locating buried corpses.

The body detector is an infra-red thermal imager that senses the difference in radiation between recently disturbed and undisturbed soil. Similar radiation is also produced by the decomposing body.

Another system used for the same purpose, uses a low frequency acoustic sweep generator mechanically coupled to the ground. The oscillator is swept through a frequency range from a few Hertz to about 300 Hz.

Disturbed soil causes a resonant peak to appear in the otherwise flat response.

HUNG UP TRAIN

Magnetic levitation of trains is being studied by California's Stanford Research Institute.

The study, undertaken for the US Dept of Transportation, aims at providing a safe, smooth, pollution-free method of transport.

Initially, the Institute will investigate the problems involved in the levitation of heavy moving masses by superconducting magnets.

ULTIMATE SUCCESS STORY?

Our London correspondent tells us that a British company specialising in miniaturization of electronic assemblies has been so successful that it has had to move into smaller premises.



PROJECTS KITS AND PARTS

E.T.1—CONCERT HALL SOUND

2 speaker boxes, 4 watt included. Good value. Complete set ready to go, \$20.00. \$2.00 p+p, NSW \$1.00.

E.T.2—"GREENER GRASS"—MOISTURE METER

(For drier sand use umbrella.) Complete kit including meter, box, all parts. \$18.40. p+p 50c.

E.T.3—CURRENT LIMITER

(Anti blow-up gadget) compl. heat-sink all parts. \$7.85. P+P 30c.

E.T.4—A.O.U. "New Sound for Guitar"

Compl. kit with board, switches, etc. Only need screwdriver/iron. \$26.30. P+P \$1.00, NSW 70c. FM CONVERSION UNIT, ALL PARTS AVAILABLE (complain to Radio Control Board, ask for FM Broadcast in Australia).

E.T.5—VARI WIPER—

A beaut for bad weather. Complete kit incl. p.c. board, relays, etc. \$16.70 with power SCR output \$16.70. P+P 30c.

EMERGENCY FLASHER

The Life Saver. Complete in box with lamp, etc. \$28.10. P+P \$1.00, NSW 50c.

E.T.6—THIEF TRAP

Will give the Police more work and you a good sleep. Compl. kit incl. box, keyswitch, p.c. board, etc. \$32.71. P+P \$1.75, NSW \$1.00. Magnetic switches as recommended \$1.95

E.T.7—BALANCE METER.

Kit complete \$11.99. P+P 30c.

E.T.8—(If you have a headache, if you have a pain . . .)

E.T.9—LOGIC IC POWER SUPPLY

(Digital project coming up ???) A.C. Board, I.C., all parts. \$21.93.

E.T.10—AF SIGNAL GENERATOR

(A prof. device you couldn't afford before.) Compl. kit incl. p.c. board, power supply, etc. \$24.56. P+P 50c. Without power supply \$19.90. Sine-wave only \$19.90.

FAMOUS STEREO HEADPHONES

Save \$2.00 or even \$3.00. Normally \$6.95—now only \$4.95. Only this month with your order for \$10.00 or more you can buy the headphones for the unbeatable price, \$3.95, the unbeatable price, \$3.95 (your not drunk!). Tech. details issue 1 & 2.

RONEC

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BALGOWLAH, 2093.
PHONE: 94 1766

**See MAX
CUMMINGS**

YOU DO A "GOOD DEAL" BETTER
WITH CASH IN HAND

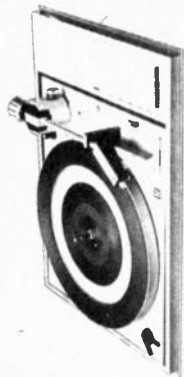


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PE 2001-2010—
2015-2016L-2018L
—2020L



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GERMAN
EQUIPMENT
UHER — REVOX
TAPE RECORDERS
ARENA
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PHOTO HI-FI

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67-2049 26-3234

JUST UP FROM LIVERPOOL ST.

news digest

COMMUNICATION INSTALLATIONS

A new company, specialising in the outside installation work associated with communications projects throughout Australasia and South East Asia, has recently been established in Sydney.

Mr. Colin E. Robinslaw, founder of the new company has considerable experience in all fields of communications in East Africa. Among his previous operations have been the Earth Satellite Station in the Rift Valley, the Kampala tropospheric scatter terminal, and the Bondwa VHF station in the Uluguru mountains.



OPTICAL COMPUTER MEMORY

An optical memory with a packing density of 150 million bits per square inch has been produced by Honeywell in the USA.

The memory is formed from a manganese bismuth film strip onto which data is entered by raising the temperature of small areas of the film above its Curie point and thus creating locally magnetized areas.

Writing is done with a helium-neon laser which has a power output of less than five milliwatts.

The same laser beam (operating at reduced power) is used to read the data.

At present reading and writing data rate is believed to be about one megahertz with 30 millisecond access time.

TEKTRONIX PROGRAMMABLE CALCULATORS

Tektronix's product range has now expanded to include programmable desk calculators for scientific, and engineering applications.

By its acquisition of Cintra Inc., of California, Tektronix Inc. will manufacture and develop the former Cintra product range under its own brand name.

The Australian Company expects demonstration units and technical data to be available locally in the near future.

VEHICLE DATA RECORDER

Research into automotive power units has always presented difficult problems for the research scientist. The traditional bench test provides an approximated simulation of working conditions and, therefore, research is hampered when results are obtained by this method.

With the advent of Philips ANA-LOG

7 Instrumentation Recorder the Inter-University Institute of Engineering Control at Warwick University, near Coventry, England, has been able to obtain statistically validated models of engine and transmission systems to provide a precise mathematical analysis of the loading requirements and dynamic performance under all service conditions.

The recorder is mounted in a fully instrumented saloon. Parameters monitored include propeller shaft torque, propeller shaft speed, fuel flow, manifold vacuum, throttle opening and brake-line pressures.

Signals from all transducers are brought to a signal conditioning unit mounted on a wooden shelf which replaces the rear seat of the car. The recorder is strapped to this shelf.

The system has shown itself to be very reliable and to function well despite rough vehicle motions. The flutter compensation technique on the ANA-LOG 7 has been of great benefit in eliminating spurious output signals.

The data collected by the ANA-LOG 7 is analysed on an SDS Series 90/2 computer. Special programmes provide real-time statistical analysis, data reduction and plotting of recorded road-test information. One- and two-dimensional probability distributions establish working patterns, and further use is made of frequency spectra and regression analysis techniques.

The project has been based entirely on analogue data collection so as to maintain the maximum flexibility in application. All the necessary analogue to digital conversions of the collected data is carried out in the computer.

In addition to improvement of existing engines, the results are directly

Saving your money is what the dick does



At Dick Smith (Wholesale) Pty. Ltd., specialists in Electronic Components at wholesale rates.

EXAMPLE

1/2-Watt carbon film resistors 4c each (No! You don't have to buy 250,000 for this price — just one.)

CARTRIDGE TAPES

Blank 64 Min. \$3.25
Head Cleaner \$2.95

CASSETTE

U.S. Imported C60 \$1.99
Head Cleaner \$2.95

CAR BURGLAR ALARM COMPONENTS

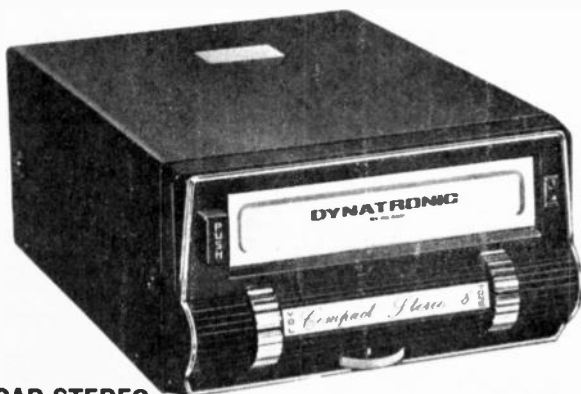
12-Volt relays \$1.60
Key Switch, with stainless steel cover
and two keys \$5.90
12-Volt Electric Gong \$13.50
12-Volt Siren \$12.50
Door Switches (each) \$1.00

CAR RADIO AERIALS

Stainless steel three section \$2.27
4ft. Lock Down (incl. keys) \$3.25
8ft. Super Range Lock \$6.25

CAR RADIO

7-Transistor, 2-diode push button with
tone control (inc. large 7" x 5" speaker
and suppression) \$49.00



CAR STEREO

Dynatronic 8-track, automatic car stereo Model 5-88 \$59.00
(Retail \$119.00)
2 Speakers, to suit above \$12.00

RESISTORS

1/2-Watt imported carbon film 4c each
1/2-Watt Philips 8c each

INSTRUMENT CASE

Model ATC P 7" x 5" x 4 1/2" \$3.75



SPEAKERS

7" x 5" 4-ohm \$4.50
6" Round, in chrome
grille (door mounting)
8-ohm \$14.00 pair



Realistic Communication Receiver \$234.00 or
Terms from \$3.00 per week

All electronic supplies at wholsale prices —
resistors, capacitors, transistors, valves, etc.

Fibreglass printed circuit
board 1 oz. 1/16" 6"x3"
\$1.27, 6"x6" \$2.00.

Large stock of Neosid
formers
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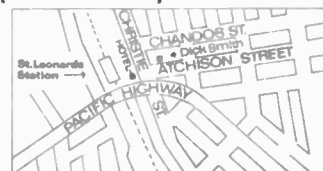
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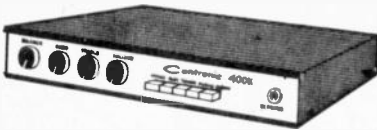
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news digest

influencing plans for the development of hybrid petrol/electric vehicles at Warwick University and for the development of electronic ignition and petrol injection systems.

TRIAC — 300 AMP

A 300 amp triac with 1,200 volt blocking voltage is due for release by Mitsubishi. The new triac is rated for use with inductive loads.

NEW STANDARD FOR ELECTRICAL MEASURING INSTRUMENTS

The Standards Association announces publication of Australian Standard 1024, Direct Recording Electrical Measuring Instruments and their Accessories.

This comprehensive standard replaces C54-1930 and applies to instruments such as ammeters, voltmeters, single-phase and polyphase meters, varimeters, phasemeters and power factor meters, frequency meters, and ohmmeters which are used for recording the instantaneous, effective and mean values of one or more measured quantities as a function of time. The standard refers to strip, drum and disc recording instruments and those instruments which incorporate rectifiers or diodes and the shunts, series resistors, indicators and capacitors used with such apparatus.

It also deals with such matters as classification, permissible intrinsic errors, permissible variations of recording instruments and constructional requirements.

Copies of AS 1024 may be obtained from the various offices of the Standards Association for \$4 each.

ELCOMA

Philips Industries Holdings Limited has formed a new independent division trading under the name of Elcoma, to handle the supply of electronic devices and components.

These activities have previously been carried out by Philips' Miniwatt Electronics Division and Mullard-Australia Pty. Limited.

Elcoma will supply electronic devices and components to Governments, industry, distributors, wholesalers and retailers. Elcoma is located at Philips' new offices at 95-99 York Street, Sydney.

The division's technical applications laboratories, engineering services and bulk stores will be at 20 Herbert Street, Artarmon.

The division will be located at the Philips offices in other capital cities.

FUEL INJECTION

A new electronic fuel injection system claimed to have five times less components than the VW/Bosch unit of Elmira, New York. The unit, which is primarily intended for current US vehicles is undergoing tests for Federal emission standards certification.

VIDEO CASSETES — STOP PRESS

In a surprise move CBS has just licenced Hitachi, Matsushita, Mitsubishi and Toshiba to produce EVR systems for export to the USA. Lloyd Singer, vice-president of Motorola Inc. says that his company in turn will export to Japan.

Exclusive picture shows Rank EVR system in use.



who needs 40 watts r.m.s.?

Obviously, from the demand for the Wharfedale "Rosedale", many music lovers have this substantial acoustic power requirement. Few speaker systems can handle 40 watts R.M.S. — and *only a handful do it well*. For sheer power handling capacity — free of colouration — the Wharfedale "Rosedale" leads this select group of high quality speaker systems.

With its 15" bass reproducer completely isolated from the 5" mid-range speaker and the 1" high pressure tweeter, the "Rosedale" has an effective frequency range of 35 — 20,000 Hz. Naturally it's a glorious piece of furniture which will grace any tasteful domestic environment. Measuring 24" x 23" x 13½", finishes available include oiled teak and polished walnut. The Wharfedale "Rosedale" will complement the highest quality amplifiers and signal sources.

But you live in a *flat!* Don't worry — you've not been neglected by Wharfedale. The "Denton", a bookshelf compact, has been designed specifically for you.

It measures only 15" x 9¼" x 9" but has a conservatively quoted frequency response of 65 — 17,000 Hz. This covers every musical instrument, every overtone.

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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.

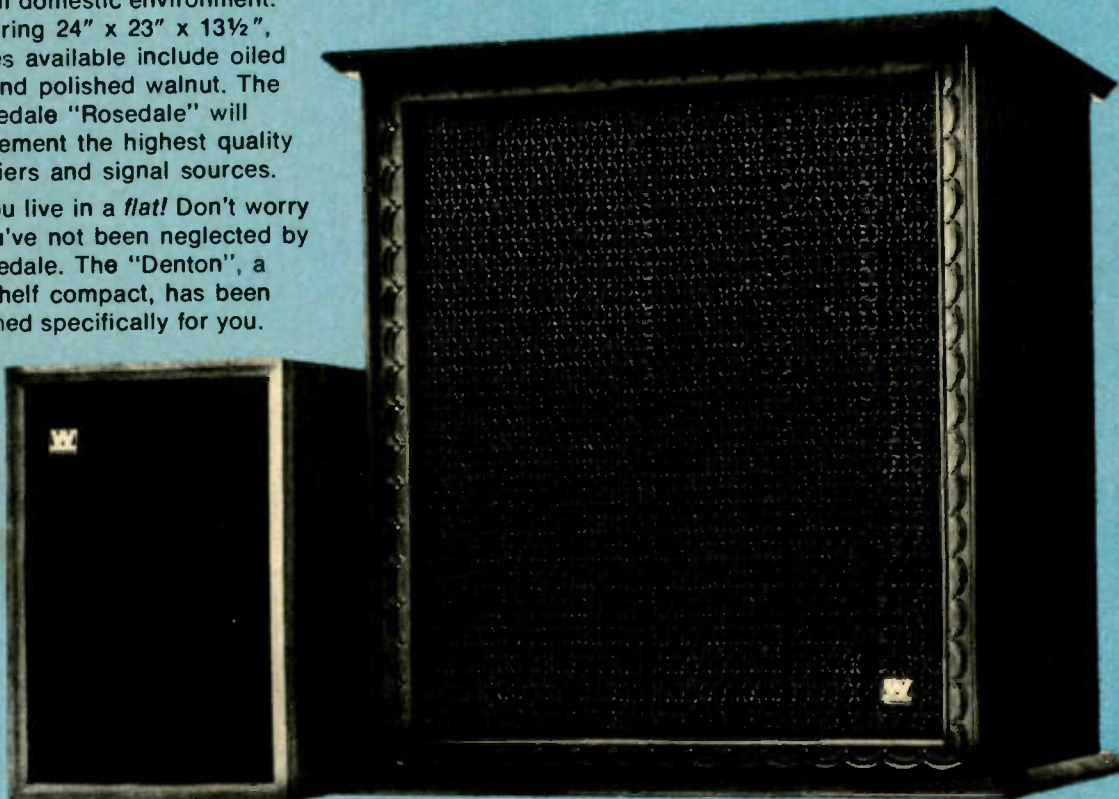
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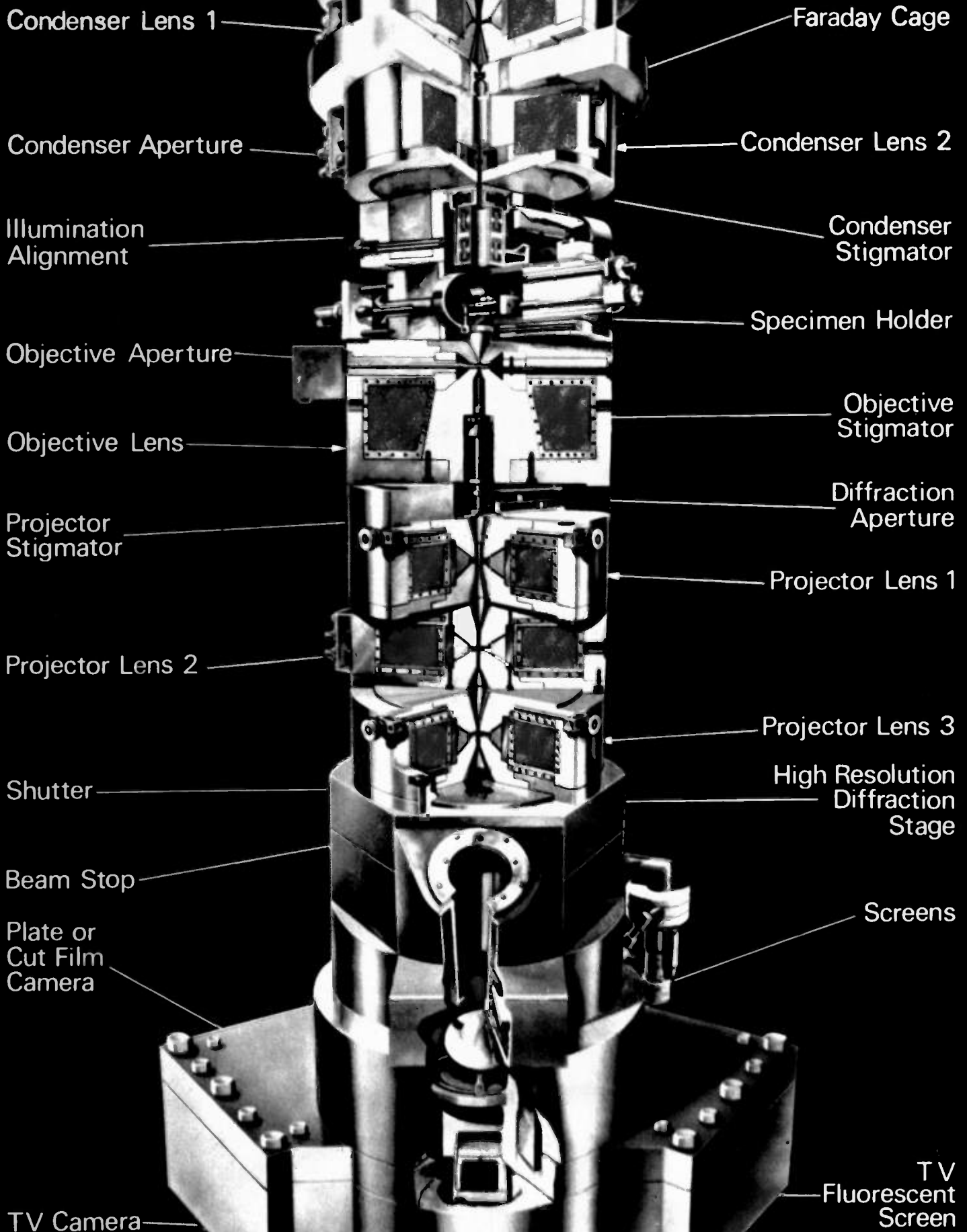
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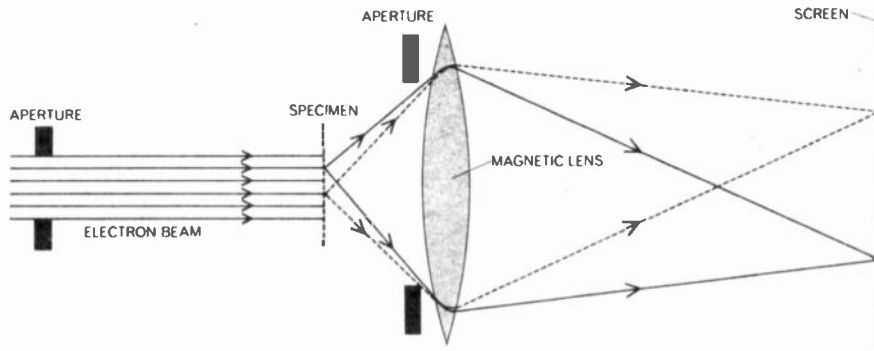
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Million-volt Electron Microscope



In the transmission electron microscope, electrons perform the same role that light rays do in an optical unit.

The resolving power of any microscope has an absolute limit which is roughly equal to the wavelength of the radiation employed.

This limits the resolution of optical microscopes to about half a micron (5000 angstroms) — about 4000 to 5000 times the diameter of most atoms. This is a fundamental barrier, inherent in the nature of light itself.

The only way to obtain greater resolution is to use radiation of a wavelength shorter than that of visible light.

A few optical microscopes have in fact been produced which use ultraviolet light to illuminate the specimen, but even these have a resolution only twice that of conventional optical instruments.

If it were possible to use X-rays in place of light, the resolution could be improved hundreds of times, but unfortunately no one has found a way to construct lenses and other optical components which can be used for wavelengths in the X-ray region (from 1000 angstroms to 0.001 angstrom).

For many years this seemed to be an absolute barrier to microscopy and man's ability to gather really detailed information about small structures.

Then in 1927 Davisson and Germer of the Bell Telephone Company published their paper confirming the wave nature of the electron, and this led five years later to the first transmission electron microscope.

This instrument, built in Germany by Knoll and Ruska, used a beam of electrons to illuminate the specimen. The electron 'radiation' which is scattered by the specimen is focussed by a magnetic lens onto a fluorescent screen or photographic plate.

Early transmission electron microscopes used accelerating potentials of a few thousand volts, however it was realised that the wavelength of the electrons decreased as the accelerating potential was increased and some of the latest units operate at 1000kV.

As the theoretical resolving power varies as the three fourths power of the wavelength this gives a theoretical resolution of approximately one angstrom (which is approximately the diameter of an atom).

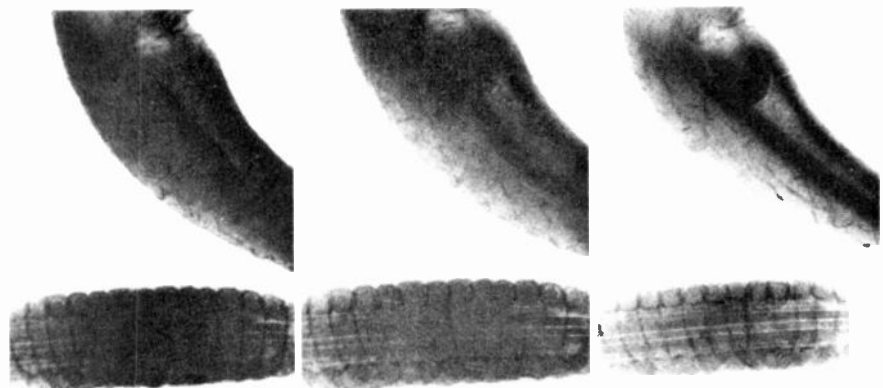
Electrons accelerated at high voltage interact less strongly with matter than those accelerated at low voltages. This has a number of advantages including the greater penetration of specimens, reduced specimen damage under most working conditions, and higher practical resolution of specimens which are too thick for satisfactory imaging at lower voltages.

ONE MILLION VOLTS

One of the most advanced electron microscopes in the world is the AEI one million volt instrument illustrated in this article.

The complete instrument which is over 20 ft. high consists of the electron microscope column and control desks, a high voltage generator and electron accelerator; and a number of auxiliary units to provide and control various services such as water, vacuum, compressed air, and miscellaneous electrical supplies.

The high voltage generator is a multi-stage Cockcroft-Walton



Three electron microscope pictures of the same specimen area of one-micron thick sperm tail. The pictures were taken with accelerating voltages of 100kV, 500kV, and 1000kV.

LEFT: This exploded view shows the main features of the 9ft. high column of AEI's million volt electron microscope.

Electrons, accelerated by a million volts, replace light rays in the world's most powerful microscopes

Million-volt Electron Microscope

multiplier enclosed in a tank and insulated by sulphur hexafluoride gas.

The accelerator, electron gun and stabilizing resistors are housed in a similar vessel mounted directly over the microscope column. The high voltage generator is coupled to the accelerator by a surge-limiting resistor.

The output from the accelerator provides a maximum stabilized beam current of 100 microamps and, in addition, an unstabilized supply of up to 200 microamps is available for irradiation experiments.

THE COLUMN

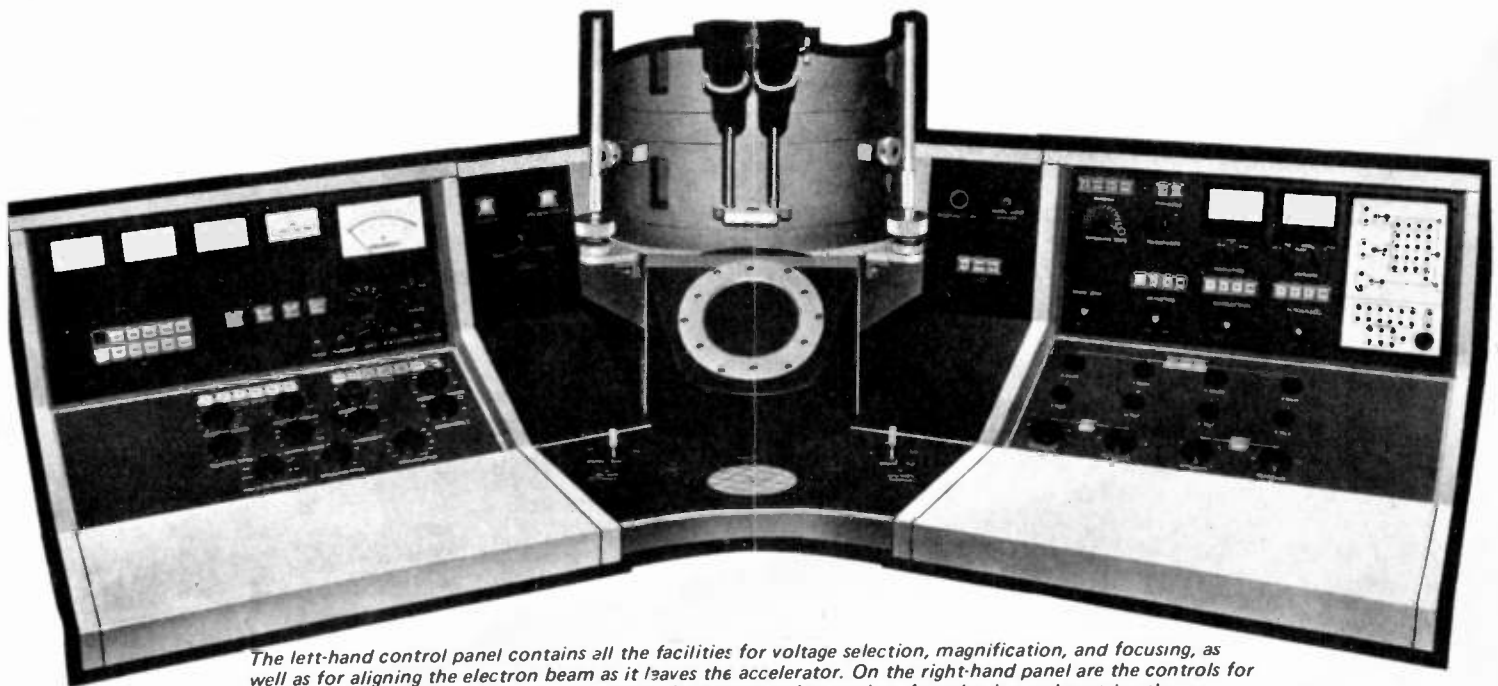
A powerful first condenser lens is used to reduce the source size, and an asymmetrical probe-forming second condenser lens controls the illumination intensity.

The minimum spot size at the specimen plane is approximately 0.5 microns, but the size of the illuminated area can be increased up to the diameter of the specimen grid if required.

The illumination intensity, which is monitored by a Faraday cage located just below the first condenser lens, can be optimized by electrical alignment of the electron beam between the accelerator and the condenser system.

Beneath the second condenser lens is

The control desks and microscope column of the AEI million-volt electron microscope.



The left-hand control panel contains all the facilities for voltage selection, magnification, and focusing, as well as for aligning the electron beam as it leaves the accelerator. On the right-hand panel are the controls for aligning the microscope in the dark or bright field modes of operation, for selecting and centring the apertures, and for operating the camera system. On the extreme right is a fault indicator panel. The part of the specimen which is under observation is displayed on the circular indicator in front of the viewing window while the specimen rotation, controlled electrically by push-buttons mounted on the centre panel, is indicated by the rotating bezel. The angle of tilt about the two axes is displayed on digital counters

U.S. MICROSCOPIST IN AUSTRALIA

In a recent visit to Australia, Professor Donald F. Parsons of the Roswell Park Memorial Institute at Buffalo, New York, had discussions with top Australian scientists about high voltage electron microscopy.

Professor Parsons, who has recently been involved in the purchase of an A.E.I. 1.2 million volt electron microscope, gave a talk at the British High Commission's Office in Sydney in which he described how his research on the structure of cancer cells had led to a requirement for increasingly higher electron accelerating voltages.

Professor Parsons found that incoherency of the image due to excessive inelastic scatter made any attempt to obtain the equivalent of the light optical phase contrast microscope impossible at conventional accelerating voltages. By passing to 1.2 Mev less inelastic scatter is present and, in addition, the reduction of electron wavelength causes the focussing or objective lens to behave more perfectly with respect to phase contrast.

Professor Parsons showed how raising the electron accelerating voltage enables dark field photographs taken at 1.2MeV to be much sharper than corresponding pictures taken on conventional microscopes.

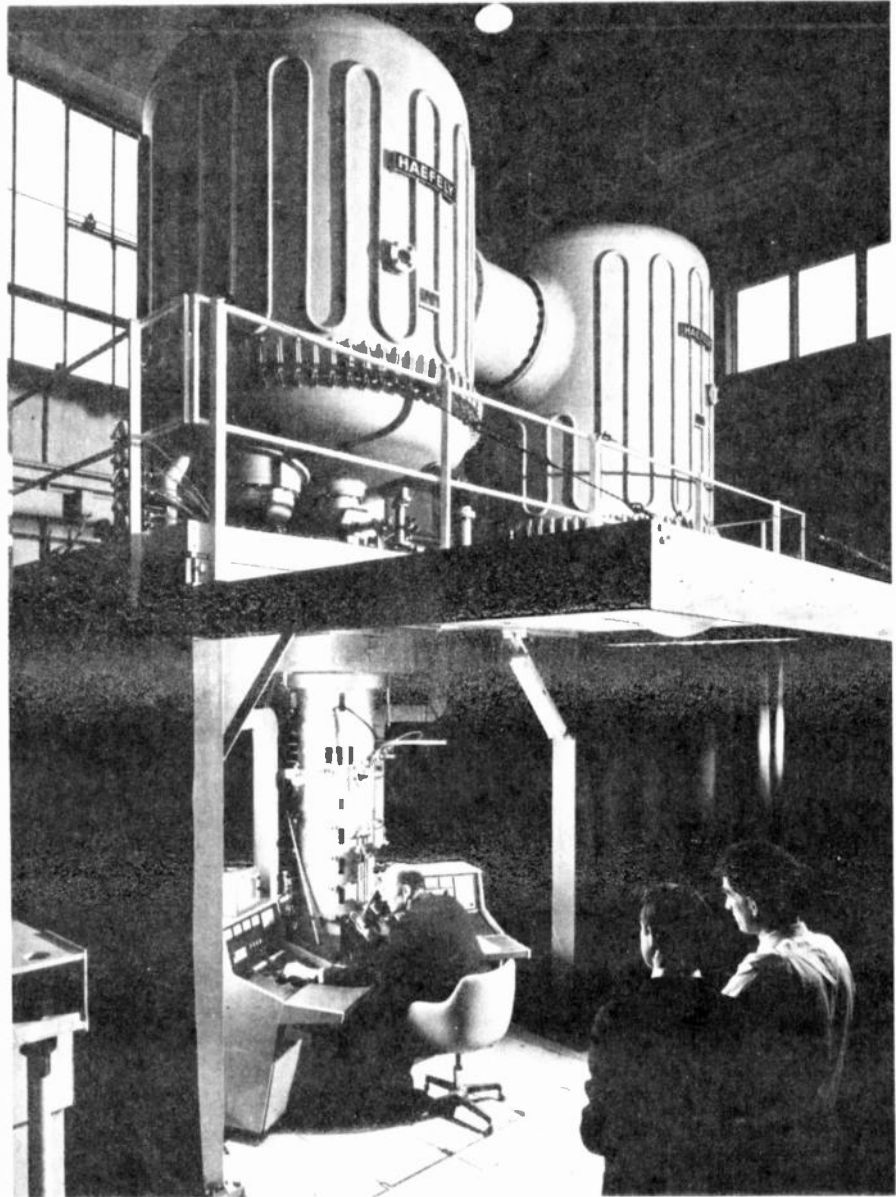
He also explained how it was possible to examine whole preparations of cells in the wet state and to view the internal structures by dark field without the need for fixation sectioning.

His research programme includes an attempt to visualise living cells in the high voltage electron microscope.

a beam deflector which serves to tilt and shift the electron beam for alignment purposes. It can provide up to $1\frac{1}{2}^\circ$ of beam tilt at 1000 kV for high resolution dark-field operation.

Air airlock permits ready access to the specimen and the microscope has a goniometer stage which permits the specimen to be tilted about any horizontal axis with little loss of resolution. In addition, specimen stages are available for heating, cooling and straining.

The focal length of the objective lens is constant throughout the complete range of accelerating voltages, and the lens has a theoretical resolving power of 1.13 angstroms at full voltage.



This A.E.I. million-volt microscope is installed at the Atomic Energy Research Establishment at Harwell in England for use in the metallurgical field.

The objective aperture rod carries three apertures and is remotely controlled from the desk for ease of interchanging and centring the apertures.

The beam then passes through the three lens projector system which covers a normal magnification range from 1000 to 160,000 times.

Automatic control of lens current ensures that the selected magnification is maintained at different working voltages.

Provision is made in the viewing chamber for three windows, the front one being equipped with a binocular telescope. A TV display may also be used.

An electrically operated camera specially developed for the microscope can take up to 48 exposures on photographic plates or cut film, up to 4" by 3". The camera chamber has an air-lock so that plates can be removed without breaking the column vacuum.

In basic operating principle, the transmission electron microscopes of today have not changed greatly from the original concept of Knoll and Ruska.

In practicability however, changes have been dramatic, and the electron microscope of today is as much a working tool as its optical equivalent.

HOW TO MAKE MEASUREMENTS AUTOMATICALLY

Data logging – the technique of data acquisition, processing and display – increasingly used throughout research and industry to record information about any number of processes or events Collyn Rivers explains what can be achieved – and how.

A DATA LOGGER in an Australian chemical plant measures temperatures at 700 different points, displays these temperatures in degrees Celsius to an accuracy of $\pm 0.1\%$, prints out all readings every 30 minutes, or on command, and sounds an alarm if any temperature exceeds individual preset limits.

In a complex manufacturing operation, another logger collects data from 175 different positions – some indicating pressure, some velocity, some pH, some temperature, and many others of varying kinds – and transmits this data to a control area two miles away, where it is displayed in the engineering units concerned. Upon command the data can be fed into a computer which, assessing all the essential parameters, can calculate the corrections required to optimize the entire operation.

Data loggers can record one measurement a day – or millions every second. The ability to operate at very high speed may be essential to ensure that data about interrelated functions is recorded as rapidly as possible, for it is not feasible for data loggers to measure and record events simultaneously (in parallel form). They operate by scanning each input for a brief period before passing on to the next.

An example of essentially high-speed operation is an airborne data logger which plots the field-strength around a radio beacon. Apart from field-strength measurements, the data recorded includes position, altitude, barometric pressure, temperature, humidity, – and unless these measurements are taken quickly and in

rapid succession, each measurement will relate to different geographical positions. (This is what statisticians call "putting a skew in the data".)

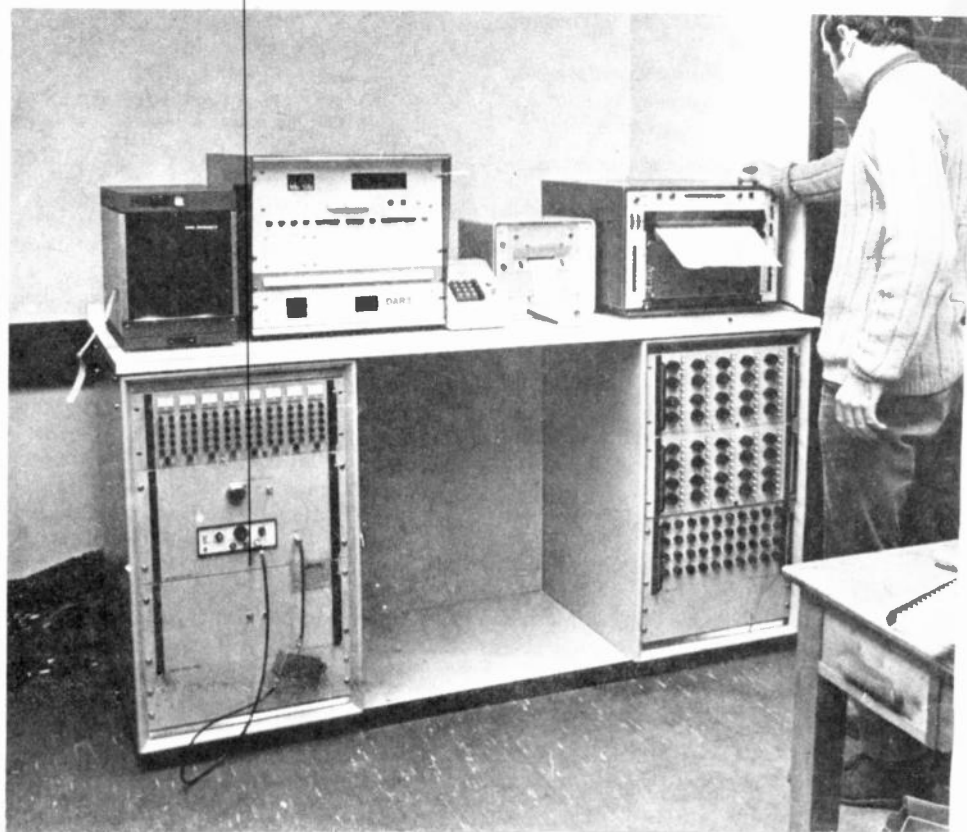
Data loggers may be small desk-top units monitoring half-a-dozen vital operations in a small plant, or they may be sophisticated systems with thousands of inputs, monitoring or controlling a major manufacturing complex. They vary in price from a couple of thousand to several million dollars.

Despite their wide range of facilities and applications, most data loggers have similar operating principles.

HOW THEY WORK

A function of a typical (though basic) data logger is shown in Fig. 1.

Each phenomenon to be monitored is changed by a transducer into an electrical signal which is proportionate in magnitude to the phenomenon. Each electrical signal is connected to the input of a scanning device in the main part of the data logger. The scanner is programmed to select each input signal for a brief period of time (either sequentially or in any required order) and to connect momentarily the selected input to an analogue-to-digital converter.



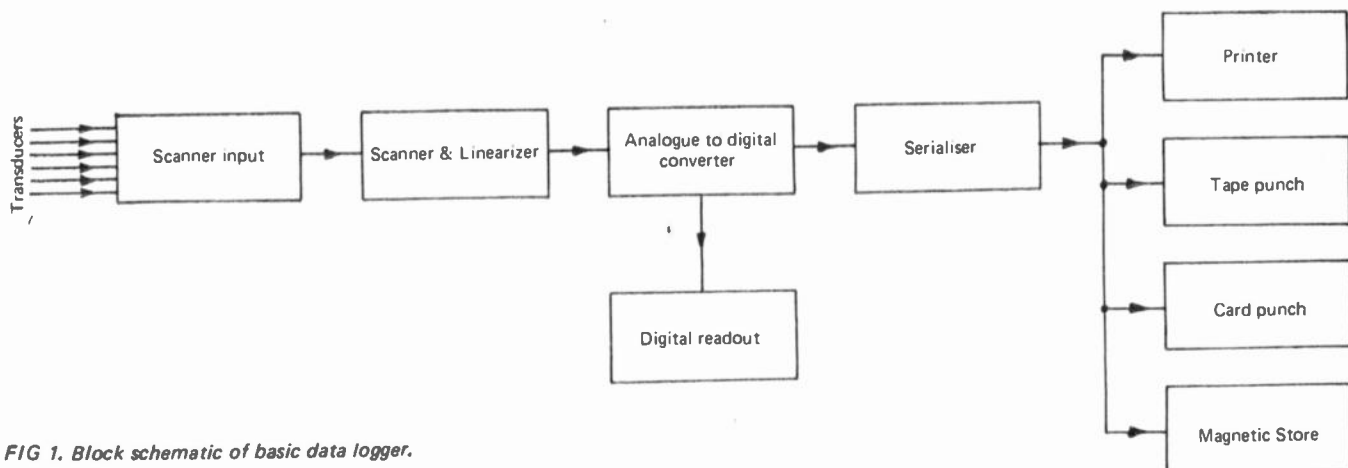


FIG 1. Block schematic of basic data logger.

The converter changes the selected input signal into digital form and passes the digitized signal to the display unit, where it is shown in numerical form.

Thus a measurement of pressure in a pipe line will be displayed in numbers directly representing so many lb/inch² or kg/cm². Temperature will be displayed directly in degrees, etc., etc.

Intermediate circuits provide the necessary calibration, amplifying or attenuating the inputs as required, and also correcting any non-linearity in the original measurement.

An indication will also be provided, identifying the input to which the displayed reading refers.

Direct visual monitoring of the displayed data is tedious and time-consuming. It also precludes input scanning speeds faster than one or two inputs a second. To overcome these limitations, most data loggers record their readings in permanent or semi-permanent form.

The data may be recorded by printing out, punching holes in tape or cards, by magnetical recording, or taken directly into a computer store or buffer.

To avoid compiling masses of possibly unnecessary data, the logger can be programmed automatically to print out a complete sequence of inputs on command, or at predetermined time intervals, or in the event of any exceptional circumstance. It can be arranged to print out only those signals exceeding or falling below preset limits. In another form,

the data logger can print out 'normal' conditions in black and 'abnormal' conditions in red.

A typical example of selective print-out is a data logger used to check the voltages of several thousand dry cells: this unit scans the total number of cells every five minutes and prints out 'exceptions' on each scan. It also provides a print-out of all cell voltages every 12 hours.

The recorded data includes input identification, time and date.

In another application, a data logger scans 200 mixed inputs every second, and on each scan transfers all data

onto magnetic tape.

To cater for the wide range of applications, and numbers of inputs, many data logger manufacturers produce their equipment in modular form; this also simplifies maintenance and enables the system to be expanded at any time.

TRANSDUCERS

There is virtually no limit to the type of phenomena that can be logged. If it is possible to find a way to measure a phenomenon, then that measurement can almost invariably be converted into a proportionate electrical signal.



RIGHT: Capacitive transducer records wave motion in 1/120th. scale model of Botany Bay. LEFT: 100 channel data logger records all relevant information.

HOW TO MAKE MEASUREMENTS AUTOMATICALLY

Some phenomena generate electrical signals that can be used directly — dry batteries, for example — others require transducers to convert temperature, pressure, strain, rate, position, weight, colour, pH, viscosity, etc., into proportionate electrical signals.

Whilst there are literally thousands of different types of transducer, they all operate on well-known physical principles. Their manufacturing problems lie not in finding a suitable operating principle but in ensuring that the transducers maintain linearity and reproducibility.

Transducers can be classified into two main types — those which derive their signal from the process they are monitoring, and those which require external electrical excitation, of which some portion becomes the measured signal.

The former type of transducer is commonly referred to as 'self-generating'. This is a misnomer, for they almost invariably take energy from the system they are monitoring (in fact, care must be taken that this type of transducer does not affect the magnitude of the phenomena that it is measuring.)

SELF-GENERATING TRANSDUCERS

A well-known example of a self-generating transducer is the piezo-electric crystal pick-up used in record players. This produces an electrical output when mechanically stressed.

Another transducer of this type is the photo-voltaic cell, which converts light energy into electrical energy.

Most electro-magnetic transducers are self-generating, one example being the permanent magnet tachogenerator, which produces a voltage proportionate to rotational velocity.

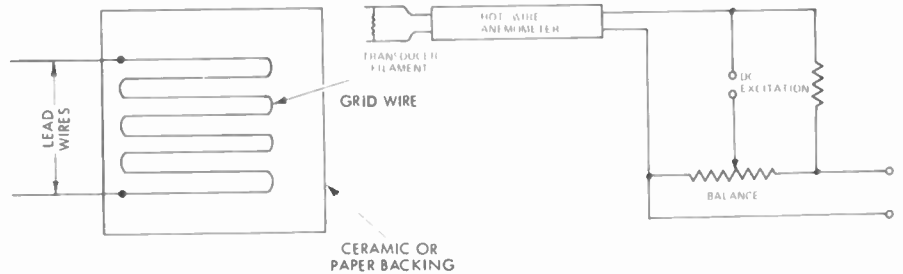


Fig. 2. Strain gauge shown above consists of a wire grid bonded to an impregnated paper backing. The resistance of the strain gauge changes when the grid is distorted.

Fig. 3. Hot wire anemometer measures small changes in wind velocity.

Thermo-couples are yet another type of self-generating transducer. These measure heat by exploiting the thermo-electric (or Seebeck) effect, in which a voltage is generated by the difference in temperature between the junctions of two dissimilar metals.

EXTERNALLY ENERGISED TRANSDUCERS

The change in resistance when a wire is stretched or heated is the basis of an extensive range of externally energised transducers.

One form of this is the resistance strain gauge (shown in Fig. 2). Resistance strain gauges are usually connected in a Wheatstone bridge circuit. One gauge is mechanically bonded to part of the structure which is subject to compression. When a load is applied, the gauge changes length (and hence resistance), unbalancing the bridge and thus producing an output voltage.

Other resistance transducers measure temperature, and this temperature measurement may be used directly or indirectly to measure other related phenomena, such as thermal conductivity or calorific value — or, in the case of the hot wire anemometer shown in Fig. 3, to monitor minute pressure changes in shock tubes, wind tunnels, air compressors, etc.

Inductive transducers require an external ac excitation voltage and facilities for resistive or capacitive balancing. This type of transducer can

be used to measure pressure, flow, displacement and vibration.

A typical example is the differential transformer illustrated in Fig. 4, which consists of three windings around a movable core of magnetic material.

The ac excitation voltage is connected to L1. When the movable core is equidistant between L2 and L3, the ac voltage induced from L1 into the windings L2 and L3 will cancel out. Any linear movement of the core from this midway position will cause the ac signal in windings L2 and L3 to become unbalanced and thus produce an output voltage which is proportionate to core movement. This type of transducer can measure displacements as large as several inches or as small as one micron.

Precise angular measurements as small as fractions of a second of arc can be made by using a differential transformer with a circular core.

SCANNERS

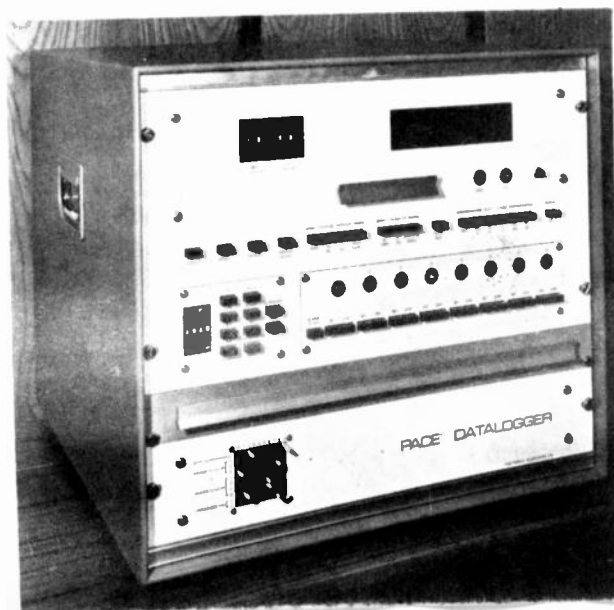
Electrical signals from all the various transducers are connected to the input scanner of the data logger.

The input scanner is basically a multi-way switch which connects any required transducer to the rest of the data logger's functions. The scanner normally switches the transducers sequentially at a predetermined speed, but arrangements are often made for the scanner to be programmed in various sequences and speeds.

The scanner is controlled by a master clock which also provides a reference signal, indicating which input has been selected.

Although simple in concept, scanners must be carefully designed to avoid inducing noise into the incoming signals, and to ensure electrical segregation between different signals. This is commonly achieved by using banks of reed relays or sealed diaphragm relays.

A refinement of some scanning input circuits is the charge-transfer system shown in Fig. 5, in which the transducer signal voltage is stored on a low leakage capacitor and then switched as required into the data logger. This arrangement improves the signal-noise ratio of low-level signals



PACE Data logger from EAI scans to 100 channels/sec. and is accurate to $\pm 0.05\%$.

and is often used in conjunction with thermo-couple inputs.

SCALING AND LINEARIZING

This may be done either before or after the scanning input. Scaling, in effect, calibrates each transducer input to ensure that the subsequently digitized reading will appear in the correct engineering units. For example, a resistance thermometer having an output of 1.013 Volts at 100°C may be scaled to read 1.000 Volts at this temperature, so that the final meter reading will be 100.0°C.

Linearizing is required where transducer output is not a linear function of the changing variable – as with thermo-couples. Linearizers usually operate by varying the gain of an operational amplifier.

Following the scanning and subsequent circuits, the selected, scaled and linearized signal is converted to digital form.

INTO DIGITS

Digitizing is performed by an analogue-to-digital converter which is usually designed for data logging applications. The A/D method used will depend upon a number of functions including scanning speed, accuracy required, signal-to-noise ratio of the incoming signals, etc. (The uses and limitations of various types of

A/D converters are discussed in the article on digital voltmeters elsewhere in this issue.)

A commonly used A/D converter is the voltage to frequency type, in which the incoming signal is integrated over a precisely controlled time period which is an exact multiple of the ac mains frequency. This ensures that the mean level of the transducer signal is sensed and that misleading transients are smoothed out; ac mains pick-up will also be cancelled out completely.

One limitation of the voltage to frequency converter is that operating speed is limited to a maximum of 40 or so readings per second.

Another type of A/D converter, which has a much higher operating speed, uses the successive approximation principle, in which the incoming signal is compared against successively smaller fractions of a reference voltage. This type of converter can operate at speeds as high as one million readings a second – but its accuracy and noise rejection characteristics are not as good as those of the voltage to frequency converter.

The output from the A/D converter is taken to the decoders and drivers of the numerical readout. (The A/D converter and readout stage is very similar to that used for digital voltmeters – in fact, some data logger manufacturers use standard dvms for the purpose.)

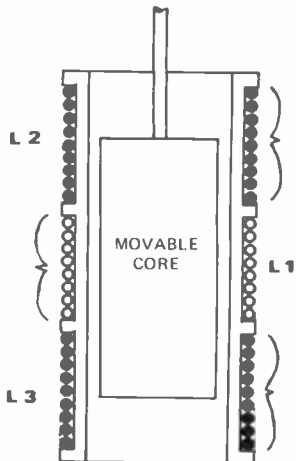


Fig. 4. Differential transformer provides output proportionate to movement.

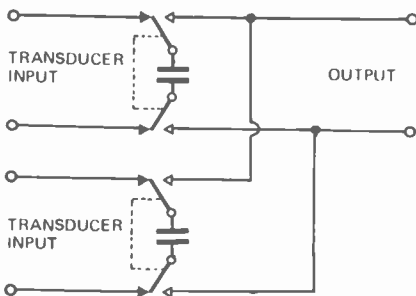


Fig. 5. Charge transfer circuit used in input scanner isolates data logger from transducers whilst taking measurements.

TYPICAL USES OF DATA LOGGING

Research Establishments

Many hundreds of data logging systems are used in Universities, Technical Colleges, Research Associations etc., for recording experimental data in pure and applied science. Computer compatible output enables direct evaluation of results.

Structural Engineering

Out-of-balance voltages from electrical resistance strain gauge bridge circuits can be readily recorded with a high degree of accuracy. Computer compatible record simplifies stress analysis. These measurements are frequently required in the field of civil, mechanical and aeronautical engineering.

Life Testing of Batteries

Voltages of a number of electrolytic cells under load can be periodically monitored with the logger under clock control. Indication can be given if the cell output falls below a pre-determined level. A printed output provides a complete record of cell performance.

Engine Test Beds

The logger can be used to gain considerably more knowledge about the true operating conditions of internal combustion and gas turbine engines. Parameters which may be recorded include engine speed, oil temperature and pressures, fuel consumption etc.

Wind Tunnels

Wind tunnel operating time is expensive and considerable savings are possible if the logger is used to rapidly record pressures and strains during evaluation of models.

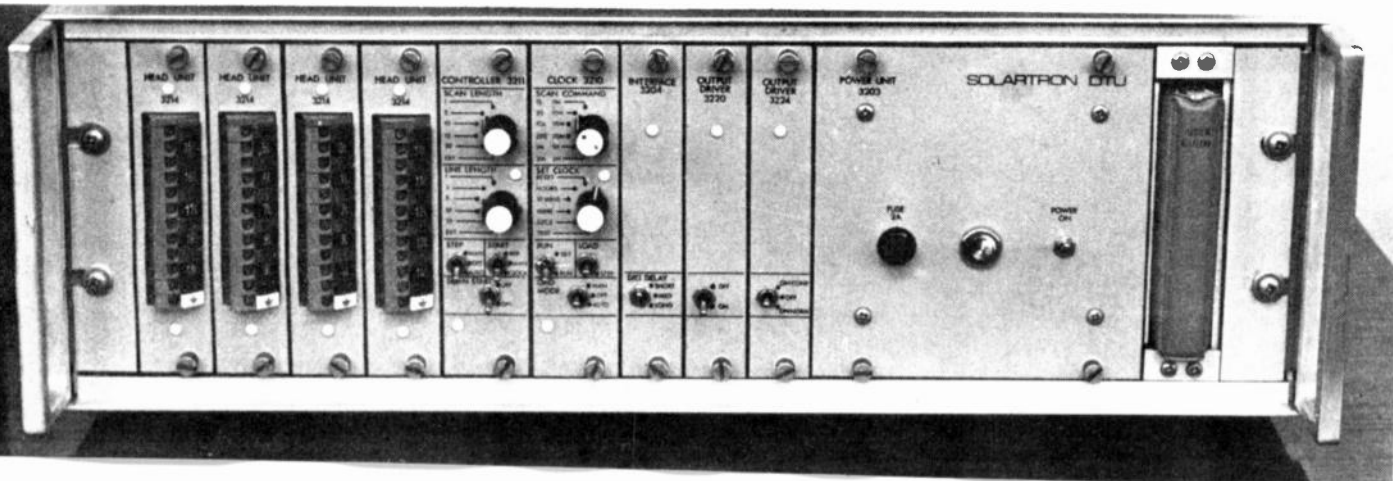
Medical Research

The use of electronic measurement techniques in the field of medical research is rapidly expanding, and a number of data loggers are currently in use recording physiological parameters.

Chemical Analysis

Many types of automatic chemical analysers require complete data processing for speedy analysis. This is facilitated by recording data in computer compatible form, for off-line processing.

This Data Transfer Unit from Solartron enables existing digital equipment to be assembled as a data logger.



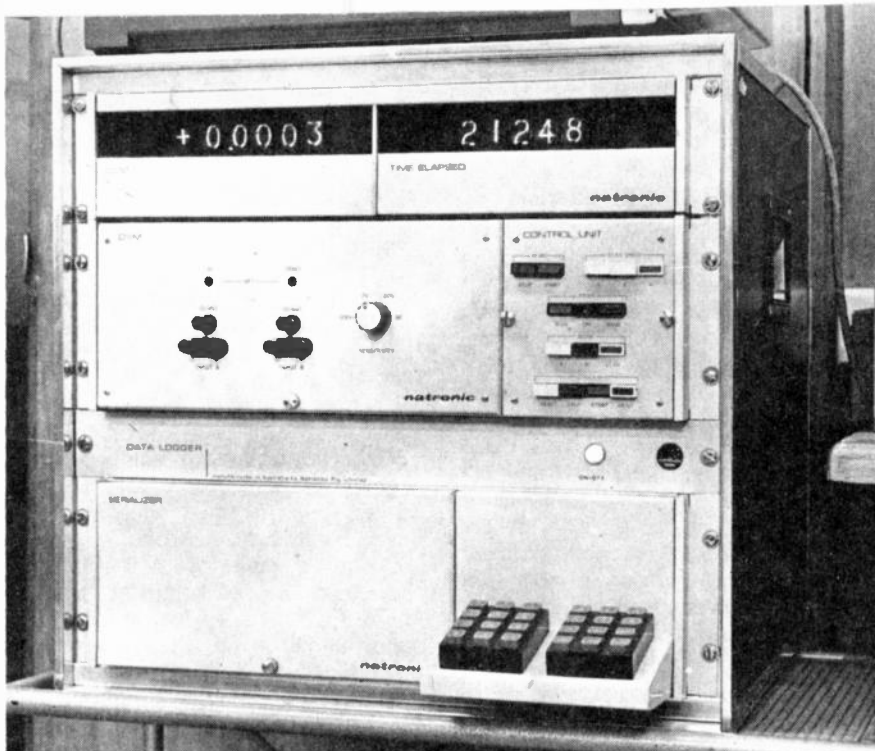
The decimal point of the displayed data will be positioned automatically, and for measurements either side of a mean position a positive or negative sign will be included to indicate polarity.

Readout systems designed for data logging provide digitized output signals for connection to various recording devices. This output may need modification before it can be used by recording devices because the output signals representing each digit occur simultaneously, while devices such as typewriters can only accept the signals serially. As an analogy, all the words on this page are in parallel form – they are all there at any one time – but are read serially.

Other converters may be used to change the output format from the readout system into the various codes used by tape punches, card punches, magnetic recorders or computer inputs.

In many cases driver stages will be required, to amplify the signals to the higher level required by the recording equipment.

When the transducers are widely separated, or are grouped a long way from the readout location, the transducer signals may be amplified or converted into digital form at source, before subsequent transmission by telephone or radio links.



This data logger from Natronics logs output and elapsed time from a dual column gas chromatograph and records the data on punched tape.

THE BUYING DECISION

Data logging is a complex technique, and nearly every installation requires individual design or selection of function modules.

It can optimize many manufacturing operations and frequently provides

data which is virtually unobtainable by any other method.

It is a technique where specialised knowledge and engineering back-up is essential, and prospective users should establish positively that this is locally available before making a purchasing decision.

OUTPUT RECORDS

PRINTED STRIP: The record is in the form of a tally roll on which each reading is contained in one line of print, as shown in the right. The first line is a record of time, followed by ten channels of data, each line being identified as follows:- channel identity (2 digits), DVM polarity and value, and DVM range indicator.

TYPED PAGE: The record is in the form of a tabulated page on which a number of readings are contained in one line of type, as shown below. The first line is a record of the time at which the readings were made. In the example illustrated, five readings are recorded per line, in which the sequence for each reading is:- channel identity (2 digits), 'space', DVM polarity and value, 'space' DVM range indicator, and two, 'spaces'. The final two 'space' characters change to 'carriage return' and 'line feed' functions in the fifth reading. This is function of the Control 3211 and can be preset to any suitable number of readings per line.

PUNCHED PAPER TAPE: The record is in the form of coded holes punched into a 1" wide strip of paper tape, as shown below, where for comparison the punched data is identical to that contained in the lower line of the typed record.

