AUGUST, 1975
75c*

electronics

Hi-Fi TODAY INTERNATIONAL

OPTIMIZE YOUR COLOR TV

Registered for posting as a periodical — Category C.

SCOOP TEST

AUTO-CORRELATOR PRE-AMP

WHATEVER YOU PAY, YOUR EARS WON'T BE DISAPPOINTED

The true audiophile needn't look any further than the range illustrated to discover the exact speaker system he or she requires for superb sound.

Each system is the result of JVC's own intensive research programme.

The compact bookshelf type have power and performance out of all proportion to their size — the ideal union of efficiency and economy.

The 5313 is JVC's enthralling omni-directional system. Wherever it is placed in a room it fills every corner with magnificent, natural sound.

SK12 and SK15 represent our most impressive systems. 6 speaker 4 way systems housed in handsome, crafted cabinets, that richly produces the entire audio spectrum.

Put them through their paces at your JVC dealer. They have to be heard.

JVC

VICTOR COMPANY OF JAPAN LIMITED

For further information please write to— JVC Advisory Service P.O. Box 49 Kensington, N.S.W. 2033
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WT.GD73J

electronics TODAY INTERNATIONAL

AUGUST 1975 Vol. 5 No. 8

main features

projects

reviews

news & information

NEXT MONTH

FIVE GREAT PROJECTS !

* DYNAMIC NOISE FILTER
* ELECTRONIC CROSSOVER NETWORKS
* LOW COST FREQUENCY COUNTER
* LOGIC PULSER AND PROBE
* DOUBLING ETI'S 100 WATT AMPS FOR 200 WATTS OUTPUT

PLUS — MAJOR FEATURE ON ANTENNAS

The feature articles listed above are included amongst those currently scheduled for our September issue.

However unforeseeable circumstances, such as highly topical news or developments may affect the final issue content.

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news digest

PLESSEY INTRODUCES LITHIUM BATTERY RANGE

The Professional Components Division of Plessey Australia has recently introduced the Eternacell range of lithium batteries.

Manufactured by Power Conversion Inc. (USA), the lithium primary battery is claimed to be the most significant improvement in battery technology for more than 25 years. Based on lithium, a metallic element of the alkaline group and an organic electrolyte, the batteries are markedly superior to any other dc power source of comparable size, say Plessey.

A torch powered by a set of Eternacell batteries will provide about 32 hours of constant illumination. Lifespan (i.e. before corrosion sets in etc) is five to ten years.

These batteries were originally developed for critical outer-space and military applications and were used to power equipment in the Skylab Orbiting Laboratory Project.

The Eternacell battery has a wide range of applications in medical and scientific electronics, transmission of weather and underwater data, security equipment, time control apparatus, transistorised devices and transportable battery powered equipment as used by police, fire and ambulance brigades, post office and defence services.

Further details can be obtained from Components Division, Plessey Australia Pty Ltd, Christina Road, Villawood, NSW 2163.

LITHIUM/METAL SULPHIDE BATTERIES

Commercial development of lithium/metal sulphide batteries gets under way as Argonne National Laboratory (USA) awards contracts to three firms for making cells and electrodes. The high-performance batteries have about five times the energy density of lead-acid batteries. First test cells are due by October; full-sized prototypes for electric vehicle tests may be available by 1981, Argonne says.

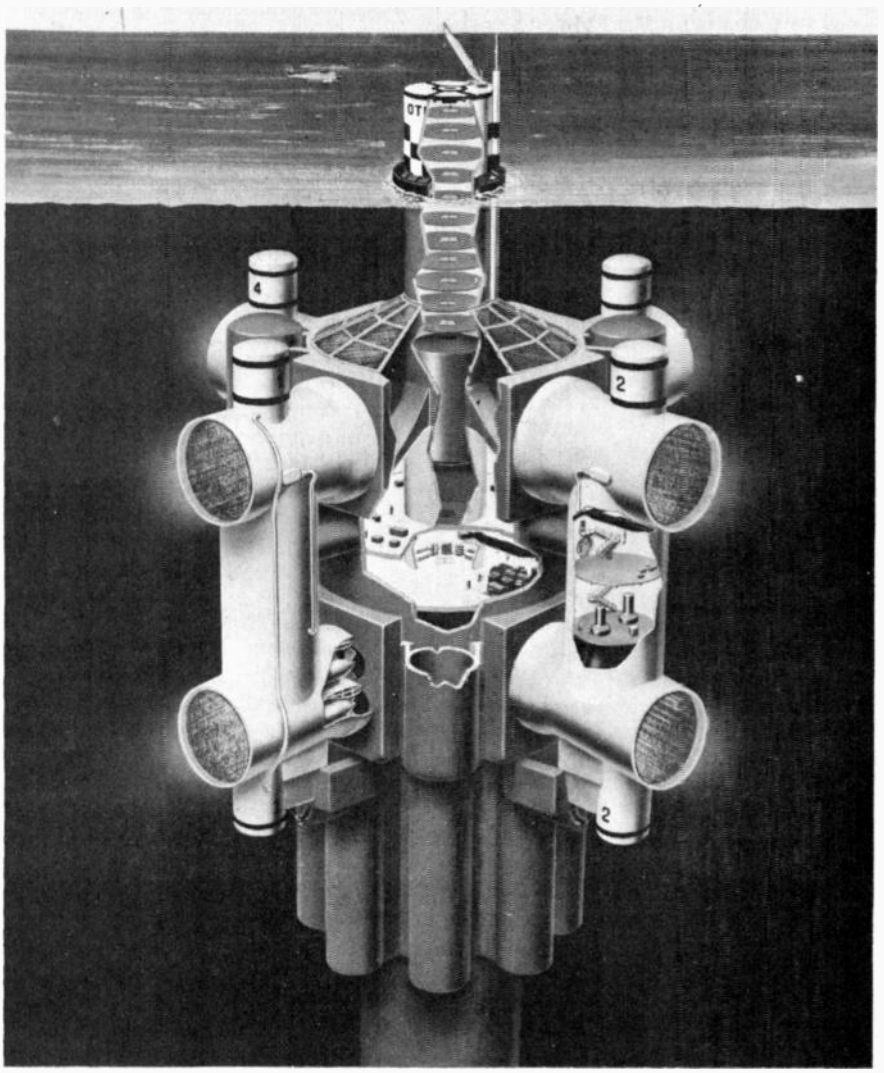
OCEAN TEMPERATURES MAY FUEL ELECTRICAL GENERATORS

Electrical generating platforms that float beneath the ocean surface, similar to icebergs, may operate in the warm coastal waters before the end of this century. The pollution-free fuel used to spin the turbine-generators will come from the sun's energy stored in the ocean surface.

Ocean Thermal Energy Conversion (OTEC), using temperature extremes of 40 degrees F., is a feasible way to produce electricity, according to a nine-month study conducted by Lockheed engineers under a National Science Foundation contract. OTEC could supplement the amount of electrical energy produced by existing plants to meet future increased demands.

The floating plants can be built from existing components, modified to meet OTEC requirements. They can produce electricity at a cost competitive with fossil-fuel plants. A demonstrator plant could be delivering electricity by 1985.

The OTEC closed-cycle concept involves heating a liquid until it becomes a gas which, under pressure, drives a turbine hooked to a generator. Lockheed proposes to use ammonia as the working fluid. After passing through the turbine, the gas is cooled by water from the ocean depths until it becomes liquid and begins the cycle again.



news digest

GENERAL SECRETARY OF I.R.E.E.

Mr. Keith L. Finney has been appointed General Secretary of the Institution of Radio and Electronics Engineers Australia. Mr. Finney is well known in the Australian broadcasting and electronics industry having for 15 years occupied a number of executive positions with AWA. He has been actively associated with I.R.E.E. since 1961 and has been closely allied with a number of the Institution's conventions. At present, Mr. Finney is fully occupied with the organisation of the Institution's "International Electronics Convention '75" to be held at the University of N.S.W., Kensington, from August 25 to 29.