MAGNETIC TAPE: The record is in the form of coded magnetic pulses stored on 1/2" wide magnetic tape (not illustrated), in a similar manner to that of punched paper tape. Its main advantages over punched paper tape are that recording speed is higher, has a much greater packing density and it can be re-used.

```

0 0 0 1 4 0 4 2 6
0 0 + 0 1 5 6 3 2
0 1 + 0 2 3 4 1 2
0 2 + 0 2 4 3 6 2
0 3 - 1 3 4 2 5 3
0 4 - 2 4 3 5 1 2
0 5 + 3 4 2 3 3 3
0 6 + 2 4 6 4 5 2
0 7 - 2 4 1 8 8 1
0 8 - 2 4 3 1 1 1
0 9 + 4 3 5 5 5 3
  
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*140426

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00 +01563 2 01 +02341 2 02 +02436 2 03 -13425 3 04 -24351 2
05 +34233 3 06 +24645 2 07 -24188 1 08 -24311 1 09 +43555 3
  
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By EDGAR VILLCHUR
Acoustic Research Inc.

How much distortion does a hi-fi speaker produce? What causes it and what are the techniques for measuring it?

Test setup that was employed for qualitative display of speaker distortion.

Distortion in Loudspeakers

LOUDSPEAKERS are the weakest link in the chain of reproducing components.

Speakers are subject to many faults, including raggedness of frequency response, limited range, and hangover.

One of the worst speaker defects is harmonic distortion. Levels of distortion which would automatically disqualify any other component from a "high-fidelity" classification are commonly found in loudspeakers. Yet loudspeaker distortion is a subject about which very little is written. Distortion data on speakers, with one or two exceptions, is not published by their manufacturers.

There are several reasons for this. One is that the distortion percentages for speakers are so high. The technically oriented high-fidelity buyer who reads specification sheets is used to amplifier harmonic distortion figures of the order of small fractions of 1%. Discovery by an audiophile that his favourite speaker showed distortion percentages (over part of its frequency range) one hundred times

greater might leave him in a state of shock.

Another and more valid reason is that absolute percentages in speaker distortion do not have the same significance as in amplifiers. Speaker distortion is likely to occur at separate frequencies or frequency ranges and to show up only when there is music in the frequency range concerned. Amplifier distortion is usually less discriminating.

Further, the highest values of speaker distortion are almost always in the low bass, where the speaker's response to the fundamental may be very much attenuated.

A particular speaker may, for example, have 50% distortion at 30Hz at a given input level. If the total output in response to that frequency input is very low, then the distortion products that are contributed to the final sound will be attenuated in proportion.

Whatever the mitigating circumstances surrounding high values of speaker distortion, comparing a low

distortion speaker to one with high distortion leaves no doubt in the listener's mind as to the primary importance of this element to natural musical reproduction.

DISTORTION LEVELS IN SPEAKERS

It is not difficult to take a rough glimpse at the magnitudes of distortion associated with loudspeakers if one has an audio signal generator, a microphone, and an oscilloscope. A sweep test record may be substituted for the signal generator if a very good record playback system is available.

The combination of microphone output and scope sensitivity must be sufficient to provide a good-sized pattern on the 'scope screen; the higher the low-frequency output of the microphone and the greater the sensitivity of the 'scope the better. If the microphone-oscilloscope combination does not provide a trace of adequate size with a direct connection, a preamplifier will have to

Distortion in Loudspeakers

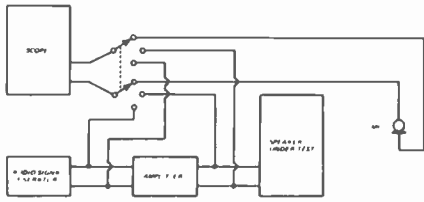
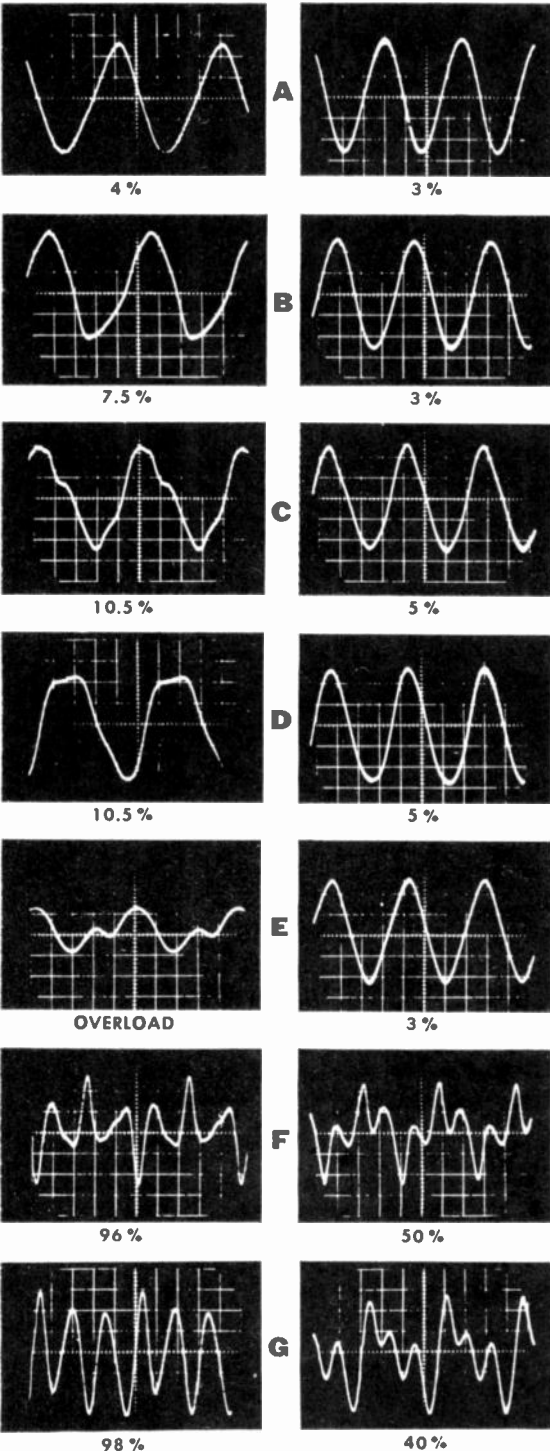


Fig. 1. Block diagram of test setup used.

30 CPS

40 CPS



be inserted between the two units.

Fig. 1 illustrates the connections required with test points for scope monitoring indicated. If we sweep the system between 30 and 60Hz, at a sound level corresponding to loud but not overpowering volume, we should see perfect sine waves on the screen when the scope is connected across the output of the generator or of the amplifier.

When we connect the oscilloscope to the microphone, however, things may be expected to change radically. At best the screen pattern at the lower frequencies will, on careful examination, show imperfections; at worst it will look like the top of a broken beer bottle.

The above test was applied to a group of speakers in current production. Each speaker was driven to the same peak-to-peak level of total sound at 30 and 40Hz input. A photograph of the oscilloscope trace of microphone output was taken with a Polaroid 'scope camera.

Electrical input power to the speakers required to produce the reference sound level varied from two to 20 watts, depending on speaker efficiency and on frequency.

Fig. 2 shows oscilloscope traces representing the acoustical output waveforms of seven speakers in the \$85 to \$250 (U.S.) price range. The wide variation in distortion characteristics is obvious.

The sine-wave distortion in these photos is not a mere technical failing, but is a major factor in the quality of speaker reproduction, particularly in those cases where speaker response to low-frequency input contained harmonic output of appreciable amplitude relative to mid-band response. One strange effect of the distortion is to make the bass appear louder and crisper, albeit wooden and nasal.

Comparison with undistorted reproduction (or with the original instruments) will, of course, reveal the essentially unnatural quality of this distorted bass.

This measuring technique is not a rigorous one, but it is sufficiently accurate to demonstrate the orders of magnitude of speaker bass harmonic distortion, particularly when different

Fig. 2. These oscillograms show acoustical outputs of seven \$85 - \$250 (US) speakers driven at the same level. The number below each oscillogram is the % rms ratio of harmonics to the total signal. Note that speaker G has almost pure 90Hz output despite 30Hz input! (Harmonic distortion is sometimes expressed as % of harmonics to fundamental only, this method would increase values of F and G quite considerably.)

Fig. 3. Only half of the voice-coil turns remain in the magnetic field of the gap.

speakers are substituted in turn in the test setup.

The results shown in Fig. 2 are consistent with what little published material can be found on the subject.

An MS.c thesis ("The Effect of Negative Source Resistance on Loudspeaker Performance" by George D. Ramig) reported on a series of studies on fifteen loudspeakers, which included measurements of bass harmonic distortion. Covering the frequency range down to 50Hz and keeping the sound level the same for each speaker, the measured distortion at the lowest frequency varied from 2% for the most distortion-free speaker to 43% for the one with the highest distortion. Input power ranged up to 20 watts, depending on speaker efficiency.

It may be assumed that these distortion figures would have been doubled at 30Hz.

Distortion in the mid-range and treble is lower in percentage and requires more careful measuring techniques, although its effects are just as raucous from the point of view of quality. It is not as liable to appear in the form of easily identifiable waveform aberrations on an oscilloscope screen.

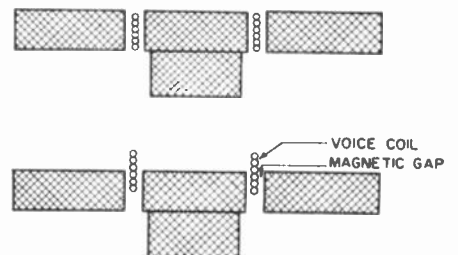
CAUSES OF SPEAKER DISTORTION

Speaker distortion at bass frequencies has two main causes, both of them related to large voice-coil excursions.

These two causes are the non-linearity of cone suspensions (spider and rim suspension) and the non-uniformity of the magnetic field over the path of voice-coil travel. At higher frequencies mechanical resonances of different parts of the speaker's mechanical system become the more significant factors.

The non-linearity exhibited by speaker mechanical suspensions is a characteristic possessed in some degree by all elastic materials. As the suspensions are stretched by the impelling force of the moving voice-coil their elastic stiffness increases, that is, they begin to "bind." Beyond a certain point they could not yield at all without tearing.

This means that the cone will travel



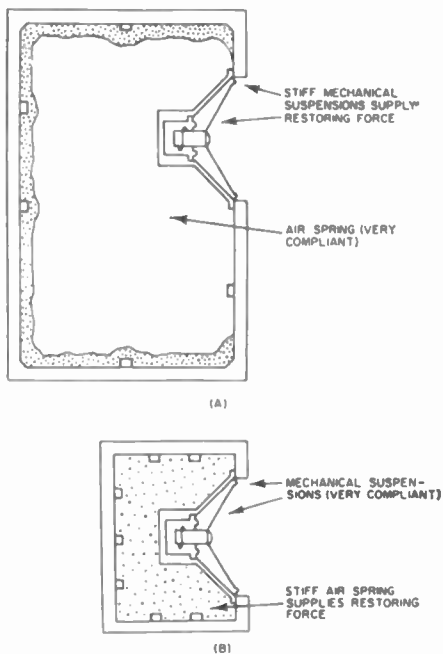


Fig. 4. Substitution of an air-spring for mechanical-suspension stiffness in the acoustic-suspension system, shown in (B), to reduce speaker distortion.

less towards the ends of its excursion — the peaks and troughs of the waveform — than the input signal dictates. Increased mechanical impedance in the face of a given applied force results in decreased mechanical response.

The process is similar to clipping in amplifiers. Since the same sort of thing takes place at each side of the excursion the distorted waveform tends to be symmetrical, which predicts odd-harmonic distortion. The most prominent harmonic component in speaker distortion is usually the third, and so the common reference to speaker bass distortion as "doubling" is not an apt expression. "Tripling" would be more accurate in most cases.

The second cause of distortion on large excursions — non-uniformity of the magnetic field over the voice-coil path — also operates to distort the signal peaks symmetrically. When the voice-coil shown in Fig. 3 has moved forward, only half of its turns are immersed in the magnetic field of the gap (actually, fringing of the field alleviates the situation somewhat). The force on the voice-coil is considerably weakened, even though the signal itself has not called for any slackening of this force.

Again cone travel is reduced at the extreme positions, and again third-harmonic distortion tends to predominate.

It will be noted that some of the wave-forms in Fig. 2 are asymmetrical, indicating even — rather than odd-harmonic distortion. This means

either that the mechanical suspensions begin to stiffen for one direction of cone travel before they do for the other, or that the voice-coil is not centered longitudinally in the magnetic field.

DESIGNING AGAINST DISTORTION

There are two general approaches to reducing speaker distortion in the bass range. One is to employ design which reduces the cone excursion required for a given bass output, and the second is to create a speaker capable of making the necessary large excursions in a linear manner.

The first and older of these two methods employs an acoustical coupling device — either a horn or an acoustical resonator — between the speaker diaphragm and the air of the room. The efficiency of coupling between the cone and the room is thereby improved; a given level of bass energy can be radiated with smaller cone movements.

Cone suspensions are not stretched as much and the voice-coil is not driven so far out of the gap, so that distortion is reduced, sometimes drastically.

A variation of this theme is the use of many large speakers for increased cone area, also for the purpose of increasing speaker-to-room coupling.

Unfortunately, a horn ceases to load its driver below the bass cut-off frequency, a point inversely related to the horn rate of flare. The area of the horn mouths must also be very large to avoid resonances and horn coloration. The solution to both of these

problems involves large physical size for the horn structure.

Acoustical resonators of different types have been used, but by far the best known is the bass-reflex design employing a classical Helmholtz resonator (as opposed to the air column or organ pipe type of acoustical resonator). A detailed discussion of the operation of the bass reflex cabinet is not appropriate here, but it is sufficient to say that in a properly tuned and damped bass-reflex system small motions of the cone in the bass range produce large in-phase motions of the mass of air in the port. A given cone excursion is therefore associated with increased bass energy radiated from the system. As in the case of the horn, coupling efficiency between cone and room is increased.

The main problems associated with bass-reflex design are those that are to be expected when anti-resonance is used as a design element. Resonant elements must be carefully tamed and controlled. Speaker and enclosure must be accurately matched, or the increase in coupling will occur at particular bass frequencies rather than evenly over the bass range.

The second general approach referred to — designing a direct-radiator speaker which does not use a coupling aid to reduce excursion requirements, but is capable of executing the necessary large excursions with linearity — requires attention to the suspension system itself.

Various configurations of suspension devices have been used to allow large

Continued on page 122

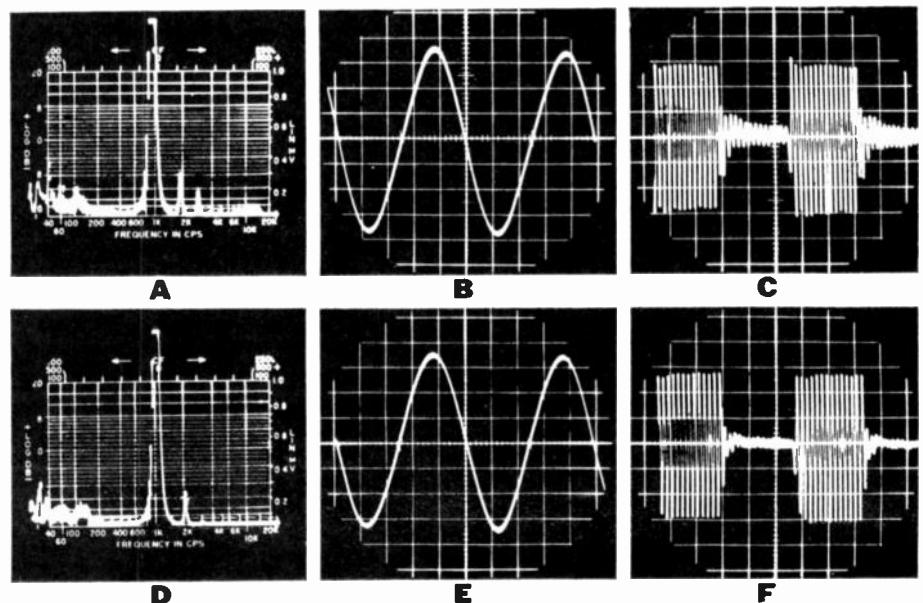
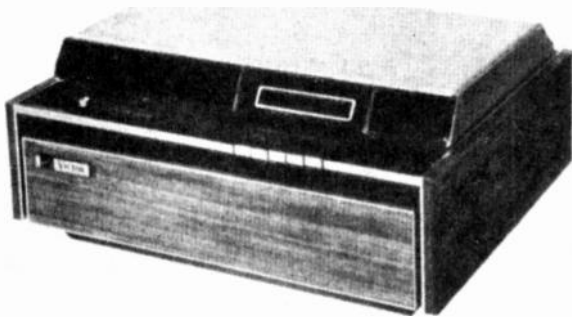
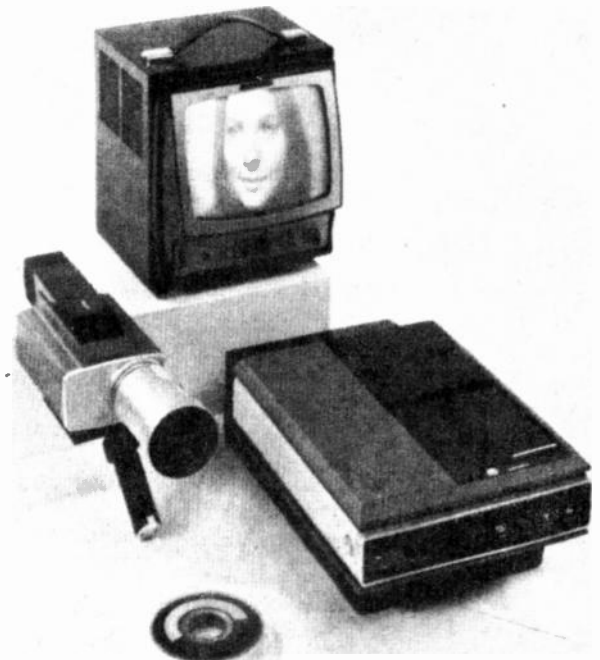


Fig. 5. (A) Display of treble distortion of rejected tweeter. The large blip at 1000Hz is the fundamental; smaller blips to the right show each harmonic of the distortion content. Hash on the left is noise. (B) Sine-wave scope trace does not reveal the distortion, but a 10.6kHz tone burst (C) shows a little overshoot as well as some ringing between bursts. Parts (D), and (F) shows the same series of scope displays but for an acceptable tweeter of the same type.

BATTLE OF THE



Both the JVC system (above) and the Ampex system (right) use magnetic tape as the recording medium.



Most top manufacturers have video-player systems ready for marketing — but full-scale production must wait until compatibility has been achieved.

SEVENTEEN major companies with little to sell are fighting for a share in the projected billion-dollar video-player market.

Each company has a different idea of what a video-player should be.

Each agrees that compatibility is essential — providing, of course, that theirs is the method used. And agreement there must be — otherwise the situation will be like having seventeen different types of gramophone records, each requiring a player that would be unusable with any other record. By comparison, the Australian railway would seem a model of planning agreement.

The video-player is — in general terms — a telephone-directory sized machine which, when connected to any standard television set, will reproduce recorded television programmes.

Although — as reported in our April issue — at least one consortium is developing a TV gramophone record, most contenders are promoting cassette or cartridge systems; but even here there is no agreement as to what the cassettes or cartridges should contain.

Some, such as Ampex, Avco, JVC, Sony and Philips, use magnetic tape, but RCA uses holographic images impressed on vinyl ribbon. Sylvania and Vidicord use Super 8mm. film, whilst EVR uses video signals impressed on continuous black-and-white film by an electron beam.

No magnetic system appears totally compatible between players made by different companies — nor, incredibly enough, between different models made by the same manufacturer.

With at least seventeen contenders, there are obviously going to be quite a few losers — and no customer wants to be left with a stack of cassettes and nothing to play them on.

The marketing battle is predicated on the assumption that the video-player will become at least as popular as the record-player; but this must surely depend on the type of recorded material that will be available. As most mass-media programmes are barely distinguishable one from another, there seems little point in just having more of the same on tape.

Nevertheless, a very substantial market must exist among TV viewers with special interests that are not served by current transmissions.

Such interests could be satisfied either by renting or selling pre-recorded cassettes, or by the television stations transmitting specialised programmes for automatic video recording during the early hours of the morning.

Another large market is for educational material. School children could be provided with cassettes for out-of-school instruction, and it would be an excellent medium for technical training — especially for demonstration of scientific medical experiments.

In Britain, publishers including Penguin Books, Oxford University Press, W. H. Smith, etc., have started or are actively establishing companies to finance, market and distribute video-tape material.

Our London office tells us that at least one publisher is currently preparing material for the video equivalent of weekly 'part-works' publications (such as 'Man, Myth and Magic' or 'Australian Heritage').

Another company has actually produced an engineering training course and now awaits production of the means to record it.

WHAT ARE THE SYSTEMS?

There are three main video-player systems which can be

VIDEO-PLAYERS



Here an EVR cartridge is loaded into the player. This is the only system in current small scale production.

Technically the most sophisticated of the new systems — RCA's SelectaVision employs laser scanning of a holographic image on vinyl ribbon.



taken seriously.

The first and most advanced of these is the EVR (Electronic Video Recording) system, devised by a partnership of CBS, ICI and CIBA and made under licence by Motorola (U.S.A.) and Rank (U.K.).

The EVR system uses a specially treated 9mm. monochrome film upon which the video signal is impressed by an electron beam. The twin-track film is scanned optically as it slides through the readout area. Sound is encoded on magnetic strips on both outer edges of the film.

When used for monochrome reproduction, the seven-inch diameter cassette operates for 25 minutes on each of the two tracks. For colour reproduction the chromatic data is encoded on the second track; stereo sound can accompany the colour reproduction by utilising both magnetic recording strips.

The manufacturers claim that EVR copies are cheap to produce, even in small batches, and quote figures of \$18 for 25 minutes of colour (for quantities of 2000). They add that this cost will be reduced when a new emulsion replaces their present haloid system.

One great advantage of the EVR technique is that the player can be stopped at any time (without damaging the film), leaving single frames projected on the screen. This, of course, is a valuable feature for educational films, video magazines, books, etc. Needless to say, the entire 'Encyclopedia Britannica' can be recorded on one seven-inch reel, if so desired.

On the debit side, EVR cassettes can only be bought in pre-recorded form; it is not feasible to produce one's own material using a camera, or recording from television. The signal-noise ratio of the film is also seriously degraded by surface dirt.

Cost of EVR players is currently quoted as \$795 in the

U.S.A. and 361 pounds sterling in the U.K. (where deliveries have not yet started). It is believed that these prices will be halved in the near future.

Other systems using film have been developed by Sylvania in the U.S. and Vidicord in Britain. Both systems use standard Super 8 home movie film cassettes. Little is known about the Sylvania method except that it uses colour material, but it is believed that the company has no immediate marketing plans.

The British Vidicord method uses an electronic scanning technique, but the method does not reproduce colour.

Major feature of this film method is that the films can be home-produced using normal movie cameras, and many prospective users will own, or have access to, a library of existing Super 8 cassettes.

The most serious disadvantage is that the cost of colour Super 8 cassettes would preclude the widespread sale of prerecorded material. The Vidicord unit is quoted at 300 pounds sterling in the U.K. — if you could buy one.

MAGNETIC RECORDING

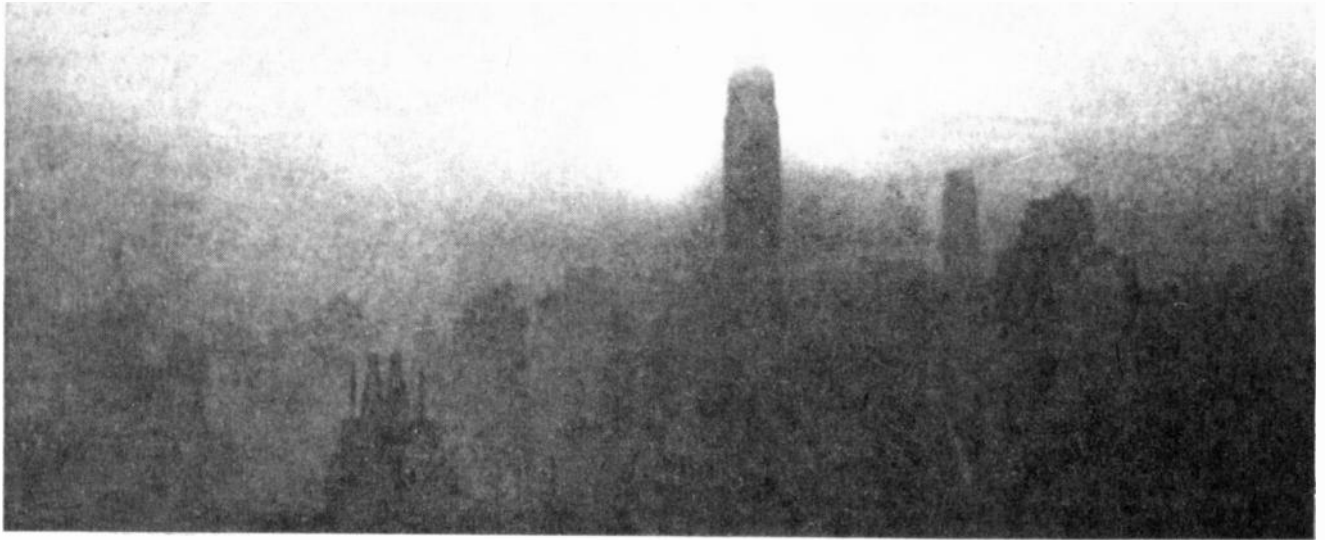
The second main grouping of video-player types is that utilising magnetic recording — and it is in this field that one would reasonably have expected compatibility of method.

Not so!

Companies in the field are Ampex, Avco, Hitachi, Grundig, JVC, Matsushita, Philips, Sanyo, Sony, Telefunken and Toshiba, and at present not one of their systems is compatible with any other. However, there is a trend to follow either the European design of Philips or the Japanese one, developed by Sony.

Sony, Matsushita and JVC have said that they will standardize colour video-tape cassettes and players, and

(Continued on page 118)



A sunny day in New York City.

Electronic Exhaust Analysis helps to control pollution

Air pollution has been with us ever since men began to live in communities — but it didn't become a serious danger until petroleum fuels came into use. This article explains why — and how electronic gas analysis is helping to reduce the problem.

BACK in 1306 England's King Edward I issued a proclamation about air pollution — and in 1542 the Spanish explorer Juan Rodrigues Cabrillo, upon seeing the Los Angeles basin, named it the Bay of Smoke.

Old though the problem is, there's a lot of difference between smoke from Indian camp fires, or London's chimneys, and the contaminants from internal-combustion automobile engines.

That difference is photo-chemical smog, first identified by Dr. A. J. Haagen-Smit as recently as 1950.

Haagen-Smit's discovery pinpointed the motor-car engine as the major contributor of smog in city areas.

What he found was that there is a photo-chemical reaction when unburnt hydrocarbons and nitrogen oxides (emitted by internal-combustion engines) are exposed to sunlight.

The resultant photo-chemically produced smog is not only irritating and harmful to humans — it can also seriously affect animals and crops in agricultural areas. It also results in less obvious but substantial losses due to deterioration of paint, metal, stonework, rubber, nylon and other textiles — and to the reduction in sunlight which in some areas of the U.S.A. now exceeds 40 percent.

Carbon monoxide, whilst not contributing to photo-chemical smog, also contributes to air pollution.

WHAT'S IN EXHAUST GASES

Figure 1 graphically illustrates the relationship between air-fuel ratio and the constituents of exhaust gas. Note that the broad top of the curve representing carbon dioxide occurs at an air-fuel ratio of 14.8:1, and that hydrogen and carbon monoxide drop nearly to zero. Hydrocarbon content decreases as air-fuel ratio is weakened.

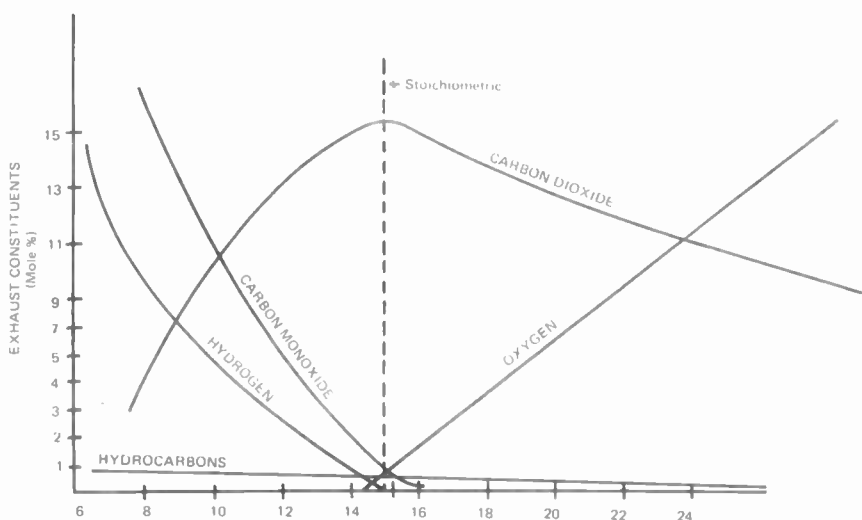


FIG 1. Graph shows how exhaust gas constituents vary with changing air/fuel ratio. (Mole % Volume is molecular weight divided by specific gravity.)

In engines which have not been modified to reduce emission, carburation is usually set to provide an air-fuel ratio between 12:1 and 13:1 during idling, 12:1 during acceleration, and 15:1 for high-speed cruising. The critical nature of air-fuel ratio in reducing emissions is obvious.

As a result of government pressures, automobile manufacturers are currently modifying engines to reduce the quantity of contaminants emitted.

One method of achieving this is extremely accurate control of carburation — especially during idling, when pollution is highest. The engine cooling system will also be modified, ensuring that the engine operates at temperatures exceeding 195°F to obtain complete mixture combustion.

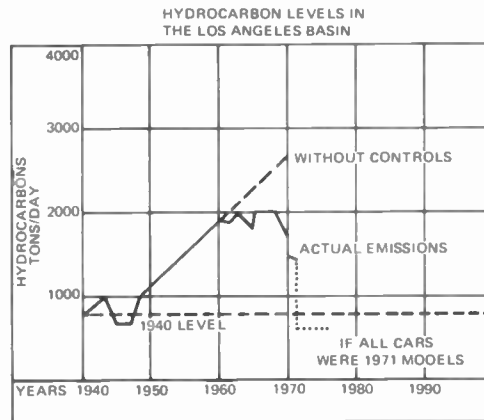
Another method of reducing contaminants is to inject air at low pressure into the exhaust ports, close to the exhaust valves. This extra air further oxidises any remaining unburnt fuel which may otherwise escape into the exhaust system.

Crankcase emission, previously vented to atmosphere via the crankcase breather, will be controlled by positive crankcase ventilation, in which manifold vacuum creates a flow of unburnt gases from the crankcase back to the inlet manifold.

No less than 10 to 15% of all hydrocarbon emissions from vehicles

Malfunction	Emission Increase	
	Hydrocarbon PPM	Carbon monoxide %
1 cylinder — occasional miss	420	—
1 cylinder — continuous miss	2000	—
Rich idle mixture	—	1.0%
Low idle speed (50 RPM below spec.) ..	45	—
Advance timing (5° beyond spec.)	60	—
Faulty positive crankcase ventilation ...	43	1.0%
Choke set rich (2 notches)	20	.60
Heat riser valve stuck open	35	.18
Air injection system inoperative	520	3.25

FIG 2. How engine malfunctions affect pollution.



GRAPH of hydrocarbon levels in the Los Angeles basin, showing effectiveness of anti-pollution devices fitted to latest cars.

are from the carburettor float bowls and fuel tanks which previously vented to atmosphere. These are now vented to the engine inlet manifold.

These modifications reduce exhaust contaminants to a level below the current U.S. legal limits (275 parts per million hydrocarbons and 1½% carbon monoxide), providing the engine is in correct working order. Fig. 2 shows the increase in exhaust contaminants for various engine malfunctions.

HOW GAS ANALYSERS WORK

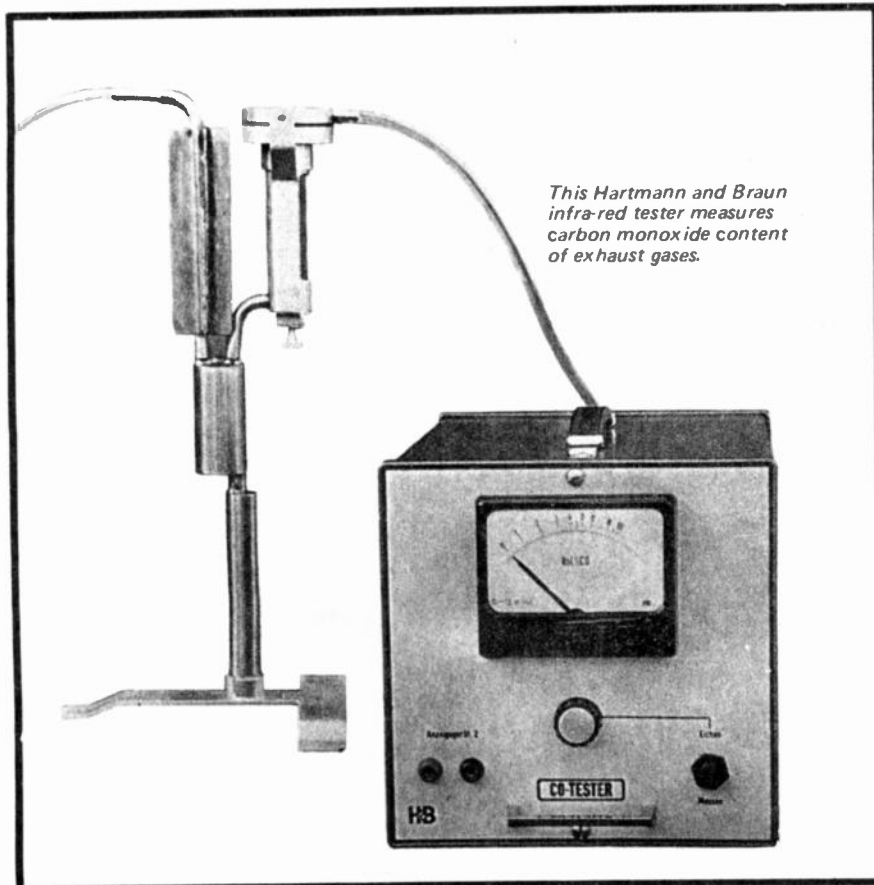
Legislation to limit exhaust contaminants is ineffective unless the various components of the gas can be isolated and measured — by motor mechanics working in the field.

Exhaust gas analysers capable of measuring the hydrocarbon and carbon monoxide content do not use the same operating principle as the thermal conductivity instruments currently used by the garage industry.

Thermal conductivity instruments measure the ability of the exhaust gas to transfer heat from a pre-heated platinum wire. Exhaust gas produced from an air-fuel ratio of 13.3:1 has the same thermal conductivity as air and thus has the same cooling effect. A mixture leaner than 13.3:1 will have a thermal conductivity *lower* than air and the platinum wire will become warmer than if it were cooled by air, whilst a mixture richer than 13.3:1 will have a thermal conductivity *higher* than air and the platinum wire will become cooler.

The relative cooling effect of the gas on the heated platinum wire causes a change in the temperature of the wire and hence a change in its resistance.

It has been proved that measurement of thermal conductivity of a gas sample correlates very closely with a chemical analysis of the same sample — but it will only do this for mixture strengths below 14.8:1 because as the air/fuel ratio increases beyond this ratio, the carbon dioxide content of the exhaust gas diminishes due to an increase in oxygen. This causes an increase in thermal conductivity and



This Hartmann and Braun infra-red tester measures carbon monoxide content of exhaust gases.

Electronic Exhaust Analysis helps to control pollution

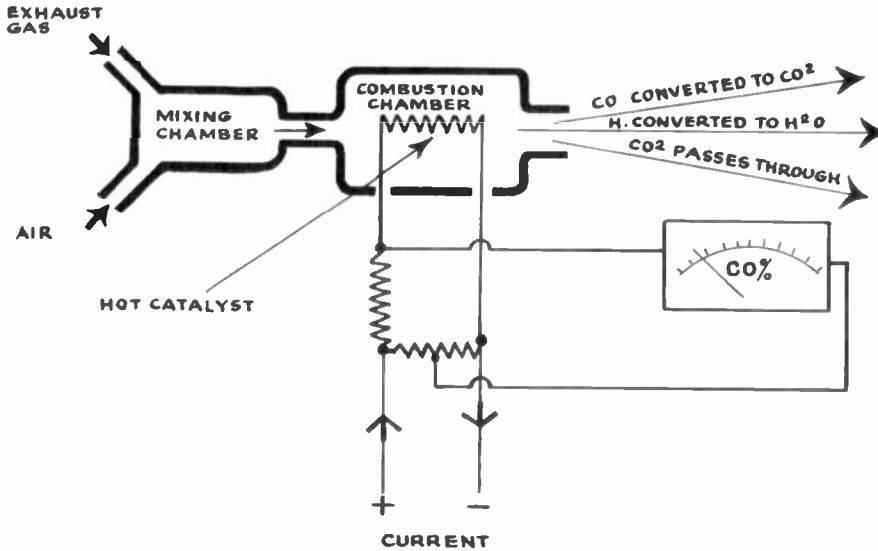


FIG 3. Schematic diagram of catalytic carbon monoxide tester.

the meter starts coming back the other way.

This effect makes the instrument valueless for pollution measurement — for, as Fig. 1 shows, it is the region around and above 14.8:1 that is so critical. This limitation applies to all gas analysers of the thermal conductivity type, irrespective of make.

The leading contenders in the new types of gas analysers are the Catalytic CO Tester and the Infra-red Tester.

The catalytic tester, because of its relatively low cost and reasonable accuracy, is a popular instrument for the measurement of carbon monoxide (Fig. 3).

In operation, a measured amount of pure air and exhaust gas is pumped into a combustion chamber, where it is heated to a high temperature by means of a heated platinum wire. This burns the carbon monoxide, converting it to carbon dioxide. The hydrogen is converted to water vapour. The resulting temperature change in the hot platinum wire is proportional to the amount of carbon monoxide in the gas.

This type of instrument measures the carbon monoxide and hydrogen content of the gas. The meter is calibrated in percentage of carbon monoxide. It is unable to measure the carbon dioxide content and is unsuitable for tuning purposes, other than to measure the carbon monoxide content at idle speed to meet legislative requirements.

The infra-red gas analysers exploit the principle of energy absorption at specific frequencies. The meter

readings of carbon monoxide and hydrocarbons result from the amount of infra-red energy which these gases (and *only* these gases) absorb or 'block off' as they pass through a beam of infra-red light. Since the amount of energy absorbed at a particular wavelength is an indication of the number of molecules present, the

infra-red instrument provides both quantitative and qualitative measurements.

One form of infra-red gas analyser is shown in Fig. 4. In this instrument an exhaust gas sample picked up from the vehicle's tailpipe is drawn into the test probe by a positive displacement pump. The sample then passes through a condenser, water trap and particulate filter. From the filter the sample passes through the three-way valve and the exhaust flow indicator, on its way to the infra-red units and their detection devices.

The sample now passes through the hydrocarbon infra-red unit, where the hydrocarbon is detected. Due to the non-dispersive characteristics of the analyser, the same sample is passed on into the carbon monoxide infra-red unit, where the carbon monoxide content is detected.

The output signals of both the carbon monoxide and the hydrocarbon detectors are fed to their respective meters by solid-state amplifiers.

In a simpler form, the infra-red unit is also manufactured to detect carbon monoxide only.

Both types of instrument are in common use around the world and are currently being evaluated in Australia.

All we need now is some legislation — after all, it's been a long time since 1306!

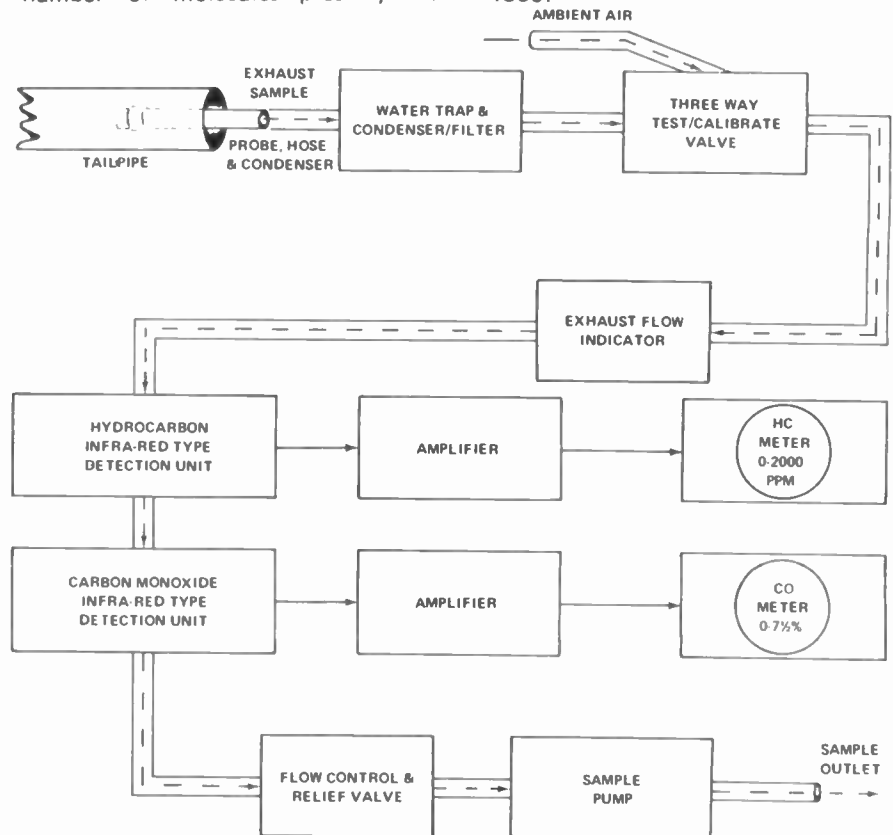


FIG 4. Schematic drawing shows operating principle of Infra-Red hydro-carbon and carbon monoxide tester.

Load-sensing full-wave speed control

This unusual Triac circuit provides feedback control of ac/dc commutator motors. Because such devices are subject to Electricity Authority control, the article is intended primarily for equipment manufacturers and full constructional details are not given.

MANY motor-driven devices require speed to be varied over a wide range. Providing the load is constant, a control circuit similar to that used for domestic light dimmers will suffice.

However, there are a number of applications such as small machine tools, potter's wheels, etc., in which the load is constantly varying — and for this type of use it is desirable to have some form of load-sensing circuit which will maintain speed at any required level despite changes in load.

There are a number of existing circuits which achieve this; but the majority of these are half-wave devices and, because of this, cannot provide controlled speed over the motor's full range.

The circuit shown in Fig. 1 provides motor speed control with full load-sensing feedback. It can be used to control any ac/dc commutator motor over a speed range of at least three to one. As the load-sensing signal is obtained by monitoring the motor current, no modifications need to be made to the motor.

When the Triac is conducting, the voltage applied to the motor is the full line voltage, less the voltage drops across the load sensing resistor R5 and the Triac itself.

Voltage for the phase control circuit is provided by the full-wave diode bridge. It is clamped at 5.1 volts by zener diode D5.

OPERATING PRINCIPLE

Assume that the Triac is switched off. The timing capacitor C1 charges to the firing voltage of the unijunction at a rate determined by the setting of R3. When the firing voltage is reached,

C1 discharges through the unijunction and pulse transformer T1, triggering the Triac into conduction.

While the Triac is conducting, the voltage on the ac side of the bridge is reduced to the level determined by the voltage drop across the Triac and the load-sensing resistor. This drop is proportional to motor current and provides the necessary feedback signal.

The feedback voltage is rectified by the bridge and charges C1 to a level determined by the motor load. The larger the load on the motor, the greater the charge on C1 — and the higher the charge on C1, the shorter the time required for it to be finally charged to the unijunction firing voltage on the next half-cycle of operation.

Thus, as the motor is loaded and draws more current, the firing angle is correspondingly advanced, causing a proportionate increase in the rms voltage applied to the motor and hence an increase in its available torque.

Diode D6 and capacitor C2 maintain voltage across the unijunction during that period of each half-cycle during which the Triac is conducting.

The value of the load-sensing resistor (R5) depends upon the maximum rated load current of the motor. Approximate value can be calculated from the equation $R5 = \frac{2}{Im}$ where Im is the maximum rated motor current.

Motor rating Amps	R5 Ohms	Watts
2	1.0	5
3	0.67	10
6.5	0.32	15

TABLE 1. Nominal resistance values.

This value is fairly critical: too high a resistance will result in 'hunting', whilst too low resistance will cause a reduction in low speed torque.

Table 1 shows nominal resistance values calculated for three different motor sizes; but since the optimum value depends upon motor characteristics as well as size, it is preferable to use an adjustable wire-wound rheostat to establish this value.

We should warn potential builders that, in common with all other power controllers and switches, this unit will be subject to the Electricity Authority regulations for 'prescribed' devices if it is built as a control box located between line voltage and controlled appliance by flexible cable.

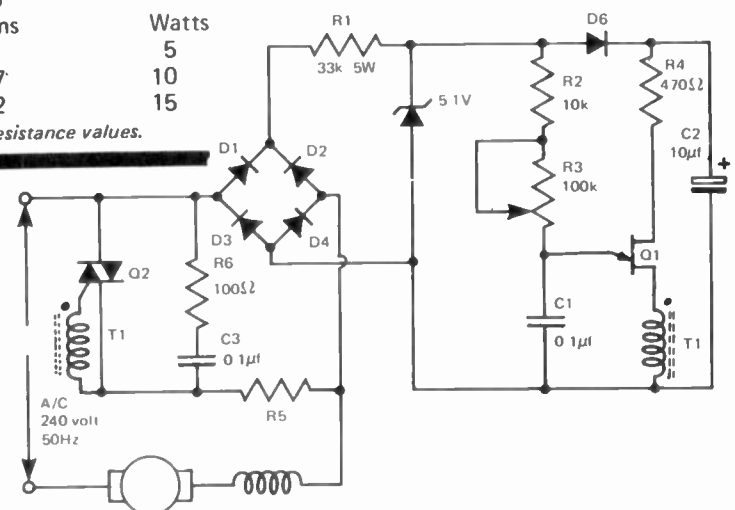
This in effect means that, if built in this form, the unit MUST meet Approval and Test Specifications C100 and C127 and must be tested and stamped by the Authority.

We will be publishing a statement from the Authority clarifying the situation, but in the meantime warn builders and kit parts suppliers that penalties for contravening the Act are severe.

It is, of course, perfectly legal to incorporate the circuit in an appliance.

Parts List

R1	33K 5 Watt
R2	10k ½ Watt
R3	100k ½ Watt linear pot
R4	470 ohms ½ Watt
R5	(see text)
C1	0.1µf
C2	10µf 10 Volt
C3	0.1µf 630 Volt
R6	100 ohms ½ Watt
D1-4	diode bridge
D5	zener diode 5.1 Volt
D6	diode EM 401 or similar
Q1	unijunction 2N2646
Q2	Triac (to suit load)
T1	pulse transformer 1:1 ratio



SPECIAL PROJECT

PRACTICAL GUIDE TO TRIACS

Part 2 - Phase control

TRIACS not only switch power on and off and thus replace mechanical contactors — they can also control the *amount* of power applied to a load.

There are two quite different ways of using Triacs for this purpose — 'phase control' and 'zero voltage switching'.

Phase control is the method used to control light dimmers, electric motors, and for voltage and current regulators.

Heating loads can also be controlled in this way — but, for reasons outlined later in this article, zero voltage switching is a better technique.

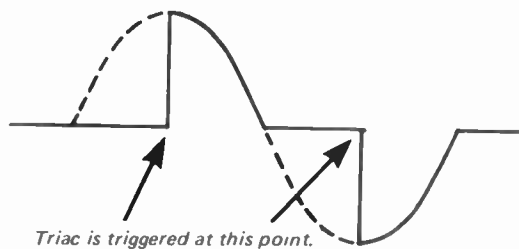
Last month we showed how Triacs are used as switches and the various ways they can be triggered. The second article of this three-part series describes how they are used to control the amount of power applied to electrical loads.

HOW PHASE CONTROL WORKS

A Triac can be triggered into conduction during any part of a half-cycle of applied voltage, and will *remain conducting* until the end of that half-cycle.

Thus, if a triggering signal is applied at the beginning of each half-cycle, the Triac will in effect conduct as if it were a switch that had been turned on. But if the triggering signal is applied halfway along the waveform, the Triac will conduct only for the remaining period of that half-cycle; and as the Triac conducts for only half the time, it reduces the power applied to the load by roughly the same amount (Fig. 16).

Thus the power input to the load can be set at any level simply by

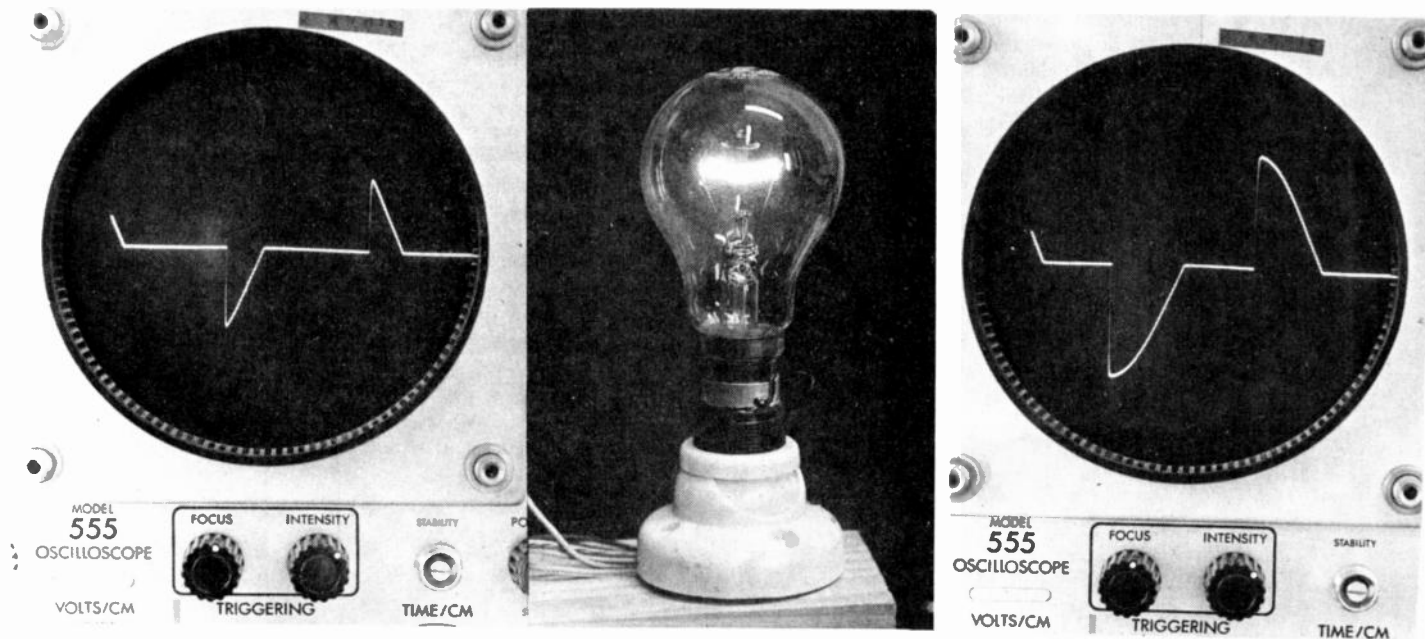


Triac is triggered at this point.

Fig. 16
Drawing shows Triac triggered at half-way point.

Fig. 17

Actual waveforms of a domestic light dimmer showing triggering at $\frac{1}{4}$, $\frac{1}{2}$ & $\frac{3}{4}$ points. Note corresponding changes in lamp brightness.



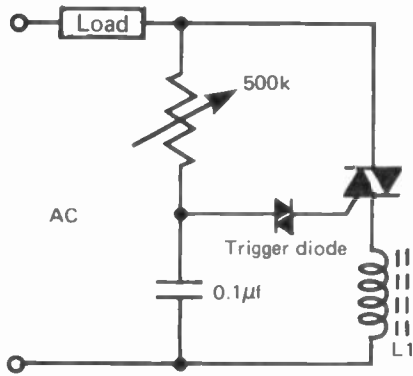


Fig. 18
Basic phase control circuit.

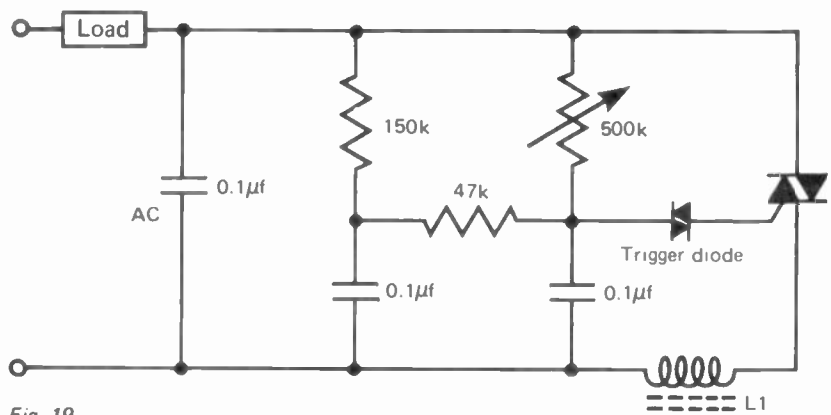


Fig. 19
Simple versatile phase control circuit is suitable for domestic light dimming and other resistive loads.

controlling the point at which the triggering signal is applied. Oscilloscope pictures (Figs. 17a, b, c) show the 50Hz waveform triggered at three different points. Notice the corresponding change in brilliance of the lamp used as a load.

LIGHT DIMMERS

The circuit of a commercially produced light dimmer is shown in Fig. 18.

During each half-cycle the 0.1 µf capacitor charges up (via the control potentiometer) until it reaches 30-32 volts. At this voltage the trigger diode conducts and the voltage across the capacitor 'gates' the Triac into conduction. (A neon lamp is

sometimes used instead of a trigger diode).

The time required for the 0.1µf capacitor to charge to the diode triggering voltage is determined by the resistance of the control potentiometer. When this is reduced to zero, the capacitor will charge to the trigger voltage instantaneously and the Triac will be gated into conduction for practically the complete half-cycle. At maximum potentiometer resistance the capacitor may not reach the diode triggering voltage until the end of the half-cycle, and the Triac will conduct for only a very short time.

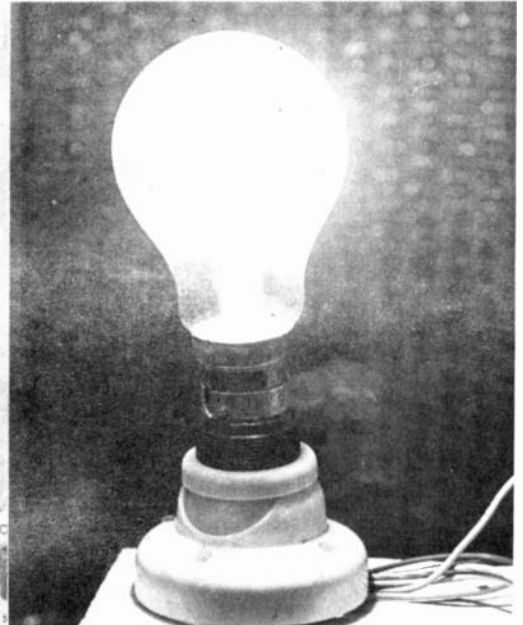
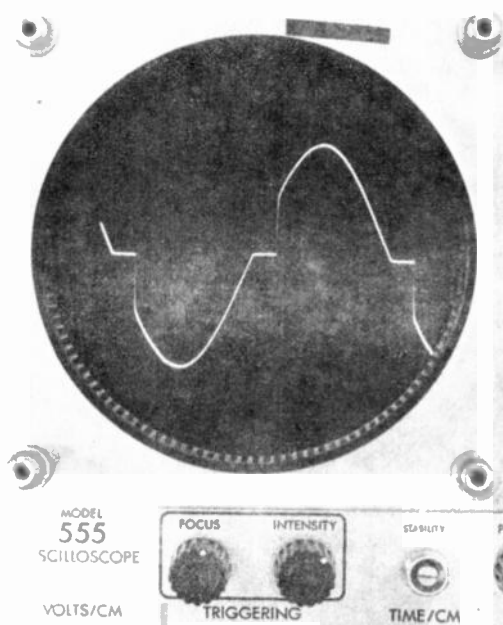
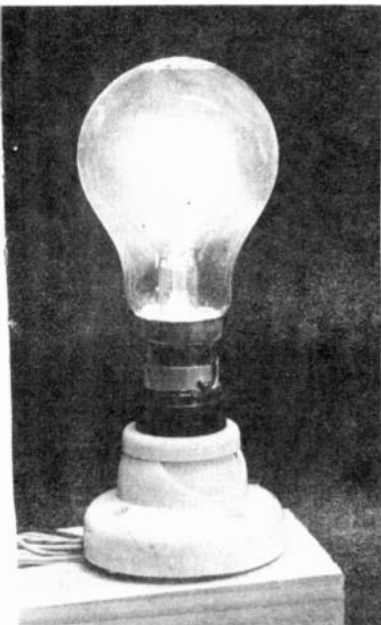
The circuit shown in Fig. 18 is very simple and cheap to make but has one major limitation — namely, that power cannot be controlled smoothly from

zero to maximum. As the potentiometer control is advanced, the load current will jump quite suddenly from zero to some intermediate value from which it can only then be controlled smoothly in either direction.

If the power supply is momentarily interrupted while the lights are dimmed below this 'jump' (hysteresis) level, the lights will remain off when power is subsequently restored.

REDUCING HYSTERESIS

The hysteresis effect is considerably reduced in the circuit shown in Fig. 19. This circuit is ideal for use as a domestic light dimmer. All components can be mounted behind a wall switch plate — and if the load



PRACTICAL GUIDE TO TRIACS

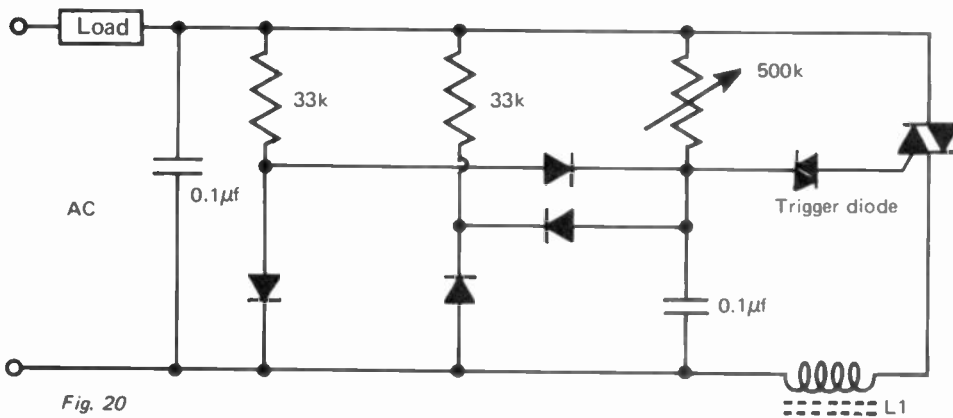


Fig. 20
Suitable for theatrical light dimming, this circuit has very low hysteresis.

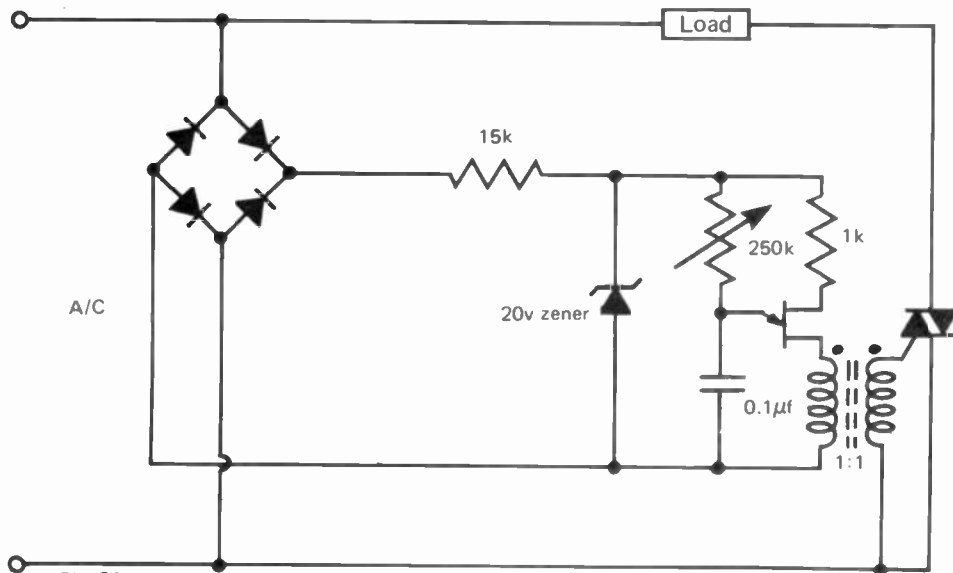


Fig. 21
Zener stabilised circuit maintains constant pre-set output despite changes in line voltage.

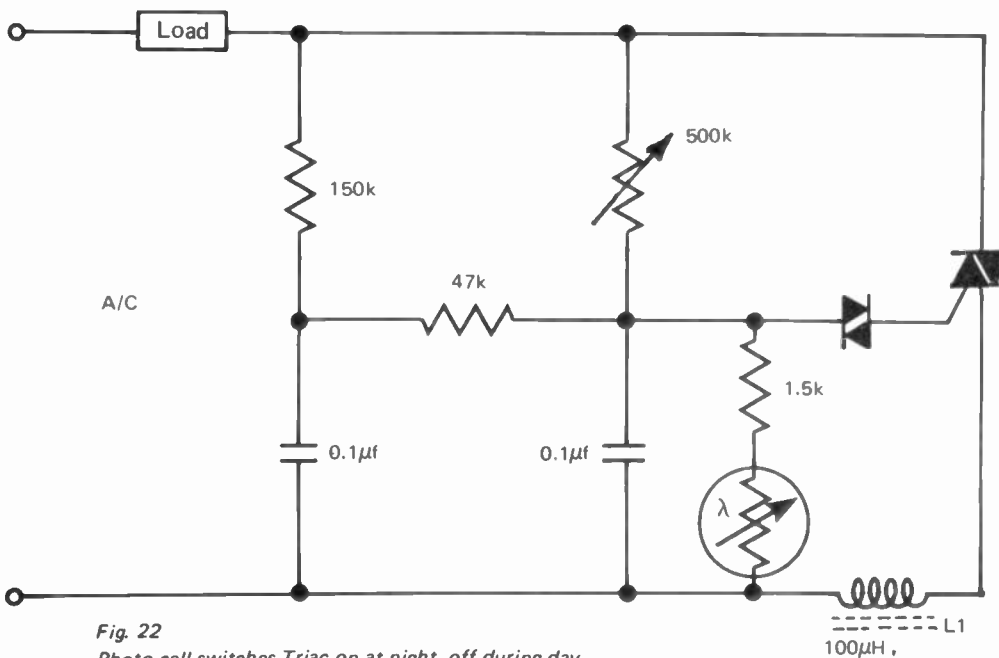


Fig. 22
Photo-cell switches Triac on at night, off during day.

does not exceed 200 watts, the Triac will not require a heat sink.

Almost total freedom from hysteresis is required for theatrical light dimmers. This can be achieved by using the circuit shown in Fig. 20.

WHAT SIZE TRIAC?

Incandescent lamps draw a very heavy current during the time taken for the filament to reach operating temperatures. This on-rush current may exceed the working current by 10 to 12 times. Fortunately domestic light bulbs reach working temperature within a cycle or two, and the short-term overload is absorbed by the Triac.

This does not apply to theatrical lighting equipment, where the larger wattage bulbs take longer to reach working temperature. For this type of use the Triac must be rated to carry at least five times the normal maximum load.

VOLTAGE FLUCTUATIONS

All the control circuits shown so far are voltage dependent — that is, the output voltage changes if the input voltage changes. This voltage dependence can be overcome by using a circuit in which a zener diode stabilizes the voltage across the timing capacitor (Fig. 21).

This arrangement will maintain practically constant output despite substantial changes in line voltage. It is frequently used in photographic and other applications where a constant light level is required.

FLUORESCENT LAMPS

With all the phase control circuits shown so far, incandescent filament lamps can be controlled with no further modifications to the house lighting system. Fluorescent lamps can also be dimmed by this type of control unit — and the technique will be fully described in a future issue of ELECTRONICS TODAY.

Quartz iodine and similar lamps using a regenerative halogen cycle should not be dimmed for any length of time. If the envelope temperature of the lamp drops below 250°C, the regenerating halogen cycle ceases. Tungsten from the filament will be deposited on the wall of the lamp, reducing filament life and decreasing the light transmission of the glass.

A modification which can be used with any of the circuits discussed so far is shown in Fig. 22. This arrangement turns lights on as darkness falls and turns them off again at daybreak. The photo cell must see ambient light and be shielded from the controlled light.

MOTOR SPEED CONTROL

Triac phase-control can be used to vary the speed of electric motors.

The universal type of series-wound motor may be controlled by circuits similar to those used for light dimming — except that, to ensure reliable commutation, a capacitor and series resistance must be connected in parallel across the Triac (Fig. 23). With this arrangement the speed of the motor will vary with changes in load and supply voltage, but for non-critical applications (such as fan speed control), where the load is constant at any given speed, the circuit may well be adequate.

Motor speed which, once pre-set, is maintained despite load changes is a useful characteristic for power tools, laboratory stirrers, watchmakers' lathes, potters' wheels, etc. To obtain this 'load sensing' characteristic, an SCR is commonly used in a half-wave configuration (Fig. 24). The circuit works quite well over a limited range of speed but is prone to low-speed 'cogging' and the half-wave operating principle precludes controlled operation much beyond half speed.

A load sensing phase-control circuit in which a Triac provides full zero to maximum control is shown in Fig. 25. This circuit is described in detail on page 33 of this issue.

INDUCTION MOTORS

Induction motors can also be Triac controlled — but some problems may be encountered, especially with split-phase or capacitor start motors.

In general, induction motors can be controlled between full and half speed, providing they are not run at full load. A reasonably reliable guide is motor operating temperature. This must not exceed the manufacturer's rating at any speed.

Once again, the modified light dimmer circuit shown in Fig. 23 can be used, but the load should be connected in the alternative position shown in dotted lines.

VARYING TRANSFORMER VOLTAGE

The circuit arrangement described above can also be used to vary the voltage in the primary winding of a transformer and thus obtain an adjustable secondary output.

This arrangement was used in a range of microscope lamp controllers designed by the writer some years ago. An adjustable zero-set was obtained by replacing the 47K resistor by a 100k potentiometer.

HEATING LOADS

Any of the Triac phase-control circuits shown so far can be used to control heating loads, although the

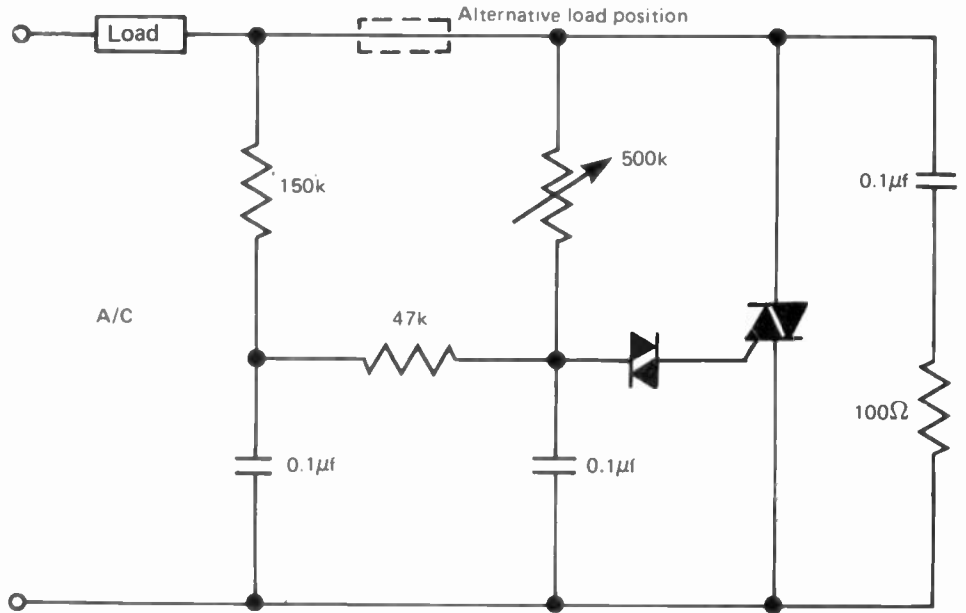


Fig. 23
Phase-control circuit for inductive loads, it may be necessary to connect the load in alternative position shown to obtain adequate control.

Fig. 24.
Half-wave SCR circuit provides feedback speed control.

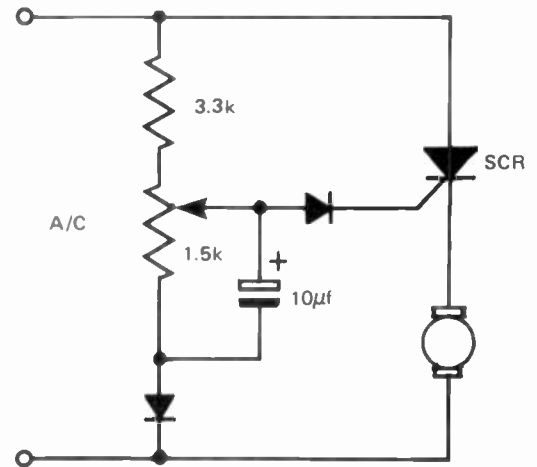
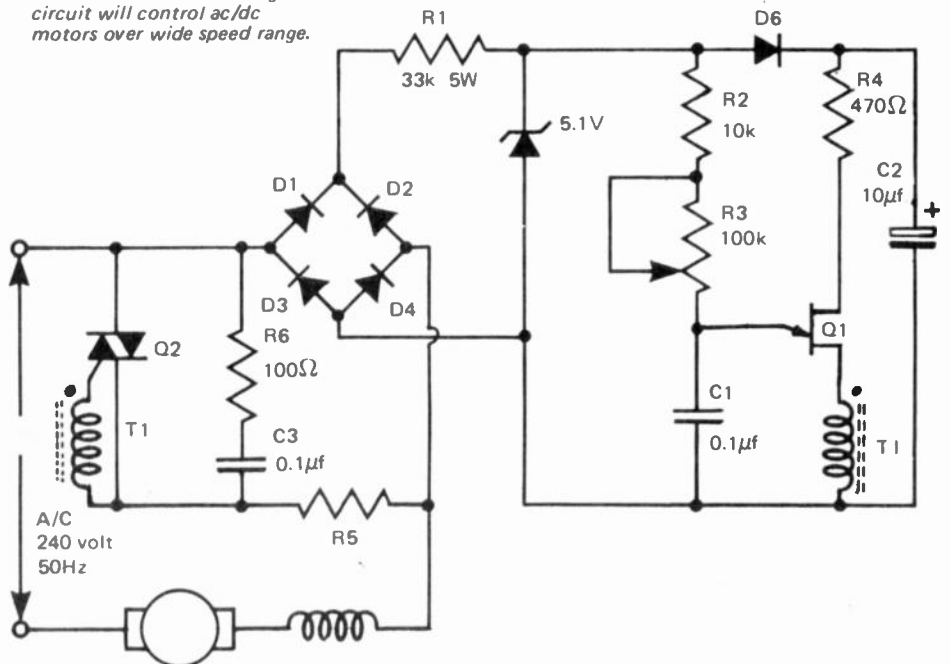


Fig. 25
This full-wave load sensing circuit will control ac/dc motors over wide speed range.



PRACTICAL GUIDE TO TRIACS

temperature of the controlled load will vary with changes in line voltage and ambient temperature.

A circuit which compensates for these changes is shown in Fig. 26. Theoretically this circuit can maintain temperature to within 1% of the set point despite line voltage changes of $\pm 10\%$. Actual performance depends upon the design and construction of the system in which the controller is used.

This circuit provides proportional control — that is, full power is applied to the heating elements while the load is warming up, until, at some intermediate state, the power is reduced by an amount proportional to the difference between the actual load temperature and the required load temperature. The proportional band is adjustable by a 'gain' control.

The circuit is simple yet effective, but it has one major failing which restricts its use to all but light loads. This is radio interference.

RADIO INTERFERENCE

All phase control systems generate large amounts of radio interference, primarily at low and medium frequencies. It seriously affects the long and medium wave reception of radio transmissions and will also be picked up by audio equipment, when it is heard as a raucous buzz. This rfi can also interfere with laboratory apparatus, especially pH meters, and has been known to cause erratic operation of digital computers and other equipment.

The radiated energy can be reduced by including an rf choke in series with the power line (shown as L1 in circuits accompanying this article). A suitable choke can be made by winding 40 to 50 turns of enamelled copper wire around a piece of ferrite aerial rod. This will provide an inductance of approx. $100 \mu\text{H}$. For greater suppression it will be necessary to increase the inductance to as much as

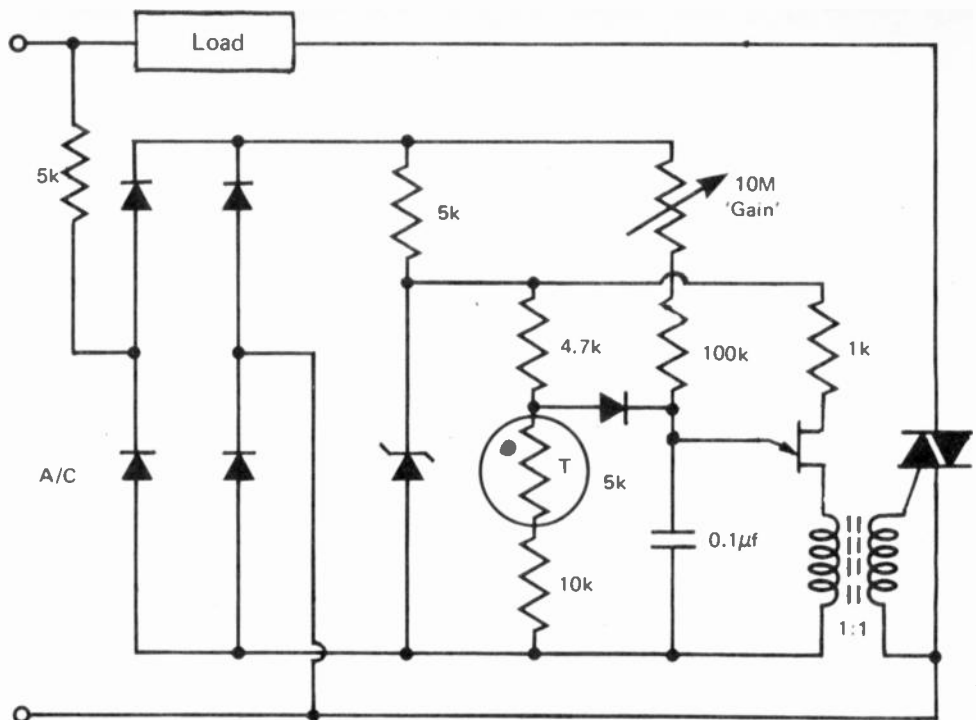


Fig. 26

This circuit provides proportional control of heating loads.

$5 \mu\text{H}$, and this necessitates a full-size choke.

The limitation of this type of circuit is that the rf choke has to carry the full load current, and once this exceeds a kilowatt or two, the physical size of the choke becomes excessive. The larger the load, the more difficult and expensive it becomes to filter out the rf components. (The problem is not as acute for inductive loads such as electric motors, where the load itself attenuates the rfi).

Phase control also introduces another problem — namely the load power factor. This is adversely affected and is something that power supply authorities regard with less than equanimity.

ZERO VOLTAGE SWITCHING

Virtually total freedom from rfi can be achieved by a Triac control system known as zero voltage switching.

This system differs from phase control in that line voltage is switched 'on' as well as 'off' only at the zero crossing points of the sinusoidal waveform. The power applied to the

load is controlled by varying the ratio of time that power is applied, to the time that power is switched off. For example, if only a small amount of power is required, the Triac is caused to pass just a few complete half-cycles, then remain switched off for a further 30 or 40 complete half-cycles before repeating the sequence (Fig. 27).

It will be apparent that the zero voltage switching system can only be used to control loads that have considerable inertia, such as heating elements which by their nature will average out the bursts of energy. Zero voltage switching cannot be used for controlling lighting or motor speed.

Load power factor is not affected in any way by zero voltage switching.

Until recently the drawback to zero voltage switching was that the technique required a large number of components.

Fortunately the functions necessary for zero voltage switching have been made available in an integrated circuit — and, by using this specialized ic, zero voltage switching circuits can be built that are outwardly no more complex than their phase control equivalents.

A full description of zero voltage switching techniques will form Part III of this article, to be published next month.

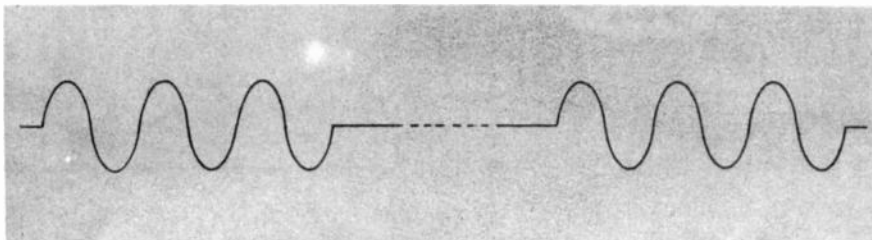
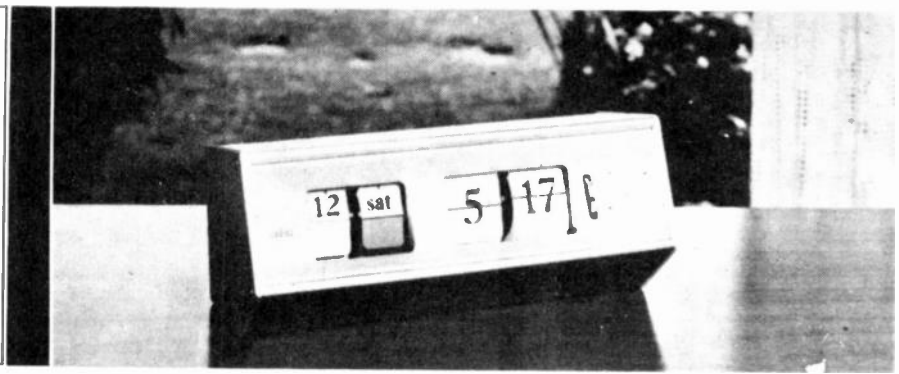


Fig. 27

Zero voltage switching waveform — power is controlled by varying the ratio of complete half-cycles 'on' to complete half-cycles 'off'.



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The cocktail party phenomenon

THE EFFECTS of attention are apparent to everyone. We cannot fully attend to all that takes place at any one time. When we concentrate fully on one conversation, others fade from consciousness: when our thoughts wander during a play, we find ourselves unable to recall the dialogue, although we were aware it was taking place.

Attention may be defined as the ability to concentrate on one source of information out of several potentially distracting sources of information.

The first complete theory of attention was that proposed by Donald Broadbent in 1958. He

suggested that the limit to the ability to understand competing messages is perceptual — only a limited amount of the information arriving at the sensory inputs can be analysed and identified.

"SELECTIVE FILTER" THEORY

Broadbent proposed that a 'selective filter' can be tuned to accept the desired message and 'reject' all others.

A flow diagram of his proposed system is shown in Fig. 1.

Information enters the system through a number of parallel sensory channels which feed their information to a short-term store — which, in turn, is followed by a selective filter.

The filter has the ability to select any one of the input channels and allow its information direct access to a limited capacity decision channel.

The handling capacity of this decision channel is very much smaller than the total capacity of the parallel input lines, and thus the action of the short-term memory store and the selective filter is to prevent overloading of the decision channel by acting as a parallel to serial processor.

Inputs to the decision channel are selected on the basis of their pitch, loudness and spatial position.

Lines which are not selected hold their messages in the short-term store for a few seconds, during which time the representation becomes progressively degraded, so that signals which are delayed before selection may be 'read' erroneously.

Signals from the decision channel can be returned to the short-term store (as when rehearsing) and there is access to and from a long-term store of learnt associations (long-term memory) at the output of the decision channel. There is also access to the motor response channel.

As the recognition of any incoming signal necessarily implies access to long-term memory, the limited capacity decision channel probably deals with the conscious perception of signals.

THEORY MODIFIED

In Broadbent's system attention is switched at an early stage on the basis of physical characteristics such as direction of sound, intensity and pitch — and this happens before any of the meaning has been extracted.

Unfortunately for Broadbent a couple of undergraduates named Gray and Wedderburn rejected the idea that attention was based on physical characteristics of sensory channels and suggested that psychological attributes played an important role in selection.

They proved their point by presenting a number of divided words alternately to either ear, finding that attention switched from ear to ear and that words were reconstructed

Scanners, selective filters and serializers are just a few of the terms used by behavioural scientists to describe their latest theories of attention.

This report by Jan Vernon indicates parallels which will be familiar to anyone involved with data logging or communications.

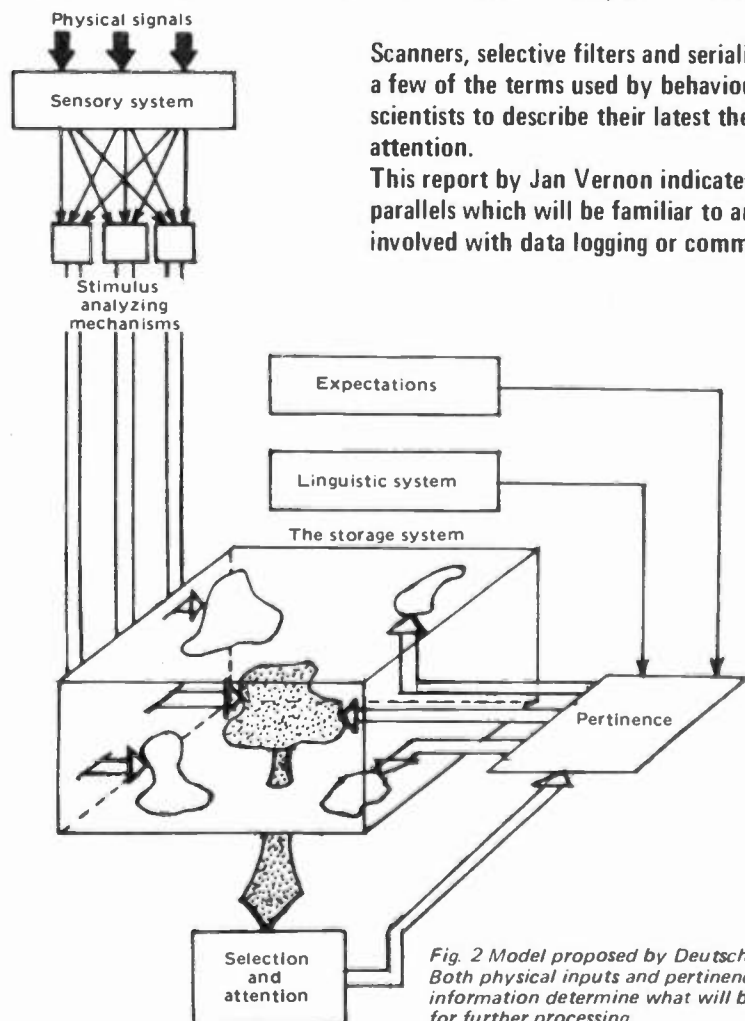


Fig. 2 Model proposed by Deutsch and Deutsch. Both physical inputs and pertinence of information determine what will be selected for further processing.

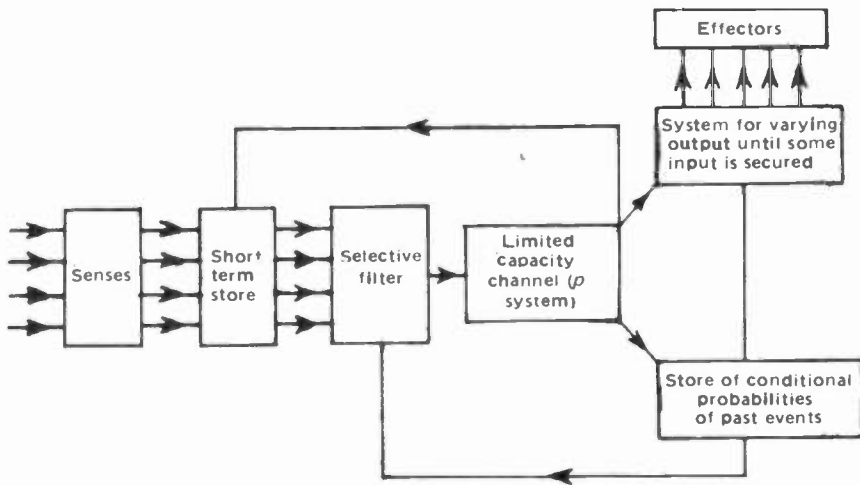


Fig. 1 Broadbent's selective filter model.

correctly. They concluded that the attention mechanism must be able to extract meaning.

These experiments caused Broadbent to modify his theory: he now holds that the channels which the filter may select are much more varied in kind than he originally envisaged and include such things as verbal classes and languages.

ANNE TREISMAN'S VERSION

A far more detailed filter theory was proposed by Anne Treisman in her doctoral thesis at Oxford University in 1961.

Anne Treisman had found that unattended signals are not blocked completely — that, despite a subject's intense concentration upon a task, he would frequently respond to his own name if it were included among otherwise unrecognised background material.

Her experiments showed that sensory cues alone are not sufficient for selection to take place.

In some respects her model for selective attention is similar to Broadbent's in that information flows into the organism through a number of parallel channels. Messages are then analysed for crude physical properties such as loudness, pitch, position, colour, brightness, etc. — and this information is available for reporting, regardless of what happens to the message beyond this point.

The mechanism can also act to attenuate the signal strength of the output of these analysers, and it is in this way that the filter works.

Thus the weakened messages, and the one unweakened message, pass deeper into the nervous system and eventually reach the pattern recogniser, which consists of a larger number of dictionary units.

Messages entering this unit traverse a logic tree with probabilistic nodes;

when they reach the end of the tree, a single dictionary unit 'fires' and the word is recognised by the observer.

This theory postulates selection during input by the attenuation of incoming rejected messages. Attenuation in this model is a two-stage process, since first there is filtering on the basis of channel characteristics, and then a second filtering, based on the threshold settings of the dictionary units.

DEUTSCH & DEUTSCH VERSION

In 1963 psychologists Anthony and Diana Deutsch criticised Anne Treisman's theory, as they felt that some aspects were redundant. They suggested that, by suitably altering the properties of the dictionary, the lower level filter is made unnecessary.

The Deutsch-and-Deutsch model is shown in Fig. 2. As can be seen, the filter for physical characteristics is omitted and the input lines run directly to the dictionary. Every signal is then analysed and recognised for the particular signal which it is.

All sensory signals excite their stored representation in memory, and at the same time an analysis of previous signals is going on.

This establishes a class of events deemed to be pertinent to the ongoing analysis. The set of pertinent items also excite their representation in memory.

The item most highly excited by the combination of sensory and pertinence inputs is selected for further analysis. Thus the most important stimulus captures the attention.

'ANALYSIS-BY-SYNTHESIS'

Ulrich Neisser, of Cornell University, has a theory quite different from those previously held.

He believes that 'analysis-by-synthesis' is the mechanism of auditory attention, and that, to follow one conversation in preference to

others, is to synthesize a series of linguistic units which match it successfully.

Irrelevant, unattended streams of speech are neither 'filtered out' nor 'attenuated'. They just fail to enjoy the benefits of 'analysis-by-synthesis'.

'Pre-attentive processes' establish localization, form crude segments and guide responses to certain simple situations, but their capacity for detail is strictly limited.

Neisser does not say how his theory deals with sounds other than speech, or with a foreign language that the listener may not have heard before but 'may be 'paying attention' to.

MORAY'S THEORY

One of the latest theories is that proposed in 1969 by Neville Moray.

Moray's theory of attention is really a modified version of Broadbent's original hypothesis. He says that 'at any moment a listener is sampling only one message'. All others are totally rejected, and sampling may continue on one channel indefinitely, until the switch is 'called' by another channel.

Neville Moray's model is similar to Broadbent's (shown in Fig. 1). The main difference is that, as the parallel channels enter the short-term memory, the linkage with the limited capacity channel switches from channel to channel. The concept of a selective filter blocking rejected messages is not necessary.

Controversy about attention concerns whether incoming messages are attenuated, or whether responses are selected.

Broadbent's model was questioned because it was shown that channels are not necessarily physical, and that rejected messages are not always completely blocked.

Anne Treisman's attenuation theory is convincing to a certain point, but does not account for the fact that information in a rejected message can sometimes go completely unheard. It is also hard to see how her filter saves work in selection, for it would seem necessary to extract the meaning of all incoming signals to determine what to attend to.

Moray's theory may be a basis for the study of individual differences.

People who say they can attend to two things at once may in reality be able to switch rapidly from one thing to another — in the same way that a high-speed data logger, or a time-sharing computer, may appear to be concentrating simultaneously on a number of different events. Some individuals appear to have the switching mechanism under conscious control and can concentrate while others are easily distracted. ●

Computerized Drawing Board

Computer-controlled machine produces three-dimensional drawings from two-dimensional plans

TOP: Exploded view of intricate mechanism was computer produced from original — below.

THE ability to manipulate things mentally, to create in one's mind a three dimensional object from two orthographic views — is a rare gift.

Yet, virtually everyone who designs, fabricates, assembles, installs or repairs a part or assembly really needs to see a picture of what he is working on.

For working from plans — flat two-dimensional orthographic drawings, wastes time and results in human error.

Two-dimensional orthographic plans are all but meaningless to the layman, and even to those skilled in interpretation they may be a cause of error.

Three-dimensional drawings whether of an office building, the hull of a boat, or a complex die-casting — save recognition time and prevent costly errors and mistakes. For architectural presentations they are all but essential.

No wonder then that technical illustrations have become such a vital part of modern technological operations.

But three-dimensional drawings take a long time to prepare, and staff with the necessary visuo-spatial ability to undertake this work are highly paid and in short supply.

MATHEMATICAL PERSPECTIVE

Until recently three-dimensional drawings were prepared on a largely empirical basis, but in 1963 T. O. McCartney developed a method which allowed any trained draughtsman or artist to prepare accurate perspective drawings using a mathematical basis.

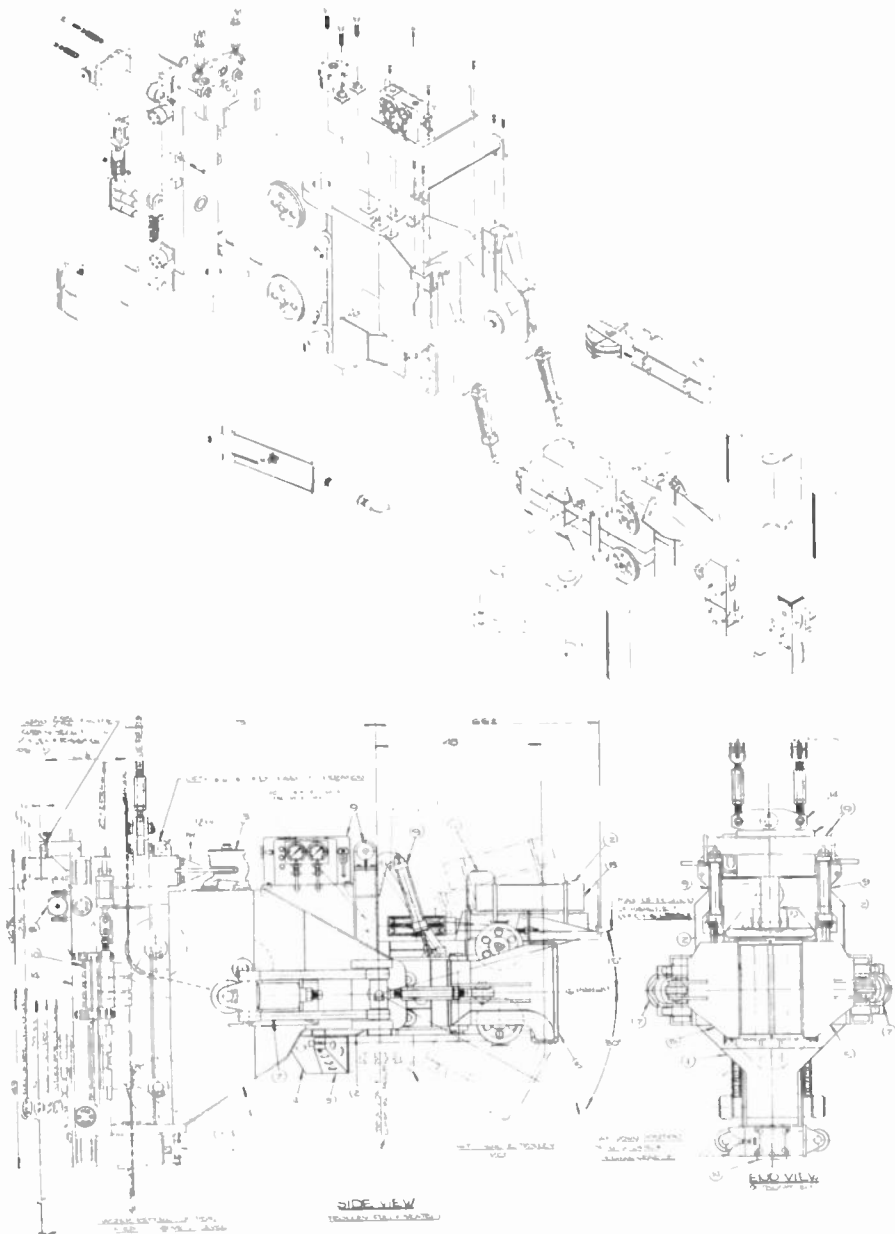
McCartney's theory stated that once the variable parameters of line dimensions and angles, station point distance, rotation and tilt were related in equation form, perspective drawing was mathematically feasible.

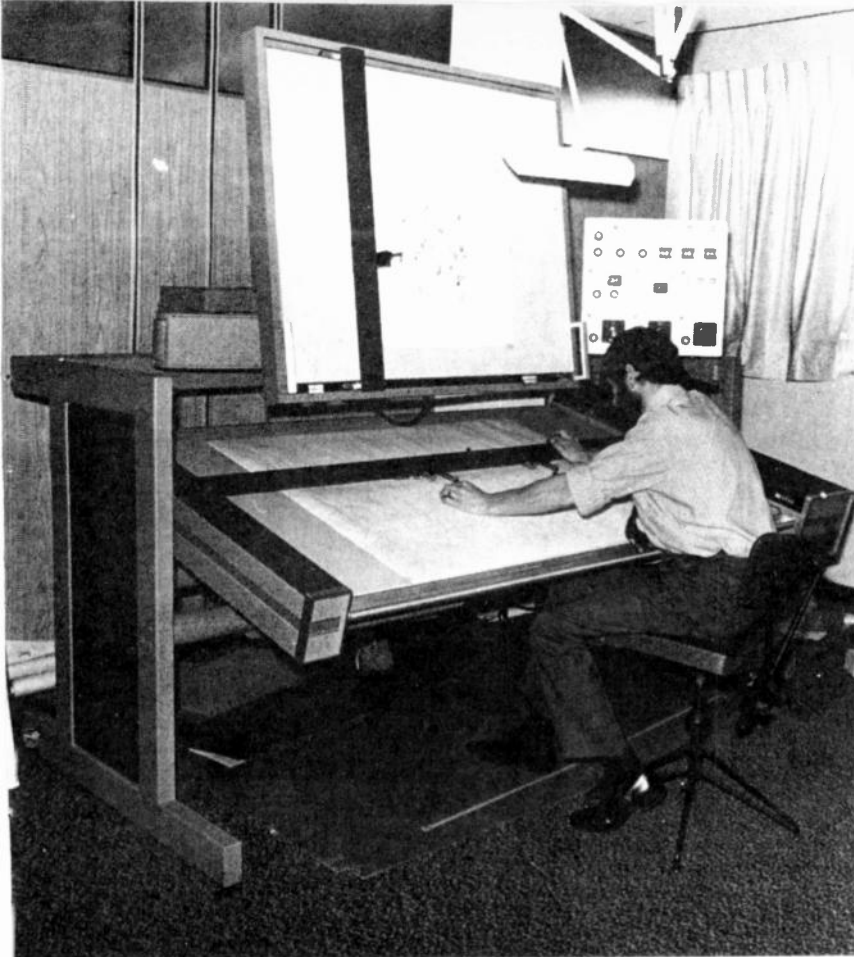
It was soon realised that once a set of equations was calculated relating the coordinate information obtained by tracing two orthographic views, it was possible for these equations to be developed into a three-dimensional drawing by an analogue computer.

Perspective, Inc. of Washington in the USA was the first company to exploit this principle. They developed a computer controlled machine that could produce a three-dimensional drawing from two orthographic projections.

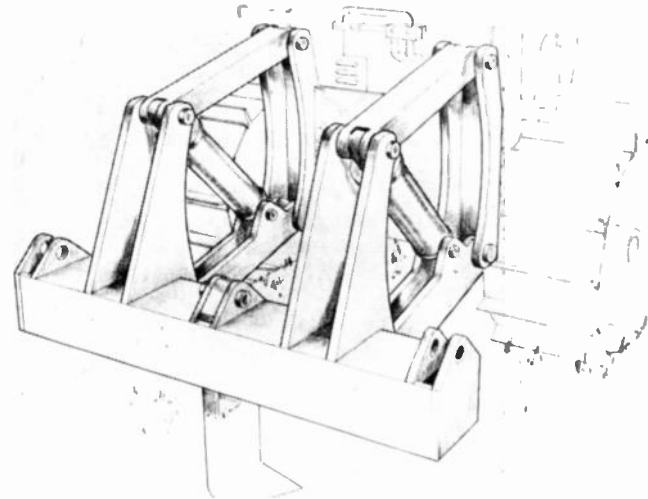
An operator simply traces over any two orthographic views of the object, and the machine produces the desired three-dimensional line drawings.

The operator's tracing stylus is connected to two linear potentiometers mounted at right angles across the full length and height of the draughting table, and thus any





LEFT: A three-dimensional drawing of an agricultural implement is prepared by Mike White of Computer Perspectives. BELOW: The finished drawing.



position of the stylus on the table is translated by the potentiometers as two discrete voltages which form the analogue inputs to the computer.

Thus when the variables (X, Y, and Z dimensions, subject rotation and tilt, and station point distance for a particular drawing) are put into the computer, the machine calculates the correct foreshortened X, Y, and Z line dimensions and the changed angles.

The output from the computer is fed to servo motors which direct the pen on the drawing board.

The result? Accurate perspective drawings at a speed claimed to be at least five times faster than a skilled illustrator.

One of these machines was recently imported to Australia by a small Sydney company specifically to offer a computer-graphic drawing service to any who need it.

The machine came complete with Chuck Osborne, the manufacturer's ex-demonstrator who felt that

Australia had rather more to offer.

Especially now that it had the machine.

MACHINE DEMONSTRATED

The company, Computer Perspective Pty. Ltd. recently demonstrated the machine's capabilities to Electronics Today.

Set up was quick and simple, requiring only a minute or two. The operator placed two mutually perpendicular views of the subject on the horizontal board. He then attached to the vertical board a sheet of paper on which the three-dimensional view was to be constructed. After initial balance had been established, the computer controls were adjusted to the desired station point distance, subject rotation and tilt, and the scale of the perspective or axonometric drawing.

Then as the operator traced two blueprint views (eg - side and end)

line information was, fed into the machine's analogue computer.

The computer instantly converted two-dimensional data into three-dimensional data; then directed the pen on the vertical XY plotting board to plot the drawing.

The machine has many different modes of operation and can produce isometric, dimetric and trimetric drawings, exploded views, and also complete drawings of a symmetrical object when given only one-half or one-fourth. It can also produce perspective drawings from any angle or distance of view.

Despite their recent inception Computer Perspectives have completed a surprisingly wide variety of work, varying from perspective drawings of the proposed Sydney Town Hall extensions to agricultural machinery, from road work studies to automobile parts manuals.

Shown a machine like this even the Flat Earth Society must be convinced.

The computer can prepare three-dimensional drawings as seen from any required viewpoint.



BIOLOGICAL

Move over, gurus and swamis
— what the study of
Yoga takes years to achieve,
electronics can do in minutes!

AFTER a lifetime of study and meditation, a few Indian holy men manage to achieve limited control of heart rate and basal metabolism.

Yet, in less than one hour, 25 students at Harvard Medical School learnt to slow their heartbeat by nine beats a minute.

Just by watching an oscilloscope — and thinking about it.

It was done by biological feedback — or the conscious control of unconscious phenomena — one of the more remarkable and significant discoveries of modern science.

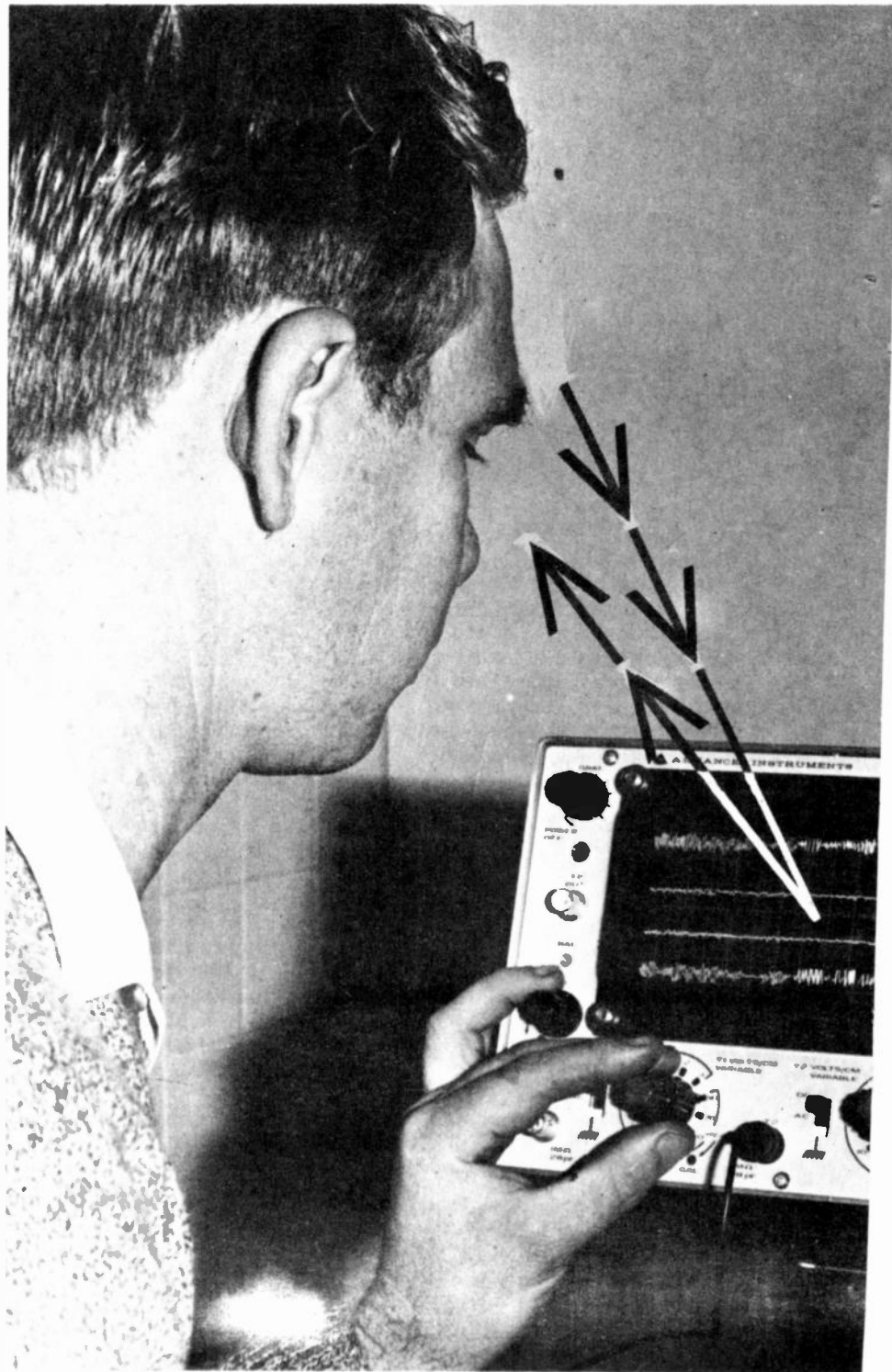
In 1929 Dr. Hans Berger, a German psychiatrist working at Jena University, applied electrodes to the human skull and, working with a number of sensitive galvanometers, succeeded in measuring 10 Hz 'alpha' rhythms. The results were recorded in his paper 'Über das Elektrokephalogramm des Menschen'.

His discovery was ignored by the scientific fraternity until 1934, when the existence of the alpha rhythm was demonstrated to the Physiological Society by Professor Adrian (later Lord Adrian) of Cambridge University.

But it was not until the advent of modern electronic equipment capable of amplifying, filtering and correlating low-level signals that the complex wave-patterns could be reliably identified and recorded.

These wave-patterns are classified (by amplitude and frequency) as alpha, beta, theta and delta. There is evidence that each wave-pattern is associated with a different state of consciousness, although there appear to be characteristic differences in wave-patterns from one person to another.

Recently scientists have established that, when in a state of profound meditation, Zen and Yoga leaders emit primarily alpha rhythms. Alpha rhythms are also apparent in most



FEEDBACK

people during pleasurable activities. Creative thinking and problem-solving activities tend to be associated with alpha/theta rhythms. Beta rhythms are commonly associated with anxiety, whilst delta and theta rhythms are apparent during sleep.

These rhythmic patterns can readily be studied by using an electroencephalograph — an instrument which displays on an oscilloscope the minute electrical currents picked up by electrodes placed on the skull.

Extraordinary though it may seem, it is not a difficult matter to consciously generate the various types of wave-forms whilst watching one's own electroencephalograph — and, in so doing, experience the various effects with which each rhythm is personally associated.

It also appears possible that people can learn conscious control of blood pressure, heart rate, metabolism, muscle tension, etc.

Some behavioural scientists believe that it is quite possible the technique could even improve memory, learning ability and creativity, although they emphasize that, despite some dramatic results, the technique is in its infancy — and as yet there is no evidence that biological feedback can cure organic damage.

Nevertheless, the possibilities are so great that normally reticent scientists and psychologists find it difficult to restrain their enthusiasm. One, a research psychologist at the Menninger Foundation, states: "Without stretching the imagination, the long-range implications and effects for society of a population of self-regulating individuals could be of incalculable significance!"

Some of the results achieved during the past three years include the following:

- At Emory University, subjects have been taught to activate individual motor nerve cells out of the hundreds of thousands in the spinal cord. This work has helped the development of prosthetic devices controlled by nerve impulses for the physically handicapped.

- A number of patients at the Gerontology Research Centre were able to reduce the frequency of abnormal heart rhythms (premature ventricular contractions).

- At the Maimonides Medical Centre, in Brooklyn, bio-feedback training has partly rehabilitated patients with multiple sclerosis and has also been used to control epileptic spasms.

- The Menninger Foundation, in Kansas, has used bio-feedback to cure chronic migraine now known to be caused by a swelling of the artery that supplies blood to the external parts of the head. The technique used at the Foundation is simply to teach migraine sufferers to pump less blood through the artery.

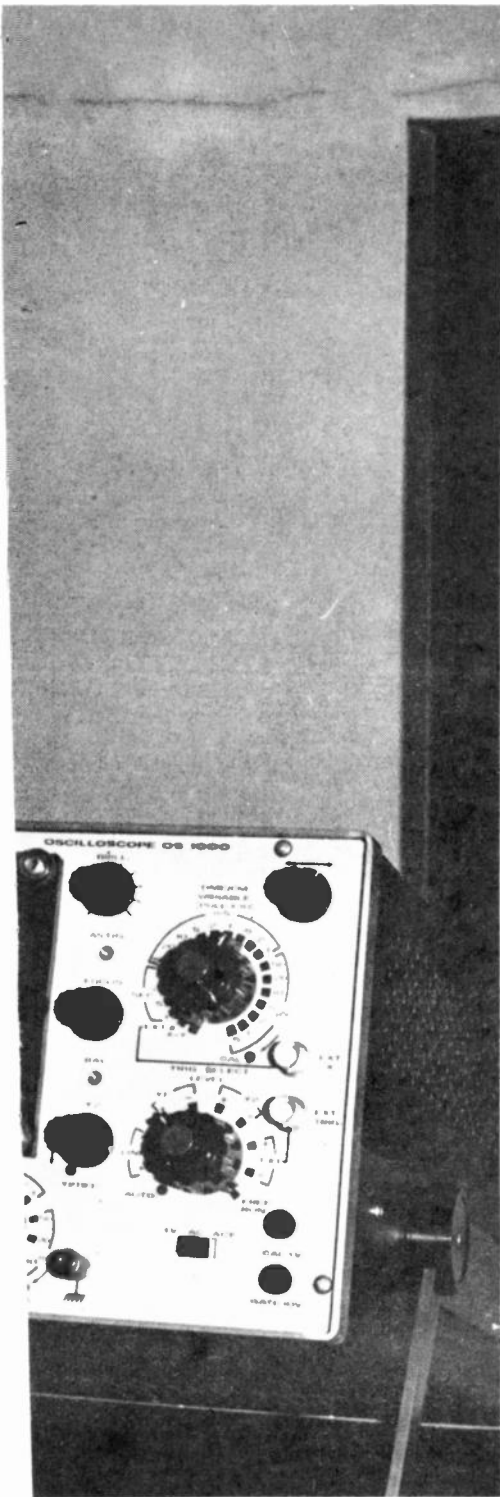
- Tension headaches in a number of patients have been cured by bio-feedback techniques used at the Medical Centre of the University of Colorado.

- In the course of a series of fully documented experiments carried out at the Menninger Foundation, a woman was taught to raise and lower the temperature of her hands by over 10 degrees.

Bio-feedback experiments have, of course, been noted with great interest by the military — and it is believed that the U.S. Department of Defense is investigating a technique of foiling enemy lie detectors by intentionally self-generated biological 'noise'.

The technique is also being exploited commercially by a number of small U.S. manufacturers who are currently marketing 'do-it-yourself' electroencephalographs at a retail price of \$250 to \$350. Behavioural scientists are not concerned about this, as they say the machines are not sophisticated enough to have anything other than gimmick value — "the only harm will be to the purchaser's bank balance", they say.

The most significant aspects of bio-feedback are, perhaps, its apparent ability to effect self-change in human behaviour, and the evidence that electronics is quite literally a part of life. ●



This probe provides visual indication of the logic state at any point in a circuit using digital ICs. Capable of detecting pulses as short as 50 nanoseconds, it is an invaluable tool for trouble-shooting and prototype development. Cost of components is about \$10.

DIGITAL integrated circuits are being increasingly used by both professionals and amateurs, and a number of projects using digital ICs will be published by ELECTRONICS TODAY.

The first of these projects is a logic probe designed to meet the needs of both professional engineers and amateur experimenters. It is not a toy.

The probe will work with all commonly used logic systems, including:

RTL (resistor-transistor logic).

DTL (diode-transistor logic).

TTL (transistor-transistor logic).

The logic probe may also be used with equipment using discrete components (such as pulse amplifiers and relay drivers).

The probe will indicate any of five conditions:

(1) Steady positive voltage.

(2) Steady ground potential.

(3) Single fast positive pulse.

(4) Single fast negative pulse.

(5) A pulse train with a frequency not exceeding 10 MHz.

As the probe must detect pulses as short as 50 nanoseconds, a monostable multivibrator is used as a pulse extender to provide indication times of 100 milliseconds. Separate monostables are used for positive and negative going pulses.

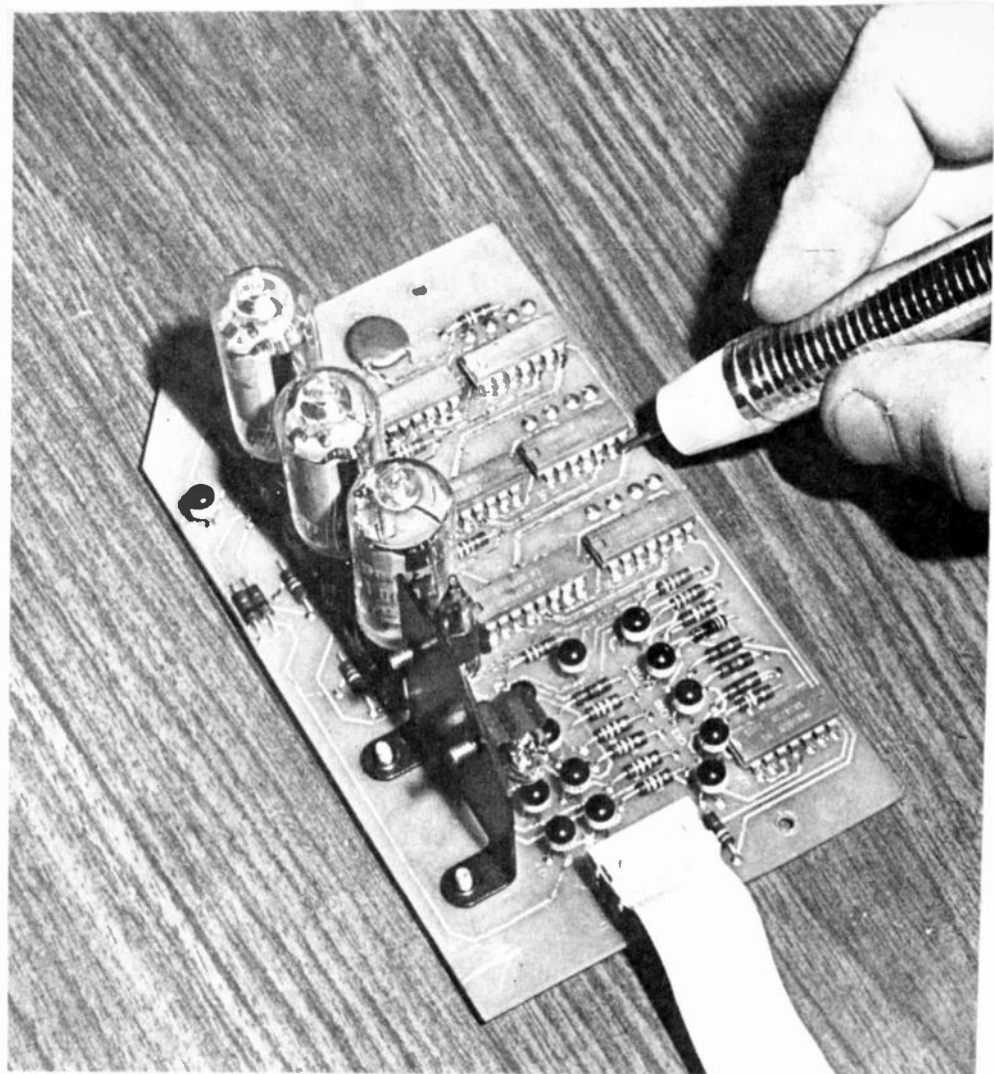
The necessary monostable and inverting functions required to meet conditions (1), (2), (3) and (4) are provided by interconnecting the gates of the quad two-input nand gate G1, 2, 3, 4.

CIRCUIT OPERATION

(a) Input Buffer

The input buffer consists of diodes D1, D2 and D3, resistors R1, R2 and R3, and transistor Q1.

With an open circuit on the probe, current flows through R1, D3 and R2, thus providing approximately 4 Volts bias on the base of Q1 which is switched into conduction. This results



in a high level at point B (logical 1 at the 7400 gate input 2).

If, on the other hand, the probe is connected to a positive voltage greater than 2 Volts, diodes D1 and D2 block the flow of current to D3 and the subsequent operation is the same as for an open circuit on the probe.

If the probe is connected to ground potential, current flows through R1 whilst the forward voltage drops of D1 and D2 bias point A at approximately 1.2 Volts. This voltage is further divided by D3 and R2, and results in a negligible voltage on the base of Q1 which is consequently switched off. Point B is thus at ground potential and R3 'sinks' the current from the input gate of IC1, resulting in a logical 0 at the input.

When used to detect pulses, the operation is the same as that described above: a positive going pulse produces logical 1, whilst a negative going pulse provides logical 0. The limit of operation is approx. 20 MHz.

(b) Monostable/Inverter

This stage is built around IC1, which is a quad two-input nand gate. As shown in Fig. 1, two gates are interconnected to form a monostable multivibrator. The remaining two gates are likewise interconnected, and the output of the first pair of gates becomes the input of the second pair.

(c) Steady Positive Voltage

When the probe becomes positive, point B becomes 1. This is inverted to 0 at point C and again inverted to 1 at point D. This logical 1 is applied to the base of transistor Q2 which is switched into conduction, illuminating the indicator lamp.

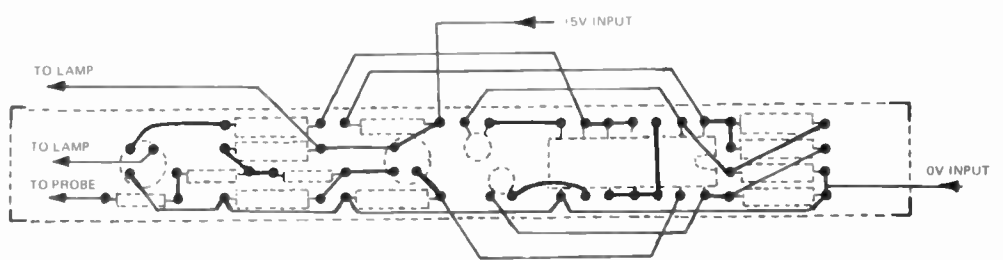
(d) Positive Pulse

The logical 1 appearing at the output of gate G3 is applied to the input of gate G4, and these two gates now act as a monostable multivibrator because

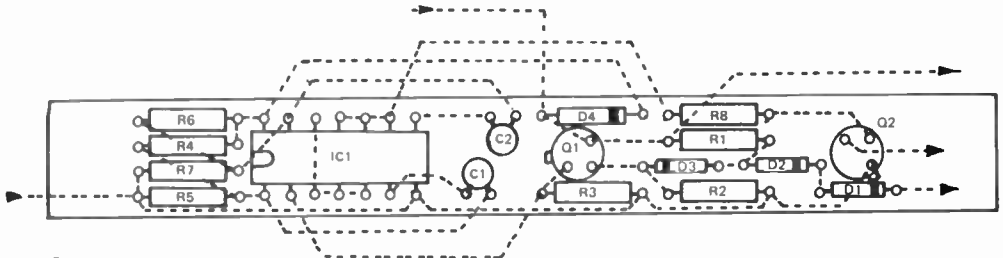
LOGIC PROBE



ET PROJECT



Wiring side.



Component side.

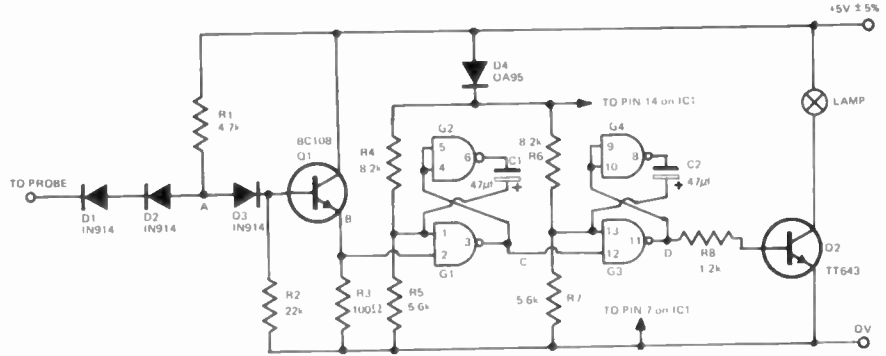


Fig. 1. Circuit diagram of complete unit.

the output G4 becomes 0 and capacitor C2 starts charging through R6/R7 potential divider.

During this charging period the second input of G1 is held at 0 and, even if output C changes to 1, the output of G3 will be 1. Thus a fast positive pulse at the probe input will be sensed and extended to illuminate the indicator lamp for 100 milliseconds.

(e) Steady Ground

A grounded probe produces 0 at point B. The 0 is inverted by G1, resulting in 1 at point C and, hence, 1 at the inputs of G2. The output of G2 is 0 and C1 is discharged. The output

at point C is also fed through G3, which inverts it to produce 0 at point D, extinguishing the indicator lamp.

(f) Negative Pulse

When the probe is at positive potential and senses a negative going pulse, the operation is as follows:

Before the negative going pulse arrives, point B is at logical 1; this is inverted to 0 at point C and again inverted to logical 1 at point D, thus causing the indicator lamp to be illuminated. As soon as a negative pulse arrives, B goes to logical 0, resulting in 1 at C; this is again inverted by G3 and the output appears as logical 0 at point D, thus causing

the lamp to be extinguished. At the same time the logical 1 is applied to the inputs of G2. G1 and G2 now form a monostable multivibrator ensuring that the lamp remains off for 100 milliseconds.

(g) Pulse Train

A pulse train will cause the monostable vibrators to cycle continuously, thus causing the indicator lamp to glow at reduced brightness.

Lamp Driver

The lamp driver stage consists of R8, Q2, and the indicator lamp. When a logical 1 appears at point D current flows through R8, causing Q2 to conduct and thus energizing the indicator lamp. A logical 0 appearing at point D will cause the transistor Q2 to be biased off and the lamp will be extinguished.

CONSTRUCTIONAL DETAILS

A pen torch case makes an ideal housing for the probe. We used an Eveready unit that has a translucent lamp surround.

A small nail glued into the translucent end serves as the probe (remember to solder a wire to the end

SPECIFICATIONS	
Supply voltage	5 Volts dc \pm 5%
Input voltage (high input)	> 2.4 Volts
Input voltage (low input)	< 0.8 Volts
Indication — steady positive	lamp on
Indication — steady ground	lamp off
Indication — fast positive pulse	lamp flashes on
Indication — fast negative pulse	lamp flashes off
Indication — pulse train	lamp glows less brightly
Minimum detectable pulse width	50 nanoseconds
Extended indication of lamp	100 milliseconds

LOGIC PROBE

of the nail before glueing it into position). With the probe in place, the translucent tip will glow due to the light diffusing from the indicator lamp mounted directly behind it.

Pen torches vary in their methods of construction, but in most cases the switch mechanism will have to be removed. If the Eveready torch case is used, the switch is removed by drilling out the retaining rivet located behind the small label on the end of the unit.

For our prototype we mounted the components on a piece of phenolic resin board (0.1" hole centres).

A printed circuit board may be used, but point-to-point wiring is considerably easier. If the conventional components specified in the parts list are used, the finished product will fit easily into the torch case.

It is advisable to wrap some insulating material around the component board before inserting it into the torch body.

TESTING

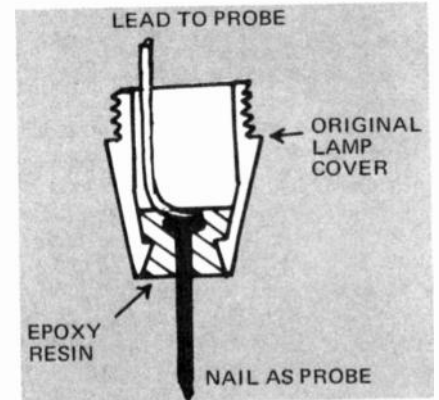
Check the wiring carefully and connect the probe to a 5 Volt dc supply. The lamp should glow immediately. If it does not, recheck the wiring and measure the voltage at points B, C and D after referring to the circuit description.

Next touch the probe onto a point that is at ground potential. The lamp should extinguish. If it does not, check

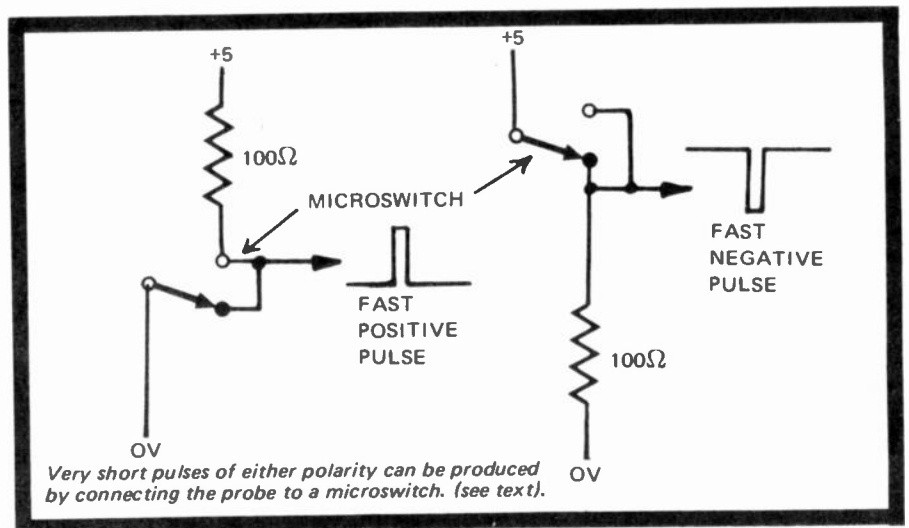
the voltages at points B, C and D as above.

A source of fast pulses is required to check that the monostable stages are working. If a pulse generator is not available, the probe can be tested by connecting it to the common connection of a microswitch. When the microswitch is operated, the contacts momentarily open circuit and produce a very short pulse across the probe.

If all tests prove satisfactory, the probe is ready for use. ●



Probe tip, solder a lead to the nail before glueing into position.



PARTS LIST

R1	— resistor 4.7k ¼ watt 5%
R2	— " 22k " " "
R3	— " 100Ω " " "
R4, R6	— " 8.2k " " "
R5, R7	— " 5.6k " " "
R8	— " 1.2k " " "
D1,2,3	— diodes type 1N 914 (or equivalent)
D4	— diode OA 95
C1, C2	— tantalum tag capacitor (STC) 47μf, 6.3 volt
Q1	— transistor, BC108
Q2	— " TT643 (STC)
IC1	— integrated circuit 7400*
Lamp	— RM6 — 6.3 V50 (Plessey-Ducon)

Matrix Board

Pen torch (see text)

* Note — the suffix for the 7400 series IC depends on the manufacturer

i.e.:

T7400	— made by SGS
MC7400	— " " Motorola
SN7400	— " " Texas Inst.



How prototype unit was constructed; the circuit board should be insulated from the metal case.



Completed probe housed in a torch case.

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• Three speeds — 7½, 3¼ and 1½ i.p.s. • Frequency response at 7½ i.p.s. = 40-20,000 Hz. • Signal to noise — 60 dB. • Twin VU meters • Inputs for tuners, pickups, microphones • Wow and flutter: 0.07% • 4 sound heads • Sound on Sound • All solid state • Twin 10 watts R.M.S. amplifiers



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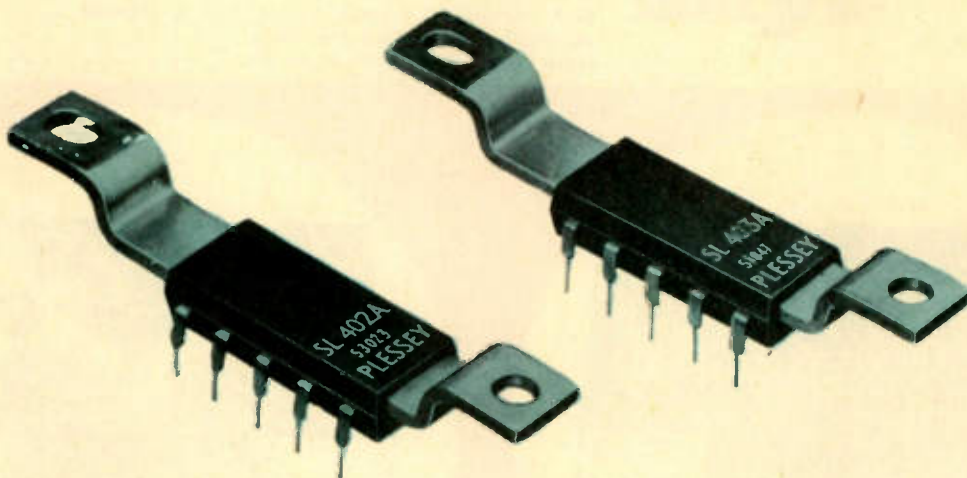
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The SL402A and SL403A Integrated Circuit Audio Amplifiers are designed for use in Professional and Domestic applications where a compact, low cost, high quality audio amplifier is required. The devices are widely used by a number of Overseas manufacturers and are designed for use by both manufacturer and hobbyist alike. Each unit incorporates a preamplifier and a Class A-B power amplification stage

capable of delivering up to 2.5 watts (SL402A) and up to 3.5 watts (SL403A) r.m.s. output power.

The circuits feature low distortion, high input impedance and use a minimum of external components. In addition the devices incorporate overvoltage protection, as a function of the design applied to the output stage, thus offering substantial protection against excessive supply voltages.

The Integrated Circuits can be used to form the basis of a simple audio amplifier, an amplifier with base and treble tone controls or to form a more elaborate three channel system in either mono or stereo. The devices are available ex stock from the Professional Components Department of Plessey Ducon Pty. Limited or through the normal trade channels. Technical literature is available on request.



Performance Characteristics

Output power r.m.s.

Input impedance

Distortion

Frequency response

Operating voltage

Minimum operating load

Preamplifier
Main amplifier
Preamplifier
Main amplifier
Lower 3db point
Upper 3db point

SL402A

2 Watt

20 M Ω

100 M Ω

0.1%

0.3%

20 Hz

30 KHz

+14 V

7.5 Ω

SL403A

3 Watt

20 M Ω

100 M Ω

0.1%

0.3%

20 Hz

30 KHz

+18 V

7.5 Ω

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AD14

TACHO-DWELL METER

ET PROJECT

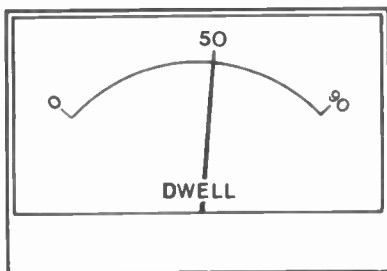
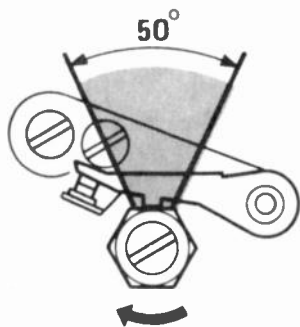
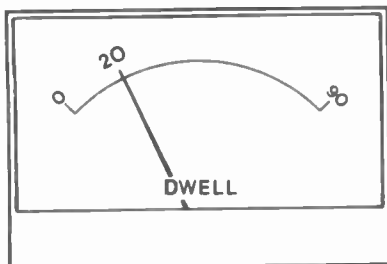
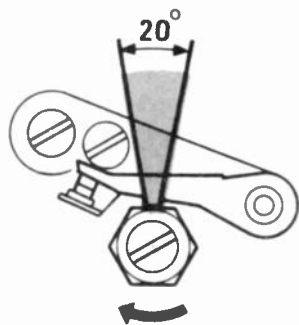


FIG. 1 and 2. Dwell angle is the angle through which the distributor cam turns whilst the contact breaker points are closed.



Both engine speed and distributor dwell angle are shown by this dash-mounting meter.

AN ACCURATE engine speed indicator is an essential instrument for the keen driver, for only by knowing engine speed is it possible to obtain optimum performance with minimum engine stress.

But the instrument described in this article does more than this — it also indicates distributor dwell angle.

Dwell angle is the angle through which the distributor cam turns whilst the contact breaker points are closed (Figs. 1 and 2).

During this period primary current is building up the ignition coil's magnetic field in preparation for the next ignition cycle.

The dwell angle is determined by the contact breaker gap. Theoretically the manufacturer's specified gap will provide the correct dwell angle — but in practice this only happens with new distributors, and not always then.

The important factor is the dwell angle, for this represents the time available for the coil to build up energy.

If the dwell angle is less than specified, the coil will have insufficient time to store energy before the contact points reopen to initiate the next high voltage discharge from the ignition coil.

On the other hand, too much dwell will result in the contact breaker points being burnt by energy remaining in the coil from the previous ignition cycle. This energy will also interfere with the next ignition cycle.

TACHO-DWELL METER

The contact breaker gap is a means of adjusting the dwell angle (Fig. 3). Nominally this gap may be .016" — but in practice, to obtain the correct dwell angle, it may be as much as .020" or as little as .010".

A dwell meter also provides some indication of contact breaker points operation at high engine speeds. The indications that are given are described later in this article.

The ELECTRONICS TODAY unit has been designed for installation in a vehicle rather than as a separate tuning instrument. A toggle switch selects either engine rpm or dwell angle; this may be mounted in any convenient position.

The circuit of the complete unit is shown in Fig. 4. Although many of the components are common to both the tachometer and the dwell meter, it is easier to follow the principle of operation by considering them as separate entities.

TACHOMETER OPERATION

1. When power is applied to the circuit, transistor Q1 is biased ON by R5, R6 and RV1.

2. Resistors R2 and R7 divide the saturation voltage of Q1. As the emitters of Q1 and Q2 are held at a positive potential of approximately 0.6V by the forward conduction voltage of diode D3, the base voltage of Q2 will be very nearly equal to the emitter voltage. Thus Q2 cannot conduct.

3. Capacitor C1 will charge through R8 and the meter (M1).

4. A pulse arriving at the TACHO INPUT forward biases D1 which conducts, thus allowing the pulse to forward bias Q2. Transistor Q2 now conducts, effectively connecting terminal A of C1 to the emitter common line. Thus terminal B of C1 will be at a negative potential with respect to the emitter common line. As terminal B of C1 is connected through R6 to the base of Q1, this transistor will be cut-off and current will flow into the base of Q2 through R1 and R2, holding Q2 on. Capacitor C1 will then discharge through RV1 and R5.

5. When C1 has discharged sufficiently, Q1 will again conduct, cutting off Q2 (as explained in sequence 2 above).

6. Thus a constant width pulse is generated at the collector of Q2. The width of this pulse (i.e., the time for which Q2 conducts) is determined by the time constant of RV1 + R5, and C1.

7. This constant width pulse is applied through R8 to the meter, the inertia of which is sufficient to hold the needle in position between pulses.

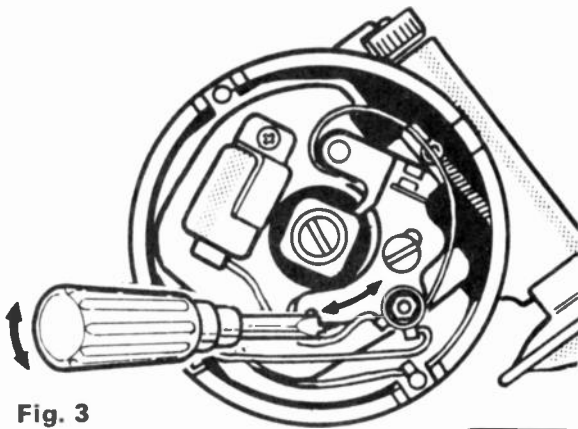
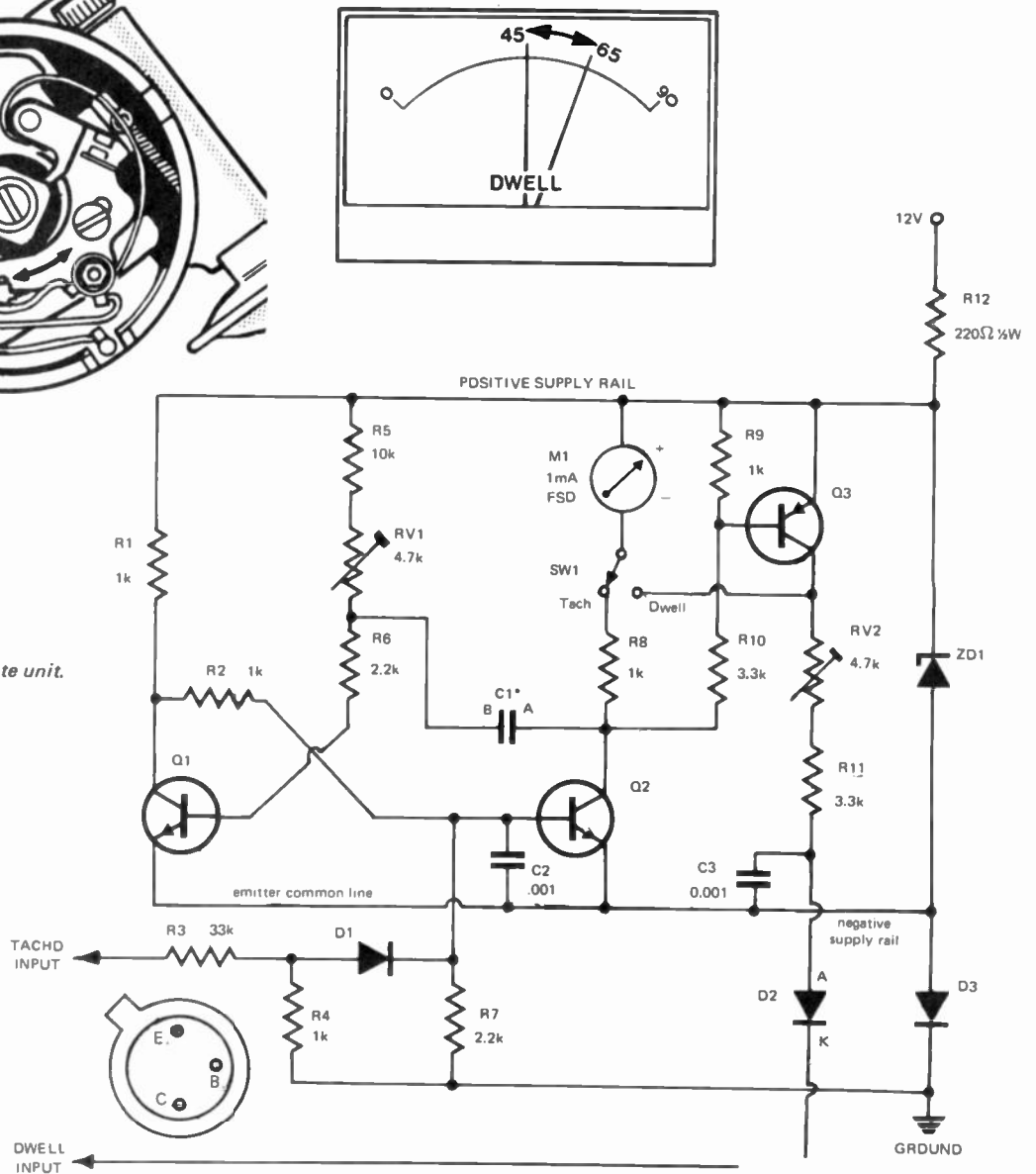


Fig. 3

FIG. 3 The contact breaker gap is a means of adjusting the dwell angle.

FIG. 4 Circuit diagram of complete unit.



* SEE TABLE 1

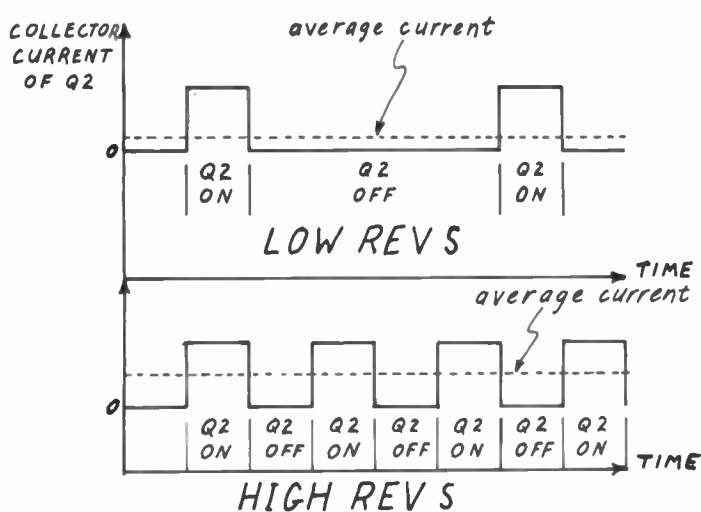


FIG. 5 This shows how average current into the tachometer varies with changing engine speed.