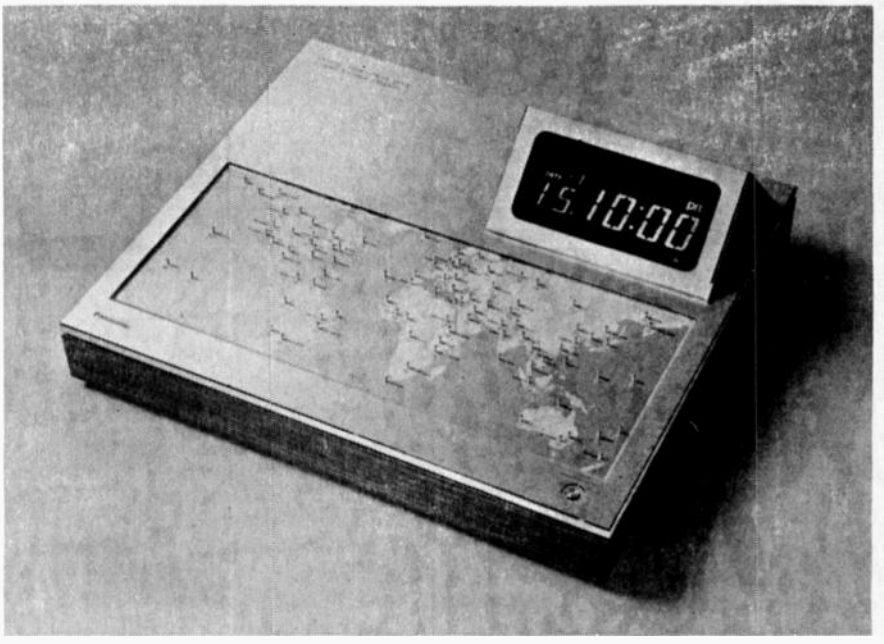
Prior to joining AWA, Mr. Finney was responsible for the formation of Canberra Radio Society and for a considerable time he has been associated with the Wireless Institute of Australia, of which he is a past President.

PORTABLE TELEVISION CAMERA ON SHOW

A new camera that will significantly contribute to colour television coverage in Australia has been launched by Amalgamated Wireless (Australasia) Limited, the major supplier of colour television equipment.

The new camera fully provides the flexibility of operation required by the varying demands of drama inserts, commercial location shots, news gathering and sports coverage. Yet it still maintains the quality of picture in areas of low light operation plus matching picture colorimetry to cameras from different manufacturers.

WORLD-TIME DISPLAY UNIT



Matsushita Electric Company of Japan have released for world distribution a unique time-piece using liquid crystal displays and which can show the date and time in 100 major cities and world time zones.

The large liquid-crystal display unit is 150 mm wide, 90 mm high, and 7 mm thick, and indicates the hour and minute by using the 12-hour system and an AM or PM indication, as well as the date. Special switches can be used to display summer (daylight-savings) time if appropriate for either local time or the selected time zone. Moreover, the display unit automatically indicates the difference in the date, if any, between local time and the time zone selected. All of this information is clearly displayed instantly, day or night, on the large display unit.

This electronic clock has pins representing 100 cities in 30 different time zones on a map of the world, and simply touching a pin causes LED lamps of the selected city as well as all other cities in the same time zone to instantly illuminate simultaneously. The date and time information for the selected time zone remains on the display unit for about eight seconds, after which the display again indicates the date and time for the time zone in which the unit is used.

Haco, the Australian distributors for the device, tell us that a unit is at present on display in the National Showroom, Cnr. Clarence and Market Street, Sydney.

NEW SOLAR CELL

A new gallium-arsenide thin-film solar cell has recently been announced by NASA. The cells are said to have longer lifetimes than conventional cells, to have higher efficiencies and potentially, much lower fabrication costs than the silicon cells now commonly used.

Sample cells have shown efficiencies of up to 15% in sunlight (compared to 8 to 9% for silicon) plus 30% less radiation damage for a longer lifetime. The Jet Propulsion Laboratory team (who developed the device) predict that within three to four months they will have cells suitable for production which have an efficiency of 19%.

The new cells called AMOS for antireflection, coated metal-oxide semiconductor, are economically promising because the gallium arsenide layer is only 5 microns thick. This allows the use of less material than in any other competing technology.

NEW COLOUR TUBE SOLVES CONVERGENCE PROBLEMS

For manufacturers of 110° colour television receivers with screen sizes of 26 inches and smaller, 20AX offers a significant advance in simplicity and economy.

In the picture tube, the electron guns are arranged in a horizontal line instead of a delta, and the phosphors are deposited on the screen in continuous vertical stripes, colour selection being effected by means of a vertically slotted shadow-mask. Adherence to the standard 36.5 mm neck diameter has made it possible to space the electron guns for optimum colour selection. Incorporation of quick-vision

(Continued on page 11)

Philips totally automatic, 209S electronic turntable.

The only thing it doesn't do is to take the record out of it's sleeve.

Philips 209S is one of the most outstanding examples of contemporary hi-fi engineering available. It not only performs every function automatically, but with a quality of precision that is equal to the best in the world. As soon as you place your record on the platter, the 209S automatically determines the record diameter and selects the correct speed. It uses 3 separate motors for drive, arm-lift and arm-return.

The cartridge is Philips famous GP 412, which is used by several professional Hi-Fi magazines to accurately test stereo equipment. The 209S features a sub-chassis to eliminate rumble, and of course, it is 4-channel compatible.

And whilst Philips 209S is totally automatic, it also features manual over-ride of all functions with electronic speed controls.

Check the specifications, then ask your Philips dealer to give you a demonstration.

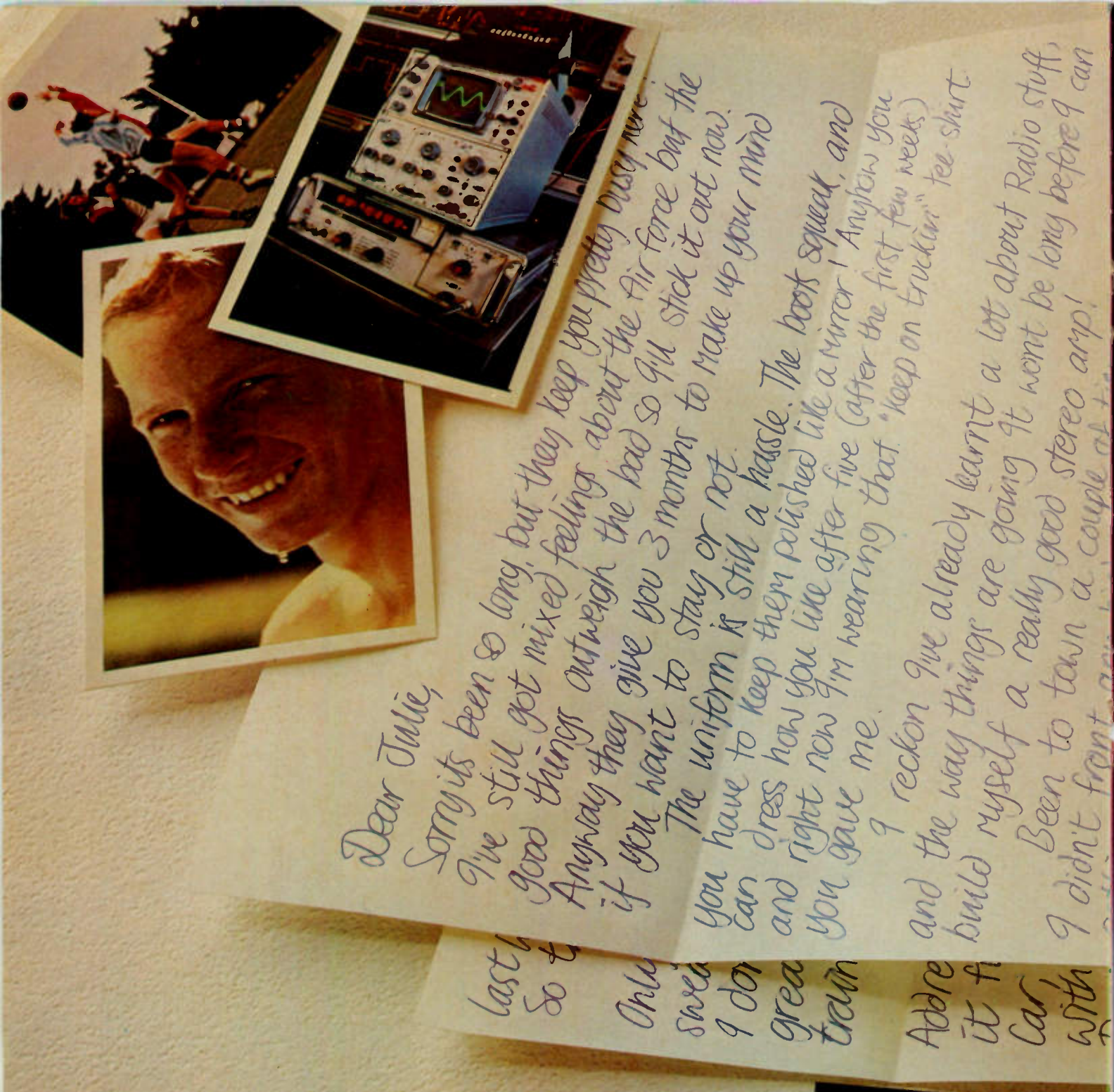
We know you'll be impressed.