8. As engine speed increases, the time between these constant width pulses will decrease — i.e., the mark-space ratio will change. This is shown graphically in Fig. 5. The overall effect is to increase the average current through the meter and hence its deflection.

9. The value of C1 is chosen to suit the maximum scale reading required, and also for the number of cylinders of the vehicle to which the meter is to be fitted. Table 1 shows several combinations — but, if necessary, the correct value of C1 can be calculated by the following formula:

$$C1 \text{ (in } \mu\text{f)} = \frac{2400}{\text{full scale rpm} \times \text{number of cylinders}}$$

DWELL METER OPERATION

The dwell section of the ELECTRONICS TODAY unit operates as follows:

1. When the contact breaker points close, the cathode of diode D2 will be earthed. This will forward bias D2 which will conduct via RV2, R11 and the meter, thus causing the meter to deflect.

2. When the points open, transistor Q2 will contact (in the same manner as for tachometer operation); but for dwell

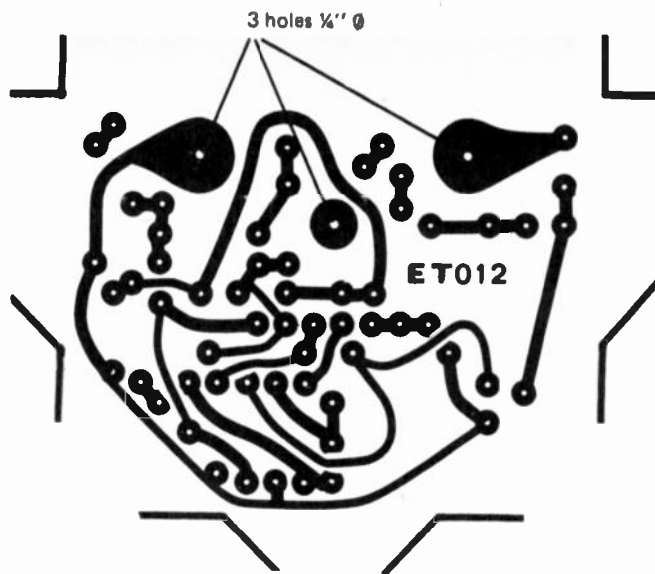


FIG. 6 Foil pattern — full size.

measurement Q2 collector current will flow through R9 and R10 which are the bias resistors for Q3, and this transistor will conduct, effectively shorting out the meter. This arrangement prevents the coil's 'ringing' energy from again forward biasing D2 before the points actually close, causing the meter to read higher than it should.

3. Thus, as the distributor rotates, the meter will attempt to swing alternately between zero and full scale deflection. But the mechanical inertia of the movement will prevent rapid needle movement, and so the meter will register an average value representing the dwell angle.

4. To prevent battery voltage changes affecting dwell reading, a stabilized supply is incorporated. Resistor R12 and zener diode ZD1 maintain the potential between the positive and negative supply at approximately 6.2V. Diode D3 is forward biased and its forward conduction voltage-drop raises the negative supply above ground by about 0.6V. Thus ground is at -0.6V with respect to the negative rail, providing the negative supply required for tachometer operation.

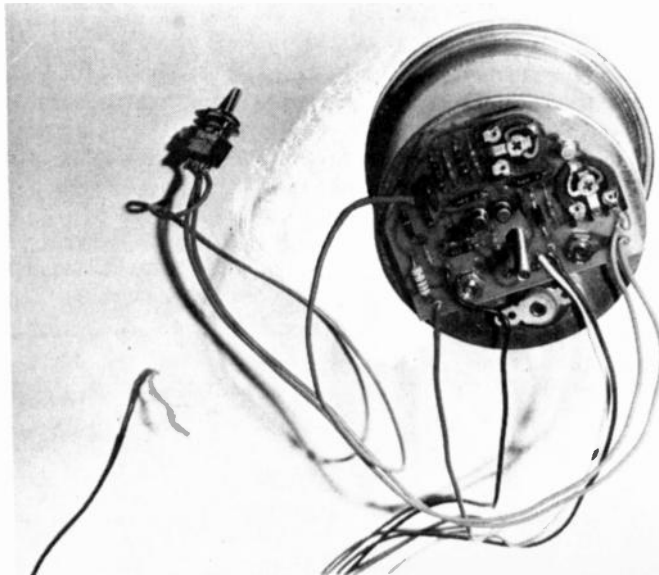
CONSTRUCTION

A printed circuit board is the simplest and most convenient way of mounting the components. The foil pattern of a pc board, designed to mount directly onto the terminals of the meter specified, is shown in Fig. 6.

Mount all the components on the pc board (Fig. 7 indicates their positions), making sure that the diodes and transistors are correctly located. This is most important.

Attach suitable lengths of hook-up wire to the points shown in Fig. 7.

The printed circuit board is mounted directly onto the back of the meter.



PARTS LIST

R1,2,4,8	— resistor 1k ¼ watt 5%
*R9	— " 1k " "
R3	— " 33k " "
R5	— " 10k " "
R6,7	— " 2.2k " "
*R10	— " 3.3k " "
*R11	— " 3.3k " "
R12	— " 220 ohms ½ watt 5%
RV1	— 4.7k TRIMPOT
*RV2	— " " "
C1	— capacitor — see table 1
C2	— " 0.001µf 100 Volt (green cap)
*C3	— " " " "
D1,3	— diode 1N 914
*D2	— " EM 410
ZD1	— zener diode BZY 88 C 6V2
*SW1	— single pole change over switch
PC1	— printed circuit board — ET 012
M1	— Meter 1 mA full scale deflection — recommended type is Ferrier Instruments CS-260-T. If using quote max rpm reading required — i.e. -5000, 7000, or 10,000 rpm. — also whether for positive or negative earth vehicle
Q1,Q2,	— BC108, TT643, or similar
*Q3	— BC178, TT638, TT644 or similar
	Use transistors quoted above for negative earth vehicles.
Q1, Q2	— BC178, TT638, TT644 or similar
*Q3	— BC108, TT643, or similar
	Use these transistors for positive earth vehicles.

* The unit can be built solely as a tachometer by eliminating those components marked thus *

TACHO-DWELL METER

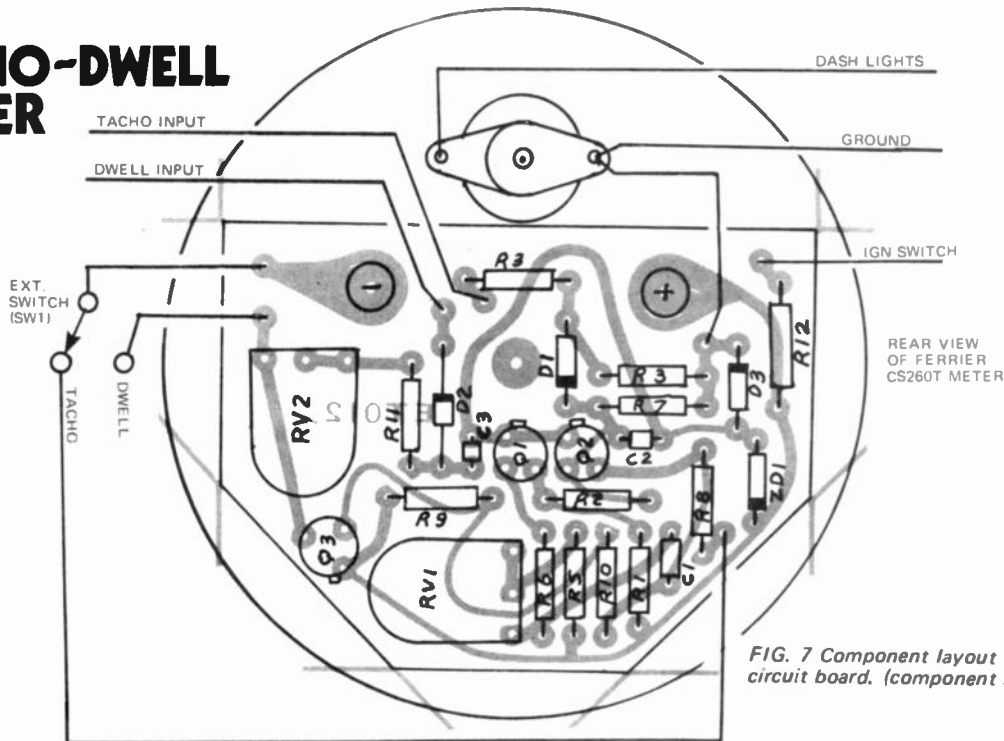


FIG. 7 Component layout on printed circuit board. (component side).

Having mounted all the components on the board, check it carefully against the circuit (and Fig. 7), then mount the board onto the back of the meter with the components outermost.

Connect the lead marked GROUND to the vehicle chassis. Connect the DWELL INPUT to the TACHO INPUT and then to the distributor side of the coil primary. Connect the lead marked BATTERY to the switched 12 Volt supply.

If the vehicle is fitted with a capacitor discharge ignition system, the connections should be as follows:

1. GROUND to vehicle chassis.
2. DWELL INPUT to distributor.
3. TACHO INPUT to live side of coil primary.
4. BATTERY to the switched 12 volt supply.

The circuit shown in Fig. 4 is intended for vehicles with a negative earth ignition system.

For vehicles with a positive earth system, the polarity of all the diodes must be reversed and the alternative transistors quoted in the parts list substituted for Q1, Q2 and Q3. The meter must also be ordered with its terminals reversed for positive earth systems.

The TACHO-DWELL selector switch should be mounted in a suitable position in the vehicle.

The meter specified in the parts list has an internal lamp for illuminating the meter face. One side of this lamp should be connected to vehicle ground and the other to the live side of the dash light switch.

TESTING PROCEDURE

The unit is now ready for testing.

With the engine running at idling speed, a reading should be obtained on the meter with SW1 in either position. (Determine which position is which).

At this juncture it may be necessary to adjust the value of R3 (nominally 33k). If no tacho reading is obtained at idling speed, this resistor may need to be decreased — probably to 22k. If, on the other hand, the meter is erratic at high engine speeds, this resistor may have to be increased in value.

CALIBRATION

Calibration of the dwell meter is simple.

Switch the TACHO/DWELL selector switch to DWELL, ensure that the vehicle's contact breaker points are closed

VALUE OF C1

No. OF CYLINDERS MAX. READING OF TACHO	VALUE OF C1		
	4	6	8
5,000	0.12 μ f	0.082 μ f	0.056 μ f
7,000	0.082 μ f	0.056 μ f	0.047 μ f
10,000	0.056 μ f	0.039 μ f	0.033 μ f

Table 1

and adjust RV2 for full scale meter deflection. That's all. Calibrating the tachometer is a little more involved.

The quickest, simplest way is to calibrate against another accurate tachometer — your local garage will almost certainly have a master tacho; or you could use the tachometer fitted to their engine tuning equipment.

Both tachometers should be connected to the vehicle. With the engine running at high speed, adjust RV1 to obtain the same reading as that shown on the master tachometer. Happy motoring!

DWELL ADJUSTMENT

To adjust distributor dwell angle, the distributor points should be adjusted while the engine is being cranked round with the starter motor. (It is advisable to do this with the spark plugs removed, to reduce strain on the electrical system.)

The correct dwell angle for each vehicle can be obtained from the manufacturer's handbook.

METER INDICATIONS

If the dwell meter reading changes by more than three or four degrees over the normal speed range of the engine, the distributor bearings are probably worn; a loose contact breaker base plate may also give the same indications.

Contact breaker points bounce will be indicated by a meter reading which fluctuates about a mean position.

**The
SANSUI
AU-101**
has been
exposed
for what
it is.



They said "Surprise Packet". That's exactly what it is. The completely independent review in the May issue of "Electronics Today" also says... "Performance of the Sansui AU-101 stereo amplifier belies its low price". And that's true, too!

Frankly the Sansui AU-101 offers more real performance than any other amplifier ever available for only \$138. Let's quote a little more from this unbiased and authoritative review...

"The measured performance of the amplifier is very good. The frequency response is exceptionally flat under all conditions of loading and the distortion is exemplary, being less than 0.8% under all conditions of testing. The intermodulation distortion was particularly good, being 0.3% at full load and less than 0.1% at 1 watt output. One of the features we liked best was the output damping factor of 70. This is the best damping factor we have seen in any amplifier under \$300, and there are

many amplifiers at \$600 which don't have as good a damping factor. This means that both the bass and transient response of the loudspeakers attached to the amplifier is immeasurably improved when compared to that provided by an amplifier with a damping factor of, say, only 20.

The hum and noise performance are both very good and better than most other amplifiers at twice the price."

"The Sansui AU-101 is a very good buy, particularly at the price..."

There are the facts. Here are brief and necessarily abridged specifications:—

***Ask for full details. Send the coupon now... we know you'll agree that the Sansui AU-101 is a real "Surprise Packet"!**

SPECIFICATIONS:

Music power: 50 watts at 4 ohms.
44 watts at 8 ohms.
R.M.S. power: 36 watts at 4 ohms.
30 watts at 8 ohms.
Total harmonic distortion:
Less than 0.8% at rated output
Frequency response:
20-60,000 Hz. \pm 2 dB.
Channel separation:
Better than 45 dB.
Input sensitivity:
3 mV (Magnetic cartridge)
Dimensions: 16" x 11" x 4 3/4"
Price: \$138

Sound **Sansui**
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Please send me all the facts on
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SWIMMING POOL

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

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

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

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

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

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

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

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

But it must be remembered that the water level in a pool may rise or fall several inches due to rain or leakage, and

any system that utilises wave action to initiate the alarm must not be affected by slow changes in water level.

Other factors to consider include:

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

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

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

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

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

ENTRY COUPON

ELECTRONICS TODAY DESIGN COMPETITION
21, Bathurst Street, Sydney 2000

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

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

NAME (block letters).....

ADDRESS.....

.....

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

FIRST PRIZE

\$1000

WORTH OF HI-FI EQUIPMENT
FROM

SIMON GRAY

Pty. Ltd.

RUNNER-UP PRIZES TO BE ANNOUNCED LATER

SAFETY CONTEST



CONTEST CONDITIONS

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

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

Judging will take into account:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

POSSIBLE OPERATING METHODS INCLUDE:

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

FOUR CHANNEL ENCODER

Sansui QS Matrix Sound System

SANSUI have released a four-channel encoder for use in professional recording studios and broadcast stations. Claimed to reproduce the original sound field with full liveliness in the listener's room, the system accepts four discrete channels and condenses them into two channels completely compatible with present two-channel programme sources, including records, tapes, etc.

The two channels thus recorded are then restored to the original four-channel sound by a Sansui QS-1 Quadphonic Synthesizer, used as a decoder.

The manufacturers claim to have overcome the problems of conversion loss and rear channel reverse-phase sound common to previous matrix systems.

THE ENCODER

A block diagram of the encoder is shown in Fig. 1. The left rear channel is phase shifted by $+90^\circ$ to avoid placing them in reverse phase to one-another. The left and right signal channels are constructed as follows:

$$\text{LEFT} = F_1 + F_r + (R_1 + 90^\circ) + (R_r - 90^\circ).$$

$$\text{RIGHT} = F_r + F_1 - (R + 90^\circ) - (R_r - 90^\circ).$$

Thus, sound images distinctively present in four discrete channels, as well as those that may be present between them, are encoded into two channels without any loss.

The phase shifter is a broad-band type. A number of these are cascaded to achieve the appropriate bandwidth and phase shift.

THE DECODER

The decoder uses the encoder system in reverse. It synthesizes the encoded two-channel signal into four-channel sound. A block diagram of the phase relationship between the four channels of output is shown in Fig. 2

The two to four-channel conversion ability of the decoder is one of its great advantages. It is also capable of synthesizing four-channel sound from existing two-channel sources. The process is illustrated in Fig. 3

(A full test report of the Sansui QS-1 Quadphonic Synthesizer was published in the April issue of ELECTRONICS TODAY.)

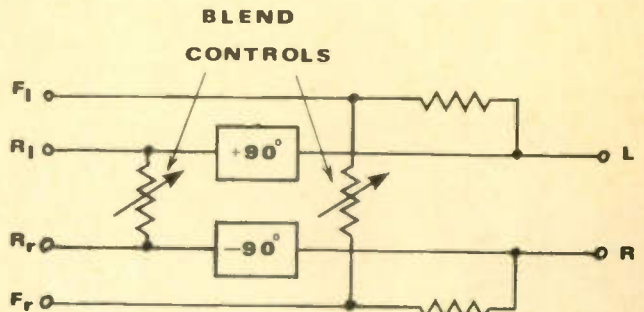


FIG. 1 Block diagram of the Encoder.

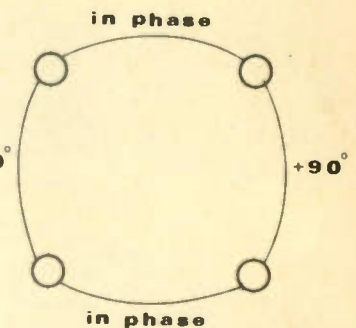
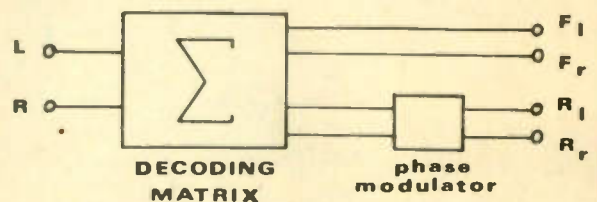
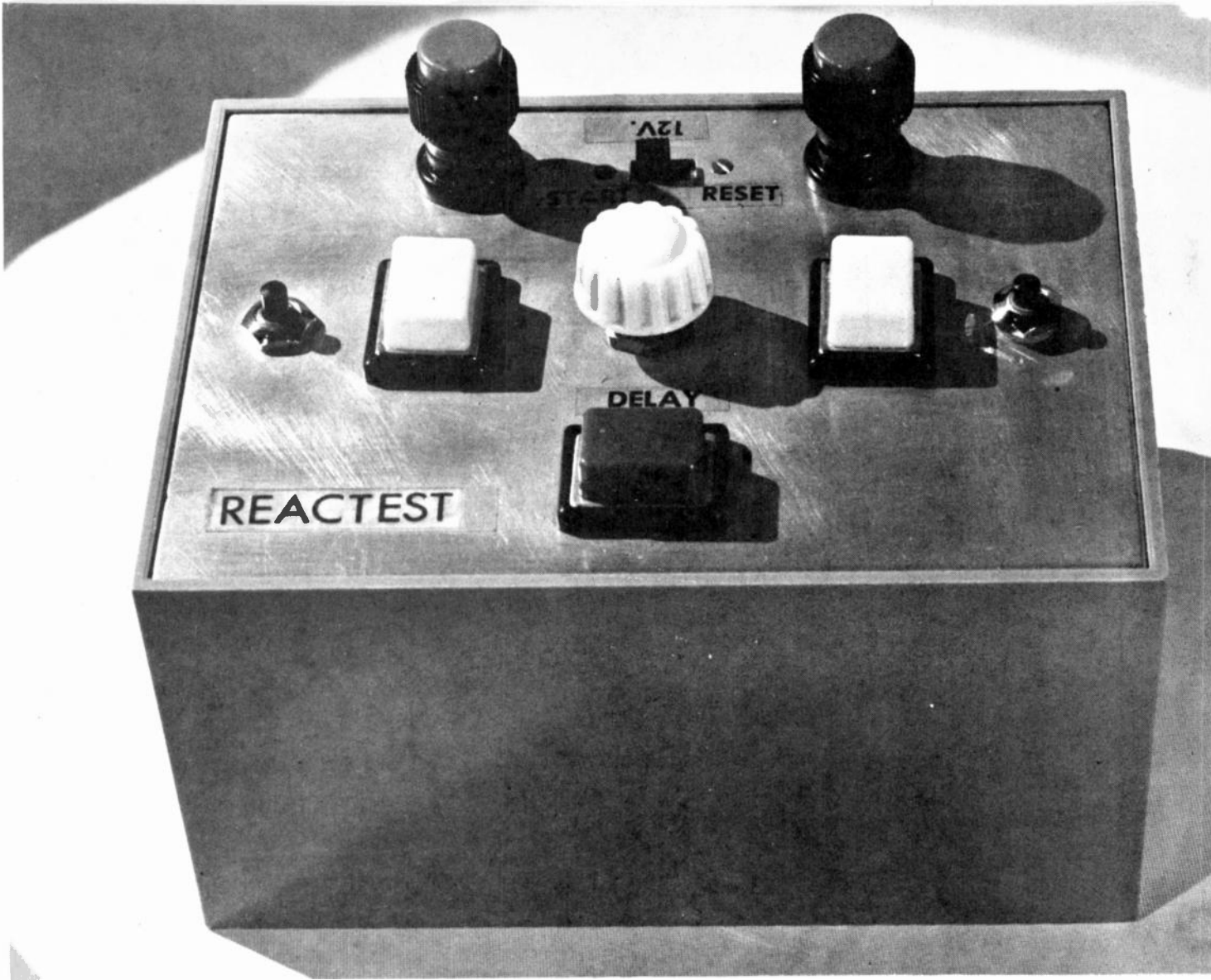


FIG. 2 Phase relationships between the four channels.

FIG. 3 The decoder synthesising process.





FASTEST FINGER IN THE WEST

ET PROJECT

So you think your reflexes are fast? — Match your reaction time against others with this easily-built device, designed by A. J. Lowe.

If you think that your reactions are 'split second', here's a gadget that'll let you prove it! It doesn't measure reaction time, but lets you compare your reaction time with that of an opponent, in a two-man contest. If you believe that your reactions aren't slowed down by alcohol; test yourself against one who hasn't touched a drop — and see.

The Reactest is shown above.

On the aluminium panel are two push buttons, each associated with a yellow pilot light; a green pilot light; a

delay control knob; and a 'Start — Reset' slide switch.

WHAT YOU DO

Contestants touch their right forefingers on the table near opposite ends of the Reactest. One of the contestants, or a third person, slides the switch from 'Reset' to 'Start'. A short, but unpredictable time later, the green light comes on. Then, and not before, each contestant tries to beat the other by operating his own push button.

FASTEST FINGER IN THE WEST

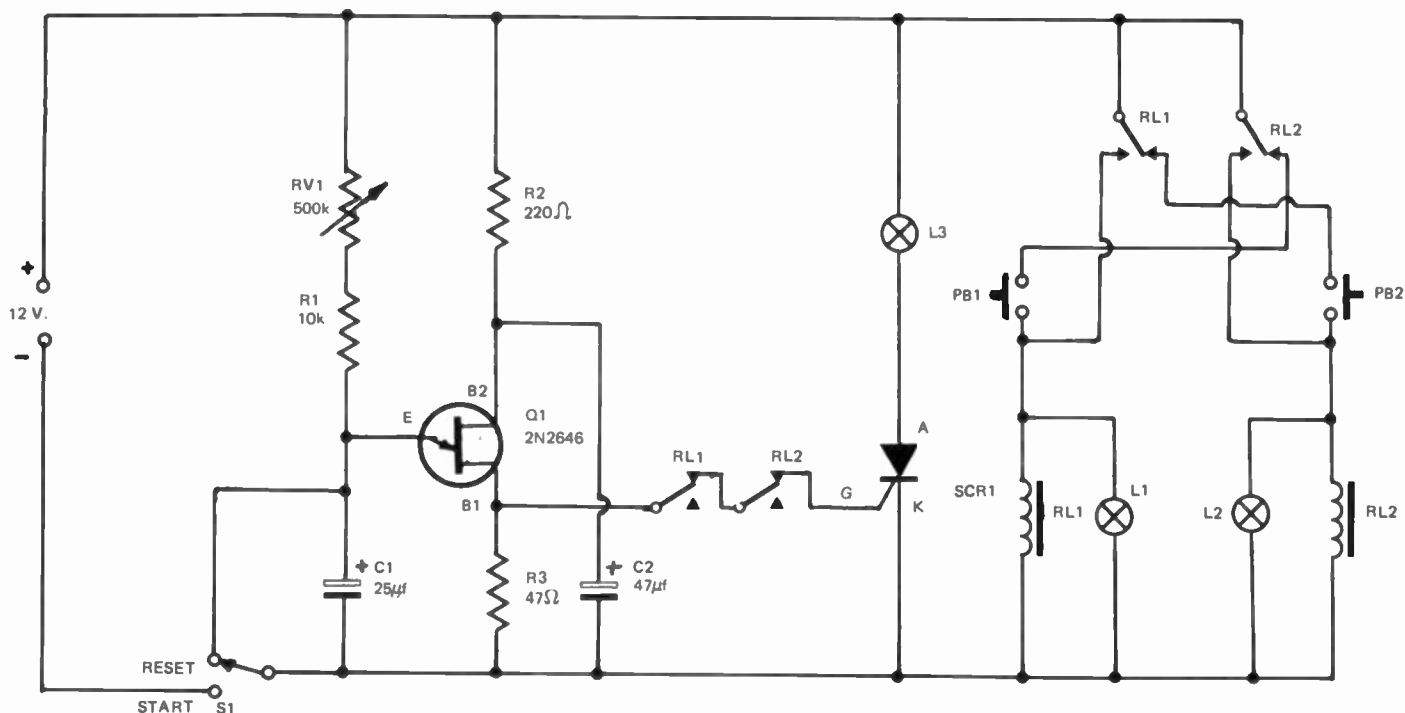


FIG. 2 Circuit diagram of complete unit.

The first to do so makes his yellow light come on. The other yellow light can not then come on, thus clearly indicating who has won. The slide switch is then moved to 'Reset', and the delay control knob 'twiddled' randomly. The contestants get into the ready position, and the slide switch is moved to 'Start' once again. This time the green light will operate after a different time delay, which may be anything from ½ second to 30 seconds or so.

The contestant who scores the best in, say ten, tries is the winner.

If a contestant gets jittery and 'jumps the gun', by pressing his button before the green light has come on, then his yellow light will still come on, but the green light will stay off — and so his early start is exposed.

CIRCUIT OPERATION

Have a look at the circuit in Fig. 2. It can be thought of two separate sections. First of all, on the right, between the positive and negative rails, are the two push buttons 1 and 2, each in series with a relay (which has a lamp in parallel with it) and the 'normally-closed' contacts on a pair of

change-over contacts, operated by the other relay. To provide a 'latching' function, the normally open contacts of the change-over set of each relay is wired to hold the relay on once it has operated. So, if push button 1 operates first, yellow lamp 1 comes on (and stays on) relay 1 operates, and this opens the contacts in series with relay 2. This prevents relay 2 operating and prevents lamp 2 coming on.

The rest of the circuit, on the left, comprises a variable timer, using a standard unijunction transistor circuit which triggers the silicon controlled rectifier SCR1, turns it on, and so lights the green lamp (No. 3).

When the main switch S1 is moved to 'Start', capacitor C1 starts to charge, and when the voltage across it is sufficient to fire the UJT Q1, a pulse is sent to the gate of SCR1, triggering it into the conducting state.

After each contest, the switch S1 is moved to 'Reset'. This discharges C1 and, of course, turns off the lamps and the relay which has operated.

It will be noted that, between base B1 of the UJT and the gate of the SCR, there are two pairs of normally-closed contacts in series. One

pair is opened by each relay. These contacts are to prevent the green light coming on if a button is pressed before the green lamp has actually lit. The operation of either relay opens one pair of contacts and so prevents the triggering pulse from the UJT reaching the gate of the SCR. In the normal contest these contacts open after the green lamp is lit, but the green lamp stays on because when an SCR is triggered it stays triggered.

It was found in the prototype that, in spite of the contacts in the gate line, if a push button were pressed just before the green light was due to come on, then the green light would be lit prematurely, (at the same time as the yellow light associated with that push button). This is caused by a slight reduction in voltage across the UJT caused when the button is pressed. To prevent this premature action, which is initiated only by those who 'jump the gun', the voltage across the UJT is stabilised by means of the capacitor C2.

CONSTRUCTION

This project can be assembled in any convenient case. The original was

housed in a plastic box measuring 5½" x 4" x 3" deep.

All the components are mounted on a piece of tagboard as shown in Fig. 3. The relays may be mounted on the same tagboard (if it is longer than shown in Fig. 3), or on the underside of the front panel by means of a small right-angle bracket.

The prototype was designed to operate from a 12 volt supply — two 6 volt lantern batteries because 12 volt relays (S.T.C.) were available. However, if constructors have a couple of matched 6 volt relays, each with

two pairs of normally-closed contacts, then the device may be run from the lower voltage. Some experimenting may be necessary with the value of R4 to ensure that enough voltage is produced across it to trigger SCR1. Lamps used must, of course, be of a voltage rating to suit the battery voltage selected. The UJT could be be any of the popular UJTs. The original used a 2N2646 in a plastic case. Any low voltage SCR with a current rating of ½ amp will do for SCR1. Once again, as SCRs vary, it may be necessary to increase the value of R4 if

the SCR is hesitant about triggering.

Care must be exercised in wiring up the relay contacts, pay careful attention to Fig. 2 and Fig. 3 and 4.

CHECKING

If the wiring is done carefully the device should work first time. However, if there is trouble, the operation and mutual blocking feature of the push buttons and relays should be checked first. If this doesn't work, carefully check the wiring of the two relays against Fig. 2.

Then check the timer circuit as a

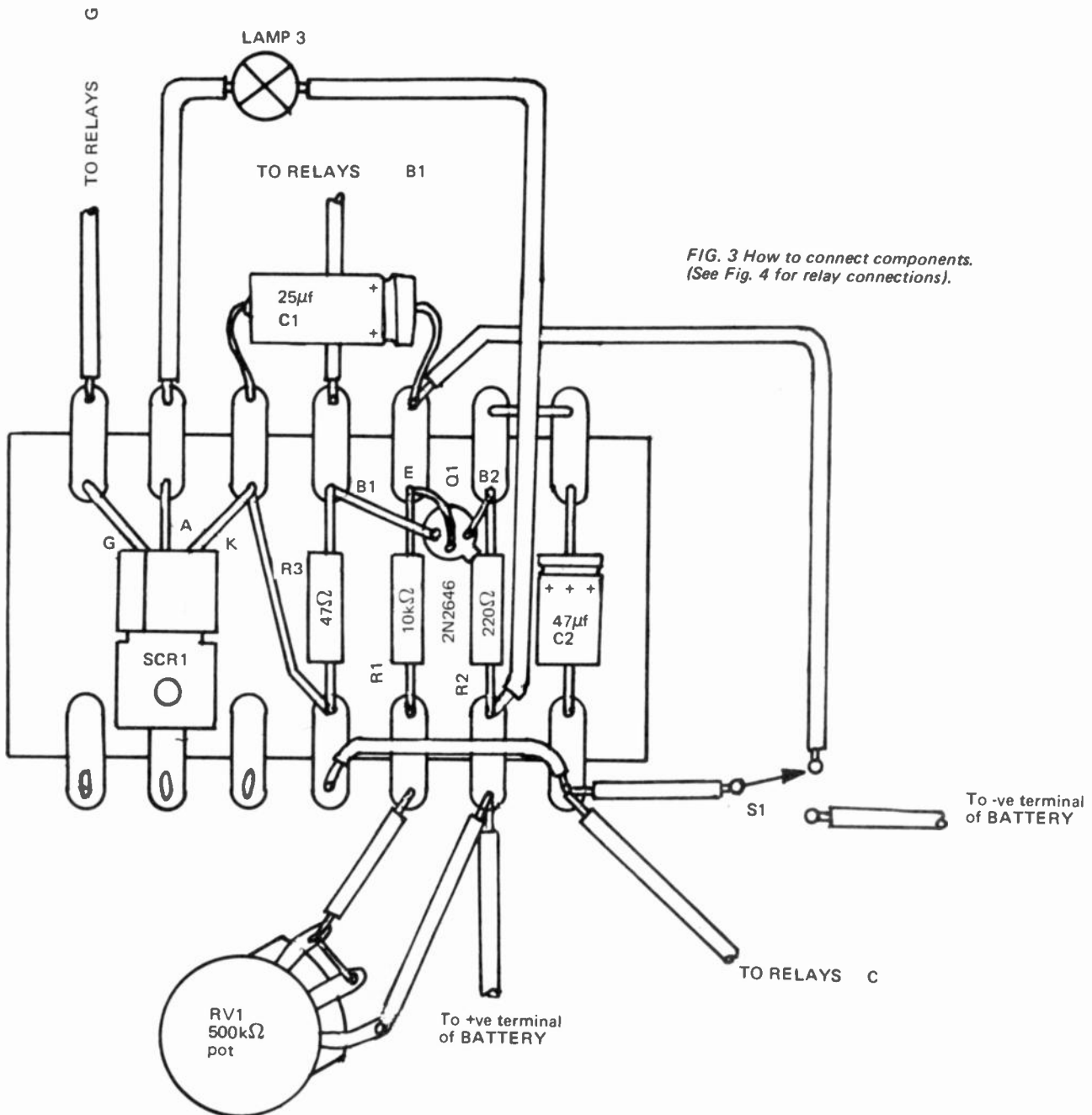


FIG. 3 How to connect components. (See Fig. 4 for relay connections).

FASTEST FINGER IN THE WEST

separate section. The minimum delay should be about 1/2 second, and this can be varied by choosing a different value for R2. Increasing R2 increases the minimum delay.

There it is — an interesting project with which you can have a lot of fun. Compare reactions of old and young, male and female, 'tipsy' and sober, smart and not so smart. Maybe you'll discover something!

PARTS LIST

- R1 potentiometer 500K
- R2 resistor 1/4 watt 10% 10K
- R3 resistor 1/4 watt 10% 220 ohms
- R4 resistor 1/4 watt 10% 47 ohms
- C1 capacitor electrolytic 20μF 25 volt
- C2 capacitor electrolytic 40μF 16 volt
- Q1 unijunction transistor 2N2646 or similar
- SCR1 silicon controlled rectifier 1RC5, C103, C106Y1 or similar
- S1 single pole double throw slide switch

Relays 1 and 2 low voltage relay with at least two pairs of normally closed contacts. IT type 240AFO 430Ω VP2 (430Ω).

Pilot lights three required — 1 green and two yellow 12 volt.

Terminals, battery, case, matrix board, wire, and two push buttons.

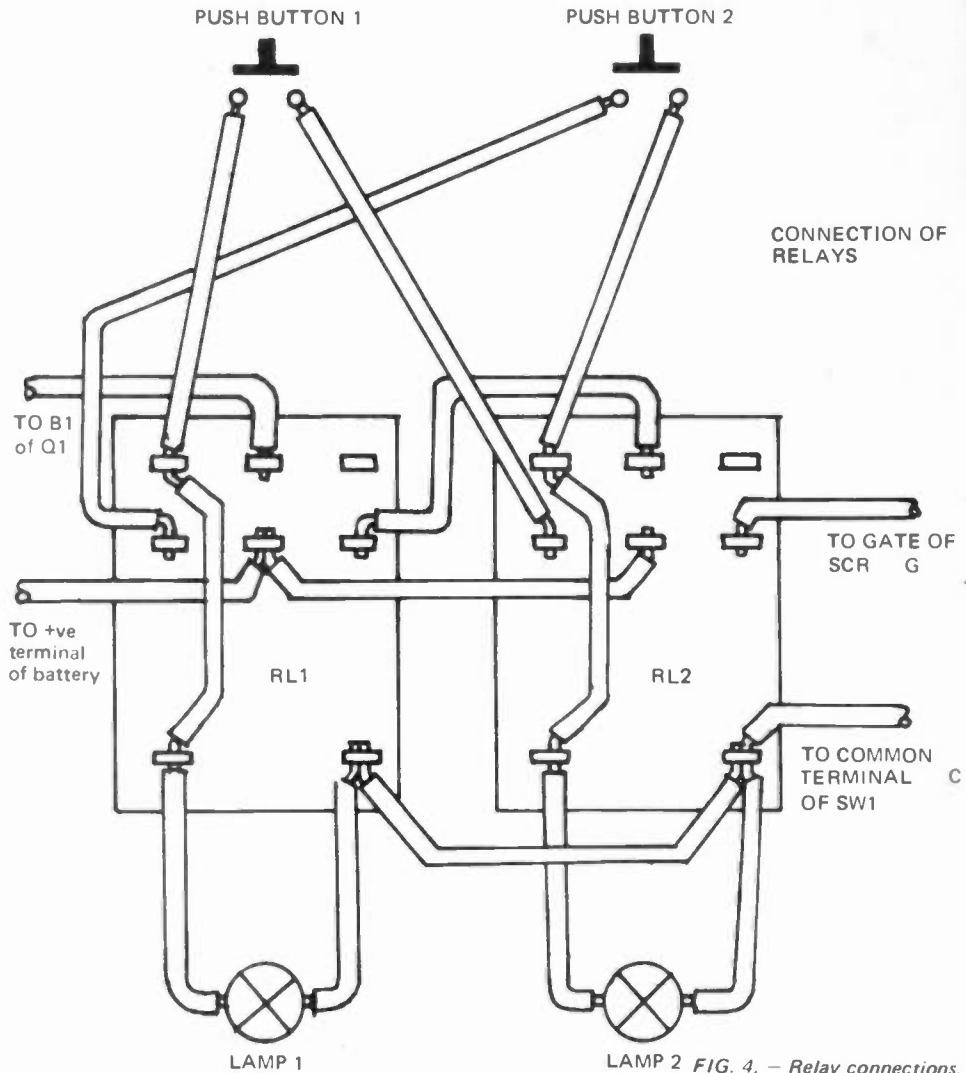
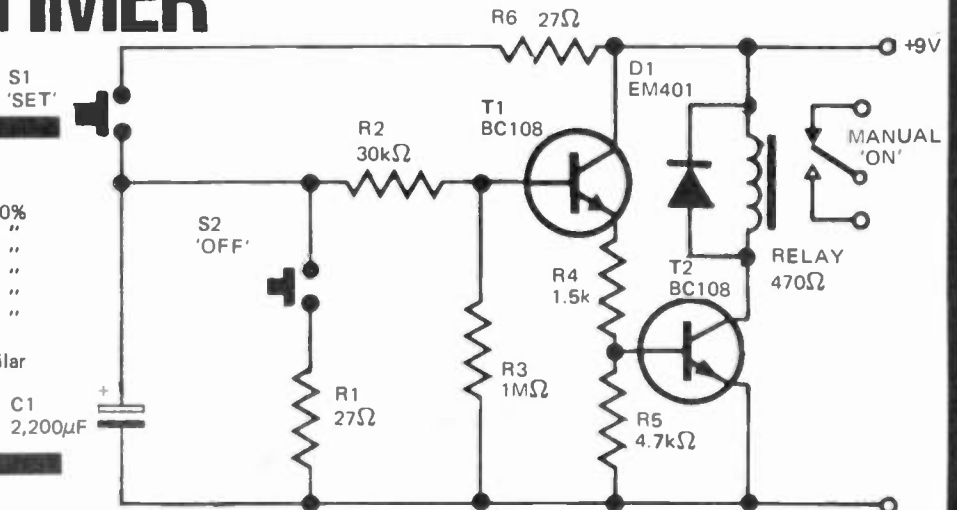


FIG. 4. — Relay connections.

ONE HOUR TIMER

PARTS LIST

- R1 — resistor 27 ohm, 1/2 watt, 10%
- R2 — " 30k " " "
- R3 — " 1.0M " " "
- R4 — " 1.5k " " "
- R5 — " 4.7k " " "
- R6 — " 27 ohm " " "
- C1 — capacitor 2,200 μf
- Q1, Q2 — transistor — BC108 or similar
- D1 — diode — EM401 or similar
- BL — relay — 470 ohm coil
- S1, S2 — push button switches



This simple time delay circuit provides time delays adjustable up to a period of one hour. If a shorter delay period is required, C1, R3 and R4 may be decreased in value. The relay is a two pole, change over type with a coil resistance of approximately 470 ohms. (This circuit was submitted by reader KR).

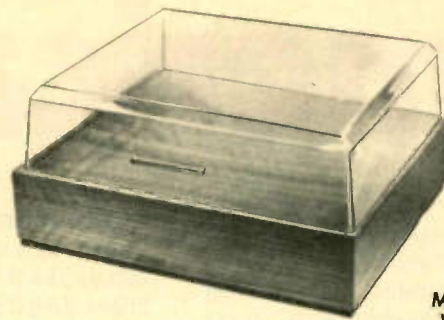
CONNECTIONS BC108

INSTROL PLAYER STANDS & PERSPEX COVERS



MODEL 65 STAND

An attractively designed de-luxe stand which is complete with hinged perspex cover. Styling of the stand includes raised side panels (2½" above player panel) and a raised rear panel (1½" above player panel). The grey tinted perspex cover features a perspex knob and measures (internal) 16½" x 13½" x 4½". Below shelf clearance is 3".
 Maple/Walnut stand \$24.00
 Teak stand \$28.00



MODEL 45 STAND WITH 415 COVER

PERSPEX COVERS

MODEL 315. Size 14½" x 15½" x 3½" outside measurements. This sleek MOULDED cover in grey tinted perspex is for use with the model 35 stand and any record player. Complete with attractive perspex knob.

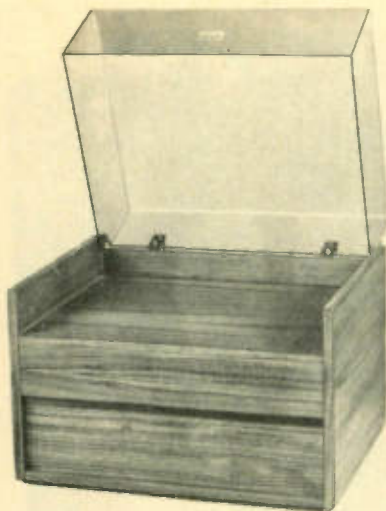
MODEL 325. Size 14½" x 15½" x 4½" outside measurements. A fabricated grey-tinted cover, ideal for record changers in conjunction with model 35 stand. Complete with attractive perspex knob.

MODEL 415. Size 17½" x 14½" x 3½" outside measurements. This attractive MOULDED grey-tinted cover is for use with the model 45 stand and any record player. Complete with sleek perspex knob.

MODEL 425. Size 17½" x 14½" x 4½" outside measurements. A fabricated grey-tinted cover, ideal for changer models in conjunction with our No. 45 stand. Complete with attractive perspex knob.

Model 315 \$9.50 Model 415 \$10.50
 Model 325 \$10.50 Model 425 \$11.50

(Extra for set of stay-up type hinges 80c)



MODEL 75 COMB' STAND

COMBINED AMP/PLAYER CABINET

This model 75 cabinet combines a player stand, attractive tinted perspex cover and amplifier cabinet (4½" x 17½"). Perspex cover comes complete with attractive perspex knob and a pair of stay-up type hinges. Cover measures 16½" x 14½" x 4½" inside dimensions. The cabinet comes as an easy-to-assemble kit of parts, both saving you money and facilitating transport. (Player panel cut to template is \$1.00 extra).

Kit of parts in Maple \$26.50
 Kit of parts in Teak \$30.00



MODEL 35 STAND WITH 325 COVER

PLAYER STANDS

MODEL 35 STAND. Size 14½" x 15½" x 3½". Complete with masonite base, rubber legs, fully veneered on all surfaces. Features attractive side panels raised by ½" from player panel.

Walnut or Maple \$9.00
 Teak \$11.00

MODEL 45 STAND. Size 17½" x 14½" x 3½". Complete with special black surround on the base, plus a masonite safety base. Fully veneered on all surfaces. Sweeping new overseas styling.

Walnut \$10.00
 Teak \$12.00

(Prices include cutting to suit template)

PACKING AND REGISTERED POSTAGE

MODEL	N.S.W.	VIC., QLD.	TAS., N.T., S.A., N.G.	W.A.
Player stand	1.80	1.90	2.40	2.70
Perspex cover	1.80	1.90	2.40	2.70
Model 75 kit	2.70	2.95	3.95	4.50
No. 65 Stand	3.50	3.95	5.15	5.90

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ADDRESS.....

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Sophisticated American

THE NAME Fisher is familiar to hi-fi enthusiasts in America, but few Australians have heard of it. The company's product range is based principally on sophisticated tuner amplifiers, straight amplifiers, and high-quality speaker systems.

The subject of this test — the Fisher XP-9C speaker system — is a little unusual in that it is the first small speaker system we have seen from America that incorporates a 15" speaker.

Over the past few months we have tested a number of systems incorporating 15" speakers, and generally only the most expensive units have provided a performance worthy of the claims made for the benefits which such an inclusion can provide.

There are numerous problems associated with placing a 15" diameter speaker in a modest-sized enclosure. Whilst we have always believed that a vented enclosure would provide a superior performance when a larger speaker is used, the past year has seen many of the leading designers in America and Japan releasing sealed enclosures which are claimed to be superior to their vented counterparts. Generally we have not found these claims to be justified — and we have wondered when we would, in fact, find a sealed speaker system incorporating a 15" speaker whose overall performance is superior to the other systems on the market.

The Fisher XP-9C is technically similar to many of the other systems we have tested; but — although we still consider that the 15" speaker has been included purely as a sales gimmick (in the same way as the eternally-published "bigger and better engines" in American cars), the system's performance has not suffered.

DESCRIPTION OF SYSTEM

This enclosure is slightly larger than other compact speaker systems we have tested, measuring 27½" high x 16¼" wide x 13" deep. The 15" speaker has the flanges on both sides trimmed to facilitate mounting. This speaker has a 2½" diameter voice coil and a 10 lb. magnet assembly

"A fine musical instrument" — that's how our testers sum up the U.S. made Fisher XP-9C speaker system.





The Fisher speaker enclosure may be used vertically as shown left, or horizontally as shown above.

MEASURED RESULTS FOR FISHER XP-9C SPEAKER SYSTEM S/N F 65807

Frequency response on axis, measured under anechoic conditions	50Hz to 20kHz \pm 6dB
Power sensitivity at 1kHz and 1 watt input:	98dB at 50 cm. on axis
Peak power handling capacity:	60 Watts
Dimensions:	27½" x 16½" x 13"
Weight:	55lb.
Price (each):	\$493 including tax.

providing a free air resonance of 10 Hz. The free air resonance frequency is, however, only of academic interest, because the mounted resonance is determined by the enclosure volume.

Between 500Hz and 1200Hz the mid-range output is provided by two conventional 5" speakers, mounted together at the opposite end from the 15" woofer.

A 2½" diameter tweeter with hemispherical diaphragm provides the output between 1200Hz and 5kHz, whilst a super-tweeter provides the output from 5kHz to beyond 23kHz.

The difference between this system and others of the same basic type is in the smoothness of the response, for, crossovers apart, this speaker produces the smoothest and flattest response we have yet seen from a *four-way* system. This smooth response is the result of the matching of sensitivities of the respective elements, both for the range of frequencies and for absolute acoustical sensitivity.

As can be seen from the level recording, the output is \pm 6dB from 50 to 20kHz. This is undoubtedly one of the flattest responses we have seen

from any enclosure costing under \$500.

The enclosure is constructed from ¾" thick walnut-veneered particle board. The back of the cabinet is epoxy-filled, sealed and polished, while the inside of the enclosure is filled with a special low-density fibreglass blanket called Acoustiglas. We are unable to rate the merits of acoustiglas compared with other infill but believe that a low-density fibreglass infill of this type is superior to the bonded acetate linings previously used — and we have used

Sophisticated American



Fisher XP 9C speaker enclosure with grille removed.

components above 5kHz are extremely directional, the overall directivity performance on normal programme material is essentially within the 120° angle of sound dispersion claimed.

We played a number of pieces of music from our standard test repertoire and found the performance superior to most other speakers we have tested. The sound is cleaner, with an apparently lower degree of distortion and variation in response level than we have become used to hearing. This may not be liked by everyone who hears these speakers for the first time but will be appreciated almost automatically by people accustomed to listening through high-quality headphones.

The bass response is conventional, and we could not subjectively pick the difference between the 15" speakers used in the XP-9C and the 12" speakers in our studio control monitors. We must note, however, that there was absolutely no trace of frequency doubling or apparent speaker break-up on passages which we played at levels above 50 watts peak power.

The XP-9C is one of the finest moderately-priced speaker systems we have had the pleasure to listen to. The designers have excelled themselves in developing speakers that produce so smooth a frequency linearity. The overall combination of speakers, crossover networks and cabinet has resulted in a combination which can only be compared to a fine musical instrument.

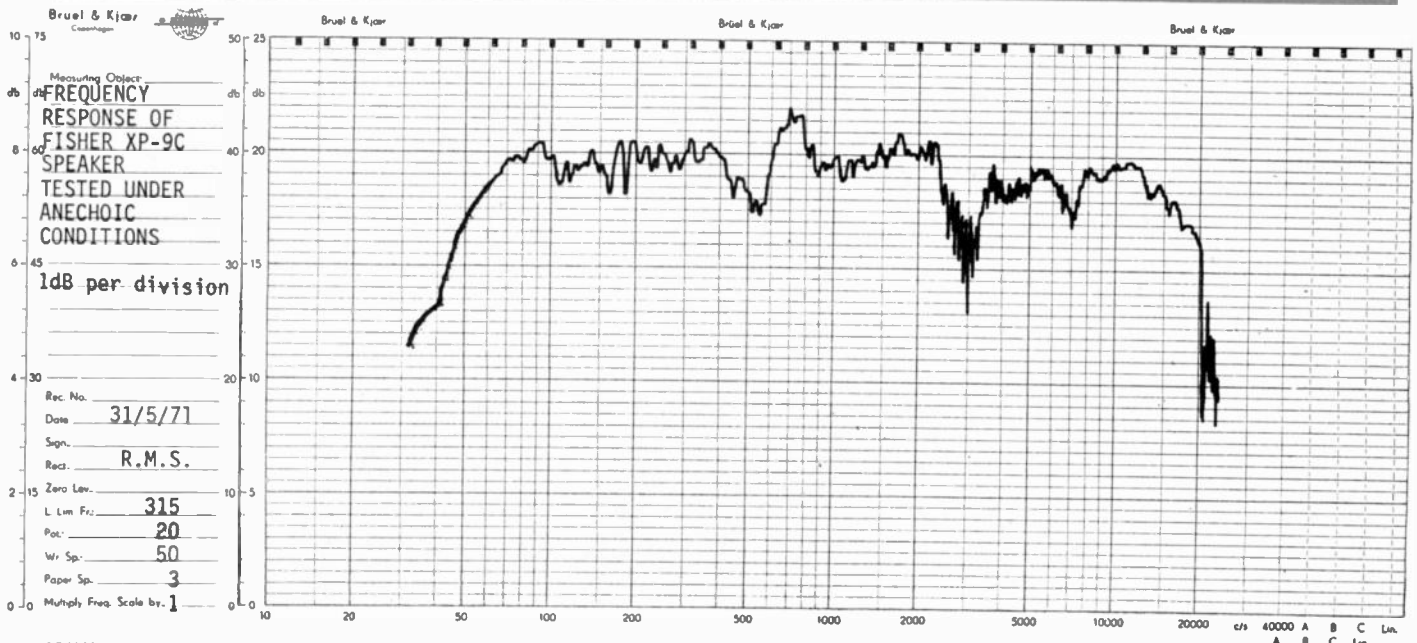
such an approach in our own laboratory speaker enclosure for some time.

The speaker grille is covered with an unobtrusive woven, gold-coloured cloth. Whilst this may suit some buyers, it is becoming apparent that speaker manufacturers could well offer the public the option of various shades of grille cloth.

LISTENING TEST

The most exacting test of a speaker is subjective listening — and this is where the Fisher XP-9C really shows the results of the smooth frequency response.

There is a remarkable lack of colouration, and the high frequency response is superb. Whilst those



DRAKE MODEL SPR-4 COMMUNICATIONS RECEIVER



All Solid State. Drake engineering and the recent development of the dual gate FET make possible the first no compromise solid state receiver. Unlike receivers with bipolar transistors which have poor cross-modulation, inter-modulation, AGC, and overload performance; the SPR-4 has signal handling capabilities superior to the best tube receivers. In addition, the SPR-4 has all of the advantages of a solid-state design such as low power consumption, mechanical and thermal stability, reliability, etc.

SPECIFICATIONS:

Frequency Coverage: Can be programmed with accessory crystals for 23 ranges (each tuning a 500 kHz band) from .5 to 30 MHz plus 150 to 500 kHz. Crystals supplied with the receiver allow coverage on these ranges: 150-500 kHz, 5-1.0 MHz, 1.0-1.5 MHz, 6.0-6.5 MHz, 7.0-7.5 MHz, 9.5-10 MHz, 11.5-12 MHz, 15-15.5 MHz, 17.5-18 MHz, 21.5-22 MHz.

Modes of Operation: AM, CW, SSB (upper and lower).

Selectivity: AM—4.8 kHz at 6 dB, 10 kHz at 60 dB.
SSB—2.4 kHz at 6 dB, 7.2 kHz at 60 dB.
CW—0.4 kHz at 6 dB, 2.7 kHz at 60 dB.

Intermediate Frequencies: 1st IF 5645 kHz four pole crystal lattice filter, 2nd IF 50 kHz four pole hi-Q Ferrite LC filter.

Frequency Stability: At room temperature, drift for all causes (including plus or minus 10% change in supply voltage) is less than plus or minus 100 Hz.

Sensitivity: SSB and CW: .25 microvolt gives 10 dB S plus N/N, AM: .5 microvolt with 30% Mod gives 10 dB S/N.

Automatic Volume Control: AVC is used on AM, CW, and SSB. Time constants are selected for the optimum effectiveness on each mode.

Audio output: is held constant to 3 dB over a 100 dB range of input signals.

Input Impedance: 50 ohms approximately (higher impedance 150 kHz to 1500 kHz).

Output Power: 3 watts into 4 ohm load (less into higher impedance loads).

Power Consumption: 18 watts on 240 VAC or 5½ watts on 12 VDC, 2 watts on 12 VDC dial light off.

Calibration: Dial is accurate to better than plus or minus 1 kHz when calibrated at nearest 100 kHz calibration point.

Hum and Noise: More than 60 dB below rated output.

Size and Weight: 5½ in. H x 10½ in. W x 12½ in. D. Weight: 18 lb.

\$520 Ex Stock plus Sales Tax.

Accessories include plug-in crystal calibrator, plug-in noise blander, loop antenna, etc.

Also available other famous **DRAKE Receivers and Transceivers, including SW4A, R4B, TR4, etc.**

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The PACE DATALOGGER is a self-contained compact data-logging system, capable of accepting up to 100 signal inputs, designed to satisfy the needs of the majority of data-logging applications at minimum cost.

DATALOGGER'S input facilities are designed for use with Thermocouples, Strain Gauges, Pressure Transducers, Resistance Thermometers and other similar transducing elements employed for monitoring parameters throughout research and industry.

Typical of the many industrial and research applications are:

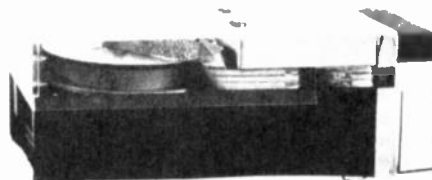
Biological Studies
Chemical Analysis
Engine Testing
Metallurgy
Metrology

Oceanography
Plant Design
Steel Processing
Structural Design
Tribology

- ★ OFFICE AUTOMATION: Adding Machines; Typewriters; Accounting Machines; Cash Registers.
- ★ Interfaced to all computers.
- ★ Data communications.
- ★ Automatic control of machinery.
- ★ Output from Dataloggers.
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First Australian test of the Drake R-4B and SPR-4 communication receivers.

DRAKE'S



electronics TODAY

scoop test

The largest and most energetic fraternity of amateurs in the world is that of the United States.

There, amateurs enjoy greater freedom than elsewhere and have the ability to buy some of the best radio equipment manufactured in the world. Regretably, most of this equipment is not readily available in Australia as the market is small, and the prices are high due to non-preferential duty and high taxes.

The little equipment that is imported is usually sold on indent or before it is even landed and so is seldom available for testing. Fortunately, two Drake communications receivers became available for review just before we went to press and although we were short time we decided that it was an opportunity not to be wasted, for the

R. L. Drake Company is well known and respected and their reputation stands high.

The two receivers tested were an R-4B, a hybrid valve/transistor receiver intended primarily for amateur use; and the newer SPR-4, a fully transistorised receiver intended both for communication and amateur use.

THE R-4B

The R-4B was the first receiver of the two that we put through the hoops. It is a compact double-conversion receiver with a host of operational features calculated to please the most sophisticated amateur (or professional).

The front panel is divided by a bold two colour treatment into two areas, the upper being light grey and the lower dark grey.

The upper area contains a large illuminated S meter, a function knob for *off/standby/on/external mute/noise blanker/calibrate*, a passband selector lever for 0.4, 1.2, 2.4 and 4.8 kHz bandwidths and a concentric knob for upper and lower sideband. A precision geared drive on the right-hand side controls a 500 kHz

bandwidth tuner. This is calibrated in 1 kHz but divisions can be accurately read to 250 Hz.

The lower section of the front panel has controls for selecting any of five crystal controlled amateur bands, 3.5-4, 7.0-7.5, 14.0-14.5, 21.0-21.5 and 28.5-29.0 MHz (for which crystals are supplied), and a control for selecting ten additional but optional crystals for 500 kHz ranges between 1.5 and 30 MHz (except between 5.0 and 6.0 MHz).

Other controls are a preselector, an RF gain, variable notch filter, a mode selector (*for AVC off, fast AVC, slow AVC, SSB/CW, and AM*) an RF gain control and AF gain control.

A control on the side of the receiver enables fixed frequency crystal operation to be selected. Also on the side is an S meter zero adjustment, a notch filter adjustment, and a phone jack.

On the rear of the receiver, sockets are provided for accessory power output. There is also an injection socket for transceiver operation, a mute jack for transmitter controlled operation, an Anti-Vox socket for use with transmitters whereby voice

PROGRESS

transmission can be inhibited, a speaker output for impedances down to 4 ohm, and an RCA coaxial type antenna connector.

The internal circuitry of the R-4B is both unusual and practical. The receiver uses ten valves, ten transistors, and seventeen diodes. There are also two JK flip-flop integrated circuits in the double binary division of the frequency calibrator.

INPUT STAGE

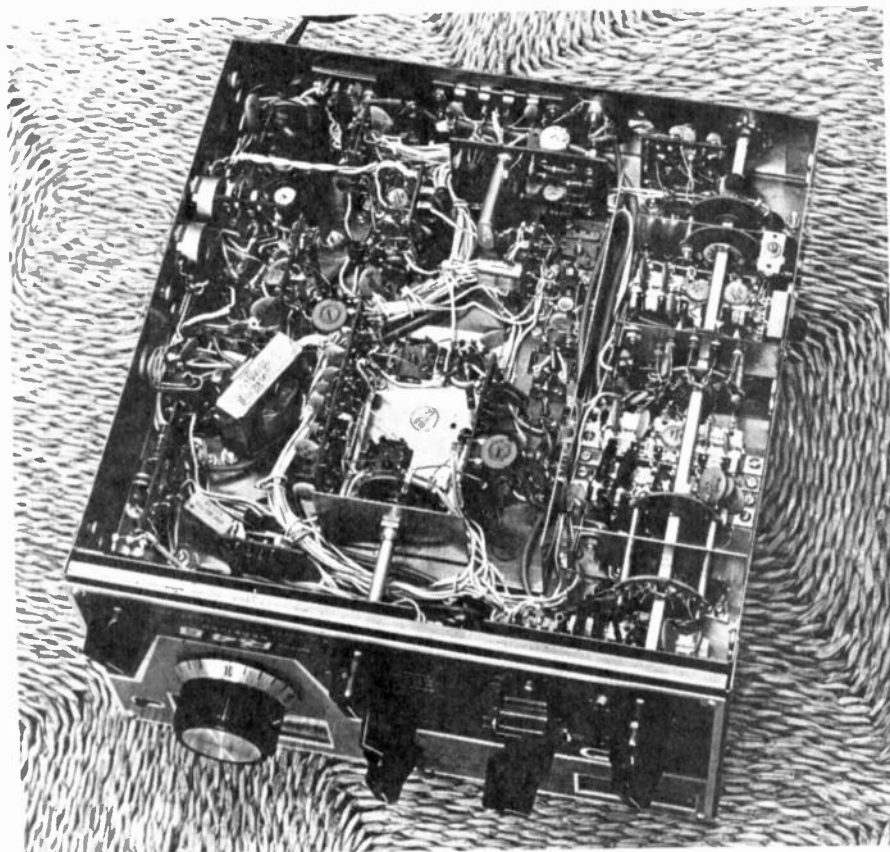
The input stage consists of a permeability-tuned transformer, tuned pre-selector, and associated RF amplifier. This is followed by a transistorized permeability-tuned V.F.O. (variable frequency oscillator) a crystal controlled oscillator, and a pre-mixer valve.

The variable frequency oscillator is tunable from 4955 kHz to 5455 kHz whilst the crystal frequency is selected so that the difference obtained by heterodyning the output of the V.F.O. will always be 5645 kHz higher in frequency than the desired signal frequency.

The first mixer is coupled through the permeability-tuned pre-mixer output coils and is heterodyned with the RF amplifier to provide the difference frequency of 5645 kHz which is passed through a crystal filter to the second mixer.

The second mixer control and screen grids are connected as a Pierce type oscillator which is crystal controlled to operate at 5595 kHz, the resulting output is then the 50 kHz difference frequency.

The 50 kHz output is fed via



permeability-tuned T notch filter to the first IF amplifier. The IF amplifier has an IF tuner incorporating four high Q, LC circuits which utilise gauged permeability-tuning to obtain four bandwidths of 0.4, 1.2, 2.4 and 4.8 kHz at the 6dB points.

The second IF amplifier is followed by a fixed tuned transformer stage and the detection circuits.

When in either the SSB or CW positions, the beat frequency oscillator is activated. This produces a 50 kHz signal which is applied to a product detector and heterodynes with the 50 kHz signal from the second IF output stage. With the receiver in the AM mode the beat frequency oscillator is off and an AM detector and amplifier is activated.

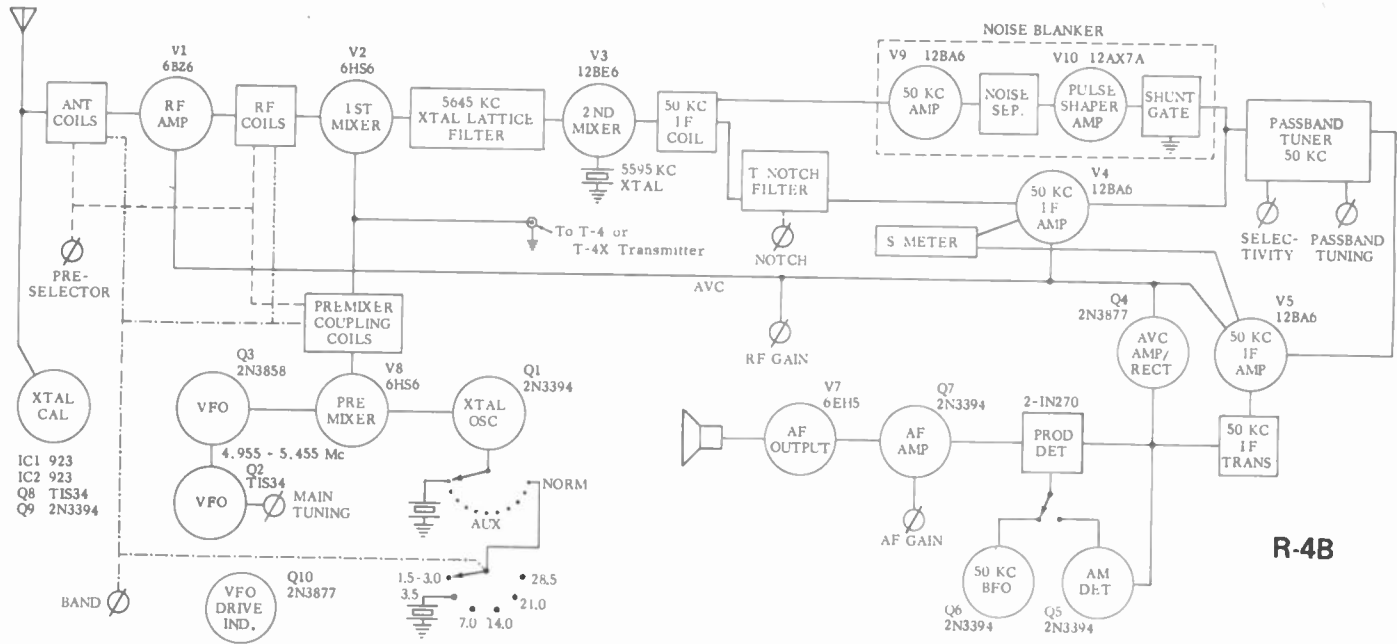


ABOVE:
Underside view of the R-4B shows excellent accessibility of all components.

LEFT:
Drake R-4B receiver — the speaker to the left of the receiver is standard equipment.

Switching Waveforms

DRAKE'S PROGRESS



R-4B

The automatic volume control system uses two transistors to provide a fast actuating circuit with a time constant of approximately 25 milliseconds and a slow actuating circuit with a time constant of approximately 750 milliseconds.

The output of the second mixer is also coupled into an effective noise blander circuit which when actuated by a noise pulse, significantly above the received signal level, shunts the output of the first IF amplifier to ground whilst the level of the noise pulse is maintained.

To provide accurate frequency calibration on each revolution of the main dial the 100 kHz signal is divided by the two micro-logic 923 JK flip-flops to provide a clean 25 kHz square wave with harmonic output suitable for calibrating to beyond 30 MHz.

The audio output stage is a class A amplifier valve arrangement with an output transformer wound for a 4 ohm load.

The receiver comes complete with a detailed 38 page handbook and excellent circuit diagram and crystals for the amateur bands. An added feature is the inclusion of a set of cable marking tags for attaching to each end of the cables used in any possible set up.

THE SPR-4 RECEIVER

The SPR-4 receiver has many similarities to the R-4B including

permeability-tuning but has been designed with a different end user in mind.

Firstly, it is all solid-state from the new dual gate MOS FETs (field effect transistors) to the audio output transistors. Secondly, it has the ability to tune from 150 kHz to 30 MHz (depending on the crystals selected) for marine, general purpose amateur or communication work. Thirdly, it is designed for mains or battery powered operation and on 12VDC only needs 2 watts of power (when the dial lights are switched off).

The two colour treatment on the front panel of the SPR-4 is similar to that of the R-4B.

The upper section of the front panel contains the S meter, a frequency preselector range switch for selecting the crystals and which simultaneously indicates the preselector position and range switching, the main tuning dial and the preselector.

The lower section contains the range switch for tuned circuit adjustment, the concentric RF/AF control, the mode selector and the concentric function selector and the notch filter.

The circuitry is almost the same as that of the R-4B receiver including the crystal filters and permeability-tuning. Transistors are used for all operational tasks of mixing where ordinary transistors seem to be at a disadvantage. To compensate for this normal deficiency, Drake have made use of dual gate FETs (MFE 3007's)

which they claim have improved cross modulation, intermodulation, and AGC performance. We found their claim to be justified.

The circuitry makes clever use of MOS FETs to duplicate the grid control performance and impedances of valves. Whilst a long tail pair is used for the first mixer, the other mixers and IF amplifiers are all dual gate FETs.

The major difference between this receiver and the R-4B is the audio amplifier which uses 7 transistors in a 'single ended' push-pull circuit. The main receiver uses 28 transistors and 21 diodes, an additional two transistors and 2 diodes are used to plug in 100 kHz calibrator and 14 transistors and 2 diodes in the plug-in 5-NB noise blander.

The handbook supplied with the SPR-4 is only 13 pages in length and is too brief to be of real technical value.

The receivers drift when initially switched on. This is to be expected and despite the drift both the receivers are immediately usable. The initial rate of drift is typically at a rate of 100 Hz per 15 minutes but this drops to 80 Hz per hour for the R-4B after two hours warm up and 75 Hz per hour for the SPR-4 after one hour warm up. The frequency stability of the SPR-4 is slightly better for intermittent mobile use and its total drift in the first hour of operation was only 300 Hz. This is particularly good.

The sensitivity of both receivers is good and well within the

communication receiver class:

Receiver Signal to Noise Ratio on AM at 1μV
Frequency: R-4B SPR-4

3.750 MHz	8dB	14dB
7.075 "	7dB	13dB
14.100 "	7dB	14dB
21.250 "	8dB	14dB
28.750 "	7.5dB	13dB

The SSB sensitivity of both receivers provided better than 9dB signal to noise ratio at all frequencies for 0.25 μV signal level.

The noise factor of both receivers is better than most communications receivers, being typically 4dB on AM at 4.8 MHz for the SPR-4, and 5dB for the R-4B.

The term *Noise Factor* is often misunderstood as it is a measure of the added noise provided by the internal circuitry of the receiver. Most other communications receivers which we have tested have been unable to provide an overall noise figure of less than 4dB.

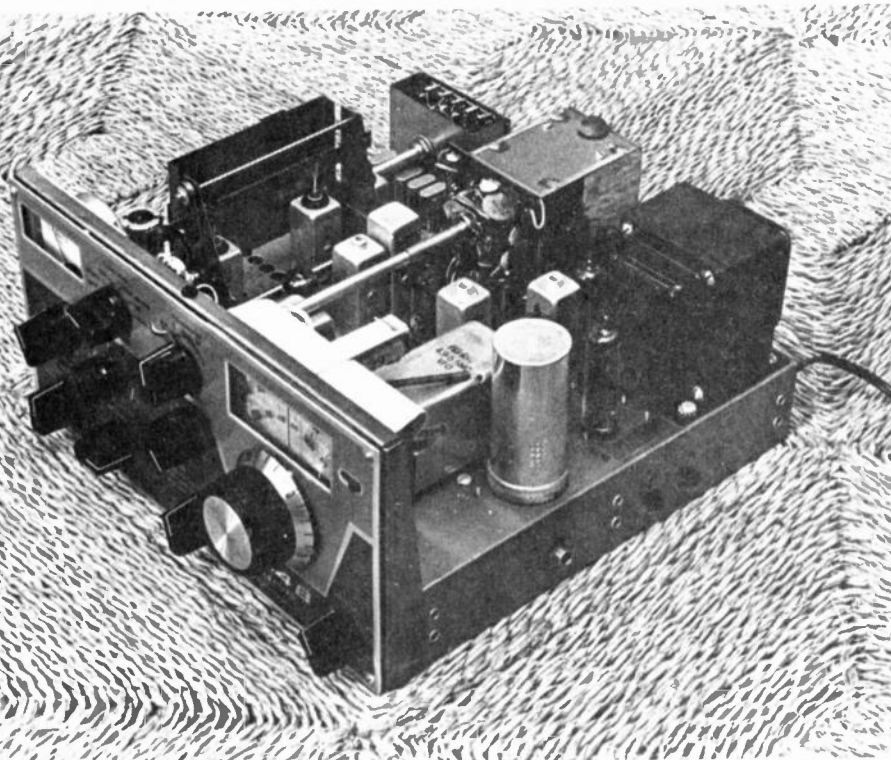
The IF selectivity is excellent and both receivers had the following basic performance:

Nominal bandwidths	Actual bandwidths at the 6dB points & 60dB points	
4.8kHz	4.8kHz	10kHz
2.4kHz	2.4kHz	7.2kHz
1.2kHz (R-4B)	1.2kHz	4.9kHz
400Hz	400Hz	2.7kHz

The image rejection of both receivers is 80dB for both the first IF and second IF, whilst the handbook conservatively claims "over 60dB".

The S meters for both receivers were checked out and whilst the SPR-4 was in order the R-4B was not correctly adjusted. The actual adjustment is not complex but we didn't attempt to play with it.

The sheet metal cover of the R-4B is easily removable.



Measured Results for DRAKE SPR-4 S/N 493 and R-4B S/N 10865 R

	SPR-4	R-4B
Frequency Coverage As supplied	150 - 500kHz .5 - 1MHz 1 - 1.5 " 6 - 6.5 " 7 - 7.5 " 9.5 - 10 " 11.5 - 12 " 17.5 - 18 " 21.5 - 22 "	3.5 - 4 MHz 7.0 - 7.5 " 14.0 - 14.5 " 21.0 - 21.5 " 28.5 - 29.0 "
Selectivity 6dB Bandwidths	400Hz, 2.4kHz, 4.8kHz	400Hz, 1.2kHz 2.4kHz & 4.8kHz
Sensitivity AM SSB	0.5μV for 8dB S/N 0.25μV for 10dB S/N	1μV for >7dB S/N 0.25μV for >9dB S/N
Spurious Rejection Spurious Signal	Image Rejection 80dB Less than 0.25μV equivalent signal on all ranges tested for both receivers.	Image Rejection 80dB
Frequency drift after 1 hour warm up A.V.C.	less than 75Hz/hour effective above 6μV	less than 100Hz/hour effective above 5μV
Audio output at A.V.C. threshold for 30% modulated signal	0.75 watts 19 watts	0.55 watts 58 watts
Power consumption 240V	10.75" wide x 5.5" H. x 12.5" deep 18 lbs	10.75" wide x 5.5" High 12.5" deep 16 lbs
Price R-4B	- \$615 plus sales tax	
" SPR-4	- \$520 plus sales tax	

The S Meter's sensitivities were as follows:

	SPR-4	R-4B
S1	1 μV	1 μV
S2	5 "	1.8 "
S3	9 "	2.5 "
S4	14 "	4 "
S5	22 "	5.6 "
S6	32 "	10 "
S7	50 "	20 "
S8	70 "	40 "
S9	100 "	70 "
+20dB	1 mV	
+40dB	22 mV	
+60dB	120 mV	

The A.G.C. action on both receivers was very good. For the SPR-4 it commences at 6 μV and holds the output within 3dB up to 100 mV and to within 6dB up to 560 mV input. For the R-4B the A.G.C. commences at 5 μV. It holds the output within 3dB up to 5 mV, and 8dB up to 500 mV.

Neither receivers has any vices in tuning in SSB, AM or CW and in each case the notch filter nulls out single frequency carriers as if they didn't exist.

During field trials out of Sydney both receivers proved to have excellent performance on both the amateur bands and the marine bands. There are only a few features which we didn't like.

Firstly we do not feel that double concentric controls are practical. The early Collins 51J4 receivers featured a lever control similar to that used by Drake and this proved to be troublesome.

Secondly the application of a concentric audio/RF control as found on the SPR-4 does not please most users searching for a low level signal.

Thirdly when used at high levels the internal speaker on the SPR-4 caused microphonics in the permeability tuners, so it was obvious that the use of an external speaker, or phones is essential.

There may be better receivers around, but these receivers would undoubtedly be two of the best general purpose tuneable receivers that we have yet seen for amateurs, coastal radio or general purpose communication work.

SUPER DYNAMIC



'A new tape with significantly different performance' – this exclusive Electronics Today test explains why.

The manufacturers of magnetic tapes have made many advances since the first magnetic tapes were developed some thirty years ago. With these developments have come a number of break-throughs in the design of tape recorders and each new development of tape seems to lead to a new development in recorders and so on.

Magnetic tapes exhibit pronounced non-linear characteristics because the magnetisation is not directly proportional to the strength of the field. This non-linearity has to be circumvented to prevent gross distortion of the recorded signal. The technique used to preclude this distortion is to superimpose a high frequency bias current through the recording head at the same time as the recording signal is injected.

Because the frequency of this signal is (typically) between 80kHz and 100kHz, its effect on play back is nullified as neither the recording head, playback amplifier, speakers, nor the human ear respond to such high frequencies.

The output signal and dynamic range are determined by the shape of the transfer curve as shown in Fig. 1, and by the degree of optimisation of the bias signal level as shown in Figs. 2 and 3. No tape recorder is perfect with all available tapes and for optimum results careful selection may be necessary.

The testing of tapes creates many problems, not because of the actual measurement required but because of the method of testing. Tapes can only be given a figure of merit by comparison with other tapes with known physical performance. This is because whilst it is possible to measure the absolute parameters of a tape, such as coercivity, retentivity, particle size, squareness ratio and many other properties, these parameters do not provide an actual usable result for the intending purchaser.

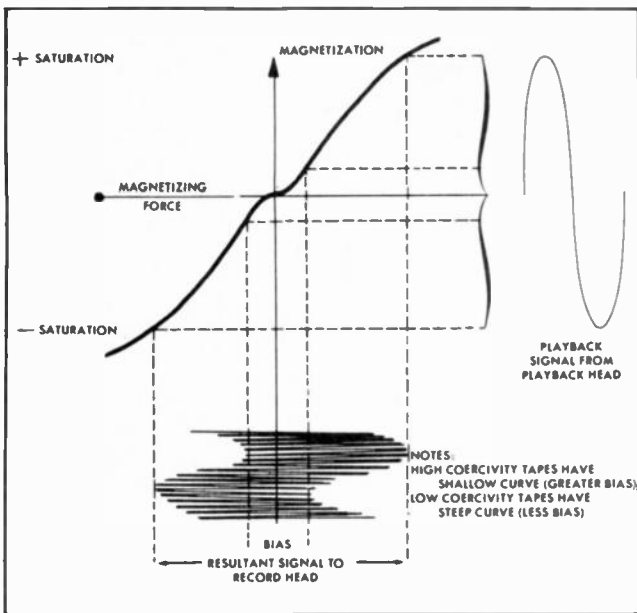


FIG. 1 RECORDING TAPE TRANSFER CURVE

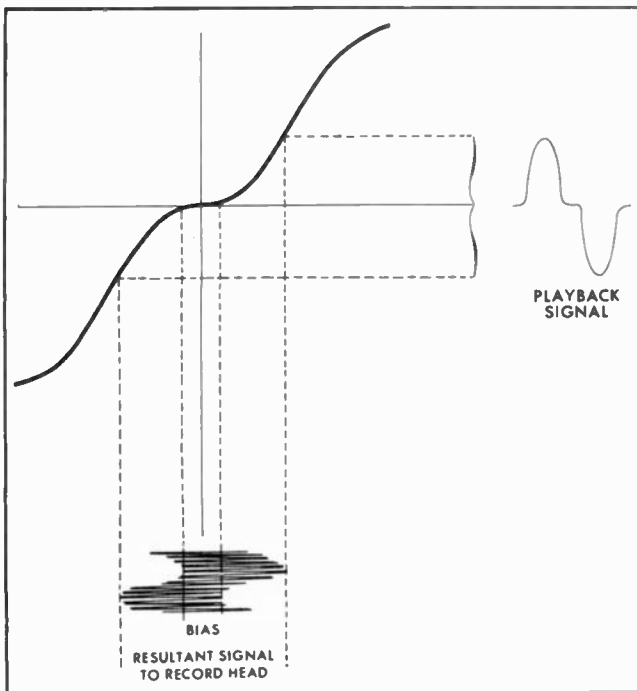


FIG. 2 UNDER BIAS CONDITION

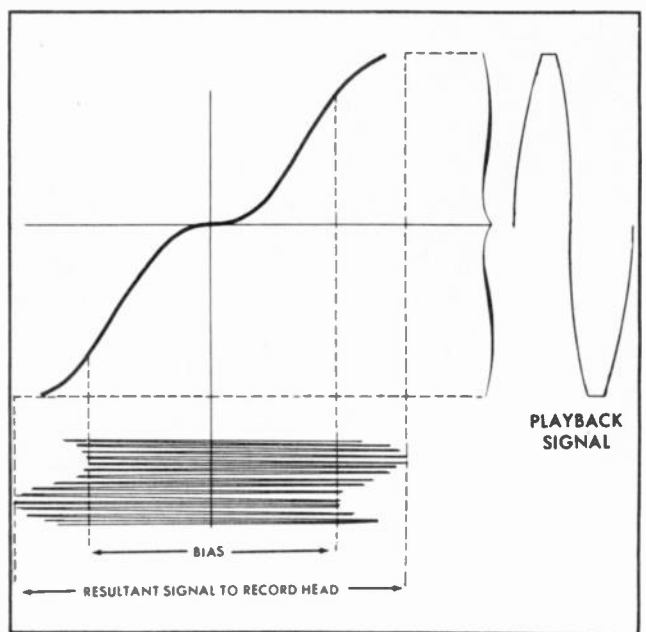


FIG. 3 OVER BIAS CONDITION

TAPE TDK-SD 150H recording tape

The parameters in which he is interested are the signal-to-noise ratio, bias requirements, frequency response and dynamic range. These parameters are all largely tied back to the parameters of the tape recorder used for testing, the track width, tape speed, bias frequency, head gap, etc.

TAPES COMPARED

The only really acceptable method of testing is to compare two or more tapes. The problem is which tapes to use for comparison.

The tapes we chose were the BASF LGS 35 and the Scotch 203. These are both widely accepted tapes and the chances are that if you take your recording seriously, you will have at least one of them. A further reason for the choice of these reference tapes is that most taperecorders are adjusted for one particular brand of tape. In the past few years, Scotch 203 or BASF LGS35 * have been commonly used for this purpose.

If the bias on the machine cannot be adjusted, then the results that can be achieved with preset bias are those which are of most relevance to the user. Our testing procedure was to use a semi-professional tape recorder which had a fully adjustable bias signal with a frequency of 100kHz. The track width was 2.3mm (¼ track) while the record head gap was 65µm. We chose a tape speed of 7½ ips since we felt that this was the most important speed for critical non-professional users.

In appearance the TDK-SD 150H tape is very similar to Scotch 203 but that's where the similarity ends for this is a new tape with significantly different performance from other tapes that we have tested. Not only is the surface finish far better than previous (standard) TDK tapes but the

* LGS35 has now been superseded by LP35 and is consequently no longer marketed.



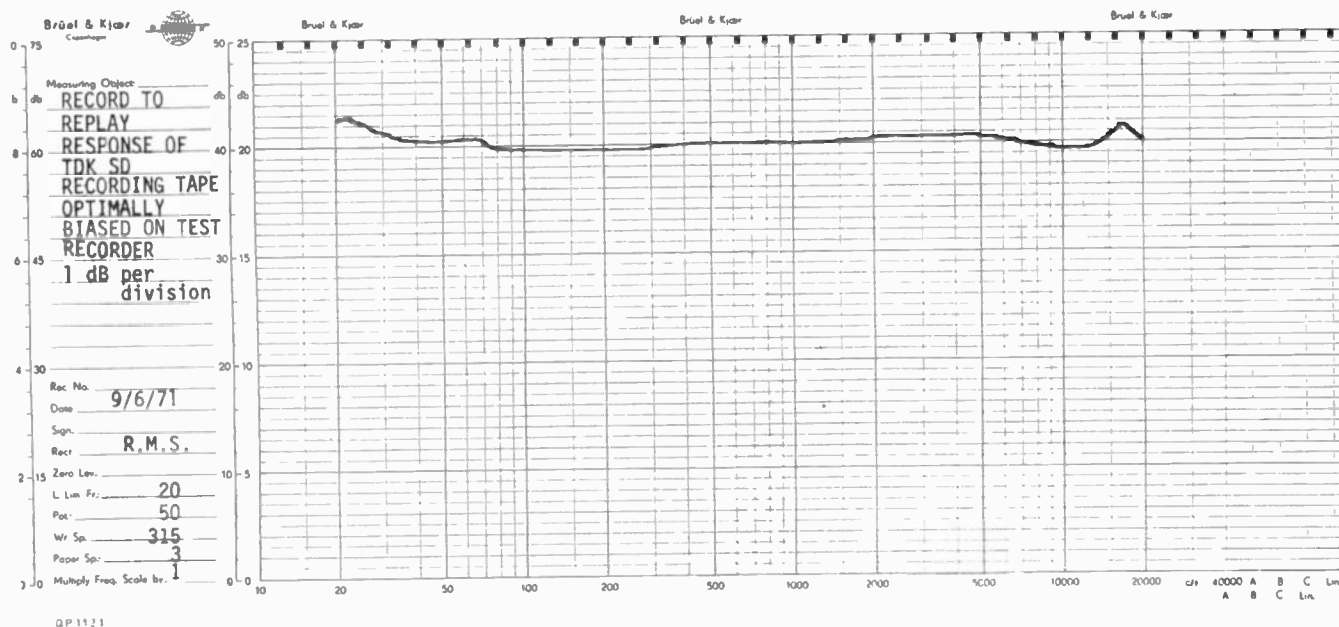
relative output is higher than other low noise tapes that we have tested. Also the coercivity of the magnetic particles is apparently higher, and the magnetic particle size is stated to be lower than that used conventionally.

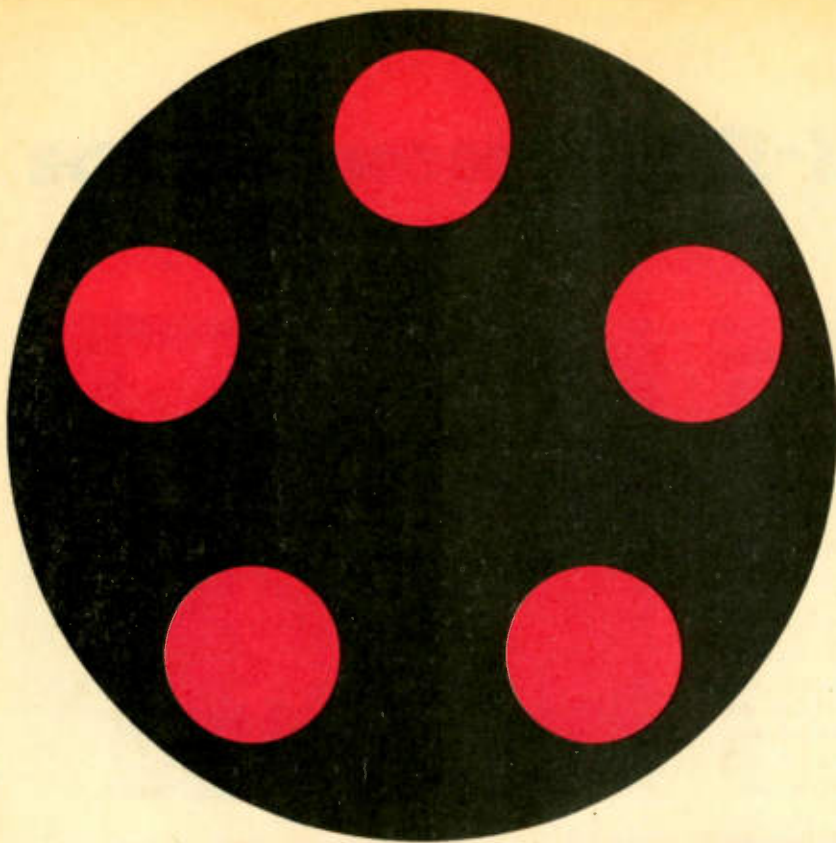
Testing proved that this tape offers a number of definite improvements over other conventional tapes. The first of these is that its output level is 2½ dB above that of the Scotch 203 which we used as the basic reference.

GOOD SIGNAL NOISE RATIO

The dynamic range is slightly greater, being 2 dB greater than the best of other tapes tested and up to 5 dB greater than LGS35. The signal-to-noise ratio is 1 dB better than

(Continued on page 75)





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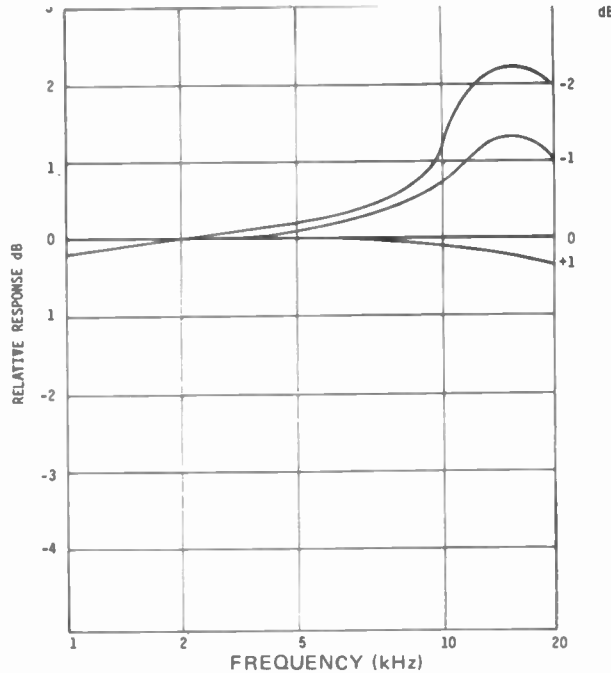
SUPER DYNAMIC TAPE

the Scotch 203 and 5 dB better than the LGS35.

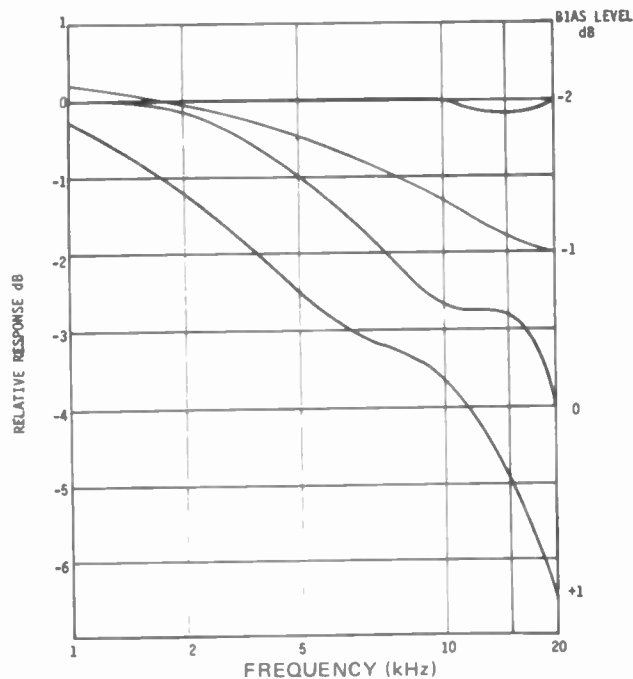
The tape consistency as measured by 1/3 octave band testing of pure tones between 1kHz and 20kHz shows that it is superior in its lack of drop-outs and consistency of level.

If your tape recorder does not include a bias adjustment or is not adjusted to a bias level suitable for Scotch 203 or equivalent (i.e. AGFA PE31 or PE36, AMPEX444, BASF PES35 LH, or Philips LP) then its use may not necessarily produce an improvement in either signal-to-noise ratio or frequency response.

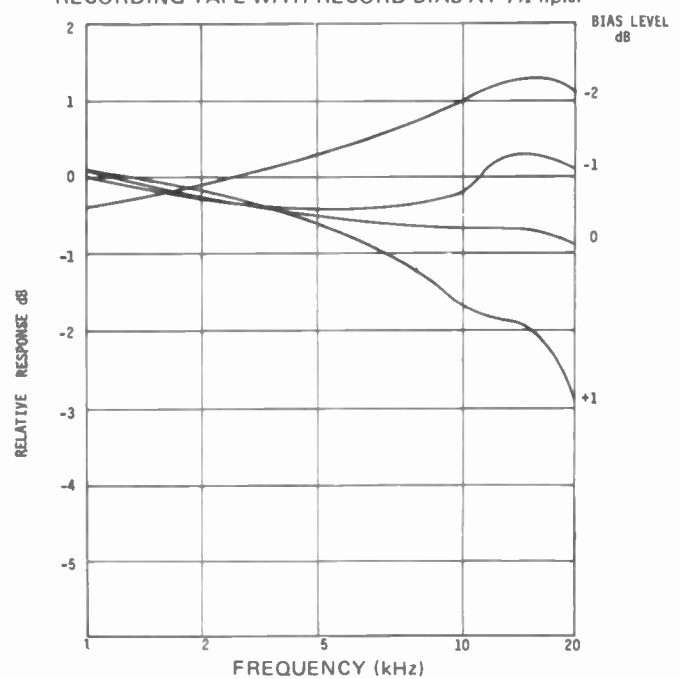
Whilst the tape is unquestionably better than other tapes which we have measured it should be equated for amateur usage in terms of the quality of the equipment with which it is likely to be used.



RELATIVE FREQUENCY RESPONSE OF BASF LGS-35 RECORDING TAPE WITH RECORD BIAS AT 7½ i.p.s.



RELATIVE FREQUENCY RESPONSE OF SCOTCH 203 RECORDING TAPE WITH RECORD BIAS AT 7½ i.p.s.



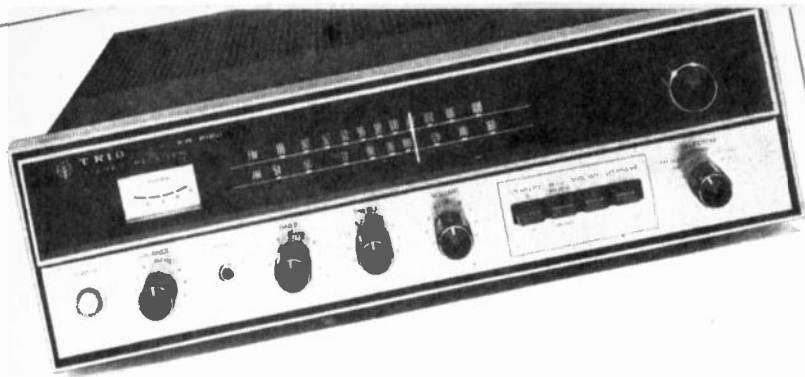
RELATIVE FREQUENCY RESPONSE OF TDK-SD RECORDING TAPE WITH RECORD BIAS AT 7½ i.p.s.

RESULTS

SENSITIVITY MAKE OF TAPE	SENSITIVITY WITH OPTIMUM FREQUENCY RESPONSE	BIAS LEVEL	SENSITIVITY WITH OPTIMUM OUTPUT AT 1kHz	BIAS LEVEL
SCOTCH 203	0.0	0	0	0
BASF LGS 35	0.0	-2	+0.2	-1
TDK SD	2.4	-1	2.5	0
RELATIVE LEVELS FOR 3.5% DISTORTION (dB)				
SCOTCH 203	-77			
BASF LGS 35	-77			
TDK SD	-75			
WEIGHTED SIGNAL TO NOISE RATIO FOLLOWING ERASURE (Re 3.5% DISTORTION LEVEL)				
SCOTCH 203	64			
BASF LGS 35	60			
TDK SD	65			
DROP OUT AND CONSISTENCY (TOTAL VARIATION IN dB)				
	1kHz	5kHz	10kHz	20kHz
SCOTCH 203	0.2	1.0	1.5	2.0
BASF LGS 35	1.0	1.5	1.5	2.0
TDK SD	0.1	0.7	0.7	1.0

ALL UNITS ARE IN dBs EXCEPT WHERE OTHERWISE INDICATED

Why engineers use Watts rms — although they know it is wrong



If It's **TRIO** You'll Treasure
It—KR-2120

The KR 2120 12 12-watt (RSIS 80) stereo receiver is a solid state instrument designed as a pleasure-producing 'treasure chest'. One of TRIO's lower priced models, it proudly ranks as high as the most expensive and modern in its class. Its sophisticated circuitry and modern front panel features include: FM stereo tuner with FM stereo speakers and handy front panel controls for FM stereo and other.



The 526 specifications:
AMPLIFIER Power output 25 watts each channel into 8 ohms R.M.S. Frequency response 20-20,000 Hz ± 1 dB. Total harmonic distortion Less than 0.5% for all power levels up to 25 watts output and all frequencies throughout the audio range. Total harmonic distortion at 1 kHz at 15 watts output into 8 ohms is typically 0.1%. Crosstalk Better than 40 dB at any frequency and at any level of output. Hum and noise Related to 25 watts output, better than -70 dB on tape playback. -60 dB on radio and -55 dB on pickup inputs. Rumble filter. Treble filter. Loudness control. Tape monitor. FM TUNER Coverage 109 MHz. Sensitivity Mono 1.5 μV, stereo 5 μV. Limiting Full limiting occurs at 5 μV. IF bandwidth 220 kHz at 6 dB down, IF rejection 90 dB. Quieting control. AM TUNER: Average Medium and Long wavebands. Sensitivity 5 μV for 20 dB, IF bandwidth 1/2 at 6 dB down, IF rejection 80 dB.

WHAT'S A WATT?

I must offer some criticism of the article entitled "How Many Watts?" (Electronics Today — May issue).

It is directed at the section headed "What's a Watt?" The explanation given in the first two paragraphs of the section is quite misleading. The definition of the rms value of a sine wave is correct but only applies to voltage or current, and not to power.

For test purposes an audio amplifier would be connected to a pure resistance as a load, so that voltage and current would be in phase. If they are sinusoidal and of frequency f Hz, then the power in the load also fluctuates sinusoidally at $2f$ Hz. The product of V and I (both rms values) gives the average or mean value of the power which is half of the peak power.

The rms value of the power waveform can be calculated but it has no significance. To any electrical engineer, or to an engineering student, the word "power" is always taken to mean the average value. With non-sinusoidal waveforms, "peak power" and "average power" retain their significance and are useful terms, although the factor of one half mentioned above no longer applies.

I realise that the term "rms power" is widely used nowadays to describe the output of an audio amplifier when, in fact, "average power" is intended.

I cannot understand why this error in

terminology has arisen. It is bad enough when used in manufacturers' advertisements and I feel that it has no place at all in an article which purports to be technical.

Yours sincerely,
T. Brownlee, C. Eng.
Head of School of Engineering,
Caulfield Institute of Technology.

The above letter arrived on our desk shortly after publication — and for a short time it created quite a stir.

For our correspondent is quite correct. His point is true by definition. The rms value of a power wave-form has no significance.

As our correspondent points out, the only term that has any real validity is 'average' power. For those who are interested the relevant mathematics are set out in the accompanying panel.

Technically we are in the wrong — but we are in very good company — for almost without exception, technical journals, testing consultants and audio equipment manufacturers the world over — also use this term.

So why do we do it?

We do it for the sake of clarity — as we feel sure do most other journals.

Manufacturers do it for another reason, perhaps mistakenly, but nevertheless with good intentions.

The reason is that there are many

different ways of expressing the power output of an amplifier, and most of these ways have some validity.

For example, the argument used to justify instantaneous or 'music' power ratings is that orchestral music has a very wide dynamic range. The average power may be quite low yet when there is an orchestral crescendo the instantaneous power requirement may be very high.

Therefore, say the 'instantaneous' power protagonists, let us quote the output in terms of what the unit can produce for a short time, a measurement in fact of the 'instantaneous' power output.

This can be quite a large number. Just how large depends on how the measurement is taken. For 'instantaneous' is not a very precise term.

Is the measurement taken for a few seconds, one second, or perhaps just a few milliseconds?

And at what level of distortion? A realistic 1% to 2% — or is it taken at the current US figure of 5%. Or with the power transformer on fire?

At the other extreme 'pop' music tends to be more uniform, and therefore the available average power is a more relevant quantity.

NO RECOGNISED STANDARD

There is no internationally

recognized standard for amplifier power ratings, and until a decade or two ago average power was the figure implied when power output was quoted. If a specification read 'Output Power — 20 Watts' you knew exactly what it meant.

At least you did if you were in Europe or were looking at a European amplifier.

The Americans on the other hand used a system that enabled a 10 Watt European stereo amplifier to be marketed in the US at 40 to 60 Watts.

(Rolls Royce ran up against a similar problem with horse-power ratings of their cars. But rather than accept a phony measurement they described their power output as 'adequate'. Not that it did them much good.)

The US rating is converted into the European rating as follows:-

(1) divide by two to obtain the output per channel.

(2) divide by one and a half to obtain an approximate conversion from short duration signals in one channel to continuous signals in both channels.

(3) divide by two to convert from peak to average power.

In other words divide the quoted figure by between four and six and this will approximate the average power per channel.

BUT WHY RMS?

The argument is that the buying public must have some basis for comparison and that whilst an rms figure is technically incorrect, it has the implication of the method of measurement. This implication is not carried by average or continuous power.

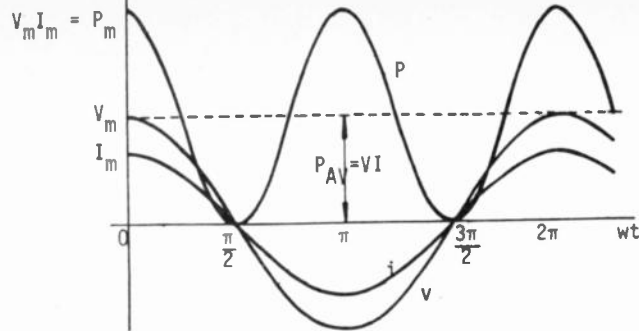
The term rms Watts is in fact a pseudonym for average power, or in another context, continuous power, and technically correct or not it has become a generally accepted expression. As we found out when we rang the design engineers at two of Australia's leading manufacturers. Their reaction was a surprised "what's wrong with Watts rms?"

Our correspondent is, as we have said, perfectly correct and we also deprecate terms that have precise meanings being used in such loose fashion.

But — we cannot join him in being the only ones in step. We shall continue to specify the output power of amplifiers in Watts rms in the full knowledge that it is technically incorrect.

Those to whom it matters must read this to mean average Watts.

As Chaucer sayde — "Forgetting not uniforme and goodly laws of propre tonge, the ways of manne and his colloque shul shew doutles how it is to be sayde".



Relationship between voltage, current and power curves in a resistor.

- (a) for resistive loads and sinusoidal inputs. V and I as functions of time are:-

$$V_1 = V_m \cos 2\pi ft$$

$$I_1 = I_m \cos 2\pi ft$$

where V_m is the max. instantaneous voltage

where I_m is the max. instantaneous current

The resistive load R , the applied voltage V , and the resulting current I .

Then V and I as functions of time are respectively:-

$$V_1 = V_m \cos 2\pi ft$$

$$I_1 = I_m \cos 2\pi ft$$

Where V_m is the maximum instantaneous voltage and I_m is the maximum instantaneous current.

The instantaneous power is given by the produce $V \times I$ 'i.e. P '. Thus power is given by:-

$$P = V_m I_m \cos^2 2\pi ft$$

The instantaneous power is given by $V \times I = P$.

Thus power is given by:-

$$P = V_m I_m \cos^2 2\pi ft.$$

This quantity is plotted in Fig 1. As can be seen, the power varies between 0 and $V_m I_m$ in a sinusoidal manner and the average power is $V_m I_m / 2$. Using Ohm's law this is equivalent to $V_m^2 R / 2$ or $I_m^2 R / 2$. Thus we define the effective voltage and current so that the average power is given by $P = VI$, and the relations between the rms and peak value are

$$V = V_m / \sqrt{2} \text{ and } I = I_m / \sqrt{2}.$$

(b) A similar argument (although more complex) for non-sinusoidal signals produce the equivalent voltages and currents as

$$V \sqrt{\text{ave}(V_1^2)} \text{ and } I = \sqrt{\text{ave}(I_1^2)}$$

hence the term 'root mean square' which is a way of expressing the operation of squaring the voltage (or current), taking the average or mean, and then taking the square root of the result.

Whilst this may seem complicated, the meters which we (and most other laboratories) use for measuring voltage or current perform this operation automatically.

Thus as we see from the above, the rms voltage is defined through the average power and nowhere is rms power defined.

ENGINEER ACOUSTICS

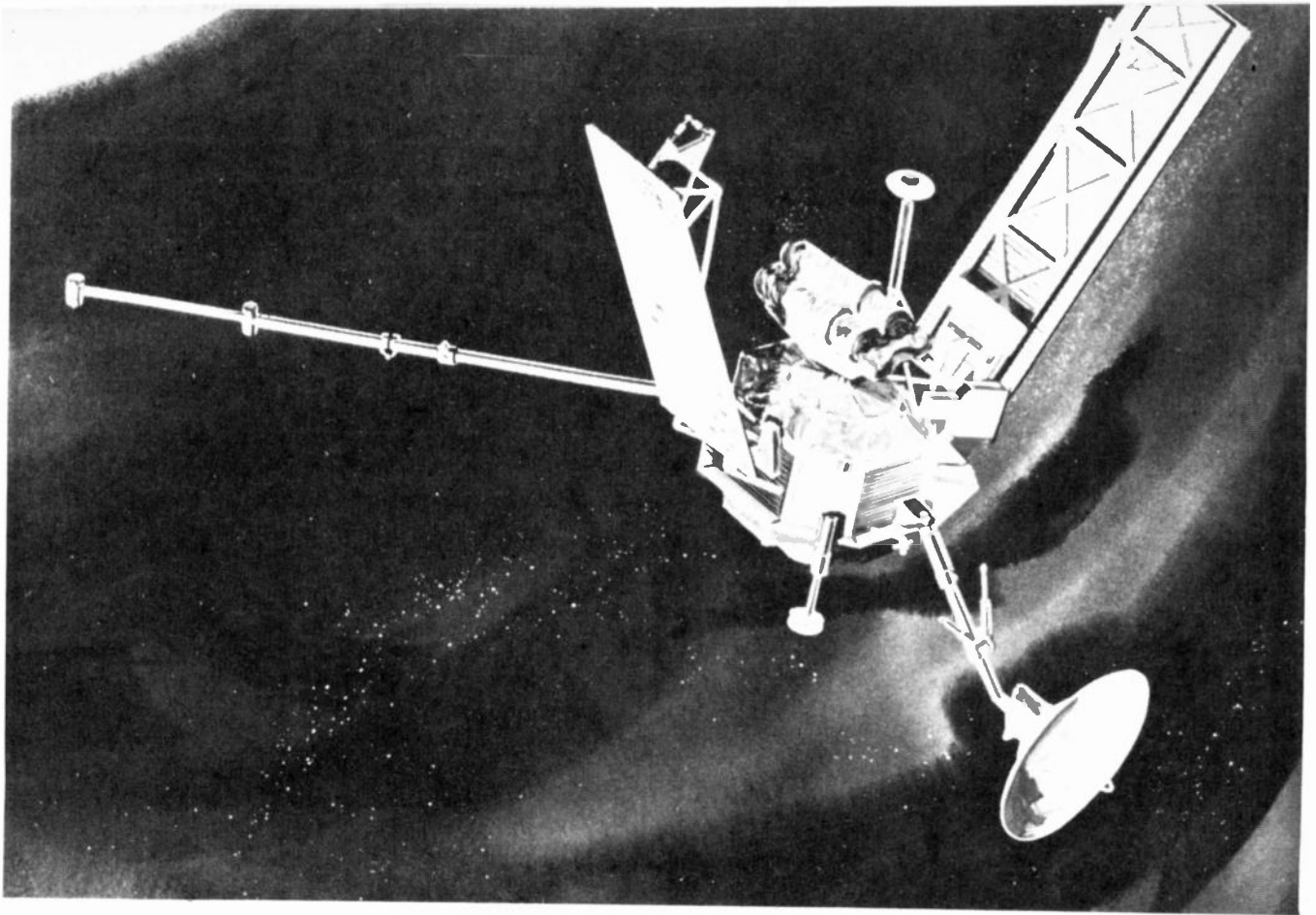
An experienced engineer is required for a consulting acoustical and vibration engineering practice situated in Sydney. Applicants must be active and capable of supervising major investigations, research development and design projects associated with the fields of electrical, industrial, architectural and airconditioning, noise and vibration control. Applicants should have the ability to supervise technical and laboratory staff in a well-equipped N.A.T.A. registered acoustics and air diffusion laboratory.

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VENUS/MERCURY SPACECRAFT

electronics in Space

VENUS/MERCURY SPACECRAFT

The Boeing Company has been selected by the National Aeronautics and Space Administration to design and build a spacecraft that will be launched in 1973 on a dual-planet mission to Venus and Mercury.

The spacecraft, will return close-in television pictures and gather a variety of scientific data about the planets.

The Venus/Mercury '73 project is being managed for NASA by the California Institute of Technology's Jet Propulsion Laboratory. The Boeing work will be carried out by the company's MVM '73 Branch headed by Edwin G. Czarnecki, branch manager, and Dr. Haim Kennet, deputy branch manager.

"The basic Mariner spacecraft, designated by Jet Propulsion Laboratory, is the nation's principal

planetary exploration spacecraft," Mr. Czarnecki said.

"Although the spacecraft we will be building will be modified to meet the unique mission requirements, our main job is to accomplish the spacecraft program for JPL in the least costly way at an acceptable level of risk.

"We will be drawing on our Lumar Orbiter and Burner II experience as well as our recent Mariner Mars '71 support work to accomplish this assignment."

In addition to the flight spacecraft, Boeing will also be providing a test spacecraft, support equipment, and technical support to JPL.

Spacecraft equipment will be built and tested at the Boeing Space Centre, Kent, Washington. The test and flight spacecraft will be assembled and environmentally tested at JPL.

COMPUTERS ASSIST SOLAR STUDY

The CSIRO Division of Radiophysics has recently installed two computers at Culgoora and Epping for processing information collected in its study of the Sun. The radio heliograph at Culgoora consists of 96 steerable aerials, each 13 metres in diameter, arranged in a 3 kilometre diameter circle. The aerials make two observations of the Sun every second. These two dimensional radio pictures are studied for the complex and rapidly changing sources of solar storms and bursts.

Each picture is received as a collection of 2,880 twelve-bit words that represent levels of radio signals. The very great speed at which information can be received by such high quality equipment necessitates provision of automatic, high-speed equipment for data collection and processing — equipment that is restricted to an individual installation.

The computer at Culgoora is a PDP-15/10, assigned to collecting data from the heliograph. It has 16,000 words of core store with fast paper tape input-output equipment and two

magnetic tape drives. A complex set of interfaces are being built by the CSIRO between the computer and the heliograph.

The chief function of the computer is to compress the information received during the five hours in each day when pictures can be received. Only vital information is retained, the work being performed in real time.

The information, stored on magnetic tape, is transported to Epping, where further processing is performed on the more powerful PDP-15/20. Contour maps showing radio intensity are produced and displayed graphically. After editing the maps are photographed or placed on tape for further processing at the CSIRO central computer.

The computers at Culgoora and Epping have been supplied by Digital Equipment Australia Pty. Ltd., who also supplied a PDP-9 computer to the CSIRO Division of Radiophysics at Parkes. An important feature of the three computers is the resultant compatibility of equipment, both in hardware and in software. Duplication of programming is eliminated and

central testing of programs is possible at one site.

NASA PROVES LIFE IN SPACE

There now seems little doubt that life, even if limited to basic form, exists outside Earth.

The Ames Research Centre of NASA report further evidence of extra-terrestrial organic molecules in the Murchison meteorite that fell in Victoria in 1969.

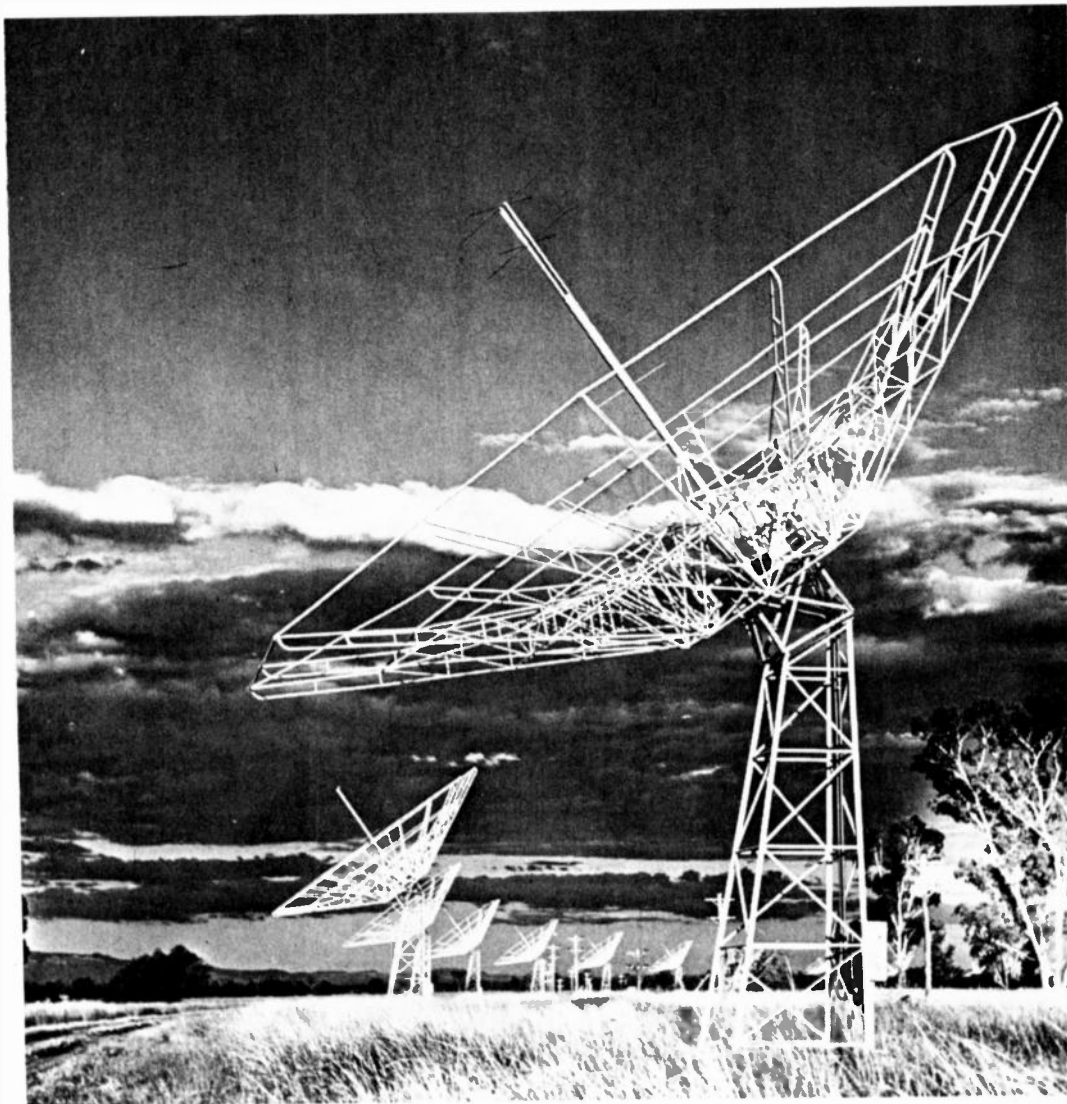
The meteorite has been shown to contain amino acids of both the right-hand and left-hand versions, and such mixtures can only be produced by chemical reactions. Several non-biological amino acids have also been found.

The sophisticated analytical equipment used by the group includes gas chromatographs, mass spectrometers with automatic readout, and a powerful computer which is used to analyse the large amount of data obtained by the instrumentation.

According to the Centre the results obtained are the first clear proof that chemical evolution is taking place elsewhere in the universe. ●

Artist's concept shows Mariner spacecraft nearing the planet Mercury after it has passed close by the planet Venus. A Mariner Venus/Mercury spacecraft will be launched in late 1973 on the nation's first multi-planet mission and the first mission to the innermost planet, Mercury.

Part of the radio heliograph complex at Culgoora, comprising 96 steerable aerials, 13 metres in diameter, and arranged in a circle of 3 kilometres in diameter. Data from the system are collected by a new PDP-15/10 and transmitted to another computer, the PDP-15/20 at Epping, where the heliographic information is processed.



Electronics in Education

AUDIO-VISUAL AID

A new and simple system for combining a slide projector and a tape recorder to give 'professional' commentaries for lectures has been developed by Convoy International Pty. Ltd. of Sydney. Called the "Pulsync", it permits the use of either tapes or cassettes without the necessity of threading the tape through loops outside the recorder, or modifying any of the equipment.

The result is that a commentary can be prepared so that the correct slide automatically appears in the projector at the required point, against a background of music and voice if required. Unlike previous pulse systems, this unit records the pulse so that the full reverse tracks of the tapes may be utilised, and there are no audible pulse signals in the recording.

The "Pulsync" was manufactured to specifications set out by one of Sydney's leading universities as an aid to teaching.

LABORATORY RECORDER FOR SCHOOLS

A simple recording machine operable by anyone who can use a Wheatstone Bridge, and selling at a price which puts it within a school's budget, has been produced by the British Company W. C. Flaig & Sons Ltd. of Broadstairs, Kent. A standard laboratory low voltage supply is used to drive the recorder pen motor and a battery supplies power for the electronic switching circuit.

There are three terminals on the recorder, and when resistors are connected across them, the pen moves to a position which depends on the values of the two resistors. This allows thermistors and photo-resistors to be connected direct to the unit without any special circuitry. The replacement of one resistor by a transistor allows

the range of the recorder to be increased. Alternatively small voltages or currents can be recorded.

The pen on the recorder moves in a straight line over 200 mm and can indicate values to an accuracy of 0.5 mm. Pen movement is 40 mm per second and a magnetic clutch is fitted to prevent damage should the recorder go off the scale. The Exelo Bridge recorder has a transparent Perspex chart table so it can be used on an overhead projector and takes any standard sheet of graph paper.

Sample experiments that may be carried out with the recorder include cooling curves for single substances and mixtures, cooling corrections in calorimetry, reaction rates using a simple calorimeter and spectra using a simple spectrometer.

The manufacturers have announced that they are opening a subsidiary sales company in Australia.

TELEVISION MICROSCOPE FOR EDUCATIONAL USE

A television microscope intended for use in research laboratories, schools, technical colleges and universities has been produced in England by Gillett and Sibert, and Link Electronics. The TV microscope is said to be particularly useful where a large

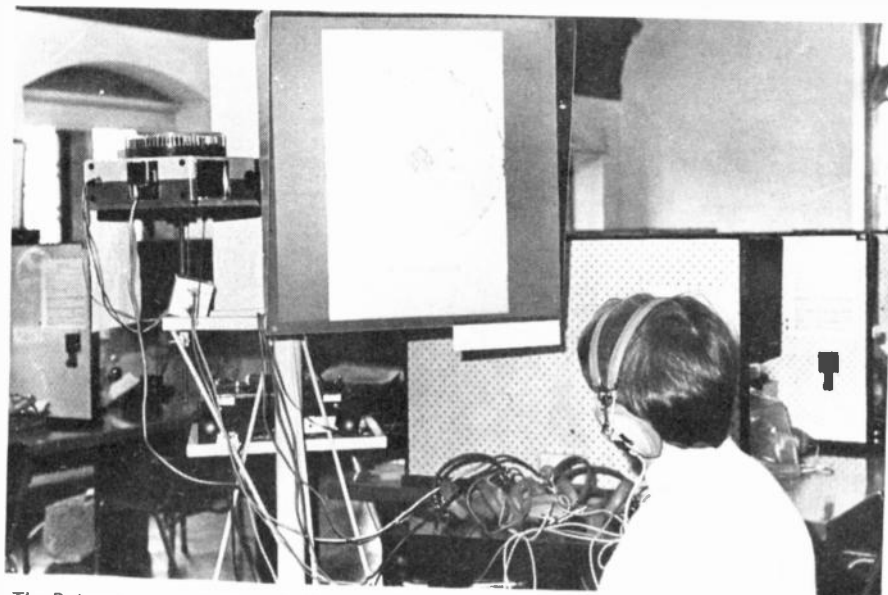
number of students need to see the microscope picture in applications where the subject matter is unsuitable for direct optical projection.

The microscope has been specially designed and integrated with a television camera to form an extremely rigid and self-contained unit, only requiring a monitor to be connected to complete the system.

The microscope has a self-contained 100 W HQ light source together with transformer and Koehler illumination optical system, all built-in to the microscope base. The TV camera system operates on 625 lines and has a resolution of 5 MHz. 525 or 405 line cameras can also be supplied. Up to 10 interlinked monitors can be added, at a distance up to 100 m.

Apart from brightfield microscopy, the educational TV microscope can be used for darkground polarisation. The phase contrast optics are stated to be particularly useful for viewing live material, pond life and bacteria.

The microscope is supplied with monocular head, splitter cube, optical tube, camera bracket, a pair of X8 Huygenian eyepieces, a spare lamp, and a plastics dust cover, complete with 625 line TV camera (Random Interlace), but without monitor and optics.



The Pulsync system automatically controls slide operation in the audio visual laboratory established by Dr. I. M. Brewer at Sydney University's School of Biological Sciences.

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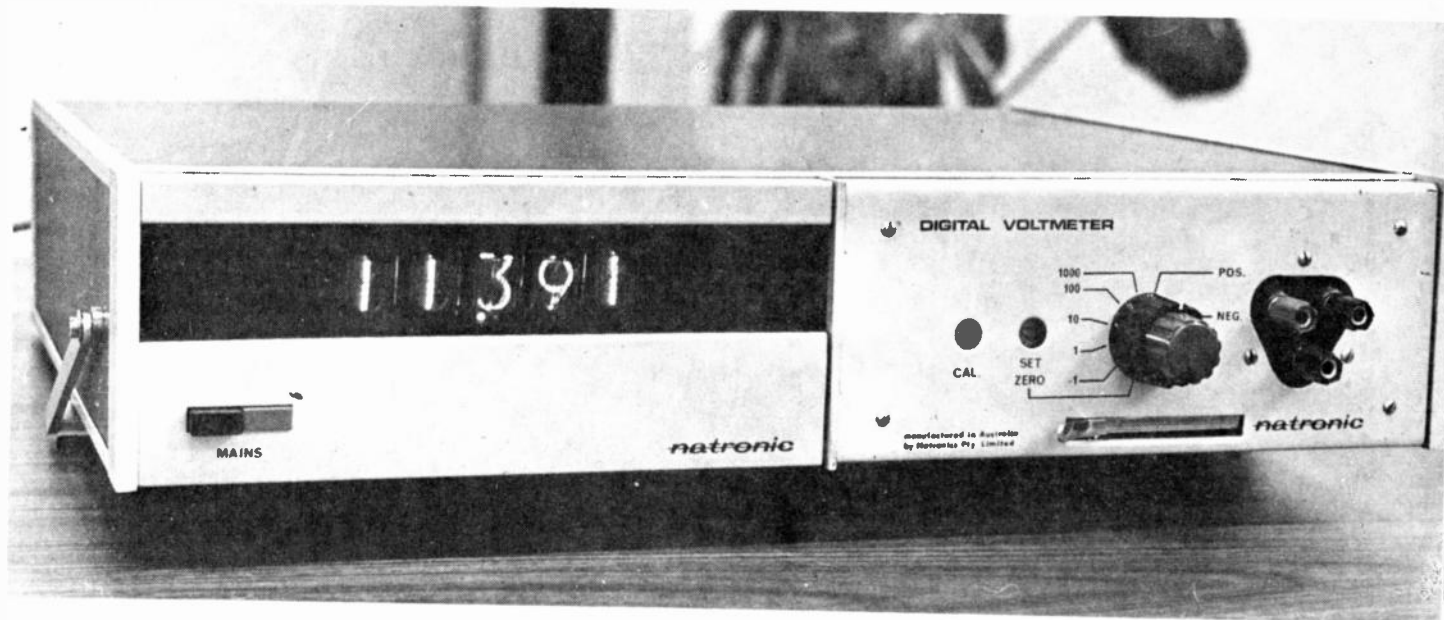
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AUSTRALIAN- BUILT DVM



AMONG the fields of instrumentation which have gained the greatest attention of late, digital instruments seem to top the lot.

Australian manufacturers may have appeared to lag behind their overseas competitors in this development, but that isn't so.

In fact, many of the local firms were quick to realise the implications and have been busily engaged in producing various classes of digital instruments.

Natronics Pty. Limited, the equipment division of IRH Industries, have introduced a new range of precision digital equipment which is basically different in concept from that produced by most other manufacturers.

Their principle has been to develop a main frame which carries the digital readout, together with power supplies, crystal oscillators and frequency dividers, and to offer various plug-in units which can perform a vast range of individual functions — including those of a dc voltmeter, ac voltmeter, multimeter, dc millivoltmeter, dc microammeter, temperature meter, counter timer, and a waveform

generator (although only a dc voltmeter, multimeter and counter-timer are currently available).

This concept, which was introduced by the Tektronix company in the late 'fifties for their cathode ray oscilloscopes, has gained a wide acceptance, and it is natural that it has been adopted for digital instruments.

INTERESTING DESIGN

The Natronic Series 500 measurement system consists of a module 17¼" wide, 3½" high and 15" deep, designed to fit into a 19" wide standard rack. Half of the available space is provided for the optional plug-in units and the rest is taken up by the main frame electronics. The 500 series main frame of the Natronic unit is particularly well designed to cope with the stringent requirements of a precision measurement system.

The main frame is assembled from aluminium extrusions and aluminium panels (the top panel being readily removeable), with a steel front panel.

The locking control for the plug-in modules is novel but seems temperamental — until one realises

that it needs to be lifted to release the locking action.

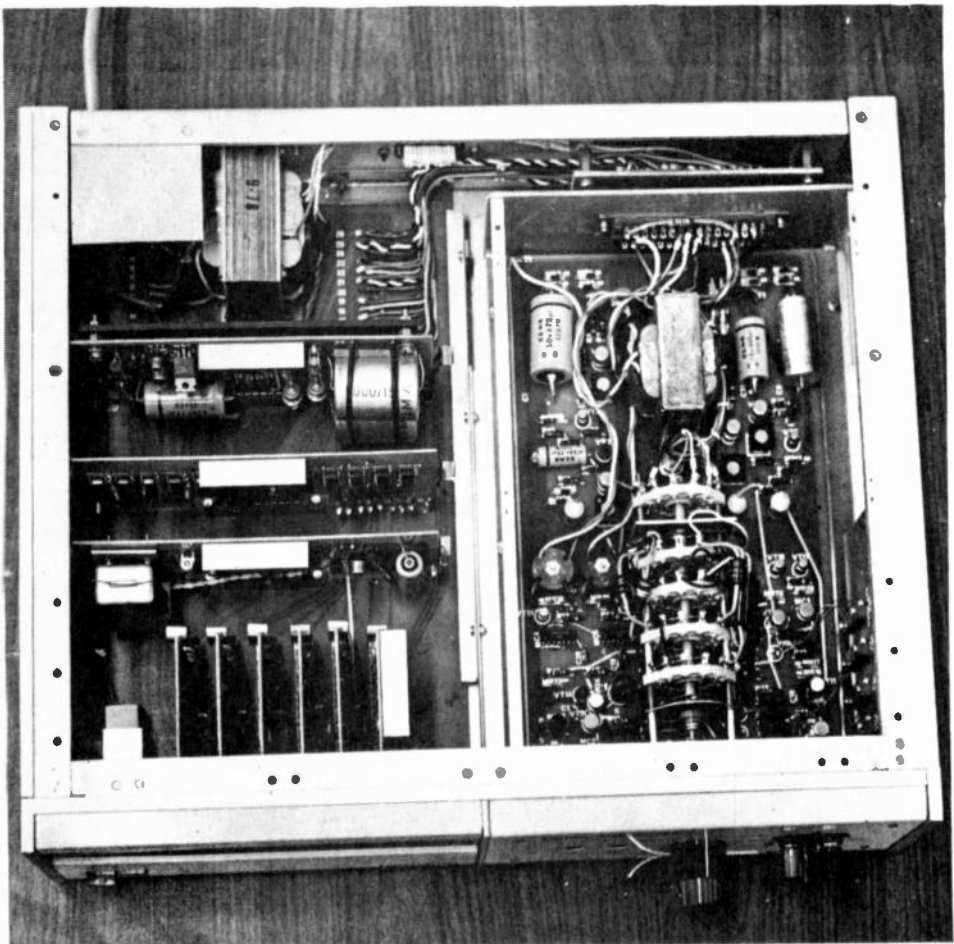
The lifting handle doubles as a means of inclining the unit when it is operated on a bench top, but it can only be used as a lifting handle at the risk of amputating your fingers — as we nearly did.

Overall finish, especially on the bright aluminium trim, falls short of what we would like to see in professional equipment.

The unit comes with well-illustrated and technically complete handbooks for both main frame and plug-in unit. They are complete with circuit diagrams and full parts list designations. The detailed description provided on each section, together with alignment instructions and complete specifications, is above average for Australian manufacturers. The handbooks are supplied in the form of spiral binders, so that additional pages can be inserted if required.

RIGHT: The power supply is both current and voltage limited.

**THE NATRONIC SERIES 500
MEASUREMENT SYSTEM —
TESTED BY
LOUIS A. CHALLIS &
ASSOCIATES**



Removeable top cover provides excellent accessibility. The DVM plug-in module shielding has been removed to show construction.

the current required to destroy transistors can flow before the fuse finally blows.

With the 'crowbar' circuit, when fault conditions occur which are sufficiently drastic to cause possible damage to electronic circuitry, a signal is applied to the gate of an SCR across the main dc supply. The SCR then becomes a short circuit which removes the supply voltage from following circuitry and also causes an overcurrent condition which will blow the main fuse almost instantly. The advantages of this circuit are that an SCR will switch very rapidly and, once switched, will stay in the 'on' condition until the supply is removed and reapplied. These two factors guarantee that any following circuitry will be adequately protected.

The oscillator is designed to give a 4MHz output with a stability of better than 1 part per million per day. This stability is achieved through the use of a crystal oven. The oven keeps the crystal at $80^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ while the unit is running. The crystal oscillator has its own separately regulated supply and has its output provided from a buffer amplifier which is compatible with transistor logic circuitry. Thus the voltage output varies between 0 volts and ± 5 volts.

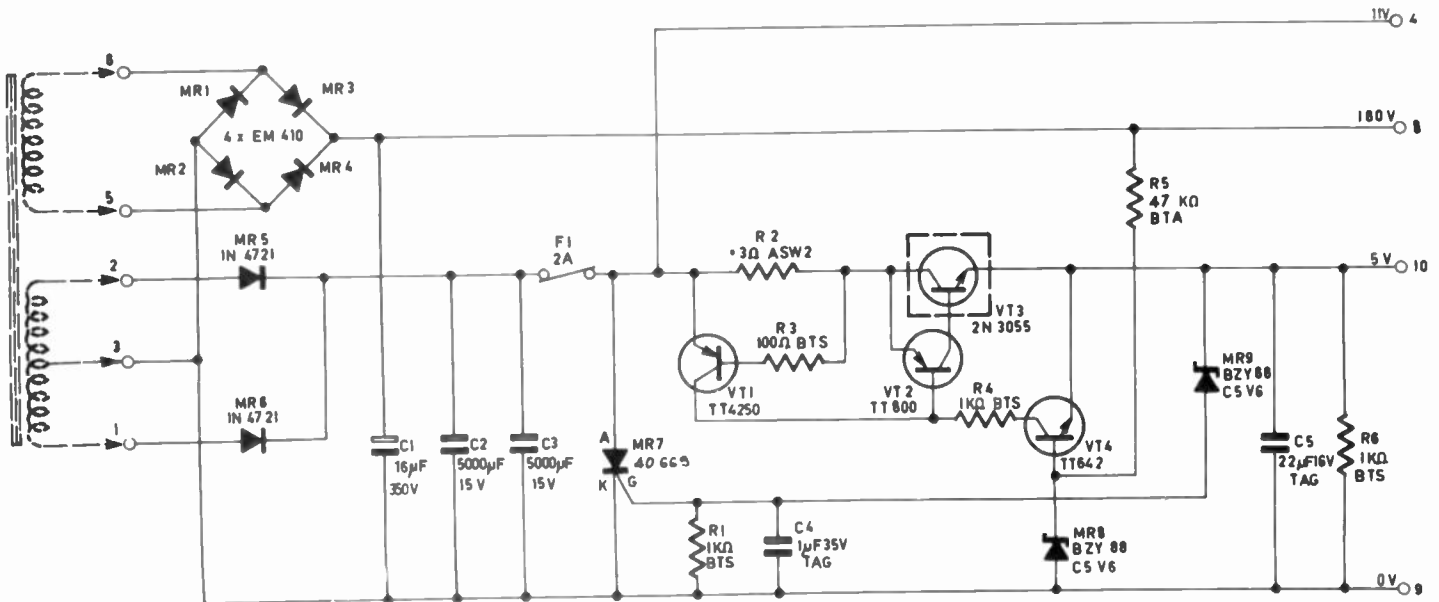
POWER SUPPLY

The design of the power supply is such that the main regulated supply is both current and voltage limited.

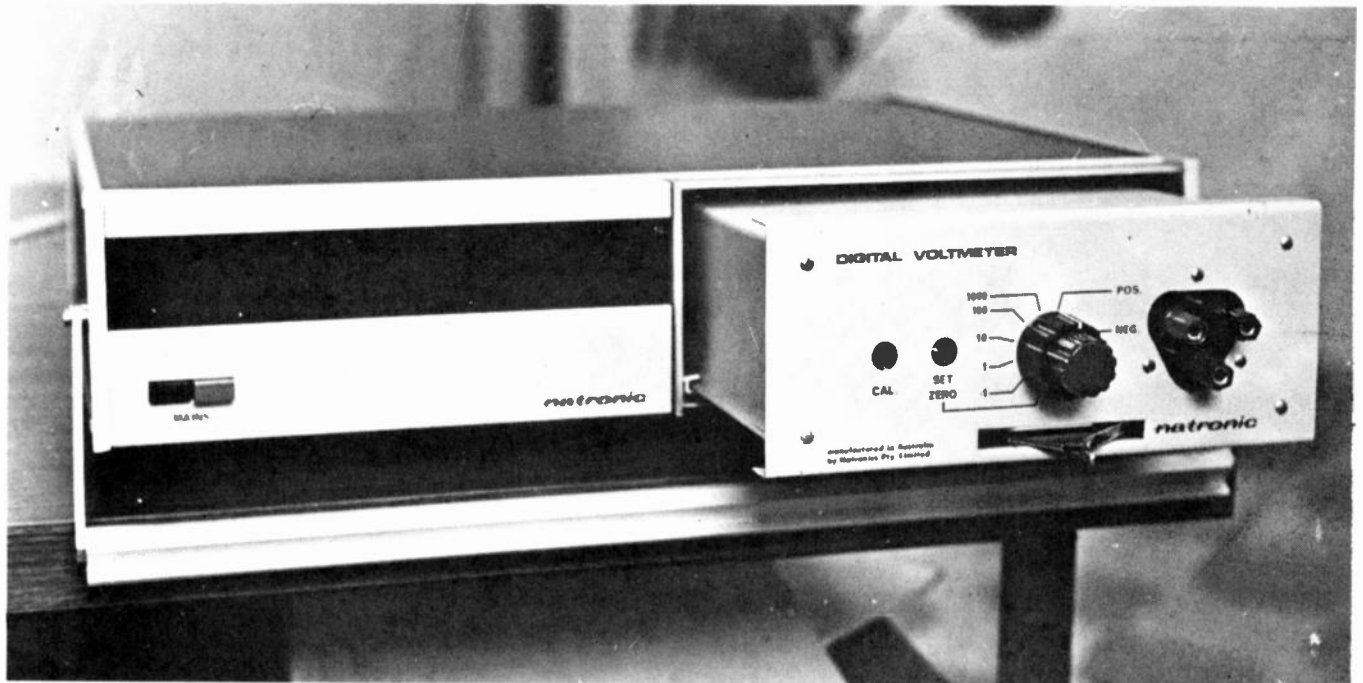
Current limiting is performed in a conventional manner, by increasing the bias on the power transistor when the current exceeds 1.5 amps. When

the current reaches 1.8 amps this transistor is cut off.

The over-voltage protection is obtained by a 'crowbar' circuit. The circuit uses an SCR to short-circuit the dc supply. This method of control is particularly effective for protection of transistor circuitry. If one relies upon a fuse for protection, up to 1000 times



AUSTRALIAN-BUILT DVM



DC VOLTMETER

The unit we have examined is the dc voltmeter type 50410 which has ranges of 100 mV through to 1000 volts, with four digits plus 1 unit for over-ranging.

Over-ranging means that the unit can have five significant figures, the first of which is 1. Thus, whilst on, say, the 10 volts (full scale) range, the meter can in fact read to about 30% above this — i.e., 13 volts — before accuracy starts to suffer. This limitation is a result of the diodes incorporated for protection of the input circuitry.

The circuitry used is conventional and is based on the following:

The dc voltage to be measured is applied to a high impedance differential transistor pair, thence to an operational amplifier integrator. As the output of the integrator is a ramp function the slope of which is directly proportional to the value of the voltage being measured, the ramp voltage is compared to a known fixed value of voltage, so that the integration is switched back to zero each time the predetermined value is reached. This produces a saw-tooth function whose frequency is proportional to the input voltage.

The use of the operational amplifier integrator provides both high accuracy and inherent noise rejection. This rejection of noise is maintained irrespective of whether the noise is random or sinusoidal in character. This is because the integrated value of a sine wave is in fact zero, as is that of

truly random noise.

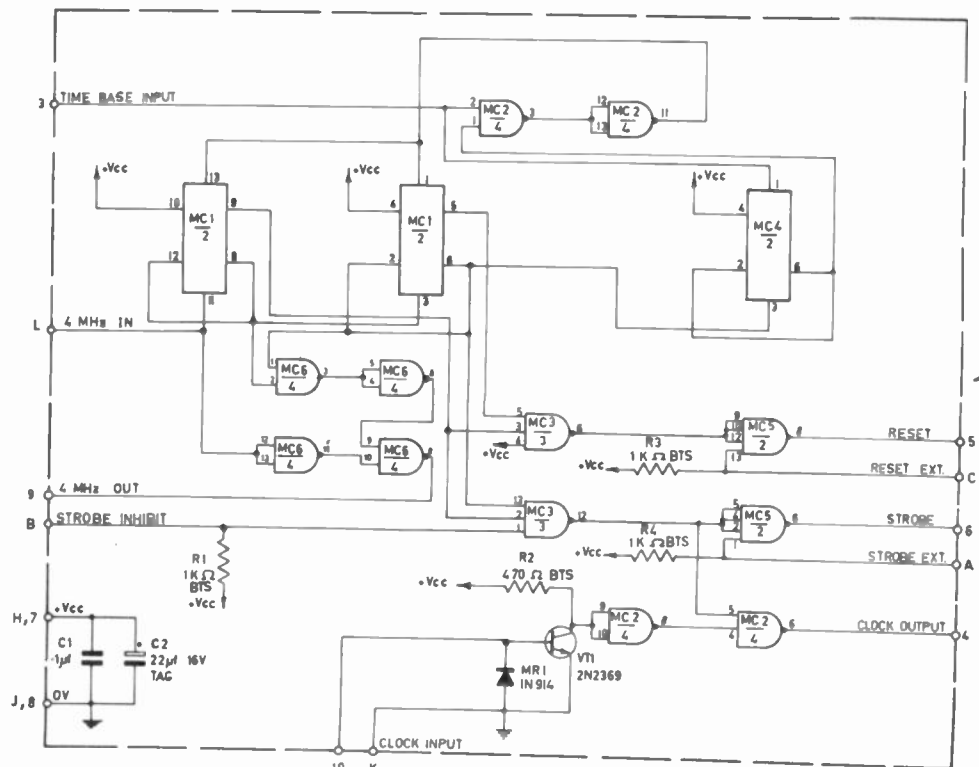
The circuitry has been designed to provide reasonable temperature stability, and three sections of circuitry have been incorporated in small ovens whose temperature is maintained at $\pm 0.5^\circ\text{C}$. Those sections are the input differential amplifier, the

reference zener and the reset transistor, whose saturation voltage is critical in providing the reset voltage time.

WHAT TEST SHOWED

In order to check the performance of the instrument we subjected it to

Driver card — block schematic drawing.



NATRONIC DIGITAL VOLTMETER TYPE 50410 S/N-NIL IN MAIN FRAME TYPE 500 S/N-NIL

Five ranges: 0-100mV to 0-1000Vdc

vigorous investigation to determine its accuracy and reliability, as well as its long-term stability. High accuracy in a DVM is of little practical value unless it can be maintained in the presence of noise and under the difficult conditions of everyday use.

The DVM requires only a few seconds of 'warm-up' time to provide accuracies of the order of 1%. For higher accuracies one must be prepared to leave the equipment continuously operational or, alternatively, allow a reasonable time for warming up (say 20 minutes), as this equipment doesn't provide a facility for leaving the ovens on while the electronics are switched off.

Voltage comparisons were made against our laboratory standards, which provide a 0.01% accuracy in the range 1 millivolt to 1000 volts.

Results of the measurement were as follows:

Reference:	Test Subject
Voltage ($\pm 0.01\%$)	Natronic 50410
100.00 volts	100.07
30.000	30.020
10.000	10.003
3.0000	3.0000
1.0000	1.0002
0.30000	0.30000
0.10000	0.10001
0.030000	0.03000
0.01000	0.01002

We superimposed noise and

sinusoidal signals with the measured dc voltages and found no difficulty in obtaining accurate answers.

The measured common mode rejection and the series mode rejection are as good as stated by the manufacturer.

Having assured ourselves that when the instrument is calibrated it will perform, we put it away for a week before conducting a retest.

When we switched on the DVM after

Overrange: Due to diode clipping, overrange error will always be in a negative direction. The actual overrange error will be 0.05% at 130% overrange. This may improve or degrade the reading, depending upon the sine of the original error.

Accuracy: all ranges to 10V $\pm 0.02\%$
30V. range $\pm 0.05\%$
100V. range $\pm 0.06\%$

Seven-day accuracy: approx. + 0.3% on all ranges.

Resolution: $10\mu\text{V}$ on 100 mV range.

Overload protection will withstand > 100 Volts over all ranges.

Input resistance: $100\text{ M}\Omega$ on three lowest ranges.

$10\text{ M}\Omega$ on 100 V and 1000 V ranges.

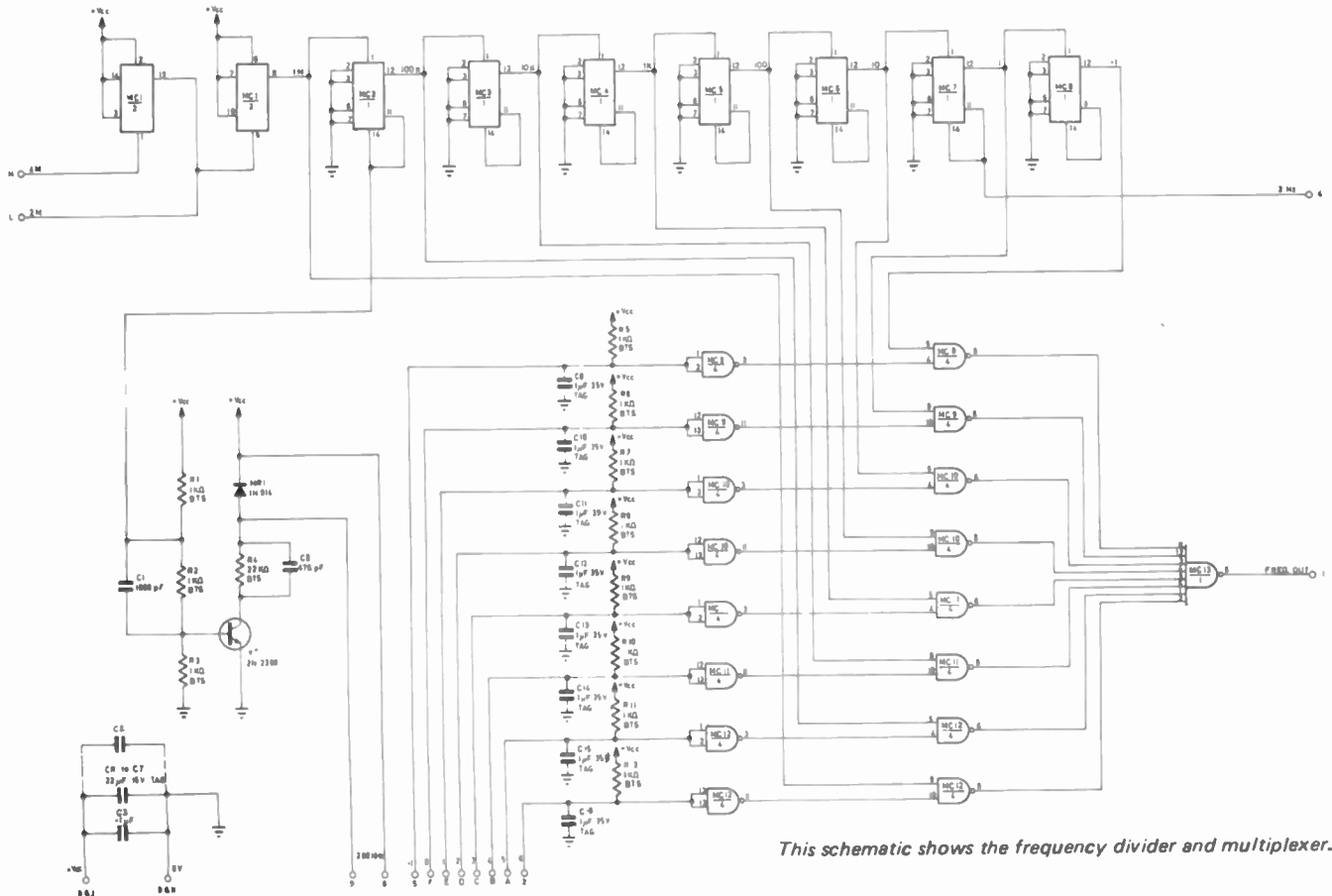
Series mode rejection: $> 80\text{dB}$ at 50Hz.

Common mode rejection: 120dB with $1\text{k}\Omega$ source unbalance. Polarity manually operated.

Response time: > 0.5 second.

the week's rest, we allowed two hours to warm up and went through the exercise again. This time all the voltages were reading consistently high by about 0.3%. As the handbook says nothing about short-term or long-term stability, we couldn't check this figure out against the manufacturer's guarantee, but it's more than we would expect from an instrument into which so much design work has gone.

As this instrument is liable to be



This schematic shows the frequency divider and multiplexer.

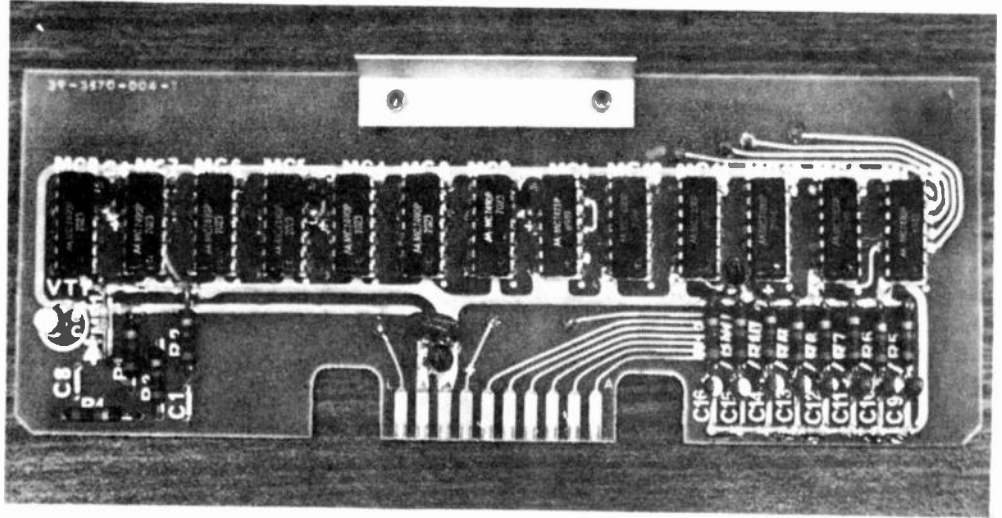
AUSTRALIAN-BUILT DVM

considered for measurements requiring high accuracy and reproducibility, it is essential that an intending purchaser should also buy at least one or more Weston Standard cells to provide a reference check against such drift.

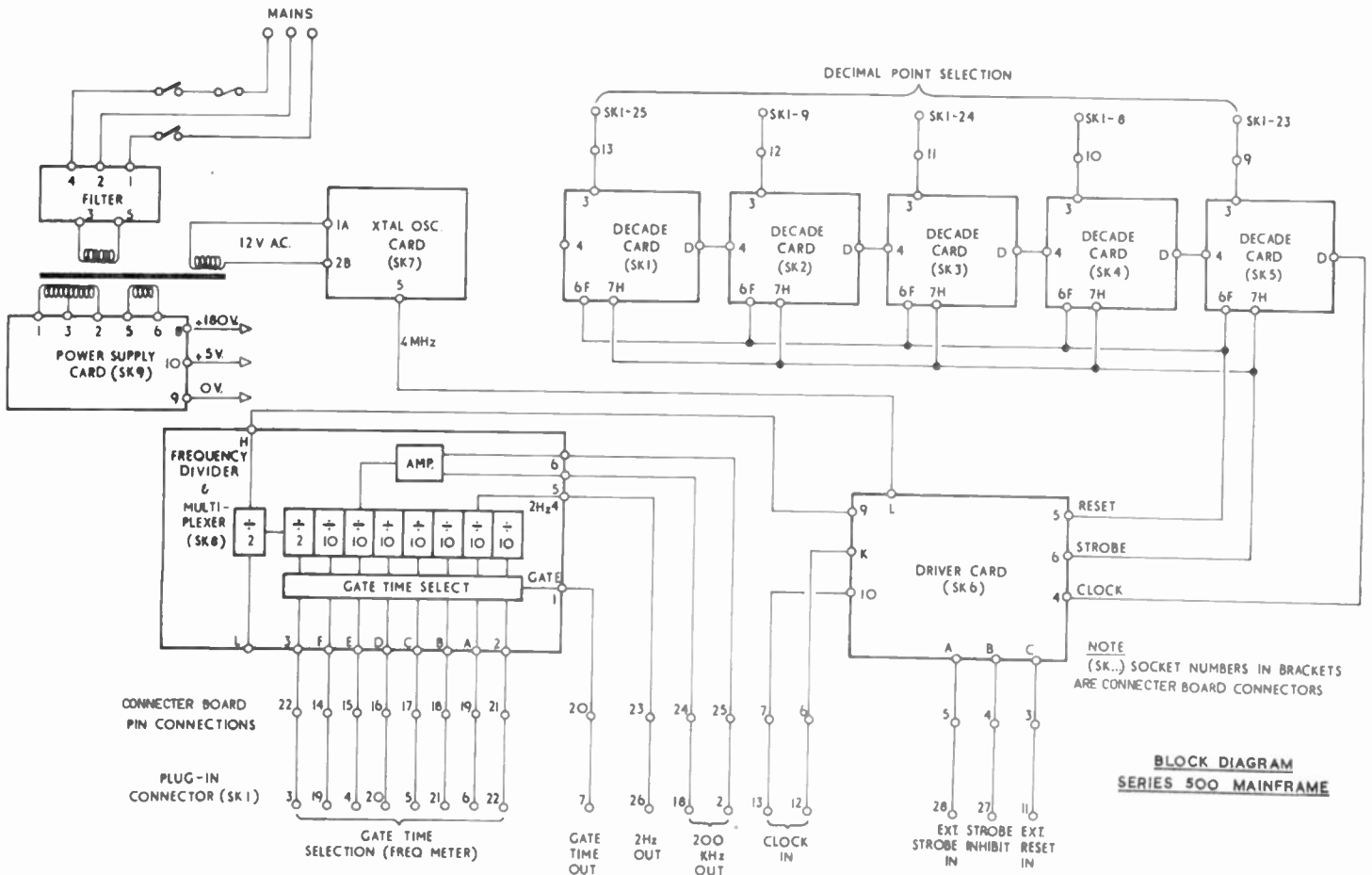
The Natronic 504100 digital voltmeter comes close to meeting most of its specifications. The main discrepancy is apparent in the absolute accuracy claimed for it. Whilst most precision digital voltmeters quote

24-hour and 30-day accuracy figures in their specifications, this unit does not. This voltmeter will provide a reasonable degree of accuracy if one is prepared to expend an additional \$30 on Standards cells.

Driver card from main frame assembly.



Block diagram, Series 500 main frame.



HOW GOOD IS YOUR STEREO SYSTEM?

In the latest issue of Australian Hi-Fi Magazine we tell you how with the aid of a simple multimeter, you can completely check out your entire hi-fi system from cartridge to speakers.

TAPESPONDENCE

Corresponding by tape is becoming increasingly popular, especially with Australia's migrant population. Our series on Tapespondence shows how to take the "ums" and "aahs" from your recording to make a professional tape.

EQUIPMENT REVIEWS IN THIS ISSUE

JBL equipment is amongst the most expensive in Australia. How good is it? Find out by reading a full appraisal of the JBL amplifier system in this issue. Other technical reviews include the Ferrograph 724 tape recorder, Acoustic Research 4X speakers, Sharp RD.423 Cassette recorder and Monarch A.5000 amplifier.