TECHNICAL DATA
(Subject to modification without notice)
(according to DIN 45 538 39 and 45 500)

Speeds	33⅓ and 45 r.p.m.
Fine speed adjustment	± 3%
Speed	Exact, using tacho generator
Wow and flutter	less than 0.08%
Rumble	better than 43dB (DIN A) (NAB) better than 65dB (DIN B) (ARLL)
Stylus force	0.75 - 3 g
Anti-skating force	adjustable
Pick-up arm bearing friction horizontal vertical	less than 10 mg
Tangential angle of error	less than 0° 10'/cm
Nominal voltage	120/240 v
Nominal frequency	50 Hz
Power consumption	10W
Dimensions	435 x 325 x 166 mm
Weight (net)	approx. 8 kg

PHILIPS

367 0485



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An apprenticeship in the Airforce. Is it really something to write home about? Find out for yourself. Send us the coupon and we'll send you a free poster and a book that gives you the lowdown on our trades and our way of life – good and bad.

So, if you've reached the age of 15 and are not over 17 on 1 January, send off the coupon. Or contact your nearest Airforce Careers Officer before 6 October 1975.

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Auth. Director-General Recruiting,
Dept. Defence & by the Dept. of the Media.
AFAP6.DPS.75

getting your letters, but please stop spraying that perfume
on them. It can be very embarrassing!!

I've put in a few photo's for you Gosh, My Mate Dronga
took the one of me just after I flipped my canoe last week.
(Dronga's the long, gormless one in the other photo). There's
one of me playing footy, and one of some of the beaut
equipment we've been using.

The trainings hard, but better than school - no wonder
blokes with an Airforce training have no worries getting
a job outside.

All the apprentices had a flight in a Hercules C130 →

forward to seeing you when my holidays
(6 weeks a year, plus plenty of other time off)
+ that? And please, no perfume when you write!

lots of love,

Peter xxx

Introducing
Ferric Oxide's finest hour...

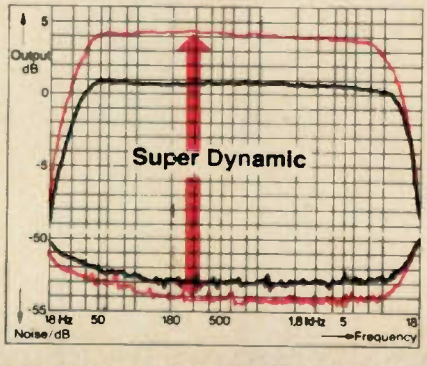
...hour and a half, and two hours

New BASF LH Super Cassettes with finer, more highly refined ferric oxide particles to give a 50% increase in volume without distortion.

Introducing a new standard of recording for all cassette recorders and decks without a CrO_2 bias switch. BASF LH Super cassette tape represents the ultimate in ferric oxide tape technology. Utilising a pure Meghemite oxide as well as a totally new binder system, LH Super features higher magnetic density and improved particle orientation.

This means more magnetic energy from the same tape surface area. The result:
50% increase in volume without distortion, across the full frequency range. An added 4 dB of low frequency, distortion-free dynamic output. A higher level of high reproduction is attainable flat to 20 kHz with a lower compression factor.

Low Noise characteristics are even lower than standard **Low Noise** tape.



Performance specifications of the higher quality cassette decks are exceeded, the reproduction of any recorder is improved.

No special bias switch is required. BASF LH Super provides professional results with standard bias settings found on all cassette recorders and decks.

BASF
BASF
the best in cassette sound

® BASF Aktiengesellschaft, 6700 Ludwigshafen/Rhein, Federal Republic of Germany.

Sole Australian Distributors: MAURICE CHAPMAN & COMPANY PTY. LTD. **Sydney:** 276 Castlereagh Street, Sydney 2000. **Melbourne:** 146-150 Burwood Road, Hawthorn, Vic. 3122. **Brisbane:** 123 Abbotsford Road, Mayne, Qld. 4006. Agents:—**Newcastle:** W. L. Redman & Co. Pty. Ltd.; **Canberra:** Sonney Cohen & Sons. State Distributors:—**Adelaide:** Neil Muller Pty. Ltd.; **Perth:** M. J. Bateman Pty. Ltd; **Launceston:** P. & M. Distributors; **Darwin:** Pfitzners Music House.

BA4472

news digest

cathodes enables the tube to display a picture 5 seconds after switch-on.

Parastigmatic deflection by means of sectionally wound saddle coils makes it possible to dispense with the usual dynamic convergence units. Instead of 15, rather intricate, dynamic convergence adjustments as typically required in previous systems, only 7, relatively simple, tolerance compensating corrections need be made. As an incidental benefit of doing away with dynamic convergence, it has been possible to shorten the picture tube by 20 mm, enabling it to be housed in an even shallower cabinet than is customary for 110° sets.

The advantages of 20AX are realized without any novel departures in circuit technology. Apart from substantial simplification, both in design and setting-up procedure, the recommended circuits are essentially similar to those already in general use.

RADIO STATION SET UP IN 2 WEEKS

A special radio station has been set up in Sydney (in less than two weeks) by Amalgamated Wireless (Australasia) Limited following a request from the Australian Government. The station has been established at Ashfield to broadcast to ethnic communities within a 16 km radius.

It is Australia's first special ethnic radio station and is a project of the office of Community Relations headed by Mr. A. J. Grassby, the Government's Special Advisor on Community Relations.

The station is operating over an experimental period of 12 weeks broadcasting in seven languages six hours each day.

The station, which comprises a low power transmitter with a limited transmitting aerial situated on the front lawn of AWA's Ashfield factory, was erected and commissioned in less than two weeks from receiving the order.

C-MOS WAR

Texas Instruments' recently cut the price of all their plastic-pack CMOS by up to 50% to bring the prices of their product below those of its competitors RCA, National and Motorola. At the same time TI also announced cuts in the prices of their standard TTL range.

Reaction to this move was swift — RCA announced that "We intend to remain the industry leader" and that they intended to meet competitive pricing from any source.

Motorola also announced that they were in a position to meet any bona fide competition. Things are getting hot!

EDGE ELECTRIC ON THE MOVE

Well known in Sydney's western districts as a wholesale retail supplier of component parts Edge Electrix has moved to larger modern premises close to their earlier location.