\$20,000 COMPETITION

Would you like to win a complete hi-fi system? Then enter our FREE competition; there are hundreds of prizes to be won and you could be one of the lucky winners.

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A special survey covers a range of popular headphones priced from \$10.00 to \$75.00. Get the facts before you buy.

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MULTIMETERS—

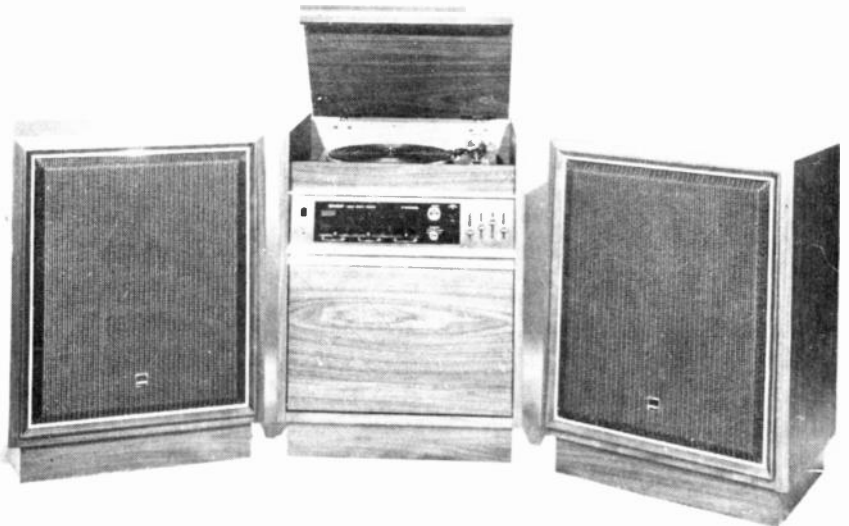
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AUDIO NEWS

SIX AMPLIFIERS -- TWO CHANNELS



A new stereo system from Japan's Sharp Corporation features separate bass, mid-range and treble amplifiers for each channel.

The six amplifiers are coupled into a pair of four-way speaker enclosures.

The unit is rated by the manufacturers at 54 watts 'music power' per channel.

The new unit -designated GS-5820, is handled in Australia by Olims Trading, 617 Prince's Highway, Tempe. NSW.

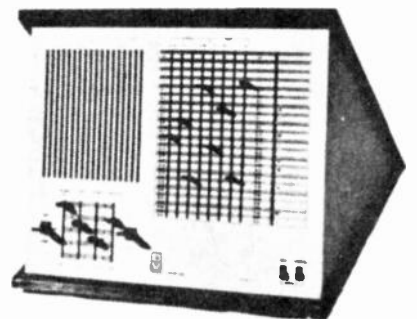
STUDIO TAPE RECORDER



Shown at the recent IREE exhibition this Plessey Electronics 700 Series tape recorder/reproducer is widely used in radio stations.

Ergonomic design ensures ease of operation.

MINI-MOOG MUSE



Once upon a time every family's ambition was to have a resident muse. Very expensive, but what a status symbol!

But the fashion died when Marconi sold out to the BBC.

These days, when the mass-media brings pop-music to every home a resident muse might again have value. One solution is to buy a Mini-Moog - a smaller home version of the \$20,000 instrument that made the company's name. Their new unit, the Model D sells in the US for \$1,195.

Another product, made by Triadex in the USA, is called appropriately 'The Muse'. It's actually a mini-computer and once programmed for tempo, pitch and other basic parameters it will compose and play its own tunes.

The instrument will only produce the diatonic scale (no sharps or flats) but can churn out 'music' for as long as thirty years without repeating itself.

Price? - \$300 US.

JOIN the TAPE REVOLUTION TDK — 'SD'* is HERE!

* Super Dynamic — Professional Quality Tape Recorders are . . . "dramatically improved"

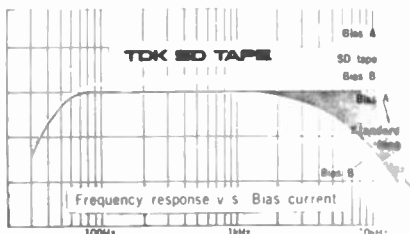
says Consumer Guide, U.S.A.

Reel Recorders, Fidelity Greatly Improved. You can record at significantly higher input levels with SD tape than with ordinary tape, and without danger of increasing distortion. On playback, the results are noticeably better signal to noise ratios and much lower tape hiss. Unrecorded passages are unmarred by annoying magnetic echoes.

Cassette Recorders, Now Hi-Fi with "SD". The handicaps of low tape speed are now completely overcome with SD Cassettes. You make recordings that rival expensive reel recorders, even low cost recorders give amazing new performance. Possible frequency range is 30-20,000 Hz. At 12,000 Hz output is up 6db.

Secret—Microfine Particles

Super Dynamic Tapes offer you performance capabilities never before available in magnetic tapes. This is because TDK has developed special microfine particle magnetic oxide of high coercivity. It is the heart of this development and unique to SD tapes. The microfine particles in a special advanced binder result in a tape so smooth that both sides look alike. Head contact is greatly improved while headwear is reduced to a remarkable degree—a great cost saving.



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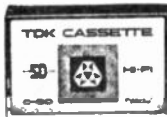
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AUDIO NEWS

JEZEBEL?

There are so many variables in optimizing speaker positioning that prediction of performance on a scientific basis is extremely difficult.

One quantitative approach recommended by Acoustical Research — is to take the square root of the area of the triangle formed by two stereo speakers and the midpoint of the listening area, note it carefully, and then have your wife tell you where the speakers look best. ●

STRAIGHT LINE TONE ARM



The RABCO company of Maryland USA have introduced a straight line tone arm that tracks a record in the same way that it was cut.

Designated the ST-4 the manufacturers claim zero tracking error (servo controlled), ability to track at 1/3rd. gram with any cartridge, simple balance and tracking adjustments, and automatic end-of-record lift.

The tone arm is offered complete with a turntable claimed by RABCO to have less than 0.08% wow and flutter, rumble of less than -60dB. The turntable is driven by a belt drive system powered by a hysteresis type synchronous motor. ●



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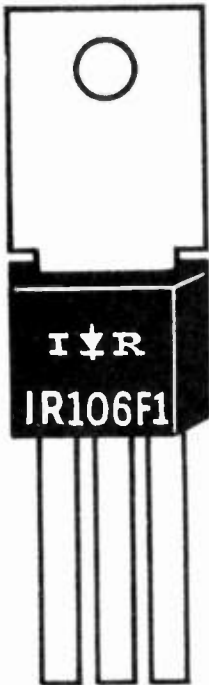
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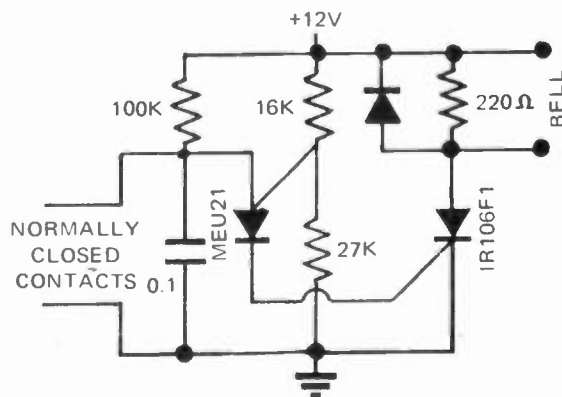
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IR 106 – LOW COST PLASTIC S.C.R.

These devices require a maximum trigger current of 200 microamps to switch 4 amp RMS loads. The IR106 will operate directly from low signal sensors such as thermistors and photo conductive cells.



TYPICAL APPLICATION

BURGLAR ALARM SYSTEM

IR 2160 – LOW COST PLASTIC U.J.T.



A good general purpose UJT for switching SCR'S such as the IR 106 series. Other applications include timers, oscillators and switching circuits.

MEU 21 MEU 22 LOW COST P.U.T.



These newly developed devices offer many advantages over conventional UJT'S. The MEU21 is for general use where the low peak point current of the MEU22 is not essential. Applications include timers, phase control and relaxation oscillators.



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WF0521

COMPONENT NEWS

GIGAHERTZ GUNN

Fairchild Pty. Ltd. announce a new series of Gunn diodes which convert dc power to microwave energy and are tunable from 8.2 GHz to 12.4GHz.

Also available are X-Band Gunn Flange Sources and X-Band Gunn Flange Oscillators.

The GO (X)-110 X-Band gunn flange source provides simple building blocks for virtually all medium and lower power applications in X-Band. The basic flange body is designed to mate with standard X-Band systems and provides a rugged diode housing, a low pass filter, a DC bias network, an efficient heat sink, and an RF impedance matching network.

The GFO (X)-100 and GFO (X)-110 series Gunn flange oscillators are the first microwave power sources in the industry with field-replaceable gunn devices. This feature should eliminate down-time due to failure of microwave power sources.

Applications include local oscillators, low power transmitters, doppler radar, X-Band microwave sweepers, communication systems, educational microwave sets, intrusion detection, amateur radio gear and experimental test sets.

Details from Fairchild Australia, 420 Mount Dandenong Road, Croydon, Vic. 3136.

BRIDGE RECTIFIER -- 25 AMPS



A new bridge rectifier from Soanar Electronics can be rated at 25 amps into a resistive load when mounted on a suitable heat sink.

Two models are available - the EB 25/200 which has a peak repetitive reverse voltage rating of 200V., and the EB 10/400 which is rated for 400V. peak reverse.

Full details from Soanar Electronics Pty. Ltd., 30-32 Lexton Road, Box Hill, Vic. 3128.

GREEN FLUORESCENT INDICATOR LAMP

A new release from Plessey is a cold cathode fluorescent green colour indicator lamp designed for complementary operation with the standard red neon lamps.

Designated RF6-G it gives a bright, brilliant green indication when used in conjunction with the type BNG clear clip-in lens. It is claimed to have a rated light output of 16 Lux at a design current of 1.5 mA ac.

Full details from Plessey Ducon Pty. Ltd. P.O. Box 2, Villawood, NSW. 2163.

LIGHT EMITTING DIODES

Fairchild Pty. Ltd. have released two new light emitting diodes. Both, of the GaAsP type, are on a plastic TO18 header and emit red light in the 630 to 690 nm region.

The first, the FLV100, typically emits 1500 foot lamberts over a 160° viewing angle. This diode is suited for use with silicon sensors or applications where maximum brightness is required.

The second has a non-glare frosted lens giving a semi-spot effect viewable over an angle greater than 180°. The FLV 101 is useful where direct viewing of a non-glare outer surface is required.

Details from Fairchild Pty. Ltd., 420 Mt. Dandenong Rd., Croydon, Vic. 3136.

WIRE WRAPPABLE SOCKET

McMurdo (Australia) Pty. Ltd. have announced the Jermyn A23-2024 wire wrappable socket which accommodates I.C.s and other devices in 16 lead packages.

The socket moulded in glass loaded nylon A190, is fitted with gold plated pre-tensioned double wiper blade contacts. Terminal posts are standard 0.025 in. square and provide over 0.5 in. of wrapping length.

Moulded extensions to the body hold the terminals rigidly in position for automatic wire wrapping. These extensions also enable the socket to be press-fitted to the board if required.

The overall dimensions of less than 0.8 in. x 0.4 in. allow close packing on 0.1 in. matrix.

Full details from McMurdo (Aust) Pty. Ltd., 17-21 Carinish Rd., Clayton, Victoria. 3168.

NEW DIGITAL PANEL METERS



Schlumberger have released a range of industrial digital panel meters featuring repairable (non-potted) circuit boards, overranging, outstanding noise rejection, compact functional styling and front panel mounting.

Taking advantage of logic and dual slope circuitry (pioneered and patented by Weston) most are available with BCD output and can be coupled to standard transducers for precise reading of any engineering unit.

Models can read voltage, current resistance and temperature.

Full details from Schlumberger Instrumentation Australia Pty. Ltd., 112 High St. South Kew, Vic. 3101.

TWO NEW STORES

Edge Electric announce the opening of their new store at 25A Burwood Road, Burwood, NSW. 2134.

They will be specialising in electronic parts and equipment.

A full range of semi-conductor devices, resistors, capacitors, valves, test equipment, switches (rotary, slider, toggle, etc.), tapes, and cassettes are on display.

They also stock all Electronics Today's kits.

A new component service for both trade and hobbist is offered by Dick Smith (Wholesale) Pty. Ltd.

The company will be stocking all types of electronic components including specialised semi-conductors, which are not normally available to the hobbist and small quantity purchaser.

Once established, Dick Smith will be marketing a full range of kits for all Electronics Today project articles.

Ample car parking is provided at the rear of the premises and the business will be open five and a half days a week.

Contact Dick Smith (Wholesale) Pty. Ltd., 10 Atchison St., St. Leonards, NSW.

EQUIPMENT NEWS

APO APPROVED POWER SUPPLY

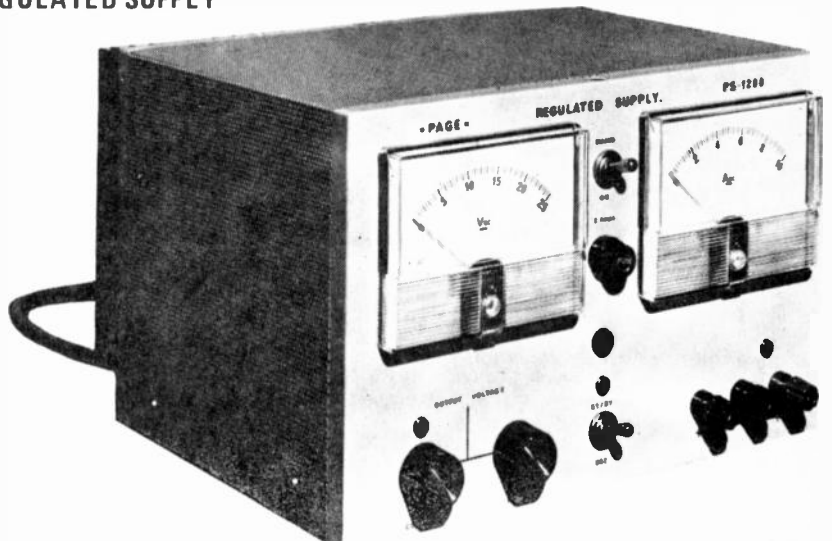


LATEST regulated power supply from A&R Electronic Equipment is double insulated and meets full requirements of the new APO regulations.

The new unit, designated PS 104 DI, has selectable outputs of 4.5V, 6V, 7.5V, 9V, or 12V dc at 0.5A. Regulation is approx. 10% on the 12 volt range and 5% on all other ranges; Ripple is less than 100mV rms.

Details from A&R Electronic Equipment Co. Pty. Ltd., 32 Lexton Rd. Box Hill, Vic. 3128.

AUSTRALIAN-MADE REGULATED SUPPLY



A NEW regulated power supply, designed and made in Australia, has been released by Auriema (Australasia) Pty. Ltd., Melbourne.

The model PS 1200A is made by Page Radio Systems, of Melbourne. It provides a constant output voltage over the 9 to 16 volt range, up to a maximum load current of 15 amps.

It was designed particularly for use in laboratory bench testing, and the testing of mobile radio transmitters and receivers.

Once the unit reaches the maximum

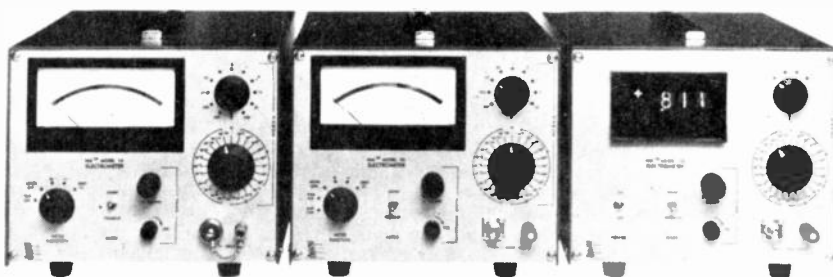
pre-set current, it operates in a constant current mode with fold back current limiting. Current limiting is automatically reset upon restoration of normal load conditions. The output may be short circuited indefinitely and recovery is automatic.

There are both coarse and fine controls for output voltage variation. Extruded heatsinks on the rear panel dissipate heat generated in the unit's four regulating transistors.

Details from Auriema (Australasia) Pty. Ltd., 63 Inkerman St. St. Kilda, Vic. 3182.

NEW ELECTROMETERS

New electrometers (P.A.R.)



A NEW LINE of multi-purpose, multi-range electrometers permitting precise, stable measurements of low amplitude dc voltages, currents and charges without significant source loading has been announced by Princeton Applied Research Corporation. The line consists of the PAR Model 134 ac line-powered electrometer, the Model 135 battery-powered electrometer, and the Model 136 digital display electrometer.

Instruments in the new line may also be used as ohmmeters, current sources, and as analogue amplifiers capable of matching low impedance circuits to high impedance signal

sources. A complete line of accessories is available including special attenuator probes, guarded test boxes and resistivity chambers.

PAR electrometers may be obtained with an input current suppression option, a variable constant-current supply for resistance measurements, and/or with a variable meter damping option. Model 135 may also be ordered with 10^{12} ohm case-to-ground insulation.

Details from Tecnico Electronics Pty. Ltd., 53 Carrington Rd. Marrickville, N.S.W. 2204.

DATA MODEM FOR 'HANDS-OFF' OPERATION

RACAL-MILGO announce the introduction of their Modem 4500/48 which simultaneously transmits and receives data at a speed of 4800 bits/sec. It was exhibited for the first time at Datafair 71 in Nottingham.

The data modem is designed primarily for use in conditions where line characteristics can vary and contains an adaptive equalizer which automatically and continuously adjusts for changes in line characteristics, providing reliable, 'hands-off' operation.

This modem has a wide range of applications including point-to-point data links which are subject to line characteristic changes, data communication links for unattended operation, bulk data transfer to and from high speed terminals, and for use with time division multiplexers such as the Racal-Milgo MC-70.

Racal-Milgo Modem 4500/48 requires a bandwidth from 500Hz to 2900Hz and operates synchronously, using amplitude modulated techniques. It is designed for use in four wire applications. Modem 4500/48 is also available in dual 2400 bps form, which enables the operation of two independent 2400 bps data streams over a single data link, with obvious improvement in line economy.

Details from Racal Electronics Pty. Ltd., 47 Talavera Rd., North Ryde, N.S.W. 2113.

STIMULUS ISOLATOR

A STIMULUS ISOLATOR from Tektronix provides true physiological stimulus isolation which permits true differential stimulation.

The unit is a tri-stable pulse generator, with the pulse polarity and timing determined by the input signal, supplied from a 26G3 pulse generator or other suitable source. The output is highly isolated from the input, both conductively and capacitively, and each polarity is independently variable and continuously calibrated through three ranges: 0 to ± 300 mA, 0 to ± 3 mA, and 0 to ± 30 mA.

Details from Tektronix Pty. Ltd., 80 Waterloo Rd., North Ryde, N.S.W. 2113.

ULTRA-COMPACT UHF RADIO

PLESSEY Electronics, the Melbourne-based manufacturers announce the release of a new range of UHF two-way radio communications equipment.

The completely solid-state mobile transmitter/receiver with 10 channels and 5 watts RF output is claimed to meet the highest standards of performance and reliability.

The equipment case contains separate transmitter and receiver printed circuit boards, laid out for ease of maintenance. Manual controls on the front panel include a channel selector switch which is omitted in single-channel models. The equipment is extremely flexible and many optional facilities are available.

Complete ancillary equipment is available for control purposes. Physical dimensions are 7" x 5" x 2".

Details from Plessey Electronics Pty. Limited, 91 Murphy St. Richmond, Vic. 3121.

'ANTI-BOUNCE' COUNTERS

AN ANTI-BOUNCE circuit which allows actuation by contacts, microswitches or reed switches is incorporated in a range of advanced electronic counters and batch counters, with or without pre-batch and batching totalizer facilities, for laboratory and industrial use.

Complete with electrical supplies for photoelectric input, all units are available with 1 to 6 stage digital output. Standard batch counters give a maximum count of 999,999 at up to 100 KHz, with maximum batching speed 5 per second. Maximum counting speed of counters is 1MHz.

Batch counters are provided with a single solid-state output of up to 150mA at 24V dc, operating at the batch count for approximately 100 milliseconds. Where a pre-batch facility is included, a second output is provided which operates at the pre-batch count.

The output signal can be used for a variety of the manufacturers' controls to give relay operation, dc or ac static switching, and various delayed or timed sequences. Other devices in common industrial use can be fed from the batch counters.

Available for operation from either 110 volt or 240 volt mains supply (60 or 50 Hz), units are 7.5 in. deep, 4.1 in. high and from



Stimulus isolator (Tektronix).

13.5 to 19.2 in. wide, depending on number of stages. They are suitable for rack mounting or free-standing application.

Details from GFC-Elliott Automation Pty. Ltd., 373 Horsley Rd., Milperra, N.S.W. 2214.

TIME SCALE GENERATOR

THE COMARK time scale generator Type 1401 provides a 'rule scale' timing waveform through a fully active output stage over the range from 1 microsecond to 10 seconds with a claimed accuracy of 0.005%.

The option of three simultaneously available waveforms makes the instrument equally useful to calibrate a time base, or mark real time on cathode ray oscilloscopes, magnetic and U-V recorders and other direct writing or visual applications.

The rule scale waveform comprises equi-spaced rectangular pulses of three distinct amplitudes, every fifth and tenth being accentuated without change of duration. An 8-position switch selects the scale by specifying the least significant interval.

The unscaled outputs are 1:1 mark:space ratio pulses from seven separate outputs with periods from 1 microsecond to 1 second. The square-wave output has a 1:1 mark:space ratio and an interval of ten times the period indicated by the selector switch. A fully active output stage gives a rise time of 40 nanoseconds and a delay time of significant falling edge of 30 nanoseconds for excellent time definition.

All outputs may be enabled by a signal on the control socket and are then initiated within 1.1 microseconds, thus simplifying record analysis by timing from a prescribed occurrence.

The internal 1MHz reference can be replaced by an external clock signal for increased accuracy or to permit generation of long time periods. Two instruments, used in cascade, will generate periods up to 10⁸ seconds.

Details from Jacoby Mitchell Pty. Ltd., 469 Kent St., Sydney, N.S.W. 2000.

HYGROMETER HAS DIGITAL READOUT

A NEW hygrometer developed by a British firm has digital readout, and its measurement of relative humidity is claimed to be accurate to within 2°C. Dewpoint.

Suitable for air, gases or liquids, including solvents and oils, it is available in ranges which together cover the whole field of humidity measurement, from 1 p.p.m. to 90°C. Dewpoint. It is fast-acting, response time being typically less than a second. It is also independent of flow within the measured medium, and can therefore be used effectively even in closed systems.

The hygrometer's sensor, which can be any one of several types differing in sensitivity and physical characteristics for different applications, is a small probe that operates on the variable-capacitance principle. Its sensing element includes a wire coated with a hygroscopic dielectric layer, which itself has a permeable coating of 24-carat gold. The capacitance of the dielectric layer varies with variations in humidity.

The instrument gives a direct indication of relative humidity in parts per million or dewpoint. No conversion or adjustment is needed. The instrument has two controls, one for on/off and the other for accuracy checks. The cable linking sensor and instrument is coaxial to avoid stray pick-up of mains voltage. It may be up to 100 metres long.

The instrument is designed to withstand relatively rough usage in industrial conditions.

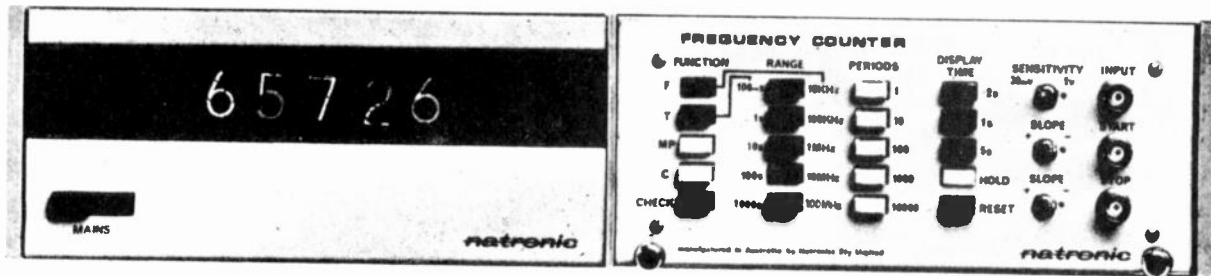
Details from Noel P. Hunt & Co. Pty. Ltd., 1-11 Hawke St., Melbourne, Vic. 3000.

AUTOMATIC DIGITAL BRIDGE

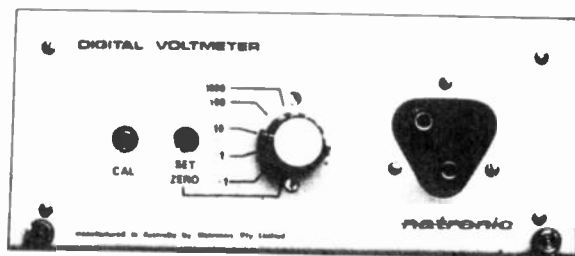
BRITISH electronics manufacturer Wayne Kerr has just released a new 0.1% 4-quadrant automatic digital bridge with twin displays reading up to 19999.

It is direct-reading in terms of capacitance, inductance, conductance, resistance, loss factor and Q. In addition to these

TWO FOR THE PRICE OF ONE



Frequency counter plug-in module type 5040 and basic main frame type 501



DVM plug-in module type 50410

Modular construction enables the Natronic 500 series of digital instruments to be used for accurate and repeatable measurement of a large number of variables. The instruments are constructed as a basic main frame with interchangeable plug-in modules.

Frequency counter plug-in module type 5040 and basic main frame type 501 combine to form a 100MHz frequency counter with facilities for period timing and event counting.

DVM plug-in module type 50410 and basic main frame type 501 combine to form a highly accurate integrating digital voltmeter. Principal features of the instrument include excellent zero stability, 0.02% accuracy maintained over a wide temperature range and good rejection of common and series mode interference.

A main frame with both plug-ins available for what you would normally pay for one instrument.

NATRONICS PTY. LIMITED

THE CRESCENT, KINGSGROVE, N.S.W. • Phone 50-0111
74 RAGLAN STREET, PRESTON, VICTORIA. 3072



THE EQUIPMENT DIVISION OF
IRH INDUSTRIES LIMITED

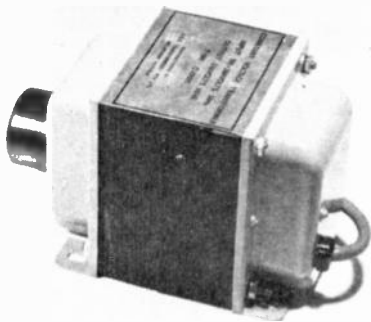
EQUIPMENT NEWS

Sweep marker generator (Wavetek).

quantities, either or both displays can be used as a 4-range DVM. Also, a reciprocal capacitance facility provides a linear distance/readout relationship for checking capacitive transducers. The bridge, Model B900, features automatic lead compensation and has TTL output.

For further information, contact Wayne Kerr, Roebuck Rd., Chessington, Surrey, England.

CONSTANT VOLTAGE TRANSFORMERS



Constant voltage transformer.

THE NOISE susceptibility of many types of digital equipment has been largely responsible for the increase in sales of constant voltage transformers, for — unlike other types of voltage regulators — CVTs have excellent transient suppression.

A new range of CVTs rated from 60 to 1000 VA have been introduced by A&R Transformers Pty. Ltd. These CVTs provide line regulation of better than $\pm 1\%$ and load regulation of $\pm 0.5\%$.

Details from A&R Transformers Pty. Ltd., 30 Lexton Rd., Box Hill, Vic. 3128.

500 MHz OSCILLOSCOPE

CLAIMED by its manufacturers to be the world's most advanced oscilloscope system, the 7904 oscilloscope, 7B92 dual time base and 7A19 amplifier are the latest extension of the Tektronix 7000 Series.

Coupled with the versatility of the established 7000 Series plug-ins (twenty others are available), the 7904 offers the highest mainframe and CRT bandwidth available today in a general-purpose real-time oscilloscope.

Direct access to the CRT provides 1-GHz bandwidth at a deflection factor of 5 V/cm. With the 7A19 amplifier plug-in the bandwidth is a remarkable 500 MHz at a deflection factor of 10 mV/cm. The 7A19 provides a 50-ohm input for optimum signal fidelity.

The 7904 CRT an 8 x 10 cm. viewing area and offers excellent visual brightness and photographic writing speed. 24-kV accelerating potential and a new CRT design provide a writing speed of 10 cm/ns with C-51-R camera, P11 phosphor and 10,000 ASA film (20 cm/ns with fogging enhancement). An optional CRT (4 x 5 cm.) and the writing rate enhancement of Tektronix' new film fogging technique extends writing speed beyond 30 cm/ns.

Most photographic requirements can now be met with 3000 ASA film. The writing speed reserve means reduced intensity settings and improved trace definition. With P31 phosphor, the optional CRT provides an outstanding method of viewing low



SWEEP MARKER GENERATOR

FROM U.S.A. comes the announcement that a new line of narrow-band sweep marker generators is available from Wavetek Indiana, Inc.

These 1312 Series instruments are all-solid-state and provide stable operation from electronically tuned and swept oscillators. The generators employ narrow, crystal-controlled pulse-type markers since the normal birdy-type markers are unusable for extremely narrow bandwidths. The 1312 Series markers are derived from unique crystal-filter circuits using inexpensive quartz crystals. The type of circuitry precludes any spurious crystal responses; no threshold or trigger-level controls are used. Thus the markers are stable and accurate, regardless of the sweeper's operational parameters.

Up to five markers may be controlled by individual front panel on-off switches and are available as positive or negative 35-volt pulses. The markers may be used for oscilloscope 'Z' axis modulation (intensification or blanking), or may be

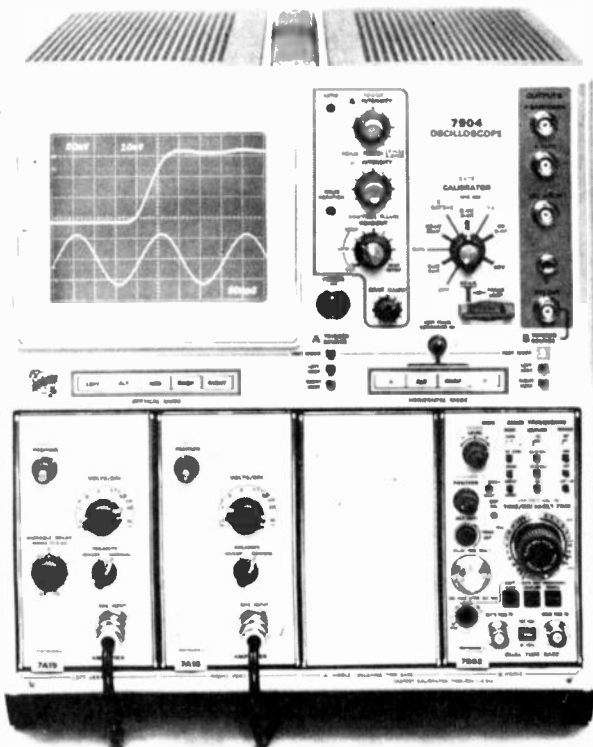
added to the vertical axis as sharp, differentiated pulses. Use of an internal jumper wire allows the markers to shut off or 'blank' the sweep oscillator coincidental with the marker frequency. Marker width is always approximately 1/100 of the scope display, providing a sharp, readable marker at bandwidths of 50 kHz or 24 MHz.

The 1312 Series also provides 79 dB in steps of 3, 6, 10, 20, 20 and 20; plus either 20 or 30 dB of variable attenuation, reducing its 1-volt rms output. Twenty or 30 dB of this attenuation is provided by an electronic attenuator using P.I.N. diodes in a closed-loop levelling system. This provides a constant-source impedance and stable centre frequency, regardless of the setting of the attenuator.

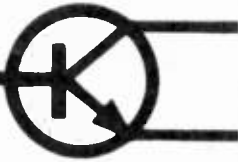
The generators are available in the frequency range of from 4MHz to 250 MHz, although the centre frequencies and maximum sweep widths are limited by the marker circuits.

For further information contact Wavetek Indiana, Inc., P.O. Box 1987, Indianapolis, Indiana, U.S.A.

500 MHz Oscilloscope (Tektronix).



PRE-PAK electronics



MAIL ORDER SERVICE:

P.O. Box 131, Kingsgrove. 2208.

SALES CENTRE—Phone 69 5922
103 Regent Street, Redfern. 2016.

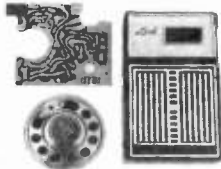
DISPOSALS CENTRE—Phone 69 5922
95 Regent Street, Redfern. 2016.

CITY SHOWROOM—Phone 211 2826
429 Pitt Street, Sydney. 2000.

24 HOUR DESPATCH SERVICE

- ★ SPECIALIZING IN MAIL ORDER (AT WHOLESALE PRICES).
- ★ ALL GOODS CAREFULLY PACKED — INVOICE AND ORDER FORMS INCLUDED.
- ★ OVER 10,000 DIFFERENT ITEMS — EX STOCK. Satisfaction guaranteed.
- ★ SEND S.A.E. FOR FURTHER ENQUIRIES ON ANY ITEMS LISTED BELOW.

SCOOP! 6 TRANSISTOR RADIO KITS



Complete with all parts including P.C. board, speaker, case and carrying case etc., with instructions.
Special Price \$7.50.

SINCLAIR STEREO SIXTY

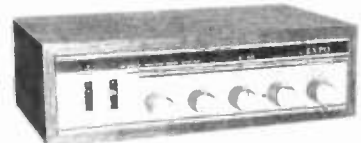
Complete, built and tested.



Z30 amp with PZ5	\$99.00
Z30	\$14.90
Z50	\$18.75
AFU	\$26.50
PZ5	\$17.60
PZ8	\$26.50
PZ6	\$29.90
Stereo Sixty pre-amp & control unit	\$34.25
Chassis suit Z30 system teak front panel	\$12.00

AMPLIFIERS 7W RMS PER CHANNEL

Amplifiers 7W per channel.



E 1000 Amplifier 7W RMS per channel, 20Hz — 25KHz suits mag cartridge, 4 inputs, tape recording output.
Price \$59.00.

CAPACITOR DISCHARGE IGNITION G.T.S. by Statronics



Unconditionally g'teed. 6 months
De Luxe \$39.95
Competition \$48.00
Marine \$59.00
Pre-Pak Electronics C.D.I. Kit contains all parts, easy to assemble, \$27.75, post 50c.

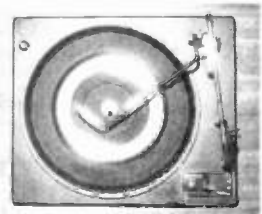
COMPUTER PANELS



Approx. 90-100 parts per board.

Qty. 1-4	\$2.50.	Post 50c
Qty. 5-9	\$2.00.	Post \$1.00
Qty. 10-24	\$1.80.	Post \$2.00

RECORD CHANGERS



Well known make, with ceramic cartridge \$39.00
As above, mini-changer \$34.00
BSR Model MA-70 \$49.90
BSR Model MA-75 \$56.50

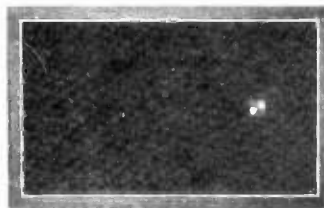
POLYTRON MODULES



R010 RF OSC / Mixer Module	\$3.95
1022 IF Amplifier, high sensitivity 455 KHz	\$7.95
A051 Audio Amplifier, 200mw, 6v battery	\$5.95

Add Ferrite aerial, tuning gang, volume control and speaker to build powerful 8-transistor radio.

SPEAKER SYSTEMS from \$15.00



1 x 8" twin-cone + 1 x 3" tweeter, teak	\$30.00
1 x 12" twin-cone + 1 x 3" tweeter, teak	\$40.00

POWER SUPPLY KITS



pictured.
PS-3 \$5.95
PS-4 \$7.90
PS-5 \$6.40
PS-1 \$27.50

0-20v Regulated and short circuit proof — 4 transistor, variable voltage and current controls, all parts including instructions.

EQUIPMENT NEWS

repetition rate, ultra-high frequency signals even in high ambient light.

The CRT is labelled with deflection factors and sweep rates, uncalibrated and invert symbols. Voltage, current, resistance, temperature and frequency are also indicated directly on the CRT when the 7D13 DMM and 7D14 digital counter plug-ins are used. A photo of the CRT gives the operator a permanent record of both analogue and digital data.

The 500 picosecond/cm sweep of the 7B92 dual time base matches the ultra-high bandwidth of the 7904 mainframe. It features three display modes: intensified delaying sweep, delayed sweep and alternate. The unique alternate mode allows simultaneous display of the intensified delaying sweep and delayed sweep. Trigger requirements are 0.5 cm, increasing to 1 cm at 600 MHz, 100 mV when externally coupled. The external trigger inputs offer either 50-Ω or 1-Ω input impedance, switch selected. Calibrated sweep rates are 500 psec/cm to 0.2 s/cm.

The 7904 is compatible with 22 7000 Series plug-ins. And the new 7A19 and 7B92 are compatible with all 7000 Series oscilloscopes. Included in the plug-ins are: two dual-trace units, a differential comparator, an ac current probe amplifier, two 1-Ω input single-trace units, a 10-μV differential, a low-capacitance FET probe amplifier, sampling (to 14 GHz) and TDR units, a digital multimeter and a 525-MHz digital counter. By electronically switching between plug-ins, the 7904 provides measurement options which are only available with 7000 Series oscilloscopes. Other single-beam scopes do not allow the simultaneous use of different kinds of plug-ins in a single mainframe.

Since the output amplifier is in the mainframe, the vertical amplifier plug-ins need only contain a preamplifier. This means that the 7000 Series amplifier units are generally lower-priced than those with comparable performance offered by manufacturers who choose to place the complete vertical amplifier in each plug-in.

Details from Tektronix Pty. Ltd., 80 Waterloo Rd., North Ryde, N.S.W. 2113.

QUALITY CONTROL MONITOR

FOOD and chemical particles are evaluated against a reference background by an electronic quality control monitor developed by a British company. It has applications in laboratories, universities, food processing, plastics and other industries.

The particles are inspected optically for surface colour against a selected reference background. Those which do not match this background trigger a conventional electronic unit which counts the defects.

Particles can be of any shape or size, from about 0.07 to 0.3 in., including cereals or small inorganic pieces, such as polythene cubes or mineral particles. The process can be in small batches or continuously. With cereals the processing rate is 11 lb. per hour.

The standard machine employs a belt feed system, but alternatives can be provided to suit the size of particle being handled. Pre-set alarms on maximum or minimum counts can be supplied for particular requirements. Count results can be displayed or printed.

Particles to be inspected are fed from a small hopper via a vibratory feeder onto a spiral unit, driven from the feed belt. They are deposited on the belt at belt-speed, with minimum disturbance. The essentially single

line feed is discharged through an optical chamber, uniformly illuminated by fluorescent tubes.

Three symmetrically placed optical units inspect particles against adjustable colour reference backgrounds, chosen to match the predominant colour appearance of the particle. Signals are obtained only when a particle deviates in colour from the matched background.

Details from Kempster & Love Pty. Ltd., 48 Wilson St., South Yarra, Vic. 3141.

RUGGED DIGITAL PANEL METER



Rugged digital panel meter (Digilin).

A DIGITAL panel meter, specially ruggedized and resistant to factory and process environments, has been marketed by Digilin Inc., of Glendale, California.

The new Type 2330 meter is housed in a cast aluminium front bezel and extruded aluminium case which acts as a heatsink, eliminating vent holes and sealing the case against contaminants. The meter's plug-in circuit boards slide into channels in the aluminium casing.

The 3½-digit, 0.1% accuracy meter features a comprehensive list of standard options plus power and space provisions for optional extras, such as inclusion of existing analogue meter circuitry.

The options can be built into the meter at the time of manufacture, or the user can add them later as the need arises.

Standard features such as hold and TTL-compatible BCD output plus optional isolated BCD output (which allows a true floating input with independent analogue and digital ground) make the new meter particularly suitable for systems applications. The floating input, for instance, permits the meter to act as an A/D converter - as well as a display device - feeding its BCD output to a computer or printer with complete elimination of ground loop noise.

The company claims that the meter's input resistance of 1000 megohms and bias current of less than 1 nanoamp maintain its high accuracy even with megohm sources. Zero drift is eliminated by automatic zero adjustment, and overload protection is 100 times range (1000 volts maximum).

Details from Kimpex Pty. Ltd., 142 Highbury Rd., Burwood, Vic. 3125.

COMPUTERISED CLASSIFIEDS

RECENTLY the Digital Equipment Corporation announced an advanced software package for compiling newspaper classified advertisements.

(Continued on page 99)

WAYNE COMMUNICATION ELECTRONICS

757 GLENFERRIE ROAD
HAWTHORN, VIC., 3122
PHONE: 81 2818

RESISTORS: ½, 1, 2 WATT MIXED VALUES. \$1.50 per bag 100. ¼ WATT MIXED VALUES. \$2.00 per bag 100.

CAPACITORS: MICA, PAPER, POLYESTER. MIXED VALUES. \$2.00 per bag 100.

CAPACITORS: SILVER, MICA, 750 volt. 10pF to 1000pF. 5c each.

TRANSFORMERS: 240v PRI. 17 VOLT 2 AMP SEC. \$3.00 each. 240v PRI. 152 VOLT 200mA + 6.3v 5 AMP. \$4.00 each.

TEKTRONIX OSCILLOSCOPE: Type 585, 85 MHz with Type 82 Dual Trace Plug-In. Complete with P6008 10xProbe and P6028 1xProbe and Tektronix 500A. Scope-Mobile Trolley. Excellent condition. P.O.A.

COMPUTER BOARDS: CONTAIN 6 VHF NPN SILICON TRANSISTORS, HIGH SPEED DIODES, ETC. \$1.25 each.

STEREOS FOR CARS

SEE ← A.W. BARRS

PHILIPS TRIPLE 5 CASSETTE OFFER
5 IP CASSETTES \$12.95

Save \$17.00 on cassettes when you buy any one of Philips cassette recorders

A.W. BARRS

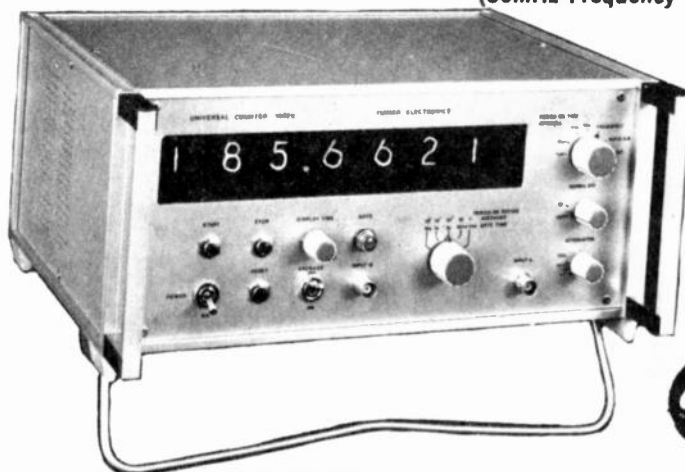
SOLE DISTRIBUTOR: A. W. BARRS—
99 Crown St., Sydney (31 0675), 70 Princes Highway, Arncliffe (59 2394), 208 Pacific Highway, Hornsby (476 1828), 368 King St., Newcastle (2 4422) (All stores open all day Saturdays).

NEW PRODUCT BY YUNKER ELECTRONICS

TYPE 185U
50U
UNIVERSAL COUNTER
TYPE 185F
50F
FREQUENCY COUNTER
\$740 FOR TYPE 50F
(50MHz Frequency Counter)

FEATURES:

- Frequency 10Hz to 185MHz.
- High input sensitivity.
- Fast warm up oven controlled 5MHz standard.
- 7 digit latched display with fast store transfer.
- Excellent serviceability by plug-in circuit boards.
- 6 month guarantee.
- Designed and manufactured in Australia.
- Cheapest counter of its class in Australia.



YUNKER ELECTRONICS

757 GLENFERRIE ROAD, HAWTHORN, VIC., 3122
PHONE: 81 2818

JVC NIVICO

PRESENTS . . .

DELUXE SEPARATE STEREO COMPONENTS

FEATURING EXCITING S.E.A. SYSTEM & SUPERB STYLING



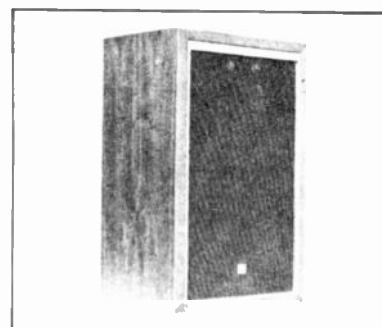
5220 TURNTABLE

The 5220 is complete with Automatic Return and Automatic Cut-off mechanisms. Plus the advanced belt-drive system for smoother, vibration-free revolution, and a newly designed universal tonearm. And that's not all. It features a moving magnet cartridge too, along with a 4-pole synchronous motor, and gentle oil-damped arm elevation mechanism.



5010 AMPLIFIER

Until now there were plenty of receivers on the market in the 40 watt range. But there wasn't one to enable the true stereo fan to direct his own show. If he wanted more power he had to go up into the higher ranges to find a receiver that would let him give direction to his musical inclinations. (And even then he had to come to JVC NIVICO, the only stereo maker offering S.E.A.) So we have made five-channel S.E.A. available in this 40 watt receiver, the distinguished 5010U.



5320 SPEAKER

Model 5320 is a full range 3-way speaker system consisting of an 8" woofer, a 3 1/2" squawker and a 2" tweeter. Each speaker has an unusually low distortion to reproduce tones with startling brilliance. It can faithfully reproduce deep, rich lows and rise up to clean, crisp highs with all tones in between in perfect fidelity. The handsome cabinet has the very best acoustical design, and there are many additional features cleverly included which you won't find on other systems.

SEE THE FULL EXCITING RANGE OF NIVICO STEREO COMPONENTS AT SYDNEY'S LARGEST JVC DEALER. • ALSO SEE SPECIAL 14-WAY S.E.A. SYSTEM ON DISPLAY. FULL REPAIR AND SPARE PARTS ALSO AVAILABLE!

AUTEL SYSTEMS PTY. LTD.

20 PITTWATER ROAD, GLADESVILLE, N.S.W.
PHONE: 89 0663. OPEN ALL DAY SATURDAY.

EQUIPMENT NEWS

The new package requires fewer keystrokes for operation than comparable packages. It includes an alphanumeric sorting capability, automatic advertisement deletions, and skip processing capacity.

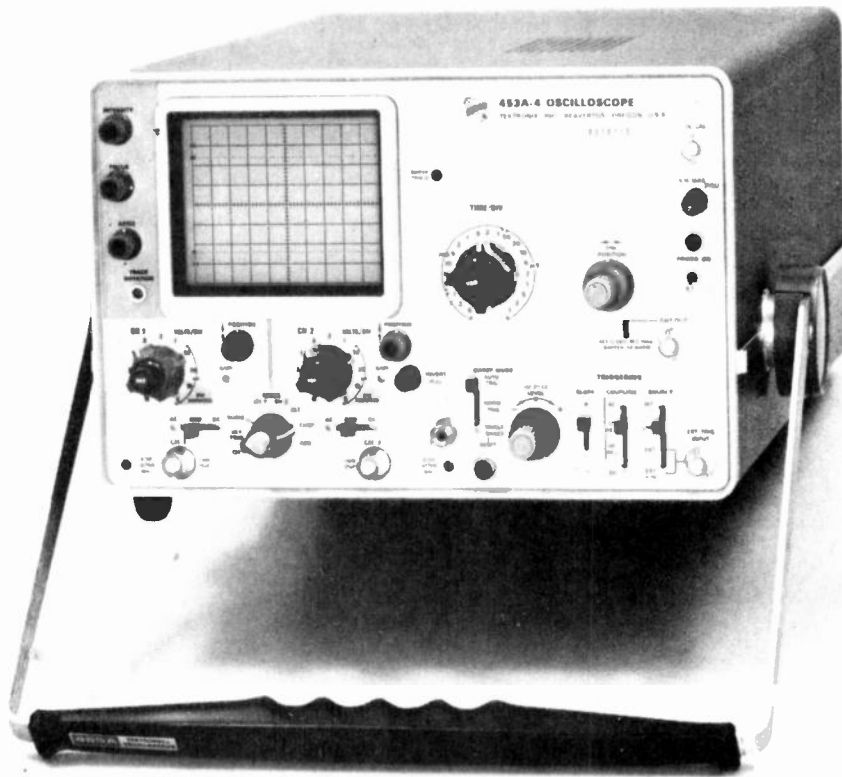
Designated Classified Ad Storage II, the package accepts paper tape output from a DEC typeset-8 hyphenation and justification programme, sorts and orders the advertisements by classification, and stores them on magnetic DECtape for later use by typesetting machines. A single DECtape unit handles up to 1000 four-line advertisements or approximately three pages of solid-set classified advertisements.

Unlike other software packages, Classified Ad Storage II sorts and places each advertisement in proper sequence at the same time it is stored on magnetic tape. The tape is always ready for transfer to paper tape for input to photo-typesetting machines.

Using the Classified Ad Storage II package, alphanumeric sorting of advertisements on the Typeset-8 is completely automatic. The programme scans all advertisements on a character-by-character basis until a complete sort is achieved. Because the user does not have to specify a sort key each time an advertisement is typed, multiple key-strokes are saved for each advertisement, thus reducing labour costs.

The automatic kill feature permits advertisements to be stored on DECtape and to be run or expired as desired by the operator. During the 'revision run' phase of classified advertisement, maintenance kills are made. The skip advertisement feature ensures that advertisements scheduled for publication do not appear on an unspecified day.

Details from Digital Equipment Aust. Pty. Ltd., 75 Alexander St., Crows Nest, N.S.W. 2065.



60MHz Portable oscilloscopes (Tektronix).

PORTABLE OSCILLOSCOPES

TEKTRONIX recently introduced the 453A portable oscilloscope. Now four new versions of the 453A are being introduced: the 453A-1, 453A-2, 453A-3, 453A-4.

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RECORDINGS... CLASSICAL

REVIEWERS: John Clare, Christopher Wagstaff, Kevin Wolfe

CHARLES IVES — Three Places in New England; CARL RUGGLES — Sun Treader. Boston Symphony Orchestra, conducted by Michael Tilson Thomas. Deutsche Grammophon 2530. Stereo.

Early in this century the American amateur composer Charles Ives employed many devices which were later to become the distinguishing characteristics of much more famous innovators. Polyrhythms, polytonality, even some atonality, quarter tones — all of these were present in works written by Ives before 1928.

It has been fairly pointed out that Bartok, Stravinsky, Schoenberg, Boulez, etc. did it all much better later on; but to leave it at that, to relegate Ives to the attic or basement where curiosities (in this case a dilettante who stumbled upon techniques he could not develop) are stored, is to do the man a gross injustice and to misunderstand his compositional motives.

Ives' impulses were often more those of a graphic illustrator or an epic film-maker than those of a composer working out new idioms within a purely musical spectrum. He used whatever devices seemed appropriate to illustrate a multiracial America marching ineluctably into the Twentieth Century, bearing with it strangely juxtaposed fragments of older cultures (consider a name like Minneapolis, mixture of Indian and Greek), growing in monolithic power even as it turned against itself in civil war. But, like Walt Whitman, like Hart Crane, Mark Twain and Melville, he did more than illustrate: he expressed a spirit which, if it wasn't really the spirit of America (and who now can say?), had its own valid life, and he helped set the tone of American art — rough-hewn, lurid, dynamic, sentimental, at once puritanical and reckless — which has persisted to this day.

In the orchestral suite 'Three Places In New England' Ives has tried to evoke both immediacy of place, and the place's residue of memories and associations — in these instances, largely Civil War associations.

One has the weird feeling of being a ghost returning to scenes of both cataclysm and peace. One is able to feel briefly that he is there in a real landscape — a feeling that

waves of memory, sourceless unearthly nostalgia and fear soon whirl away. To achieve this feeling Ives has used (particularly in the second piece) polyrhythms, polytonal discord, and divisions of the orchestra into completely unrelated parts — different though quite definite keys, melodies and rhythms — to suggest bands approaching from different directions. Strident military music is often allowed to dissolve into a whirling, oddly ethereal confusion. The music fluctuates radically, now immediate, now remote.

The third piece contains a holocaust of sound quite awful in its power, which suggests to me ghostly forces locking together and shaking each-other. If I have aroused your interest, I suggest that you listen to the recordings and read the cover notes which include an explication of each piece, making any attempt on my part quite redundant.

It was the Boston Symphony, incidentally, which first performed this work in 1931. I cannot find much fault with their performance here. The trumpets, though very powerful, are not particularly precise in the marching sections, but a certain roughness is not undesirable.

If Ives' work can be described as collage, his fellow-American Carl Ruggles (who also has some reputation as a painter) can be said to have concerned himself in his rather small output with works that are unified, refined and self-contained, after the thinking of Cezanne. The analogy with visual arts is not inappropriate, for Ruggles lays panels and strands of tonal colour in succession or juxtaposition with painterly care.

'Sun Treader' is in one sense rather static. It has a limpid, slow stealing motion, with yet a unifying dynamism — rather like the surface tension on a still, clear rainpool. Melodic development is minimal and one has the feeling of watching rafts of brass sound, curtains of strings, replace each-other with fluid precision. If this sounds a little like first impression, or even waffle, that is not far from the truth, for I am certainly not familiar enough with this particular work to criticize it — or its performance — at this stage.

Suffice to say that I have found it to be a rather lovely experience.

The recording is remarkably quiet on the surface — a particular virtue for the Ruggles work — and the sound is very clear and free from distortion. —J.C.

MOZART — Piano Concertos No. 19 and 27. Clara Haskil, piano, with Berlin Philharmonic (19) and Bayerisches Staatsorchester (27). Conductor, Ferenc Fricsay. Heliodor 2548 032. Stereo.

Mozart perfected the piano concerto form and raised it to its highest level. The concertos on this record are two of the finest examples of this. Unfortunately the performances under review are nothing to rave about.



In Concerto No. 19 the orchestral playing is not crisp enough by a long chalk, particularly in the first movement. The second movement is quite good. The last movement is taken at a cracking pace, and once again the orchestra is not tight enough. Clara Haskil plays quite well, but the piano is too far forward for me.

Concerto No. 27 is Mozart's last — and possibly his best — piano concerto. The performance here is better than the No. 19. The balance between piano and orchestra is better, and the performance has a vitality which the No. 19 lacks. Miss Haskil plays with considerable authority and is well backed up by the orchestra. —K.W.

DEBUSSY — Sonata for Violin and Piano, Sonata for Cello and Piano, Sonata for Flute, Harp and Viola, Synchrony for Solo Flute. Joseph Silverstein, violin; Michael Tilson Thomas, piano; Jules Eskin, cello; Burton Fine, viola; Doriot Anthony Dwyer, flute; Ann Hobson, harp. Boston Symphony Chamber Players. DGG 253049. Stereo.

Debussy's few chamber works show that he did not have to depend on the resources of a full orchestra to achieve his exquisite and distinctive nuances of atmosphere and colouration. They also demonstrate that which is not sufficiently emphasised in most popular literature — that Debussy was an extraordinary melodist, and that his music should be heard in linear terms as well as from the point of view of 'washes of tonal colour.'

The first and final movements of the Sonata for Violin and Piano contain melodic figures that are at once moments, experiences in time, which outside his own string quartet can hardly be rivalled; moments which seem to freeze into indelible images of fragility and elegance: snow, and glass shopfronts; white crystalline forests with, somewhere, icy water trickling. These things are achieved with great economy and precision, and they are (to reiterate) achieved melodically: intervals

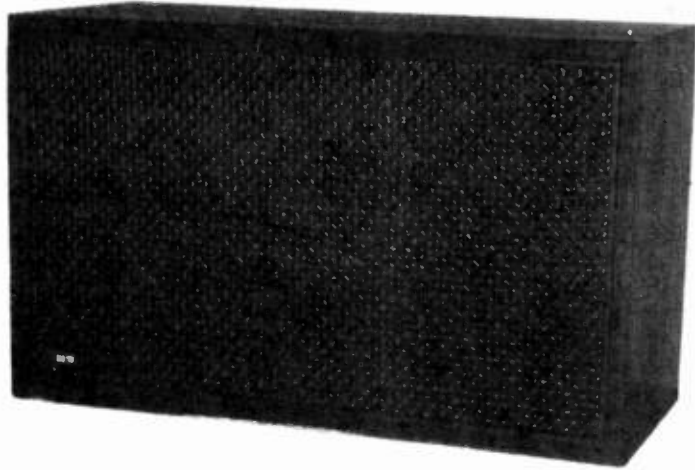


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articulated by the melodic idea create the aura, the evocation.

These moments are all the more remarkable when one realises that the composer was suffering from cancer at the time, and had the additional distraction of knowing that at any day the advancing German armies might enter Paris. In the work Debussy made a conscious effort to return to the traditional classical forms of the 17th and 18th century French instrumental masters. Whatever the reason — and reasons are not to find — the work falls a little dead in places, to my ears at any rate, as though craftsmanship had been deserted here and there by inspiration.

Silverstein seems to me to have beautifully realised Debussy's violin conception. His tone can be frosty, sighing, remote or thrillingly immediate, and his playing is not without a certain gypsy quality which seems quite appropriate. Thomas' piano — a glorious sounding instrument, incidentally — is strong but well controlled. Much the same things can be said of all the Boston Symphony Chamber Players. They have put a lot of thought into playing Debussy, and have been surpassed in my recent experience only by the Vlach Quartet, on a Supraphon recording of the String Quartet.

The Sonata for Cello and Piano is overall a more satisfying work, and it is again given an exemplary performance. The finale reveals what would probably have emerged in the florid arabesques of the Sonata for Violin and Piano, had Debussy been under less pressure: a rhythmic and directional force which seems to me almost Hungarian. It is, in fact, interesting to note that Bartok — who counted Debussy among his chief influences — was intrigued by the Hungarian quality of some of his work. Amusing, too, to surmise that many people, on hearing anything that sounds remotely like Debussy, probably classify it subconsciously as sounding very French. Note the beautiful piano chords behind the more reflective passages.

The Sonata for Flute, Viola and Harp is the most forward-looking work here. Just as a possible Hungarian influence influenced in turn a Hungarian composer, so Stravinsky — who learned much from Debussy — has in his turn influenced some of this piece. In the finale particularly can you feel some of the flavour of the quiet interludes of the 'Rite Of Spring'. But the work is more than contemporary in its historical context. There are pre-echoes here of much music which came later, including certain resemblances to serial music. Although it has some of the unpredictability and apparent fragmentation of the last-mentioned, it is again supremely melodic. The interdependent 'fragments' are cells of melody in themselves.

In this, and in the Syrinx for Solo Flute, Doriot Anthony Dwyer produces the most sumptuous flute sound I've heard in quite a while. I am almost certain that he is playing the increasingly rare wooden flute.

Apart from a slight tendency to boom in the lower reaches of both the harp and the piano, the sound is fine. The only real criticism I can offer of this excellent recording is that the playing time on side two is rather short. Beautiful Monet on the cover, incidentally. — J. C.

THE ORGAN OF LIVERPOOL METROPOLITAN CATHEDRAL.
Olivier Messiaen — L'Ascension No. 111. J.S. Bach — Chorale Prelude

'Liebster Jesu, wir sind hier' (BWV 731). Jean Berveiller — Mouvement C. M. Widor — Toccata from Sym. No. 5. Charles Tournemire — Suite No. 24 from 'L'Orgue Mystique'. William Mathias — Invocations, Op. 35. Performers: Jeanne Demessieux (items 1-4), Flor Peeters (item 5), Noel Rawsthorne (item 6). DECCA Ace of Diamonds SDD-236. Stereo.

Magnificent — both the playing and the new organ! What a treat it is to hear a well-voiced English cathedral organ without a booming open wood and overblown pedal reeds.

In this organ nothing dominates. Everything blends (except, of course, the orchestral trumpets) to give a glorious blaze of sound. It was designed to be able to perform all schools of organ composition, and this it does admirably. The fanfare trumpets look and sound most exciting. On the record cover are shown their brass resonators, displayed horizontally and set in juxtaposition to the free-standing ranks of flues. The sound is much cleaner than certain Spanish 'en chamade' trumpets I have heard.

The main attraction of this record (apart from the sound of the organ) is Jeanne Demessieux' playing. This may well have been one of the last records she made before her death at the early age of 42. Her complete mastery of the instrument is strongly evident — everything sounds easy for her.

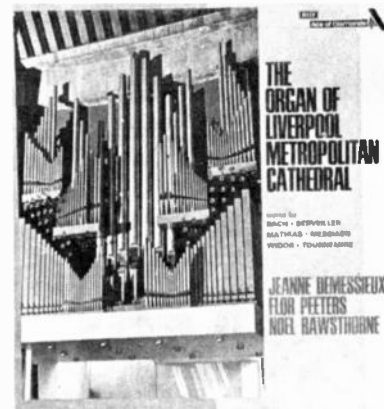
I was astounded at the way she played the Messiaen (one of his most difficult movements) — not only the speed but her complete conviction and understanding of the Pauline text on which it is based. The pauses are well controlled and the accents (which so many of today's organists do not bother about) clearly defined. A pity we do not possess any other recorded instance of her Messiaen playing.

Her Bach is beautiful — how moving a simple chorale prelude can sound in the hands of a fine artist! The Berveiller 'Mouvement' with its ostinato motif in the pedals shows her excellent pedal technique. That rather hackneyed Widor 'Toccata' takes on a new light here. It is the most exciting (as well as the fastest) performance I know, and from beginning to end it just scintillates sparkles. She was one organist who played the opening right-hand configuration of eight semiquavers with the first note legato, the second accented and the remaining six notes staccato against left-hand chords accented on the main beats of the bar, as written!

Flor Peeters plays convincingly in the Tournemire 'Suite' — a delightful work based on a plain-chant motif. His use of the solo strings against stopped diapasons (especially in the 'Elevation') is very effective.

The Mathias 'Invocations' was specially commissioned for the opening of the cathedral, when it was played by Noel Rawsthorne (to whom the work is dedicated). It certainly displays the full resources of the instrument, from the mild solo strings to the strident fanfare trumpets, as well as developing a strongly rhythmic idea heard at the opening. In the second section I would have preferred some of the rests between the two contrasted ideas to be slightly longer, but nonetheless the work is well performed.

It is unfortunate the specification of the organ was not included, for the record is



meant to show the qualities of the organ. I understand the reverberation time for a full chord on this organ is around nine seconds (when the cathedral is empty), so the engineers have done a good job of microphone placement. There is impeccable clarity as well as an appropriate atmosphere, and the 'ping-pong' effect with the fanfare trumpets is delightful.

Thoroughly recommended. — J.C.

BEETHOVEN — Piano Concerto No. 1. Daniel Barenboim, piano, with the New Philharmonia Orchestra, conducted by Otto Klemperer. EMI OASD 2616. Stereo.

I have never previously been particularly fond of this concerto. It was written in 1797 — before Beethoven's deafness started to overtake him — and, although a composer of some promise, he was probably interested in establishing himself as the best pianist in Vienna.

The performance under review changed my opinion. In Klemperer's hands the work assumes a new dimension for me — a breadth and grandeur that I have never been aware of before. Add to this the magnificent playing of Barenboim and, as far as I'm concerned, you've got perfection. Barenboim has replaced the over-long Beethoven first movement cadenza with one he has written himself.

Listen to this record and hear the concerto in a new perspective. Recording and fidelity are excellent. — K. W.

BEETHOVEN — Symphony No. 5. Vienna Philharmonic, conducted by Karl Bohm. Deutsche Grammophon 2530 062. Stereo.

Here at last is a performance of the Fifth which I can recommend wholeheartedly. Eliminate most of the negative things I have said about other versions, and you are left with this very fine performance.

I suppose you could say that Bohm's is a pretty 'straight' interpretation, but it is by no means an uninspired one. The music is allowed to speak for itself with, obviously, great eloquence and power, though Bohm does not make so much of it rhythmically as does Klemperer.

The playing of the Vienna Philharmonic is splendid throughout, but particularly in the magnificent 'tutti's' are their control and spacious power evident.

The recorded sound is not perfect. Rather it has almost a concert-hall ambience which is unusually satisfying. It is a most fulfilling experience to hear a man of Bohm's age impart a tangible fervor to this great orchestra, and I am glad that it was not 'preserved' in layers of clinical studio sound.

— J.C.

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DUKE ELLINGTON — 'Duke Ellington'. Liberian Suite, A Tone Parallel to Harlem. Duke Ellington and his orchestra. CBS 62686. Mono.

In jazz it's often the case that a 'head' arrangement worked out on the spot will become a timeless classic, while any number of ambitious suites or extended works, jazz concerti, etc., will take their place in the museum of musical curiosities.

Ellington is one of the few who have been able to extend themselves without sounding pretentious, overblown, or simply unoriginal. In fact, much of Ellington's very best material is to be found in his longer works, which are in the main free from the tendency toward suaveness that some of his less ambitious band pieces display.

'A Tone Parallel to Harlem' is a continuous work with some degree of thematic development, some extremely interesting orchestral effects and several swift, thrilling climaxes. The 'Liberian Suite' is a series of short dances which could well have appeared separately, though they share a certain unifying character. Each is a small gem displaying those facets of the band one hears less frequently on record these days: the absolutely unique textures, the masterful alternation of the mellifluous and the dissonant, the command of orchestral overtones which allows Ellington to produce ghostly notes in addition to those being actually sounded on the instruments employed at a given time.

This is a great band of either the late '40s or very early '50s. The brass section has a real timbre that no other band except Dizzy Gillespie's has even remotely approximated (so many good big bands sound as though they have the one big clean, precise trumpet rather than a glorious choir) and a precision that Gillespie's insane aggregation were not really trying for. The reeds have a voluptuous yet muscular fullness that no band — except Ellington's own in the mid '50s and earlier in the '40s — has ever come near. But one does not hear the band in terms of sections: rather as a swirling, flowing current, spiked by flaring dissonances, great rumbling pedal notes.

I suggest that, if you really want to know

what Ellington is about, why so many of us cannot speak or write about him without a certain dazed admiration confusing our words, you get hold of this and another recent release on French CBS — 'Primping At The Proms'.

The performance of 'A Tone Parallel to Harlem' is not as good as the one on that old Philips recording, 'Ellington Uptown' — but it is the only one you can get hold of these days, and as such makes this record an essential buy. This was the band in the early '50s, minus Hodges and before Cat Anderson and Willie Cook joined Ray Nance, Clark Terry and Harold Baker to create that unforgettable brass section.

The recorded sound is grainy, not lacking in impact but limited in dynamic range. In short, it sounds like a reissue of an old recording, but the music triumphs. Apart from the birthday concert double album on United Artists, this is the best Ellington record we've had here for about ten years.

— J.C.

COUNT BASIE — Swinging the Blues, 1937-9. Swinging the Blues, Blues in the Dark, Georgianna, Don't You Miss Your Baby?, Lady Be Good, Listen My Children, Dupree Blues, Red Wagon, Boogie Woogie, How Long Blues, The Dirty Dozen, Hey Lawdy Mama, The Fives, When the Sun Goes Down, Oh Red, Fare Thee Honey, Fare Thee Well. Swaggie S1275. Mono.

First off, 'Lady Be Good' has the classic Lester Young solo. If you haven't got it, here is a golden opportunity. That said, we can go on to criticise the record.

If I had a fairly wide range of material from this wonderful period in the history of Count Basie bands, I would have chosen from it a substantially different set of tracks with which to make up a representative recording. Of course, I don't know how much material Swaggie had access to, and everyone should be grateful for this opportunity to fill in gaps or replace worn copies.

Personally, I would have limited to three or four those tracks on which Count Basie soloed with just the rhythm section. Here we have a whole side of piano solos, with two more on the reverse. There is just too much brilliant band stuff from this period, most of which has brief solos by the Count, who is at his most effective in this context — at least, that is my humble opinion. We are left with six band tracks. This being the case, I would not have included four Jimmy Rushing vocals, much as I admire him — in point of fact, I enjoy Rushing's later work much more than his work of this period, and I am not alone in this.

It's all stuff that is well worth having — but what a recording it would have been if everything were up to the standard of 'Swinging the Blues' and 'Lady Be Good'. The first showcases the contrasting styles of Basie's two tenor stars, Lester Young and



Herschell Evans; Herschell fullsome, virile and stomping, Lester aloof and joyful in his own little world, smoothly planned, abstract, running almost independent of the beat. Each man makes his point quite clear in twelve bars.

You know, we had 'Swinging the Blues' in a book of Comb-Orks many years ago, when we were appallingly ignorant of anything before Charlie Parker. "This old one goes over all right," we would say, fishing it out indifferently. It never occurred to us to hear how it should have been played.

'Lady Be Good' has Lester running along very fast, but finding all the time in the world to create beautiful forms. He improvises on the tune in its entirety twice, and the two solos are separated by a fine muted trumpet solo of the same length. I think this is Buck Clayton. This is one track which I can never play just once and leave it at that.

A final hearing of the whole record before getting this review off shows that I have done Jimmy Rushing an injustice. 'Blues in the Dark' is a very strong performance.

Sound is not particularly good, even for vintage stuff; but, despite a certain roughness when the ensemble or just the brass are playing, the music is alive and immediate.

— J.C.

JABBO SMITH — Jazzmakers' Series. Swaggie S1212. Mono.

I may be mistaken, but I think it was Jabbo Smith who put a crown on his head one night when he heard Louis Armstrong playing trumpet in a Chicago club in the 'twenties. The gesture implied that he was a better trumpeter than Louis. He went on the stand to prove his claim, failed, and left the club discomfited and embarrassed — with Louis on the stand, wearing the crown and playing some of the meanest and savagiest trumpet of his life.

But, I repeat, I may be mistaken. If so, I apologise to Jabbo, who was one of the

JAZZ

greatest trumpeters of the 'twenties and who is an unnecessarily neglected musician.

The Melbourne reissue label Swaggie did something to remedy this poor state of affairs by putting out a 16-track of Jabbo in its Jazzmakers Series.

These sides were made in 1929 for American Brunswick, apparently encouraged by Okeh's success with its Armstrong Hot Five and Hot Seven records.

They prove that Jabbo Smith was a great trumpeter with a technique that could have been faster than Louis'. But he lacks Louis' poise, invention, majesty — genius, for want of a better word.

He had some great men with him, too. Omar Simeon, who was Jelly Roll Morton's favourite clarinetist, is on several tracks, and so are the pianists Earl Frazier and Alex Hill. As well there are Hayes Alvis on tuba (he played bass with Ellington for a while in the 'thirties) and the magnificent Ikey Robinson on banjo. The banjo is not one of my favourite instruments, but Robinson plays splendid stuff, tastefully and with formidable technique.

On the first track — 'Got Butter on It' — he plays two short guitar solos. Smith sings on several tracks and here he turns out a scat chorus, more in the style of George Thomas, of McKinney's Cotton-Pickers, than that of Louis Armstrong. Which still means first-rate.

On 'Sleepy Time Blues' which, backed by 'Little Willie Blues', I imported from the States nearly 20 years ago, his scat singing is impassioned. Notice Robinson's great break between the vocal and trumpet choruses. This track is beautiful after-hours stuff and should appeal to the distinguished Melbourne musician, Adrian H. Monsborough, who also records for Swaggie.

There are shades of Ade, too (foreshadowings would be an apter if clumsier word) in George James' clarinet solo on 'Till Times Get Better'. This track begins with a quote by Earl Frazier on piano from Rachmaninoff's Prelude in C Sharp Minor and then after a fast passage by Frazier, goes into a medium slow tune of the 'Lazy River — Good Time Flat Blues' pattern.

Jabbo opens 'Croonin' the Blues' with a break which could well have been inspired by Louis' introduction to 'West End Blues', made the year before.

Louis was, I think, the first cornettist-trumpeter to play against stop chords on record, and Jabbo follows proudly and ably in his footsteps on 'Boston Scuffle' and 'Michigander Blues'.

His fast opening break on 'Take Me to the River' supports the theory that he may have been a faster technician than Louis. He plays wondrous and muted trumpet behind Simeon's clarinet on 'Sweet 'n Low Blues'.

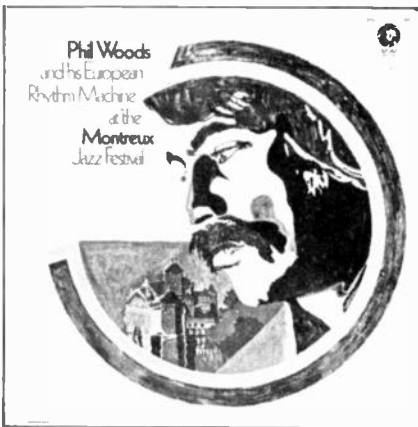
Simeon, one of the most accomplished of all New Orleans clarinetists (and God knows how many excellent ones there were), is at his best on 'Little Willie Blues', 'Ace of Rhythm', 'Sweet 'n Low'. And he jumps into his alto sax solo on 'Boston Scuffle'. Admittedly, his clarinet playing on this record is not so inspired as with Jelly Roll Morton and Earl Hines about the same time.

Casin Simpson was just an obscure name to me until I heard this record. He plays most unusual piano, for the period, on 'Take Your Time'. It is quite different from the comparatively simple, clear-cut right-hand octave style. Earl Frazier uses on most of the tracks. He sounds like a distant ancestor of Milt Buckner and Errol Garner.

Allow me also to commend to your attention Jabbo's trombone solo on 'Lina

Blues' — the only title I know of on which he recorded on this instrument — and the agile tuba of Hayes Alvis on 'San Sha Stomp'.

This is an excellent record by musicians who have been too quickly forgotten. But don't expect it to be greater than Louis Armstrong's Hot Five and Hot Seven groups of the 'twenties. And don't expect better trumpet from Jabbo Smith than you ever heard, or will hear, from Louis. — B.W.



PHIL WOODS AND HIS EUROPEAN RHYTHM MACHINE — At the Montreux Jazz Festival. Capricci Cavaleschi, I Remember Bird, Ad Infinitum Riot. Phil Woods, alto sax; George Gruntz, piano; Henri Texier, bass; Daniel Humair, drums. MGM 2315 009. Stereo.

Phil Woods is one of a select group of musicians whose ability and numbers would indicate that it is possible for some but not many white men to play great jazz. The men he has with him here prove that is possible for a European rhythm section to go like hell, but they are just about the only ones I have heard do it.

Woods, some of whose best performances were with the Dizzy Gillespie band, remains a bopper in basic concept, though he has certainly felt the influence of Coltrane and Ornette Coleman. In fact, his hard-edged alto sound is at times reminiscent of Coleman's, though it is more grainy in texture, less electrically bright, and that is the way he has always sounded.

Woods gets on his bike and pedals like mad from the opening bar. The bike soon leaves the ground. It is interesting to hear Texier and Humair providing a variety of rhythmic landscapes for Woods to fly over. Familiar bop phrases take on a new life as the ground beneath them goes sliding off at right angles, stabilises, rushes forward with a dark complexity of forests, and then drops away to the rear in half time, only to begin jumping unpredictably as though rocked by explosions. It would have been interesting to hear Charlie Parker and Elvin Jones or Tony Williams, although Max Roach was laying down some pretty wild cross rhythms and off-beat accents.

It so happens that we have just got hold of this record, and we would like to bring it to

your attention as soon as possible. Deadline looms — so, in place of a detailed analysis, you have my word that this is a furiously swinging jazz album; well recorded, though Woods is a bit far back at times, particularly on 'Capricci'. — J. C.

MASTER JAZZ PIANO, Volume One. I Got Rhythm, I Want a Little Girl, Anything for You, Squeeze Me, Lady Be Good and five blues improvisations by Earl Hines, Sonny White, Claude Hopkins, Cliff Jackson and Jay McShann. Swaggie SI274. Stereo.

Now available on the Australian 'Swaggie' label, this is a most interesting album of five mainstream pianists recorded by Master Jazz Recording on five different session dates around mid-1969.

It is rather disappointing that one rarely if ever hears solo jazz piano and, in fact, four of the five pianists on this album have never before recorded alone.

I often wonder how many contemporary jazz pianists could create excitement and make a piano swing if you took the bass and drums away.

Each of the five pianists here plays one standard and one 12-bar blues, and in my opinion Earl Hines is easily the most interesting and by far the best executant. His two numbers — 'Feelin' Fine Blues' and 'I Got Rhythm' — occupy nearly eleven minutes of playing time and some of his broken rhythms, for which he is famous, are breathtaking.

Hines, who is at the peak of his playing at the moment, makes frequent tours in England and it is our great loss that no promoter has brought him to Australia because, unlike many jazz pianists playing today, Hines would appeal equally to both followers of traditional jazz and those who prefer the modern style.

For sheer warmth, tone and meaty voicings, Cliff Jackson's renderings of 'Memphis Blues' and 'Squeeze Me' are most appealing: although older than the other pianists under review (he was born in 1902), he has everything under complete control and I could detect no traces of uncertainty in his playing.

One could hardly say the same about Claude Hopkins, who is one year younger and although his own composition, 'Anything For You', lasts only 2min. 35sec., it is inclined to be rather repetitious.

Some of the pianists are just as comfortable with a standard tune as they are with a 12-bar blues, but Jay McShann is obviously more at home with the blues sequence which is his real thing. So 'Friday Strut' which is exuberant and vital, comes off much better than 'Lady Be Good'.

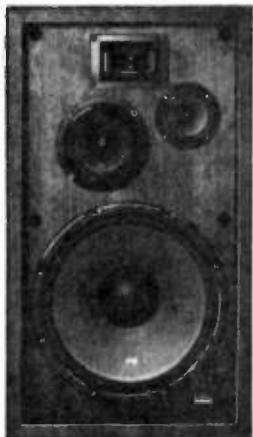
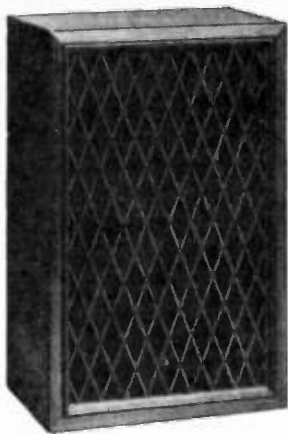
Those of us who grew up with Billie Holiday's heartrending version of 'Strange Fruit' will always remember the very beautiful and sensitive piano work of Sonny White. On this occasion Sonny contributes four seconds more time than Earl Hines, and this was his first recording date since the 'forties.

When he arrived at the studio he had nothing prepared — having misunderstood that Master Jazz would specify the tunes! In spite of this, only one take of each tune here was needed — and he plays 'Blues for Betty C' and 'I Want a Little Girl' with ease and a sense of finality.

Signal level seems to be low at the beginning of Earl Hines' solo on Side A, but this is easily rectified. — G. B.

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THE DALY WILSON PHENOMENON



BIG BANDS MAY NOT BE COMING BACK, BUT DALY WILSON IS HERE!

IT SEEMS doubtful to me that "big bands are coming back" — but at the same time it is quite clear that the Daly Wilson big band has arrived. Doubtful that big bands are coming back because Australia can probably support only one or two top-class big bands, even as part-time entities like Daly Wilson. Fortunate, then, that this is the best big band we've ever had — no Australian band has roared or swung the way this one can; and fortunate that it has been able to appeal to such a wide range of age groups — a good big band should not be a 'coterie' thing. It should belong to everyone.

One is tempted to say that the Daly Wilson band has everything going for it. This is not true, but they do have a lot in their favour. They can give the younger members of their audiences some of the best rock group sounds they've heard just by allowing their rhythm section of guitar, bass guitar, organ and drums to play on its own. Then they can gladden the hearts of

the older listeners and startle the younger ones by unleashing the full big band sound over the top. They can play tear-away jazz pieces at impossible tempi — and when they really lock in, they can get a pounding slow rhythm you can practically lean against.

Their final trump is the young singer Kerri Biddel, who must surely be the best popular, jazz-oriented singer we have had. She is equally effective on driving soul material, big production dramatic ballads, or dazzling up-tempo improvisations in the Ella Fitzgerald manner.

Daly Wilson consciously aim for the widest possible appeal within that audience, which likes a lot of rhythm and excitement. They even play a bit of syrup, but it's usually in the nature of a send-up.

Some might wonder what a big band has to offer a pop audience in these days of massive amplification, when — theoretically at least — you could pluck a single string and amplify it

until it was putting out more watts than a symphony orchestra. The answer is breadth and richness of sound, as well as a variety of solo instruments to break the curse of the inevitable guitar, playing what usually sounds like the same solo you heard last time and the time before. A big band can fill out huge chords and produce unusual textures and voicings — particularly a range of intriguing and often exciting dissonances which would be sheer agony if voiced entirely on electric instruments at high volume.

The Daly Wilson band was formed in 1969, when drummer Warren Daly returned to Sydney from America, where he had played with the Si Zentner band and the Glen Miller revival orchestra under Buddy De Franco. With his old friend and musical associate, trombonist Ed Wilson, he inspired a group of top-line musicians to devote a lot of time and enthusiasm to the rehearsal of a band which was obviously going to remain only a part-time thing, over and above their regular jobs, for an indefinite period. Musicians work funny hours, and they get tired like everyone else, so Warren must have brought some kind of electricity back from the States.

Here are Warren Daly's impressions of the Zentner band:

"The absolute most tremendous ball I ever had in my life. Big bands are my first and foremost love, and often after rehearsals I used to come out trembling with excitement. It was such a powerhouse group, yet not just in the way of being a loud band. It was dynamic. We used to do big screaming shuffles that I will never, never, never forget. The range of the brass players was something else, and I was extended to keep up with them. If they had a chord at the end of a tune, or any passage that was double forte, look out!"

Something of this feeling has infused the Daly Wilson band, and their concerts at venues ranging from the Musician's Club to Sydney University have been sellouts. Bobby Limb's Air Media Company is making a colour

POP TRENDS

film of the band which it hopes to sell overseas, and Blood Sweat and Tears' Bill Motzing told us that he thought the band could do quite well on a U.S. college tour. A recording of their Cell Block concert has sold very well and has even got air play on commercial radio, which is nothing short of amazing.

They do indeed have a lot going for them.

But not everything. In Warren Daly they have a big band drummer with both technique and heart. In Col Nolan they have a soloist on piano or organ who can bring an audience to its feet. In Ned Sutherland they have a strong guitarist in either jazz or rock style. In Doug Foskett, one of the most exciting altoists around. Tony Buchanan is a very strong tenor and baritone soloist and should be given more space. The trumpet soloists, however, are generally rather stiff (though they swing very hard in section). Deiter Voigt is beginning to swing more and more — the trumpet has only recently become his major instrument.

The band's arrangements are in the main quite ordinary, and those that are more interesting from a technical point of view have awkward transitions, unswinging sections, and generally a lack of warmth, which not even the enthusiasm with which the band tackles anything can disguise. The band sounds so good, whatever it plays, and it swings so hard when there is any possibility at all of doing so, that this does not matter too much yet — but it will in the long term.

I suggest they investigate the possibility of such things as Cubana Chant, featuring Col Nolan on piano, and Mantecca theme with Doug Foskett out front — and I really mean out front: it is possible to have a soloist's every note audible without destroying the dynamics of the band; the trumpet soloists cut through with plenty of impact, and it is much more exciting to hear that than to hear the ghost of a saxophone sound swimming hopelessly under the waves of sound from the band.

The brass section overbalances the reeds just a fraction too heavily at the moment, and I am sure that this is deliberate. It's the Buddy Rich wall-of-sound syndrome. Richness and depth are sacrificed for impact. Again, this is OK in the short term, but not a good long-term policy. It is not easy to dismiss the fact that Ellington and Basie have outlasted everyone — not that anyone should want to dismiss it.

Finally, they seem too anxious in

their programming to show all the facets of their repertoire in too rapid a succession. They will consistently break moods too quickly, and this leads to a certain residue of frustration at the end of a concert, however brilliant it has been. On W. D. & H. O. Blues one night, Col Nolan's smoking organ solo and the roaring accompaniment from the band created an atmosphere you could bite off and chew. Their next number was a bright brash white swing piece updated with a couple of time changes, and it completely destroyed the mood, which could have been sustained for at least one more number, or broken by something different but strong: a real flag-waver, or a song from Kerri Biddel.

I venture these criticisms because everyone else has just patted them on the back, as though there were no way they could improve themselves. I very much want them to succeed because they have the musicianship, spirit and dedication to show everyone what a big band is all about. They are certainly much more exciting, and have more heart, than the technically brilliant but rigid and mechanical Ted Heath band, which I saw several times in London. And look how big they were!

JIMI HENDRIX — The Cry of Love. Polydor 2480027. Stereo. Freedom, Drifting, Ezy Rider, Night Bird Flying, My Friend, Straight Ahead, Astro Man, Angel, In from the Storm, Belly Button Window.

This is previously unissued material, and it's all of a pretty high standard. I am not often in agreement with the people at Go Set, or those who write the same level of criticism for the University papers. Their standards are drawn from their own extremely limited musical world; nothing else could account for the exaggerated homage they pay such average musicians as Eric Clapton, Creedance Clearwater, Uriah Heep, Free, etc., singers Melanie, Jim Morrison, Janis Joplin, and so on and on. But when it comes to Jimi Hendrix, I am on the bandwagon with everyone else.

This recording has a beautiful feeling throughout. The band really moves, it does not just thump dully. Hendrix's guitar ties



touch belligerent knots, unwinds and releases a wild skirling cry to heaven. Hendrix is one of the few who looked like doing anything new with the tonal distortions possible on an electric guitar. It is a tragedy that he died before putting together the ten or twelve-piece band he spoke about in a Rolling Stones interview, a band which would include many experimental musicians unknown to the pop world. On this recording Hendrix plays more straight-ahead guitar, but it flies, it really flies.

Sound is excellent, though the drums could be a bit sharper on some tracks. One of the most satisfying records I've heard for a while.

KLAUS WUNDERLICH — Hammond Pops 5. Royal Sound SLE 14574. Stereo. Babuschkin, Oh! Lady Mary, Oma Mama Bambola, Let It Be, Love a Little Bit, Raindrops Keep Falling on My Head, Caroline, An einem Sonntag in Avignon, All Kinds of Everything, Mademoiselle Ninette, El Condor Pasa.

Mr. Wunderlich is enormously popular, yet to me he seems a singularly stiff and unmusical organist. I suppose it is presumptuous for me to say any more than that this is a collection of tunes — some old, some new, some American, some Continental — which should go down well with Klaus Wunderlich fans. However, if we were to limit our commentary always with regard to the feelings of others, we would not often say anything very interesting.

My apologies, then, if I am talking about you — but it seems to me that people who go for this stuff must sing along, either out loud or to themselves, and impose their own interpretation of the various melodies over the rigid but clearly marked blueprint provided by Mr. Wunderlich and his rhythm section.

Actually, I entertain the same speculations when I see people shaking themselves in a frenzy of joy to a quite mediocre pop group. The group is just laying down the framework. They are creating the excitement within themselves. And who is to say there is anything wrong with that? I could even be jealous.

Anyway, here is a collection of tunes, etc., etc. Sound is very bright. Recommended to Wunderlich fans — with apologies to same.

FREE — Highway. Island Records SIL 934 100. Stereo. The Highway Song; The Stealer; On My Way; Be My Friend; Sunny Day; Ride on Pony; Love You So; Bodie; Soon I Will Be Gone.

Free have the reputation of being a teenybopper group, but — as it is not infrequently the case — they are just as musical as many 'heavy' groups. This is not to say they are anything to write home about. Just a pleasant, competent group who writes fair to good melodies and, often, quite surprisingly good lyrics.

In some ways they are a throwback to Traffic, in that they will use piano and acoustic guitar with the electric instruments to produce a sweet and soothing texture of tinkling and chiming sounds. A strong country influence, fragments of baroque clichés, folk elements and rather restrained rock: all these things are present, as they were in Traffic, but they are not in that class — not able to improvise as freely as Traffic, nor get so many things going at the same time.

Not surprisingly, they are much more impressive through earphones, and it is clear

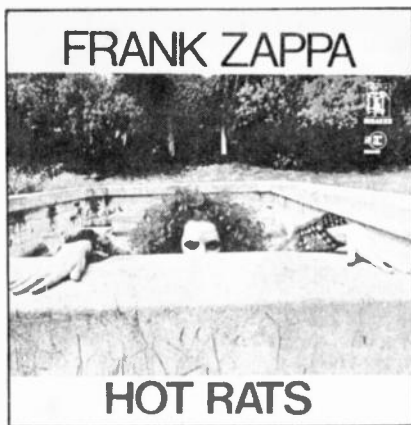
that care has been taken in the recording to exploit spatial effects. Commonplace phrases are much more effective if they are being played by a piano in one ear, a quiet guitar in the other, and a bass gently bouncing on the top of your head. In a couple of places strings are used briefly, and — as on the Beatles' 'Abbey Road' — they are played very softly, seemingly from a great distance above the listener's head.

As with Traffic, they exploit the technique of imparting simple 'advice' in their lyrics. Donovan does this sort of thing too. Such things as 'Get On Your Bike and Do What You Like', 'Let It All Wait' and 'There's Nobody Else Can Judge You' are whispered in your ear. The tone is usually that of reassurance, and I am sure that many young people are comforted by this sort of thing. Personally, I find it a bit annoying. Whatever else I might try to find in art, I am not looking for a wet nurse; but this is to take the music too seriously. It is good pop music — nothing more — and as such worth a listening, whoever you are.

— J. C.

FRANK ZAPPA — Hot Rats. Reprise RS 6356. Stereo. Peaches en Regalia; Willie the Pimp; Son of Mr. Green Genes; Little Umbrellas; The Gumbo Variations; It Must Be a Camel.

These are all Frank Zappa compositions and arrangements. On the face of it, you can't accuse him of being stuck in the one groove. 'Little Umbrellas' has a vaguely Turkish theme on saxes, which are all played by Ian Underwood and multi tracked