The new premises, at 31 Burwood Road, Burwood, cover some 2 000 square feet of showroom and storage space with a display frontage of nearly 40 feet.

TV GAMES LSI CHIP AVAILABLE SOON

Rumours have been abounding for about a year now that an LSI chip for television games was being developed.

We now have definite news that Logic Leisure, a British Company, have produced a chip which will produce four TV games, with two variations on each, giving eight permutations. There is score and sound facility. Type number is not yet known but the chip is suitable for both 625-line, 50 Hz and 525-line, 60 Hz.

It is hoped that the chip will be on sale in October.

(So far we are not aware of an Australian agent — British agents are — Television Sports Co. Ltd., 6 Halfmoon St., Mayfair, London, WIY 7RA).

TRANSDUCERS IN MEASUREMENT AND CONTROL

A series of articles dealing with all aspects of transducers was published in Electronics Today during 1972 and 1973, The series were written by ETI's special contributor Dr Peter Sydenham M.E., Ph.D., F.I.I.C.A., M. Inst. M.C.

Continued requests from tertiary institution teachers, both in Australia and in Britain have resulted in the series being reprinted as an inexpensive reference and teaching text. Research workers, hardware system designers, students in engineering and the sciences, scientific instrument manufacturers and their agents, and managerial level technical executives should find this extensive cover of value.

Profusely illustrated with several hundred diagrams and photographs, it explains how the commonly encountered measurement variables are converted into electrical signals in order to make records or achieve control. Each chapter contains a reading list: an index has been added.

Transducers in measurement and control is now available at $4-50 post paid (in Australia) from Electronics Today International, 15-19 Boundary St, Rushcutters Bay, NSW.

CONSTANT FREQUENCY GENERATOR

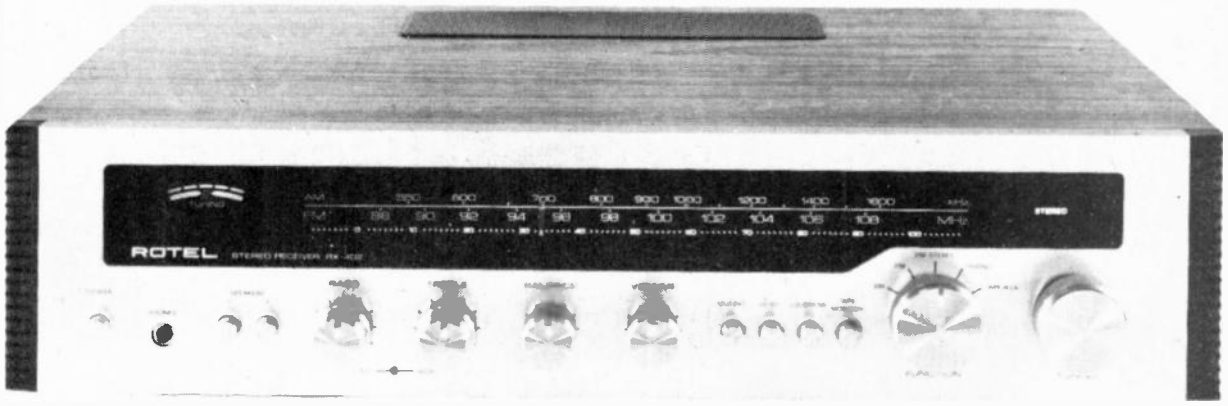
A totally electronic means for providing constant frequency output from an electric power generator operating at random speeds has been introduced by the (US) Bendix Corporation's Electric and Fluid Power Division.

Primarily designed for use aboard aircraft, the new constant frequency generator (CFG) electronically converts mechanical power from a variable speed input shaft to constant 400 Hertz electric power. The mechanical constant speed drive, an integral part of high performance aircraft AC power generating systems for years, has been eliminated.

The Bendix CFG has successfully undergone flight tests aboard U.S. Navy aircraft in addition to approximately 10 000 hours of laboratory testing. To date, Bendix has produced and tested 12.5 kvA and 20 kvA rated CFGs. Higher rated units are currently in the design stage.

ROTEL® RECEIVERS

The Rotel range of Receivers will give you the best of both worlds — superb AM-FM tuner reception, and magnificent reproduction from your favourite records or tapes, at a price that is true value for money.



RX 402

RX402: Excerpt from laboratory measurements conducted by Stereo Review: "With both channels driven into 8 ohm loads to rated 25 watts per channel output the total harmonic distortion was about 0.1% . . . At half power or less THD was well under 0.07% from 20 to 20,000 Hz . . . FM tuner section . . . Phase locked-loop for the multiplex demodulator.

COMMENT: Not only are the published specifications of the Rotel RX-402 very complete and generally better than one would expect for a receiver in its price range, but the tested receiver equaled or bettered almost all of its ratings, sometimes by a comfortable margin. The FM tuner section is especially noteworthy for its low stereo distortion and excellent channel separation. Specifications aside, the RX-402's handling and listening qualities left little to be desired. Tuning was smooth and quite noncritical, muting was positive and thump-free, there were no switching transients, and it sounded fine. All in all, this receiver represents an excellent audio value."

RX602: The American magazine, Hi Fi Stereo Buyers Guide, said: "The frequency response at 30 watts/8 ohms measured ± 0.2 dB from 20 to 20,000 Hz at a distortion no higher than 0.07% THD at any frequency . . . Overall sound quality of this amplifier is notably good, much better than implied by the price."

RX802: A high powered receiver with exceptional output characteristics — 50 + 50 watts RMS, both channels driven into 8 ohms. Overall frequency response is a wide 5 Hz — 50,000 Hz. The FM tuner section complements the quality of the power amplifier with 1.5W sensitivity and selectivity of 80 dB.

RX202: Contains everything you would normally find in a much higher price range: 15 + 15 watts RMS, with response from 20 to 70,000 Hz. Harmonic distortion is below 0.2%. The high performance FM tuner section uses FET's in the front end for high sensitivity and low distortion.

A complete range of pre-main amplifiers and matching AM/FM tuners is also available.

Australian National Distributors:

INTERDYN

INTERNATIONAL DYNAMICS (AGENCIES) PTY. LTD.
P.O. Box 205, Cheltenham, Vic. 3192.

Available from:
A.C.T.: Duratone Hi Fi, Cnr Botany St & Altree Crt, Phillip 2606. Telephone: 82-1388. N.S.W.: M & G Hoskins Pty Ltd, 400 Kent St, Sydney 2000. Telephone: 546-1464, 547-1093. QLD.: Stereo Supplies, 95 Turbot St, Brisbane 4000. Telephone: 21-3623. S.A.: Challenge Hi Fi Stereo, 96 Pine St, Adelaide 5000. Telephone: 223-3599. TAS.: Audio Services, 44 Wilson St, Burnie 7320. Telephone: 31-2390. VIC.: Encel Electronics Pty Ltd, 431 Bridge Rd, Richmond 3121. Telephone: 42-3762. W.A.: Arena Distributors, 282 Hay St, Perth 6000. Telephone: 25-2699.

news digest

Extensive testing has shown that the Bendix electronic converter provides a more accurate frequency output and is as much as an order of magnitude more reliable than its earlier mechanical counterpart.

The Bendix CFG consists of a brushless generator, a static dc-link converter and logic and control circuitry. The generator is mounted directly on to the engine and is driven at varying speeds, limited only by the speed range of the engine.

The generator used in the CFG is a salient pole, synchronous machine with a brushless ac exciter. A three-phase, full-wave rectifier provides dc to the salient pole field. Six diodes and protective resistors are used in a rotating rectifier arrangement. The resistors reduce voltage spikes to protect the diodes against self-induced voltages.

The dc-link converter, as the name implies, converts random ac power to dc and back to ac. The initial conversion is accomplished by a full wave rectifier. The dc is then chopped into square-wave voltages by a series of three-phase silicon-controlled rectifier bridges and summed in a transformer to produce a high quality sine wave output.

In addition to high performance aircraft applications, the CFG concept can be tailored to any number of requirements calling for the conversion of variable frequency to precise, single frequency ac.

The Bendix Electric and Fluid Power Division is located at Eatontown, New Jersey 07724, USA.

NEXT FROM SINCLAIR: PROGRAMMABLE CALCULATOR

It is expected that Sinclair will be announcing another addition to their calculator range at about the time this issue goes on sale: a fully programmable calculator. No details are known other than the fact that the price will be "well under UK £50', according to a spokesman for Sinclair.

ONE-HOUR TV CASSETTE

Japan's Sony Corporation have introduced a new video tape recorder and playback system using ½ inch width tapes with playing times of 30 minutes to one hour.

The tape deck called Betamex, sells in Japan for the equivalent of $600. The system complete with receiver is about $1200, cassettes cost about $7 and $12 each.

ELECTRONICS IT'S EASY! – NOW IN BOOK FORM

Very many readers have asked us to published our popular Electronics It's Easy! series in book form.

This we have done and the first volume – containing parts 1 through 12 – is now available. The contents have been revised and updated where necessary.

Electronics it's Easy Vol 1 costs $3.00 and is currently on sale at all main newsagents. In the event of difficulty it may be bought directly from ourselves post free. Address to Electronics Today International, 15-19 Boundary St, Rushcutters Bay, NSW.

WORLD INTEREST IN ELECTRONICS CONVENTION

Scientists and engineers from at least 10 overseas countries will participate in the "International Electronics Convention '75" organised by the Institution of Radio and Electronics Engineers Australia in Sydney from August 25 to 29.

The Convention, to be held at the University of New South Wales, is expected to attract 1500 delegates and 20 000 visitors. In addition to a number of Australian speakers, addresses will be given by scientists and engineers from U.K., U.S.A., Finland, Japan, India, New Zealand, Germany, Israel, Czechoslovakia and Singapore.

Contributed by top ranging electronics authorities from overseas and in Australia more than 250 technical papers will be presented. Each day six of the University's lecture theatres will be occupied by speakers delivering these papers.

Described by I.R.E.E. General Secretary, Mr Keith Finney as "the shop window for the electronics industry in Australia", a comprehensive display of equipment will cover 30 000 sq ft. of space. Major Australian manufacturers and suppliers and a number of British companies will be represented.

The keynote address at the Convention will be given by Mr David R. Israel, Chairman of A.E.R.O.S.A.T. Council of the Federal Aviation Administration, Washington, U.S.A.

Other overseas speakers include:
Prof. Brook, University of Birmingham, U.K.
Prof. J.Ashley, University of Colorado, U.S.A.
Prof. Matti Otala, Technical Research Centre, Finaldn.
Dr. Yasuo Komaniya, Electrotechnical Laboratory, Japan.

news digest

Dr S.R. Jawalekar, Indian Institute of Technology, Bombay.
J.D. McCormick, Institute of Nuclear Science, New Zealand.
Dr R. Hertz, Siemens A.G., Germany.
Prof. P.B. Fellgett, Dept. of Engineering & Cybernetics, England.
Dr A. Cohen, Ben Gurion University, Israel.
W.J. Williams, University of Michigan, U.S.A.
Bohumil Lojek, Czech. Technical University, Czechoslovakia.
Prof. D.O. Pederson, University of California, U.S.A.
Dr P.S. Kooi, University of Singapore, Singapore.
Dr T.T. Tjhung, University of Singapore, Singapore.
Dr H. Singh, University of Singapore, Singapore.
Prof. B. Mc A Sayers, Imperial College London, U.K.
Dr Y. Miyazaki, Nagoya University, Japan.
Dr L. Rhode, Rhode & Schwarz, Munich Germany.

More than 250 technical papers, contributed by many of Australia's most notable engineers and from top ranking scientists and engineers in the United Kingdom, Europe, Asia and the Americas will be presented. The papers specially selected for their importance, covering a wide range of electronic subjects, will be delivered to large numbers of delegates each day using six lecture theatres daily.

BUSH TV

If you want to go bush and still watch TV – or if you just appreciate being able to shift your viewing position from room to room or into the garden and back again – the ideal companion is a National TR-505DU 5-inch screen black-and-white portable. It is rugged, reliable, has an excellent electronic track record and offers a three-way power choice – dry batteries, house power or car-boat power. Screen size is 5 inches (127 mm).

ERRATA AND ADDENDA

SPEAKER SYSTEM ETI 400
JUNE 1975

The chokes used in the cross-over may if desired be wound with 0.8mm (20 B&S) wire rather than the 1.0mm (18 B&S) specified.

Both chokes will be electrically similar but the 0.8mm wire is cheaper and will fit onto the specified bobbins more easily.

SIMPLE 25 WATT AMPLIFIER
ETI 440
JULY 1975

Component overlay page 68. The capacitor across the primary of transformer T1 should be labelled C35 not C42. The capacitor C41 (centre of PC board) is shown with reversed polarity (circuit diagram is correct).

Page 70 – measured performance is to –0.5 dB between 15 Hz – 30 kHz (the figure 15 Hz was accidentlly omitted.

3600 SYNTHESIZER
MAY 1975
VOLTAGE CONTROLLED FILTER
page 63.

The printed-circuit board artwork supplied to some kitset suppliers differs slightly from the one published.

On these boards provision has been made to obtain gain from IC4 and IC5. This consists of resistors between pin 6 and pin 2, and from pin 2 to +7 volts on each IC. This gain is not now required and a link should be installed between pins 2 and 6 on each of the relevant ICs.

50 WATT STEREO AMPLIFIER
ETI 422
MAY 1974
POWER SWITCH

Several people have experienced failure of the power-switch specified for this amplifier. Another switch by ISOSTAT is available, but its use requires shifting the power transformer.

A recommended replacement is the SCHADOW type NE15 No 4 chassis-mounting switch distributed by IRH Industries. This can be fitted without moving the tranformer.

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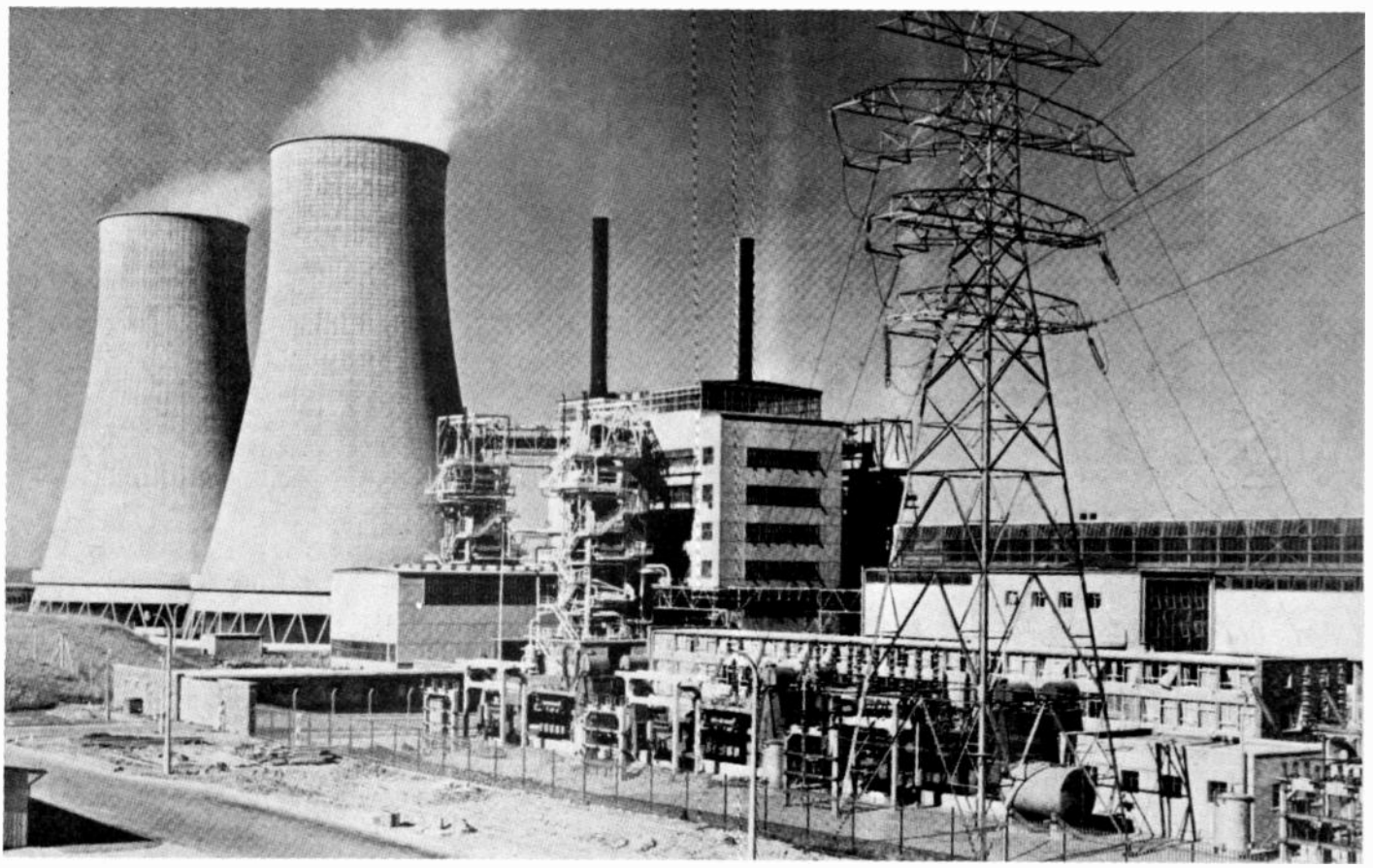
ELECTRONICS IN MEDICINE