— his harmonies sound a bit like a less-hairy Roland Kirk.

'The Gumbo Variations' is a long jazz rock jam over a repeated figure in the bass. Underwood plays a strong, hard-edged tenor and Sugar Cane Harris plays a very wild violin.

'It Must Be a Camel' is a jazz theme in modal form — not unlike some of the things Bryce Rohde has written — played again on multi tracked saxes, with a disappointingly few bits and pieces from Jean Luc Ponty on violin.

'Willie the Pimp' is a seemingly interminable jam over a riff similar to those used by Howlin' Wolf, and so it goes.

For all this disparity, everything begins to sound rather samey after a while. Mainly, I think because it's all played at about the

same level. The tempo does not vary all that much either. Sound is very hard and clear. Frank's guitar is disappointing. Only in today's insulated rock world could it be passed off as good improvisation.

All in all, it's quite a good record, but one of which you should hear no more than one side at a sitting. Otherwise you're likely to get halfway through the second side and find it really getting on your wick.

As it is right at this moment beginning to get on mine. Dig you a little later, Frank.

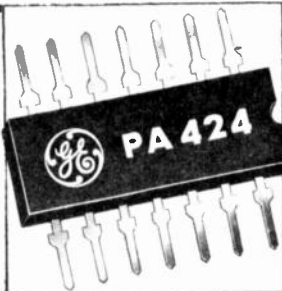
JOHN & BEVERLEY MARTYN — The Road to Ruin. Island Records SIL 93410. Stereo. Primrose Hill, Parcels, Auntie Aviator, New Day, Give Us a Ring, Sorry to Be so Long, Tree Green, Let It Happen, Road to Ruin.

This is a folk rock sort of a set, with saxophones or flute added on some tracks. As is usual with these groups, I like the way they play, the supple, flowing rhythms and the understated funkyness. I also like the feeling and texture of piano, bongo, drums, guitar, bass and flute. The voices of John and Beverley are pleasing enough, without being particularly expressive.

The group's major shortcoming is their material. Most of the songs were written by John and Beverley Martyn; on the evidence of this recording, neither is possessed of any great melodic gift, and the words are not up to much either.

Recording quality is quite good, though I would have liked to hear the bass up a bit and the drums a shade sharper.

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BOOK REVIEWS

REVIEWER: Brian Chapman

HOW TO USE VECTORSCOPE — OSCILLOSCOPES AND SWEEP MARKER GENERATORS — by Stan Prentiss. Published by TAB Books (U.S.A.), 1971. Soft covers, 253 pages, 5½" x 8½". Price \$6.15. Obtainable from Grenville Publishing Co. Sydney.

Ten years ago the serviceman who owned an oscilloscope was reasonably rare — and indeed, even today, the use of oscilloscopes in TV workshops is mainly reserved for the really tough 'dogs'. But those servicemen who do become familiar with oscilloscope service techniques find that they have a very powerful diagnostic tool which can eliminate much straining of grey matter, unsoldering of components for testing etc.

With the advent of colour TV — and more especially of integrated circuit techniques — the serviceman will find the oscilloscope an essential tool.

It is impractical to isolate a faulty integrated circuit by replacement. This exercise can quite often result either in the ruination of a perfectly good integrated circuit, or damage to the printed circuit itself. One must be sure exactly where the fault is, as far as possible, before producing the soldering iron. Consequently more sophisticated test instruments are not only desirable but essential, and TV servicemen will have to become familiar not only with the basic oscilloscope but with a whole range of scope-based instruments such as spectrum analysers and vector scopes.

This, then, is what the book is all about — scopes, scope-based instruments, and how to use them.

It is written for the TV serviceman specifically but is of value to technicians of any discipline who want to bone up on the new instruments.

The book is written in conversational, unmathematical language and is well illustrated with photographs of typical waveforms and displays. Examples are also given of some typical colour TV circuits, together with a discussion of servicing methods and problems associated with that particular circuit.

Some of the other instruments discussed are sampling scopes, storage scopes and sweep generators, and a section at the end of the book is devoted to the servicing of stereo multiplex circuits with a vectorscope. A topic which will, of course, be only of academic interest to Australian readers.

The copy supplied to us left a lot to be desired in terms of printing quality, most of

the photographs having a washed-out grey appearance. In addition, reading was not made any easier by the fact that one 32-page section was bound in upside-down. I hope that this was just an isolated case; nevertheless, do check pages 33 to 64 before buying your copy.

ELECTRONIC PRINCIPLES — PHYSICS, MODELS AND CIRCUITS — by Paul E. Gray and Campbell L. Searle, of the Massachusetts Institute of Technology. Published by John Wiley & Sons Incorporated (U.S.A.), 1969. Hard covers, 1016 pages, 6½" x 9". Price \$16.75. Obtainable from John Wiley & Sons (Aust) Pty. Ltd. Sydney.

This book has been shaped to meet the educational needs implied by the dominance of integrated circuits in electronic technology and by the use of digital computers in engineering design. Thus the book begins with the physical principles that are involved in the operation of semiconductor components, proceeds through the physical electronics, modeling and circuit characteristics of these components, and engages the questions and problems that arise in the computer-aided design of complex multistage amplifiers and functional assemblies of the type found in modern integrated-circuit packages.

The book covers five principal areas:

- An introduction to electronics;
- Semiconductor physics;
- Device physical electronics, models and properties;
- Multistage circuits in which transistors are used as linear amplifiers;
- Multistage circuits in which transistors are used as switches.

During the past eight years about 1200 M.I.T. undergraduate students have studied from portions of the material presented in this book. It is a book specifically designed for use by instructors of undergraduate electronic engineering courses; hence it has many worked examples and is far more exhaustive in its treatment of the subject than any normal textbook required for such a course.

The Massachusetts Institute of Technology is renowned the world over for the quality of its electronic engineering graduates, most of whom are eagerly snapped up by commercial electronic companies for their research and development laboratories. A corollary of this, therefore, is that any book written by members of the faculty is most

likely to be — and usually is — the best and most complete treatment available on the subject.

This book is no exception to the above and must be considered a valuable reference manual for the electronic design engineer.

The shape of things to come is reflected in the subject matter of the book: almost entirely, the circuits and principles examined are those involved in the design of integrated circuits. Discrete component design, although treated, appears to be merely a path towards the understanding of linear and digital integrated circuits. Further, some nostalgia is added by the 61-page 'historical' treatment of vacuum tube electronics.

Thoroughly recommended.

TV TROUBLE DIAGNOSIS MADE EASY — by Art Margolis. Published by TAB Books (U.S.A.), 1970. Soft covers, 255 pages, 5½" x 8½". Price \$6.15. Obtainable from Grenville Publishing Company, Sydney.

Mr. Margolis is obviously a good TV technician himself, and the book is a complete guide to both black-and-white and colour servicing. No doubt the book could be useful to someone who knew nothing whatsoever about servicing — but I'm afraid I would recommend that any budding serviceman buy one of the many other similar texts available.

English expression is appallingly bad and, to my mind, could only lead to confusion on some points. In addition, Mr. Margolis has certainly not thought clearly enough himself about the theory he sets out to convey to others.

For example, let us take page 49. In the second paragraph, talking about valves versus transistors, the statement is made: "Actually, they are both current devices." Surely this is a misleading statement to make to a novice, when the real point is that the valve is 'controlled' by a grid 'voltage' whereas the transistor is 'controlled' by an emitter 'current'. Of course we know that both devices draw current. Why cloud the issue?

In the next paragraph we have the following statement. "In an npn transistor the collector emits a stream of electrons into the semiconductor material. The collector is maintained at a higher positive voltage than the emitter and, therefore, attracts the electrons." Apparently the emitter does nothing!

Fourth paragraph on the same page: "In an npn transistor made of silicon the typical emitter has about +0.6 volts on it and the base about +1.2 volts. This gives the emitter to base junction a forward bias of about +0.6 volts, enough to turn on the transistor. The collector has about +4.5 volts on it."

What's all this? Why does the emitter have to be typically at +0.6 volts or, for that matter, the collector at +4.5 volts? Surely both these voltages depend on the circuit configuration. The quoted voltages are certainly not typical. The emitter voltage could be zero and, for that matter, the collector voltage could be normally at 45 volts, not 4.5 volts. The only valid point is the +0.6 base to emitter voltage.

Surely most confusing for the novice — and all the above comment is related to only one page. Need I say more?



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Just Released! AKAI GX-365 Professional Stereo Tape Deck and Full Recorder. 3 motors, 3 heads, automatic continuous reverse, automatic shut-off, sound on/ with and over sound plus a score of other exclusive AKAI features including the "all new" glass and crystal ferrite head to give 150,000 hours guaranteed life! Price on application.



Sony Super Special Tape Deck — 630-D with 4 tracks, 3 speeds, 3 heads. Professional Full Control . . . echo effects, sound on sound, truly a magnificent model. Exclusive to Douglas Trading.

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Above: It's hear before you buy at Douglas Trading — every piece of equipment is linked to pushbutton comparators!



New shipment!
New Low Price!
AKAI X-160D Tape Decks.
*World Patented Cross Field Head.
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*All Silicon Solid State.
Rush these at \$229.



Monarch — the King of Hi-Fi Systems! Made to Douglas Trading specifications to give you the best Hi-Fi ever, at the price. Models range from a low \$195 (like the one in the foreground above) and just look what you get for your money . . . Powerful solid-state amplifier. 20 WATTS RMS power. Bass and Treble controls. Loudness control. Top-quality magnetic cartridge, anti-skate diamond stylus. 2 heavy-duty wide-range speaker systems housed in attractive hand-crafted cabinets.

At Rear The Fabulous MONARCH Modular Console At \$449.

Below: A visit to Melbourne would not be complete without a visit to Douglas Trading's first floor sound lounge. See \$100,000 worth of equipment from speakers to stylus comparators and HEAR it in action!



SUBJECTIVE LOUDNESS

There is an error in your article on noise reduction (Electronics Today — May issue). The article states that 'a noise twice as loud or half as loud is a change of 10 dB'.

Any technician knows that a level change of the ratio 2 : 1 is a change of 3 dB, not 10 dB. — R.J.H. Wembley, WA.

● Maybe they do — but if they relate this to sound they're wrong! Subjective loudness just isn't that simple. To start with the ear's response is logarithmic not linear. Our statement is a generalisation but basically true. Various authorities quote figures between eight and eleven dB.

Dr. Pierce, Director of Research at Bell Telephone Laboratories and Dr. David, Director of acoustics research at the same company, state 'to double the subjective loudness requires that we increase the loudness level by 9 dB.'

SOUND ADVICE

I am thinking of building a stereogram to house record player, tape deck, amplifier, speakers, etc. Have you published anything like this? — G.R.C. Ballarat, Vic.

● Good stereo reproduction requires that speakers be placed at least seven to eight feet apart.

It is impracticable to build a free standing unit this large. These are also

major problems in overcoming mechanical feedback from speakers to record player and tape deck in monolithic units.

The best plan is house the record player, tape deck and amplifier in one unit and to have separate speaker enclosures. We will be publishing speaker enclosure designs shortly.

An alternative method is to house all components in modular wall units — these can be purchased from most furniture stores.

FOUR-CHANNEL SOUND

What do you think of four-channel sound. — R.T., Double Bay, NSW.

● If God had intended four-channel sound he would have given us four ears.

CASSETTE RECORDERS

I want to buy a stereo cassette recorder, where can I obtain information about this type of machine? — Y. Y. Birchgrove, NSW.

● We will be publishing tests of stereo cassette recorders in the very near future, information can also be obtained from any good hi-fi dealer.

SYNCHRONIZED SOUND

Could you publish a circuit for synchronizing sound with 8mm films. I have in mind recording a synchronizing signal onto one track of a tape recorder and then using this signal to control the speed of the

projector, so that the sound on the second track would coincide with the action on the film. — R.L.C. Footscray, Vic.

● This system has been tried in the USA but with disappointing results. It is very difficult to maintain exact synchronization.

We would like to hear from any readers interested in the technique.

HOW MANY WATTS

Why do different types of speakers have different efficiencies? — K.W.M., Parramatta, NSW.

● See the article on distortion in speakers in this issue. We shall be covering this subject in depth in future issues.

GOLD DETECTOR

Can you publish a circuit for an electronic metal detector that can locate gold. — V.H., Concord, NSW.

● If we could, do you think we'd be sitting here!

PROJECT PARTS

I am constructing the time delay circuit shown as Fig. 12 in your 'Practical Guide to Triacs' (June issue). So far I have not been able to obtain the SCR C106Y1. Where can I buy one? — G.G.C. Sandy Bay, Tasmania.

● We have received a large number of letters complaining of difficulty in obtaining parts. Many readers try to

ACOS

REPLACEMENT LONG LIFE CARTRIDGES

Acos 90 Series — a family of pick-up cartridges covering all the main types needed today, each fitted with Diamond Stylus at no extra cost.

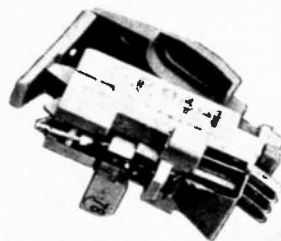
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GP93 STEREO CRYSTAL	\$8.55
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CORRECTION

The photographs of the C.D.I. kit and the 10 plus 10 amp kit appearing in the Kitsets Aust. advertisement, page 41, June issue of Electronics Today were inadvertently transposed.

buy project components from radio and TV dealers — without success; for components such as SCRs are not used in domestic radio or TV sets and it is not reasonable to expect dealers to stock them.

Practically every kit-set supplier advertising in this magazine carries our project components in stock — although shortage of space may preclude them from advertising all items.

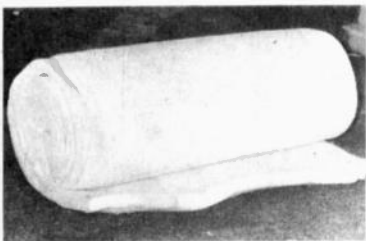
We will shortly be including an index of suppliers known to be stocking project components.

THE GOOD OIL

Where can I purchase the 'engine oil monitor' featured in your June issue. — M.V.H., Gawler South, SA.

• Complete units are obtainable from Plessey Telecommunications, Farady Park, Meadowbank, NSW. The 'E' cells from the Professional Components

"INNERBOND"[®] BONDED ACETATE FIBRES



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87 James Street, Leichhardt
N.S.W., 2040.
Box 548 G.P.O., Sydney 2001.
Phone: 56 2780.

Division, Plessey Ducon, Christina Rd., Villawood, NSW.

BEGINNERS COURSE

I read and enjoy your magazine for the wide range of interest that it covers — but I'm sure that I am not alone in knowing next to nothing about electronics. Do you intend to publish a beginners course.

• We certainly do! It will commence shortly and will be essentially practical.

COLOUR TV

Why cannot we have colour television in Australia — after all even backward countries have had it for years. — F.L., Ashfield, NSW.

• Our guess is that the Australian Govt. wishes to restrain the economy during the current inflationary period. If this is the reason it is sound economic sense, but why can't they say so? Incidentally, 'backward' depends upon how you define civilisation, FL.

PROBLEMS

I have read the May issue of your magazine from cover to cover and can hardly understand a word of it. — G.N., Katherine, NT.

• We all have our problems.

STARTING FROM SCRATCH

I intend to purchase some hi-fi equipment but can only afford to spend a small amount of money initially. Can you give me any advise. — J.N., Newtown, NSW.

• Yes. Buy a good turntable and stylus, and you will have playable records when you finally upgrade your system.

DIGITAL VOLTMETER ARTICLE

Due to shortage of space, the digital voltmeter article referred to in our data logging feature has been held over until next month.

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BUILD YOURSELF A TACHOMETER!



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Resistors—1/8, 1/2 or 1 watt 5c ea.
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Circuit wire, 11/.0032 8 yds. 35c ea.
Circuit wire, 7/.010 8 1/2 yds. 35c ea.
35c Packs of red fibre washers, eyelets (.125" dia.), nut and bolts 6BA, 1/8", 5/32 Whit, dial cord (tight or standard).

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ing Irons — Relays — Plugs — Sockets
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240 Volt, 6 Volt or 12 Volt 4 Amps Switch Over Complete with Leads, Meter, Fuse Metal Case, S.E.C. tested \$21.50. Postage \$1.00. Battery Charger 6 Amps \$27.50

C TYPE CASSETTE TAPES

C 60 80c
C 90 \$1.50
C 120 \$2.00
Postage 10c

NEW

VACUUM TUBE VOLT METER MODEL K1420

NEW

(Suitable for FM Radio Stereo T/V) and communication apparatus Model 195 V/A DC (6") Mirror Scale DC Probe Test Lead Red and Black and Book. High input impedance, 11 Megohms DCV. Price \$69.50 Postage 80c.

MASTER METERS NEW

Model S34/24F/499. 0.1M/a—0.1M/a Centre. Reading Plain Face. Face Size 4 1/2" x 4 1/2" mounting hole 3 1/2". Price \$4.00. Postage 20c.

DELUXE 150 ELECTRONIC PROJECT KIT

Using integrated circuit, in hardwood carrying case, contains all parts for 150 different projects, including IC, diode and transistor radios, electronic switches, relays, alarms, test equipment, etc., etc. VERY GOOD VALUE. Price \$30.95. Postage 75c.

STANDING WAVE BRIDGE + FIELD/S/ INDICATOR NEW

Model 23-126. SWR 1:1 to 1:3. Accuracy = 5%. Impedance 52 ohm. 100 V/A D/C Meter. Antenna 5/section Collapsible. Price \$16.50. Postage 30c.



SCOOP PURCHASE

1 WATT TRANSCEIVER, 13 TRANSISTOR, 3 CHANNEL and Call System. Specifications: Circuit: 13 Transistors, 1 Diode, 1 Thermistor. Range: Up to 10 miles (depending on terrain, etc.). Frequency: 27.240 MHz (PMG approved) Freq. Stability: Plus or minus 0.005%. Transmitter: Crystal controlled, 1 watt. Receiver: Superheterodyne, Crystal controlled. Antenna: 13 Section Telescopic. Power Source: 8 UM3 1.5 volt pen batts. Size 8 1/2 in. x 3 1/2 in. x 1 1/2 in. Weight: 25 ozs. Other features: Leather carrying case, battery level meter, squelch control, earphone jack, A.C. adaptor jack, etc. Price \$75 A PAIR. Single units available, \$40 each. Be early!

CRYSTAL RADIO KIT NEW

Model 28-207. Tunes Am.B/casts complete with all ass. Price \$3.95. Postage 30c.

NEW C/X CABLE 1/2" DIAM. 50 ohms. 95 yd.
NEW C/X CABLE 3/16" DIAM. 50 ohms. 45 yd.
ROLLS 100 FEET. 300 ohms, open line cable, \$5.30. Postage 20c.
SINGLE CORE & SHIELDED MIKE CABLE. NEW 20c yd.
TWO CORE & SHIELDED CABLE. NEW 30c yd.
FIVE CORE & SHIELDED CABLE. NEW 38c yd.
T/V RIBBON 7" YD. 300 OHM.

GENERAL COVERAGE COMMUNICATION RECEIVERS



"REALISTIC" DX150. Solid state (as reviewed in Electronics Today product test page 61, June '71 issue) 4 bands covering 535 kcs to 30 mcs fully transistorised SW/CW/SSB/AM broadcast 240V A.C. or 12V D.C. operation. Product detector for SSB/CW plus fast and slow AVC—variable pitch

BFO—illuminated electrical bandspread, fully calibrated for amateur bands, Cascode R.F. stage—ANL for R.F. and A.F.—Zener stabilised—OTL audio—illuminated "S" meter—built-in monitor speaker. Price \$234.20

Matching speaker 8 OHM for use with "Realistic" DX150. Price \$13.60
"TRIO" 9R59DS. (General coverage.) 4 bands covering 540 kcs, valve type, to 30 Mcs. Two mechanical filters ensure maximum selectivity. Product detector for SSB reception. Large tuning and bandspread dials for accurate tuning. Automatic noise limiter. Calibrated electrical bandspread. "S" meter and B.F.O. 2 microvolts sensitivity for 10 db S/N ratio. Price \$178.50

SP5D. Matching 8 OHM speaker unit for use with Trio Equipment. Price \$15.30

LAFAYETTE HA-600, five-band, bandspread tuning, solid state SSB-AM-CW. \$199.50

LAFAYETTE HA-800, solid state, as above but Ham Band Only, SSB-AM-CW. \$195.00

NIBBLING TOOL (ABEL) NEW

Trims, notches, cuts round, square or irregular holes any shape size over 7/16". Price \$6.20. Postage 20c.

BROADCAST BAND TUNER

Locally made, Model 401 uses a shielded 3-stage I.F. Module with a single transistor mixer-osc. An AGC voltage is developed and applied to the 1st I.F. stage. High sensitivity is obtained with a ferrite rod, 8-in. long, 3/8-in. diam. Sensitivity 150 uV; bandwidth: 8 KHz; supply voltage: 9V; supply current: 5 mA; audio output voltage: 0.5-1.0V; load impedance: not less than 47K. Complete in plastic box with dial. Ready to plug in. Price \$25.00 nett.

SOLID STATE STEREO AMPLIFIER

8 watts r.m.s. per channel. Input for magnetic, crystal and ceramic type microphone. P.V. cartridges, tape recorder input and output, tuner input, stereo headphone jack. Reduced to \$55.00. Postage \$1.20.

NEW LITERATURE

NATRONICS PTY LIMITED have sent us their latest specification sheets detailing modules currently available for their modular data logging system.

Natronics Pty. Ltd., The Crescent, Kingsgrove, NSW. 2208.

AUSTRONIC ENGINEERING LABORATORIES have sent us details of the Greer Micromanometer for which they are agents.

The details in the form of an informative and well presented two-colour brochure describe the principle and applications of the instrument which is used primarily for measuring very small changes in air or gas pressure.

ALSO FROM Austronic is a 16 page catalogue describing the range of J & P radio-isotope scanners for which they are agents.

The scanners — all of which are intended for medical use — are designed to comply with N.I.M. system specification TID 20893.

Austronic Engineering Laboratories, Pty. Ltd., 452 Victoria Street, Brunswick, Victoria. 3056.

PYE TELECOMMUNICATIONS have published some very useful engineering notes to enable users to obtain optimum results from the 450MHz Pye Pocketfone System.

In particular, emphasis is given to the choice and installation of antenna systems, and to the ranges which can be realistically obtained in various conditions.

Pye Industries, 53 Carrington St., Marrickville, NSW. 2204.

NEW FROM McMurdo is their 220 page electronic components manual.

The manual contains details of 3820 components including printed circuit fittings; semi-conductor heat sinks, mounting pads and sockets; a wide range of switches; various relays, sockets, bases etc; connectors; plugs and jacks, etc., etc.

This manual would be of great assistance to hobbyist and professional alike and whilst it is unusual to charge for catalogues, the sheer size and complexity of this one makes it a reasonable exception.

Price \$4.00, McMurdo (Australia) Pty. Ltd., 17-21 Carinish Rd., Clayton, Victoria, 3168.

DIRECT from Rank Precision Industries in England, a single page brochure describing their new seven element fibre optic digital readout device, called the 'Drod'.

Rank Precision Industries Ltd., Industrial Division, 200 Harehills Lane, Leeds England.

RECEIVED from Selectronic Components a booklet listing their range of wound components which they manufacture for radio, TV, and electronic equipment manufacturers, Govt. Depts., and wholesalers.

Selectronic Components, 17 Barry Street, Bayswater, Victoria, 3153.

THE MAY 1971 issue of Variscope, published by the Electron Tube and Device Group of Varian, contains details of the 8873 family of grounded grid zero bias triodes, millimeter reflex klystrons, Gunn effect oscillators, etc.

There is also a technical description of Varian's range of microwave filters; this includes graphs illustrating the filter's pass and stop band characteristics.

Varian Pty. Ltd., 38 Oxley Street, Crows Nest, NSW 2065.

IN JANUARY 1971 the process control and electronics division of ACI became a company in its own right and moved from Sydney to its present location in Clayton, Victoria.

The company — now called ACI Electronics have produced a brochure outlining their capabilities in the fields of radar, communication, electronics and telemetry. The brochure also contains details of the Thomson — CSF and Serck Controls equipment with which ACI Electronics is associated.

ACI Electronics, 310-324 Ferntree Gully Road, Clayton North, Victoria, 3168.

WARBURTON FRANKI PTY LTD have sent us a copy of a book produced by Keithley Instruments describing a series of physics experiments in which their instruments can be used.

The book is specifically intended for university level physics. Included in the book are experiments in radiation laws, mass spectrometry, nuclear physics, fringe photometry, laser demonstrations, etc.

The book is called 'Contemporary Experiments for the Undergraduate Physics Laboratory'.

Warburton Franki Industries Ltd. 372 Eastern Valley Way, Chatswood, NSW. 2067.

THE A & R/SOANAR group of companies have produced a 42 page catalogue describing their full range of manufactured and agency products.

Included in the catalogue are full details of their extensive range of power, audio output, transistor driver, and other transformers, filter chokes, baluns, and power supplies. Other items included are the wide range of Elna capacitors, KOA and Fox resistors, Noble potentiometers, and ITT rectifiers.

The catalogue, sensibly printed on a heavy matt paper, is strictly functional and contains more detailed information on nearly every page, than some glossy brochure do in their entirety.

A & R Electronic Equipment Pty. Ltd., 30-32 Lexton Road, Box Hill, Victoria. 3128.

A PRODUCT GUIDE to environmental testing has been produced by the N.I.C. Instrument Company. The two colour six page brochure describes environmental test chambers for low temperature, temperature-humidity, temperature-vibration, and drying operations.

Other areas of environmental testing included in the brochure are temperature, noise and vibration.

N.I.C. Instrument Company, Essendon Airport, North Essendon, Victoria 3041.

RECEIVED - from the Electronics division of EMI - a brochure describing their recently developed blood flow stethoscope. This is a diagnostic tool which utilises the Doppler shift of an ultrasonic signal to provide an audio output proportionate to blood flow rate.

EMI (Australia) Ltd., Electronics Division, 109 Burwood Road, Hawthorne, Victoria 3132.

WE HAVE received from Leroya products a very informative four page leaflet which explains in clear, simple English, practically everything that the prospective buyer needs to know about the various components of a hi-fi system.

The leaflet packs a lot of information into its modest size. Leroya Industries Pty. Ltd., 266 Hay Street, Subiaco, WA. 6008.

ELECTRONIC THIEF TRAP

It has been found possible to assemble this circuit (using the printed circuit board layout) in such a way that diode D1 is connected to the battery side of SW1 (1). This may result in premature failure of transistors Q1 and Q2.

The circuit shown in Fig 4 in the original article is correct and constructors are advised to check their board layouts against this diagram. If in doubt, remove D1 from the board and connect it directly across the relay terminals.

Note - this comment only affects those who have constructed the unit on the pc board.

trend 500 LIGHT DIMMER



Just as in a theatre, Trend light dimmers match room lighting to every mood or occasion —finger-tip control from a mere candleglow to full scintillating brightness.

Economy

Trend light dimming saves money. You pay only for the light that you need. As the light is reduced, electrical consumption falls accordingly.

Installation

The Trend 500 simply replaces the existing light switch. Two models are available— an architrave type measuring 3½" x 1½", and a wall plate type measuring 4½" x 2½".

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\$9.98

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RANGE
CAN NOW
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SOUND
LOUNGE**

● **MIRACORD 770H \$249.50**
NOW WITH ADJUSTABLE
SPEED AND TILTABLE HEAD
SHELL AND ILLUMINATED
STROBE

Precise cueing—Flipping a lever gently raises the arm and lets it float with the stylus a fraction of an inch off the record's surface. You can then position the stylus wherever you want it. Flipping the lever back releases a silicone damped piston which allows the arm to sink smoothly into the selected groove.

Effective Anti-Skate System—A calibrated dial can be set to compensate for forces tending to produce skating, regardless of the position of the tonearm on the record. This assures uniform tracking accuracy at all points on the record.



● **MIRACORD 50H, \$109.50**
Exclusive method for locating the stylus. The 50H will track any cartridge at its recommended stylus setting to less than half a gram. Another exclusive feature is the Papst hysteresis-synchronous motor which provides locked-in speed accuracy.



● **MIRACORD 630 \$159.50**
All the basic Miracord "musts" are here!!! and at a significantly lower price . . . The specially designed shaded 4-pole induction motor provides unvarying speed. Exclusive feathertouch push-button controls. Freedom from rumble, flutter and wow. Gentle record handling.



● **MIRACORD 610 \$132.50**
Precision electro-mechanical components including such features as anti-skate system, precise cueing, dynamically balanced tone arm. The 610 has a heavy, pressure-formed nonferrous turntable that provides an efficient flywheel effect for smooth steady motion. While it does not have all the features of the 630 and deluxe 50H, it offers far more than automatic turntables in its price class.



MIRACORD 161 \$67.00
Fitted with KST 112 ceramic cartridge for direct recording on to your tape recorder, etc.

**CONTACT US FOR THE BEST TRADE-IN VALUE
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★ CARTRIDGE EXTRA.**

**THE BEST AUTO-MANUAL TURNTABLES IN THE
WORLD**

BATTLE OF THE VIDEO-PLAYERS

(Continued from page 29)

they are currently negotiating with Philips, Telefunken, Grundig, Toshiba, Sanyo and Hitachi to arrive at an internationally accepted standard. The negotiations are complicated by Philips' quoted offer of free licence to any company wishing to enter the market. (A similar dodge enabled the Philips-developed type of magnetic tape-recorder cassette to sweep the world.)

Magnetic systems have several things going for them. These include ease of recording (at least in monochrome), the ability to erase and re-use tape, and the minimizing of problems caused by dirt on the tape.

On the debit side, it is generally not possible to obtain a picture with the tape stationary — and the cassettes are much larger than the film and vinyl types.

It is, on the other hand, the system most likely to achieve compatibility.

Cost? — Philips (U.K.) quote 200 pounds stg. for the player and a manufacturing cost of 12 pounds for a 60-minute programme (100 copies). Delivery could be as soon as next November.

SELECTA-VISION

The final — and technically most interesting — system is RCA's Selecta-Vision, which uses a holographic recording technique to emboss a laser scanned image onto vinyl ribbon.

To replay, the ribbon is illuminated by coherent laser light and the embossed image recreates the picture onto a small image-orthicon tube. This then encodes the picture and passes it onto the viewer's TV set, in much the same way as normal television transmission.

The RCA system is still very much in the experimental stages, and lagging behind most other contenders.

Its advantages are the low cost of pre-recorded material (and that's all there will be, for it would be virtually impossible to home-record) and almost total disregard for tape misuse, because each part of the holographic image is distributed across the entire 'frame' — even obscuring half the frame area will only result in a slight loss of overall brightness.

Problems? — First, development is lagging behind its competitors, and this alone may exclude the system commercially. Secondly, it is unlikely that there will ever be a way of producing one's own material. Thirdly, the colour reproduction seen at the only demonstration given so far was so dreadful that RCA have never let an outsider see it since.

Cost is quoted at \$400 for a player. Delivery? — A great big question mark.

VAST MARKET POTENTIAL

Even by conservative estimates, the potential world market for video-players is huge. One economist, not known for rash comment, estimates the U.K. market alone as worth \$150 million a year.

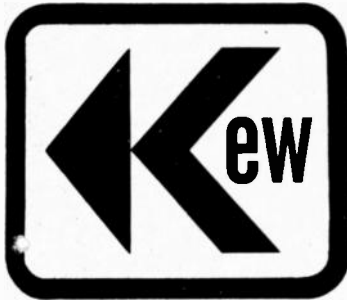
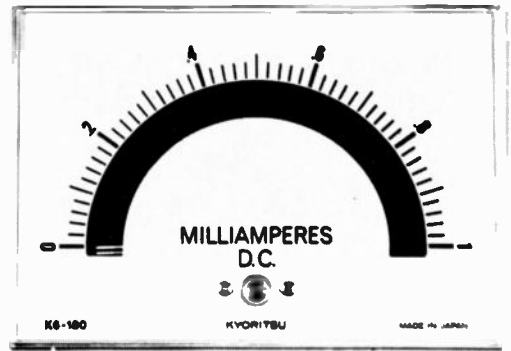
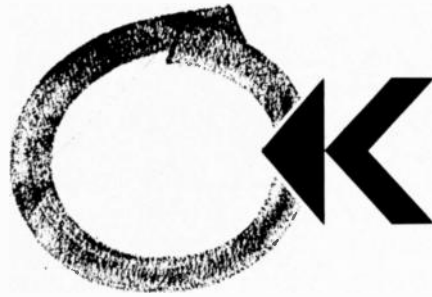
And if the prediction that video-players will eventually move into the general-interest and book-publishing fields is correct, the potential will be even greater.

Which of the several systems now being developed will end up winning general acceptance — and the rewards that must follow?

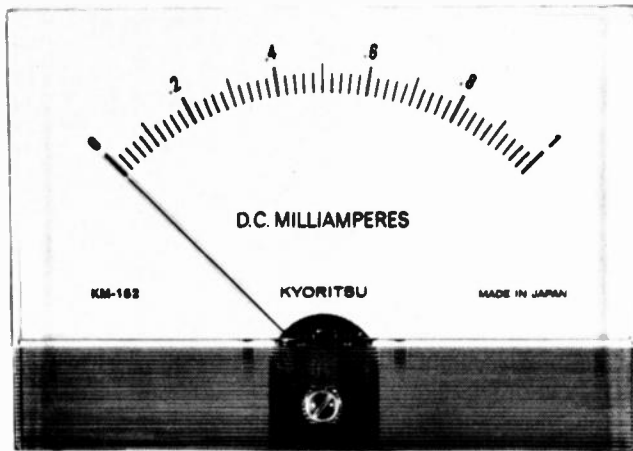
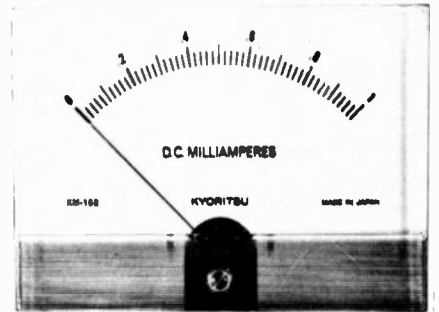
We will stick our necks out a bit and suggest that there will be two. The EVR for educational purposes, and for book and magazine publishing. The Philips system for entertainment.

International compatibility *must*, however, be reached first — for no company can go into large-scale production until it is.

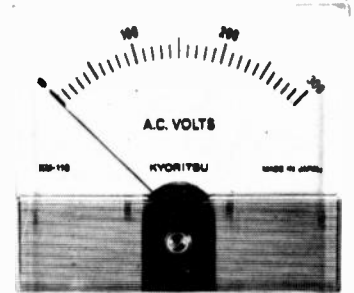
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and EDGEWISE METERS

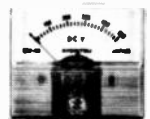
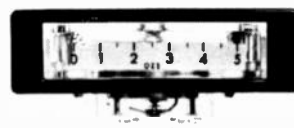
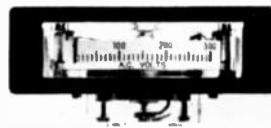
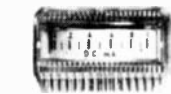
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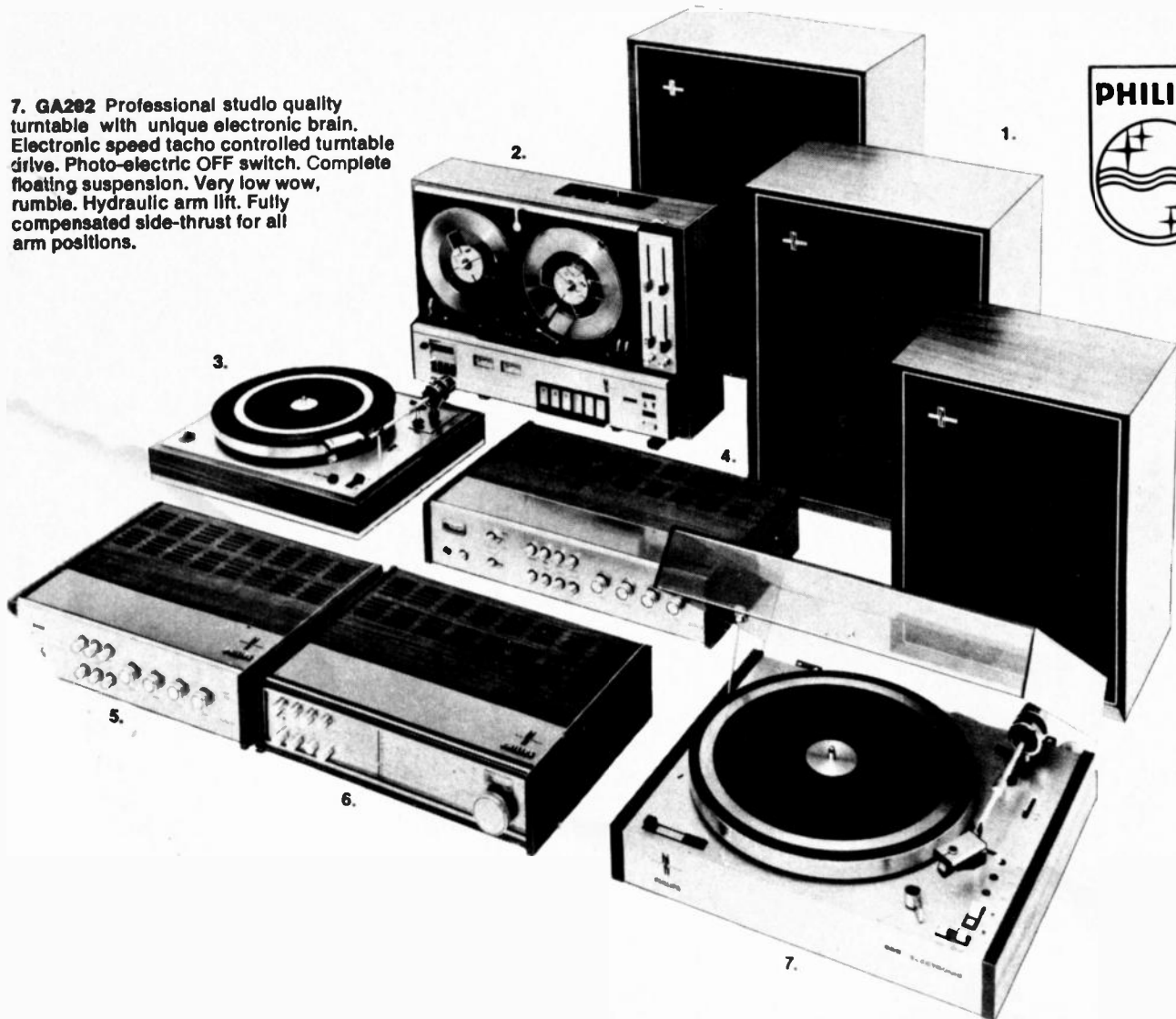
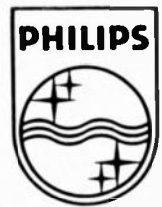
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Distortion in Loudspeakers

Continued from page 27

stretching without undue stiffening at the end of the stretch. These suspensions have had to perform a second function over and above centering the voice-coil and cone. They have had to provide the speaker with elastic restoring force, an indispensable element in speaker design.

With the specific aim of substantially eliminating suspension non-linearity, the acoustic suspension system employed a new approach to providing cone restoring force.

As shown in Fig. 4, the volume of air enclosed by the cabinet walls is used as an air spring, substituting for the mechanical suspensions as a source of elastic restoring force. The mechanical suspensions cannot be dispensed with because they must still perform their centering function, but they can be made so limp that the problem of suspension non-linearity is eliminated as a practical consideration.

The air spring itself is almost ideally linear in the degree of compression to which it is subjected. With the acoustic suspension system, then, we can expect large cone excursions without mechanical suspension bind. The maintenance of a uniform magnetic field over the voice-coil path therefore becomes especially important. This is achieved by overhanging the voice-coil past the gap, that is, making the voice-coil longer than the gap, so that the same number of turns remain in the gap when the voice-coil moves axially.

It is this voice-coil overhang factor that is primarily responsible for the relatively low electroacoustic efficiency of acoustic suspension speakers, rather than design elements inherent in the acoustic suspension system itself. Efficiency is sacrificed for low distortion.

RIGOROUS DISTORTION MEASUREMENTS

The bass distortion levels in loudspeakers are generally high enough so that the non-rigorous methods described at the beginning of this article are adequate to reveal orders of magnitude of distortion, particularly in comparing different speakers.

Careful measurements under controlled anechoic conditions are nevertheless a necessity when accuracy is desired. There must be control of the solid angle into which the speaker radiates, there must be a free-field

environment down to the lowest frequency of interest, and there must be a minimum distance between the speaker and the microphone.

Decreasing the solid angle into which the speaker faces, increases fundamental bass output and decreases distortion. Testing a speaker in an uncontrolled acoustical environment brings into play standing-wave effects, which can seriously affect the ratio between fundamental and harmonic sound intensities at the microphone position.

EIA standards call for a microphone-speaker distance at least three times the diameter of the speaker's radiating area to avoid the effect of the near field, which does not accurately represent the actual radiated sound energy.

TREBLE DISTORTION

The measurement of high-frequency distortion requires more sensitive techniques than those employed for the bass range. A very small distortion percentage in the treble may, because of the high orders of harmonics involved (fifth, seventh, etc.), have a pronounced subjective effect, while a greater distortion percentage of lower harmonic orders may be inaudible.

Standard intermodulation measuring equipment does not help because the frequency separation of standard test signals is so great as to apply the lower frequency test signal to the woofer and the higher frequency test signal to the tweeter system.

By definition there can be no intermodulation between two signals reproduced through separate distorting devices, and the excellent reading we will get with such test frequencies will merely reflect the benefits, in reduced intermodulation distortion, of assigning parts of the spectrum to different speakers.

High-frequency speaker distortion can be tested by the CCIF intermodulation measuring technique, in which the spectrum is swept with closely spaced test frequencies. Both test signals are then reproduced simultaneously by the same speaker unit.

Another and very effective method is to sweep the speaker system with a sine-wave signal generator and to listen. Even though results can be affected by an uncontrolled listening environment, the ear is surprisingly

accurate and effective in this application. It is usually able to detect high-frequency distortion before aberrations are visible on a scope trace. The ear will probably provide better information than an analyzer that reads total harmonic distortion, since the latter cannot, as can the ear, differentiate between orders of harmonic distortion.

The analyzer used for the displays of Figs. 5A and 5D sweeps the speaker over its frequency range and displays the different harmonic orders of distortion. It is the workhorse instrument for checking treble distortion at Acoustic Research, combined with sweep-ear tests.

Fig. 5A is a photograph of this instrument's screen display of the output of a rejected distorting AR tweeter. The blip at 1000Hz is the input and the fundamental; each blip to the right represents successive harmonic distortion products. Second-harmonic distortion is most apparent, but does not represent the real trouble. Distortion products in the 10kHz region are intolerably high for these harmonic orders. The waveform of the 1000Hz output (Fig. 5B) appears perfect and would not lead one to suspect trouble, but a tone-burst picture with 10.6kHz input (Fig. 5C) clearly shows unacceptable ringing.

The corresponding set of photos in Figs. 5D, 5E, and 5F represents the performance of an acceptable AR tweeter. There is still measurable second-harmonic distortion, but nothing significant above that. The high-frequency tone burst picture is clear of ringing.

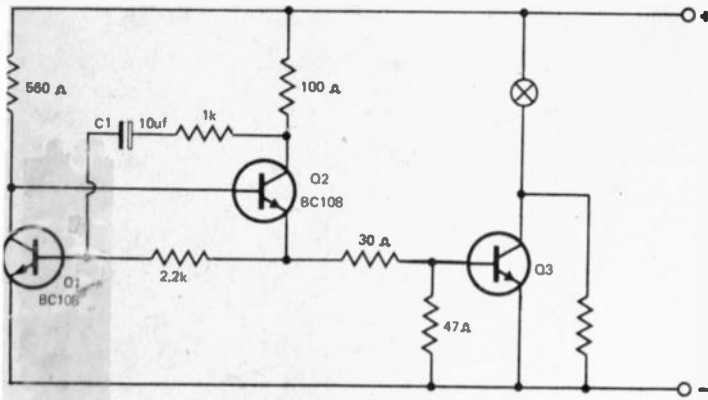
The sine-wave display, on the other hand, looks no different from that of the defective tweeter and measured total rms harmonic distortion — about 2% at the most critical frequency range not very much lower than the distorting tweeter.

It is of interest that the display of the rejected tweeter, which required so much test equipment, would not be audible to anyone on a test.

The design battle of loudspeaker distortion ended. It has probably been ignored because ignored.

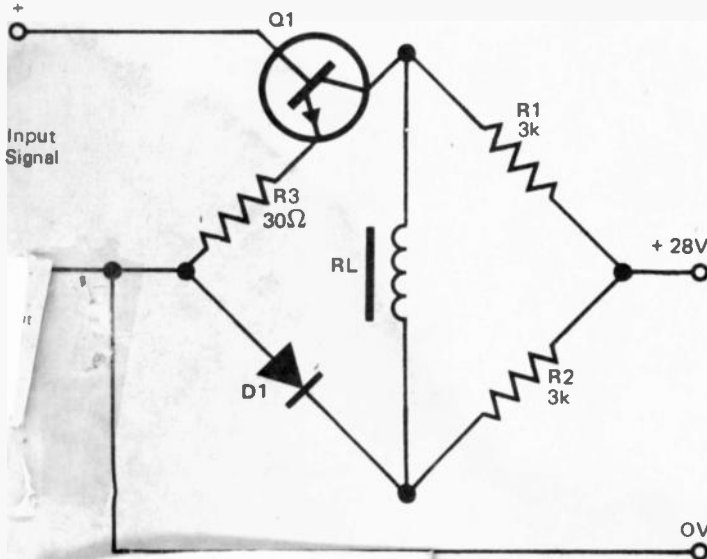
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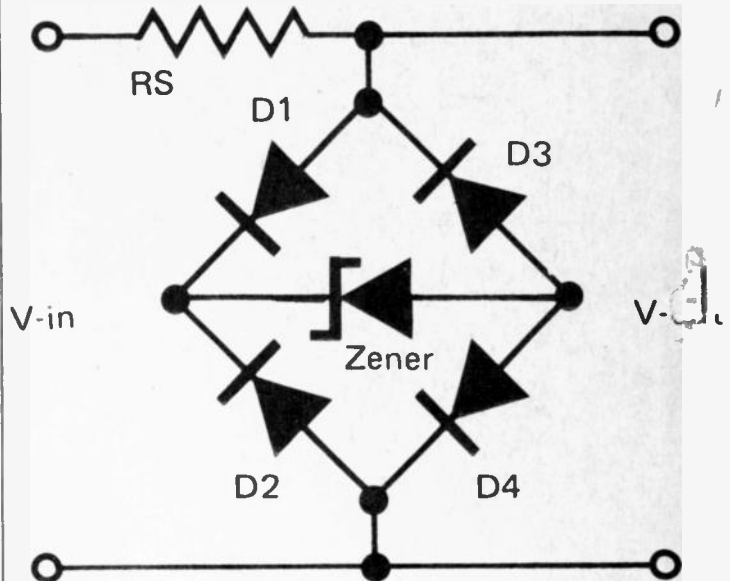
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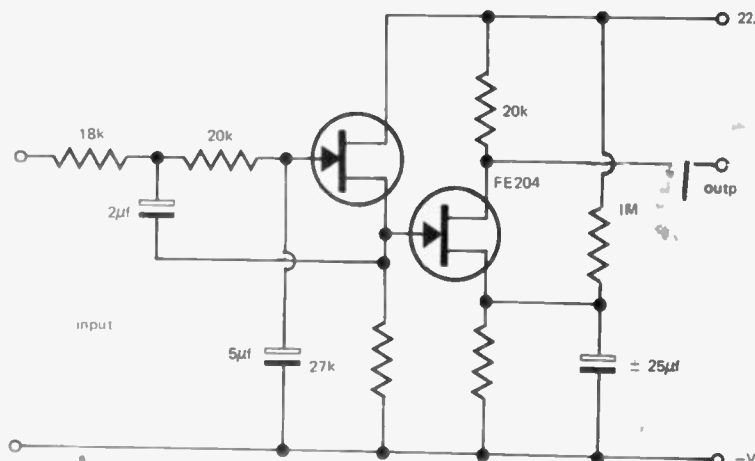


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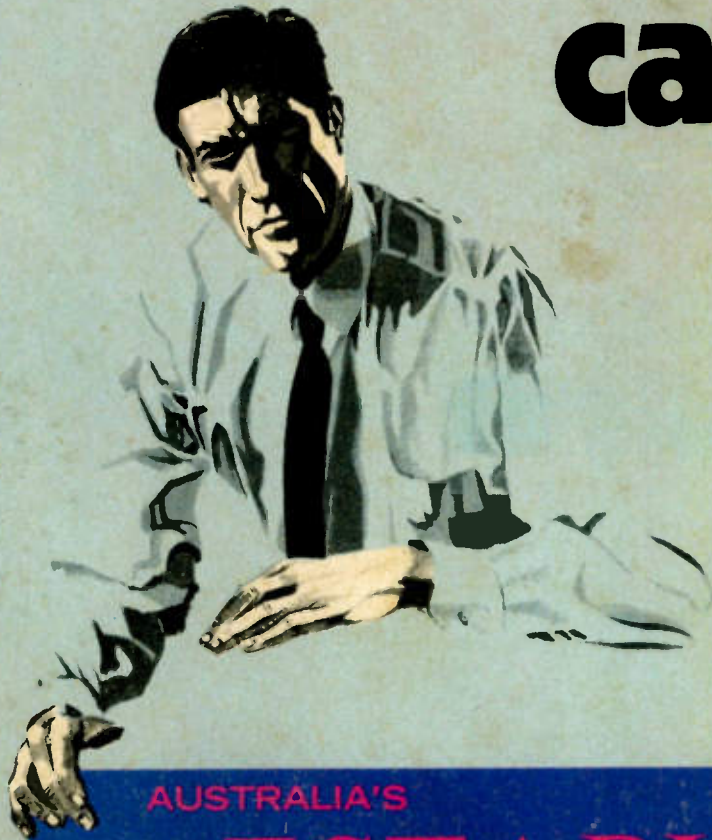
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