PART 2

by Dr. Peter Sydenham University of New England, NSW



▲ *Fig.1. Isotopes for medical use are created in atomic reactors – this is the world's first full-scale atomic power station, Calder Hall in Britain.*

The subject of this second part on measurement methods used in clinical pathology is nuclear medicine. We return to the Institute of Medical and Veterinary Science, Adelaide to study the range and extent of diagnostic aids that make use of nuclear techniques.

RADIOACTIVE ISOTOPES are trace elements that liberate a continuous stream of fast particles that can be detected with suitable instruments.

The quantity and type of emitted particles depends upon the isotope.

The strength of this process diminishes with time, reducing to half intensity in a time that is known as the half-life (denoted $T_{1/2}$). Some radioactive substances have half-lives of seconds, others tens of thousands of years.

An incredibly large number of radio isotopes can be made, and since 1896, when Becquerel first discovered radioactivity, they have found innumerable applications. Medicine is credited as being the first science to employ them for a useful purpose.

Isotopes are largely created by irradiating substances in the many forms of nuclear reactors like that shown in Fig. 1 for instance.

Their dominant use is as a tracer or marking substance. A suitable radio pharmaceutical (the isotope combined with other chemicals) is first introduced into the body itself or into a body specimen. Its flow path, or the accumulated strength at a particular spot, is monitored with detectors thereby providing information about the processes of the system under study.

This concept is well illustrated by an amusing yet profound use of an isotope which was probably the first ever application for detection. History has it that around 1910 Georg von Hevesy, a pupil of Rutherford, was having domestic problems with his landlady. He suspected she was using the scraps left in their plates to make the meat pies of subsequent days. One Sunday – the roast day – Hevesy seeded his meat left-overs with radioactive lead. On the following days he sampled the meals and tested them to find, indeed, the existence of radioactive lead. Hevesy, later in life, won a Nobel Prize for his work on radioactive indication.

In diagnostic aspects of nuclear medicine the radio isotope of interest can be introduced into the live person – (called "in vivo") for a patient study. Alternatively, the radio isotope may be introduced into sampled biological material – called "in vitro" testing. The patient (or sample) is then subjected to tests that measure parameters such as concentration, take-up rate and distribution in the organ or area of interest. The size of a radioactive dose given today is minute; public fear of nuclear medicine is quite unjustified for there is no danger in the processes used.

A table of uses has been compiled for this feature by IMVS staff – see Fig. 2. In each case the underlying principle is initially the introduction of a suitable isotope – by injection, inhalation, via food or by direct placement. The isotope may be conveyed away by physiological processes providing a marker as the isotope disperses. Alternatively, it can flow continuously coming to more or less permanent rest in different locations – cancerous (carcinoma) growths, for example, having a higher metabolism, take up more isotope than surrounding areas. In another type of use – respiratory investigations – the patient inhales isotope atomised into the breathing air intake. Where the individual lung cells accept air, isotope is deposited. Unhealthy lung tissue receives none. Detectors are then used to map the intensity of the static or dynamic distribution of the isotope – thus providing the diagnostic output required by the physician.

What happens to the radioactivity given in such dosing? The answer is simple. The isotopes used have comparatively short lives, for example, one Techetium isotope used, ^{99m}Tc, has a half life of just six hours. This means that six hours after initial preparation its radioactivity has fallen to half, twelve hours later to a quarter and so on. It is, therefore, only a comparatively short time before its energy is negligible, much less than the naturally existing background radio-activity in fact. All that remains is the original trace element which is removed by normal body processes.

Radio pharmaceuticals or radio nuclides are selected and manufactured in accordance with the sensing sensitivity available, the physiological characteristics that decide where the trace elements end up or pass through and the acceptability of the body to the trace chemicals. A second table, given in Fig. 3, lists some of those used in organ studies. Others based on chromium, cobalt and molybdenum are used in other tests. To give some idea of the dose, a patient needing a brain study is given 10 millicuries of ^{99m}Tc, this liberating a radioactive dose of roughly 0.14 rads. This is similar to that received during a routine chest X-ray. The choice of chemical, isotope and technique is a skilled task requiring highly specialised personnel.

SUMMARY USES OF NUCLEAR MEDICINE TECHNIQUES IN CLINICAL DIAGNOSIS

NERVOUS SYSTEM –
- A. **BRAIN SCAN** – NEOPLASTIC DISEASE – NON-NEOPLASTIC DISEASE
- B. **DYNAMIC STUDIES** – CEREBROVASCULAR DISEASE
- C. C.S.F. STUDIES – C.S.F. RHINORRHEA – SHUNTS

THYROID GLAND –
- A. UPTAKES – THYROTOXICOSIS – EUTHYROID – HYPOTHYROID
- B. **IN VITRO STUDIES**
- C. SCANNING – "COLD" NODULES – NEOPLASTIC – NON-NEOPLASTIC; "HOT" NODULES; METASTATIC LESIONS

PARATHYROID – PARATHYROID ADENOMAS – "HOT" NODULES

RESPIRATORY SYSTEM –
- A. PARTICLES – PERFUSION – PULMONARY EMBOLISM – OBSTRUCTIVE AIRWAYS DISEASE – CARCINOMA
- B. GASES VENTILATION

BLOOD –
- A. **BONE MARROW** – RED CELL PRECURSORS – RETICULOENDOTHELIAL
- B. **IRON METABOLISM** – ABSORPTION – TRANSPORT – UTILIZATION
- C. **VITAMIN B_{12} METABOLISM**
- D. **BLOOD VOLUME**
- E. **RED CELL SURVIVAL**
- F. **SPLEEN SCANNING**
- G. **PLATELET**

CIRCULATION – BLOOD POOLS – HEART, e.g. PERICARDIAL EFFUSIONS – PLACENTA, e.g. PLACENTA PRAEVIA

SKELETON –
- A. **BONE SCANNING** – NEOPLASTIC – NON-NEOPLASTIC
- B. **BONE VIABILITY STUDIES**

GASTROINTESTINAL –
- A. ABSORPTION – SUGARS – LIPIDS – VITAMIN B_{12}
- B. LOSSES – BLOOD – PROTEIN

LIVER –
- A. LIVER SCAN – NEOPLASTIC – PRIMARY – SECONDARIES; – NON-NEOPLASTIC – ABSCESS, TRAUMA, CYSTS – DIFFUSE DISEASE – CIRRHOSIS
- B. **LIVER BLOOD FLOW STUDIES**

PANCREAS – PANCREATIC SCAN – NEOPLASTIC – NON-NEOPLASTIC

KIDNEY –
- A. RENAL SCAN – NEOPLASTIC – PRIMARY – SECONDARY; – NON-NEOPLASTIC – TRAUMA – ABSCESS – RENAL ARTERY STENOSIS – CONGENITAL ABNORMALITIES
- B. **FUNCTIONAL STUDIES**
  - RENOGRAPHY – R.A.S. – OBSTRUCTIVE UROPATHIES
  - **BLOOD FLOW STUDIES** – R.A.S. – CYST OR TUMOUR

Fig. 2. Table summarizing the uses of nuclear techniques in clinical diagnosis.

RADIATION PRODUCTS EMANATING FROM ISOTOPES

Radiation products occur as three types of energy: alpha particles, beta particles and gammy rays, denoted by α, β, and γ.

Alpha particles are protons (atoms stripped of electrons). Being relatively large and possessing comparatively low kinetic energy, these are unable to penetrate much more than a thin sheet of paper.

Beta particles are electrons but, although only 1/1850th of the mass of the alpha particle, possess much higher kinetic energy by virtue of their far greater velocity. These can penetrate further than alpha particles but still only a little distance – a 0.5 mm thick piece of aluminium reduces their intensity by half.

Gamma particles are more adequately identified with

Organ	Radionuclide or Radiopharmaceutical	Imaging Technique
Brain	^{99m}Tc (Sodium pertechnetate)	Gamma Camera
Ventricular System, Spinal Cord	^{131}I-HSA (Human Serum Albumin)	Rectilinear Scanner
Thyroid	(i) ^{131}I, or	Retilinear Scanner
	(ii) ^{99m}Tc (sodium pertechnetate)	Gamma Camera
Lung	(i) ^{131}I-MAA (Macroaggregated Albumin), or	Retilinear Scanner
	(ii) ^{113m}In-Fe $(OH)_3$	Rectilinear Scanner or Gamma Camera
Liver and Spleen	(i) $^{99m}Tc_2S_7$-S (Technetium-sulphur-colloid)	Gamma Camera
Kidney—		
(*a*) Scan*	(i) ^{197}Hg-chlormerodrin, or	Rectilinear Scanner
	(ii) ^{99m}Tc-Fe ascorbate	Gamma Camera
(*b*) Renogram*	^{131}I-Hippuran	Gamma Camera
(*c*) Blood Flow*	^{99m}Tc-(Sodium pertechnetate)	Gamma Camera
* Generally performed as a combined study at one "sitting"		
Mediastinal Blood Pool	^{131}I-HSA	Rectilinear Scanner
Pancreas	^{75}Se-methionine	Gamma Camera and 1600 Channel Multi-parameter Analyser
Parathyroids	^{75}Se-methionine	Rectilinear Scanner
Placental site	(i) ^{131}I-HSA; or	Rectilinear Scanner
	(ii) ^{99m}Tc-HSA or ^{113m}In-gelatin	Gamma Camera
Bone or Skeletal Survey	^{18}F	Positron Camera

Fig. 3. List of organ studies and the isotope preparation used.

ELECTRONICS IN MEDICINE

electromagnetic EM radiation because they exhibit characteristics of X-rays of very short wavelength. These pass through most materials, the best common absorbing material being lead – a 13 mm thick shield provides 50 per cent loss. It is this radiation product that finds greatest use in nuclear medicine, for the former two have insufficient penetration for most applications – doses deposited in the interior of the body would not be easy to monitor externally due to the severe attenuation.

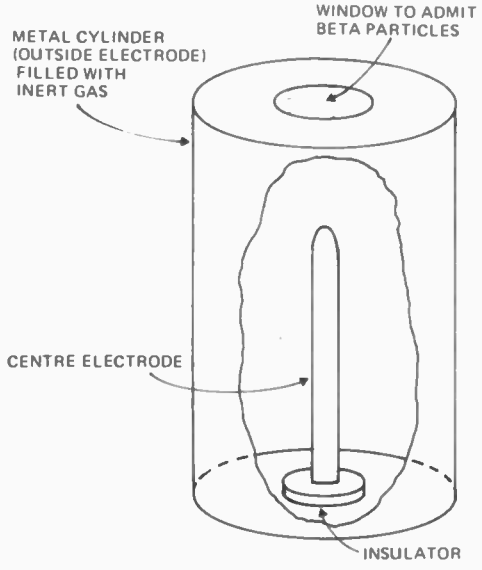


Fig. 4. Basic arrangement of ionisation kinds of radioactivity sensors – the G-M tube, ionisation and proportional detectors.

BASIC RADIATION DETECTION

Radioactivity was discovered by Antoine Henri Becquerel in 1895 when he observed its effect on photographic plate; it also causes fluorescence in certain substances (re-radiation at visible radiation wavelengths) and can also ionise gases. Direct photographic methods play little part in nuclear medicine as they require extreme exposure times for realistic safe dose levels.

The next simplest method of detection makes use of the ionising effect of radiation. The so-called Geiger counter uses a Geiger-Muller (G-M) tube which comprises an insulated wire anode placed inside an inert gas filled metal case which acts as the cathode – see Fig. 4. At one end is a "window" of beryllium, mica, nylon or other material that is adequately transparent to β and γ nuclear radiation products; α particles cannot pass into the chamber. These cells are particularly sensitive to β particles which ionise the normally conducting gas allowing a momentary current to pass through the cell. Gamma rays can be detected with the G-M tube but via a secondary effect in which they liberate electrons that start an ionising action. Ionisation detection is enhanced by the application of a steady dc potential of mm 500 to 3000 V (positive to the wire): this puts the gas closer to an ionisation state. Ionisation chambers and proportional counters are similar in structure to G-M tubes, the differences being in the magnitude of ionising potential applied in each case.

The output of each of these three alternatives is similar – as a series of pulses of different amplitude and frequency of occurrence with time. The actual characteristics depend on the mode used – the G-M tube is the most sensitive but lacks response time and all pulses have the same energy. Pulses produced in these detectors are counted over a chosen timing interval to provide a measure of radiation intensity – a faster count rate indicates higher intensity.

The practical difficulties and relatively insensitive characteristics of these detectors largely excludes them from nuclear medicine however, the dominant detector being the scintillation counter.

SCINTILLATION DETECTORS

The difficulty with ionisation style detectors is that the inherent energy of the radiation products is not used efficiently thereby reducing the available sensitivity. As well as this shortcoming is the practical problem of amplifying small signal levels of a signal having random noise characteristics: the amplifier will also amplify noise – not being able to distinguish between the two.

The scintillation counter makes use of the photo-multiplier detector which can provide excellent low-noise amplification of light energy (photons) – gains of 1 000 000 are used with

negligible degradation of the signal/noise ratio.

Radiation products, however, are at a higher energy level than photons so a conversion process is used to transform the high frequency energy down to optical wavelengths. This is done in a scintillating crystal.

In these crystals, ionising radiation gives up its energy which is reliberated as scintillations at optical wavelengths.

The basic arrangement is shown in Fig. 5. The larger the crystal the better the "capture" of energy. The choice of crystal material (usually sodium iodide) and phosphor of the photo multiplier decides what radiation level the unit sees (the phosphor converts photons to electrons, another transformation stage, in the photo-multiplier).

The vast majority of the instruments used in nuclear medicine are based upon the scintillation counter which possesses extreme sensitivity along with the ability to allow analysis of the energy levels of the radiation pulses. As with the ionising tube style of detector, these also provide a pulse form of output. Pulses are formed from successive transformation stages — ionising radiation particles cause optical scintillations as photons which, in turn, produce electrons to form the current pulse that is detected.

Scintillation counters have found application in two distinct ways. First as single detector units that provide count levels at a chosen position or on a chosen sample. Secondly, as imaging arrays wherein as many as 37 scintillation detectors see the subject simultaneously providing a graphical two-dimensional picture of radiation intensity emanating from an area.

COUNTING UNITS

These are used either to study samples loaded into a machine or alternatively the sensor is taken to the patient and directed at the area of interest.

Housed together in the Counting Laboratory are several different kinds of sample counting devices — two automatic gamma counters, an automatic liquid scintillation spectrometer, a large-volume counter, a proportional counter and a gas flow detector.

This collection enables a wide variety of tests to be carried out that estimate the radioactivity liberated by gamma-emitting substances and also by weak and strong alpha and beta emitters. The instruments enable volumes ranging from 5 ml vials to containers holding two litres to be measured. The laboratory also has a 128-channel pulse height analyser for use with various detector assemblies.

Automatic gamma counters

The Nuclear-Chicago system 4216, pictured in Fig. 6, is designed automatically to load, one by one, 100 preloaded vials into the measuring area where a scintillation detector determines the gamma radiation level. This is recorded on a printed output. The cross-section, shown in Fig. 7, shows the well-type detector of this system. Effective shielding is vital, for the sample under test must not be contaminated by the others waiting above. Note particularly the thickness of steel, tungsten and lead that is used to ensure that the 50 mm or 75 mm diameter, thallium activated, sodium

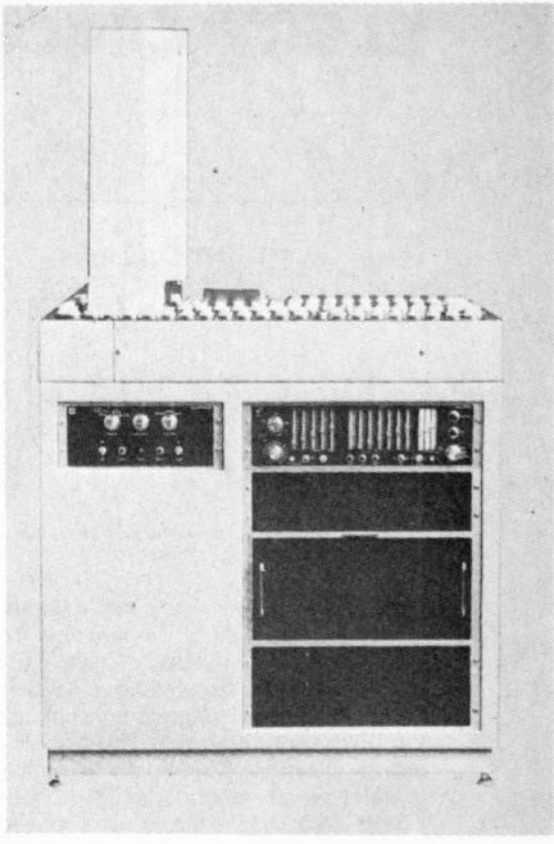


Fig. 6. Automatic gamma counting system of Nuclear-Chicago.

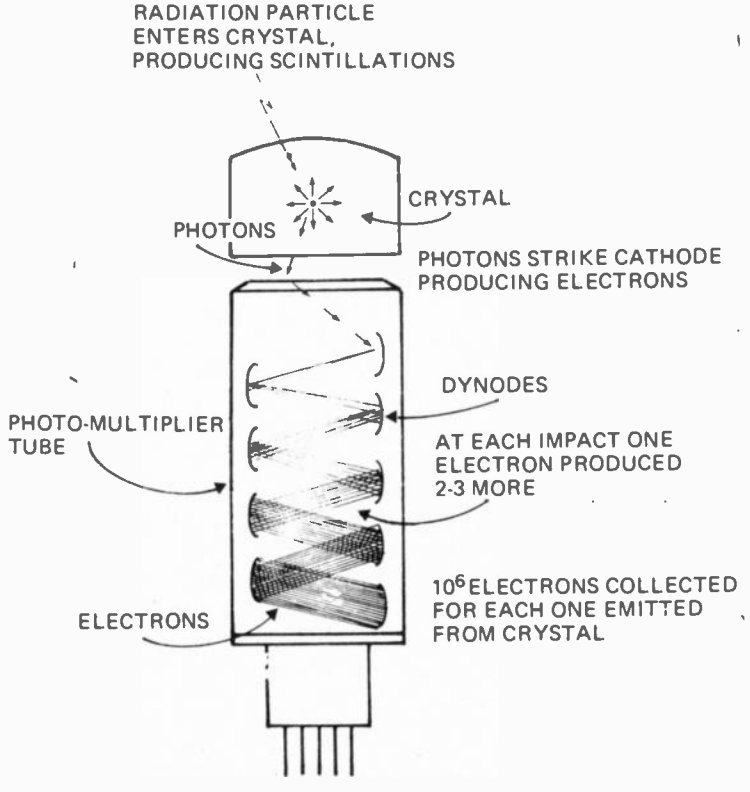


Fig. 5. In the scintillation counter a crystal absorbs the radioactivity energy liberating optical wavelength energy that is detected with a photo multiplier.

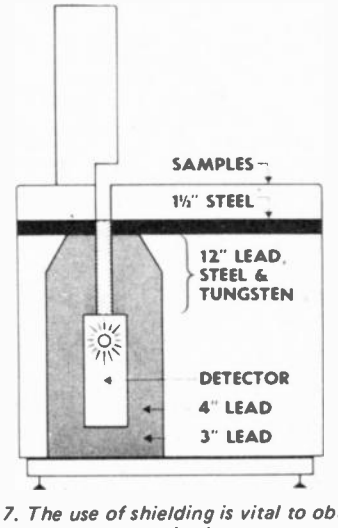


Fig. 7. The use of shielding is vital to obtain correct measurements in the gamma counting system.

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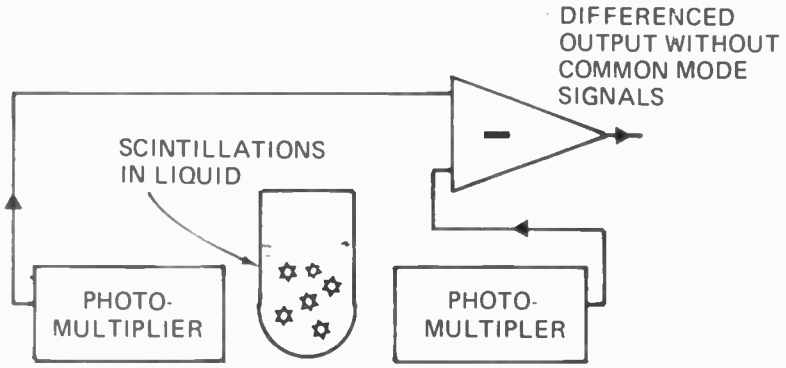

Fig. 8. Differential detection provides common-mode signal rejection in the liquid scintillation spectrometer.

iodide crystal sees only the sample loaded into the well. It is impossible to eliminate all stray radiation; the aim of the shielding is to ensure that the background count remains constant as the vials and transport mechanism change position. This relatively small machine weighs around 500 kg!

Built into the console is a pulse height analyser that can be set to measure specific pulse energy levels. This enables the diagnostician to monitor specific isotopes, largely ignoring other unwanted ones that may be present in the sample. A typical count run would take around a minute, involving half a million individual counts. It is also possible automatically to subtract the background count.

A second counter, a Philips Model PW4003, performs a similar function for a 50 sample loading.

As these scintillation counters have pulse height analysis facilities, they can be used to measure specific wavelength gamma rays by much the same concept as an optical spectrometer which separates wavelengths. For this reason these systems are sometimes referred to as gamma spectrophotometers.

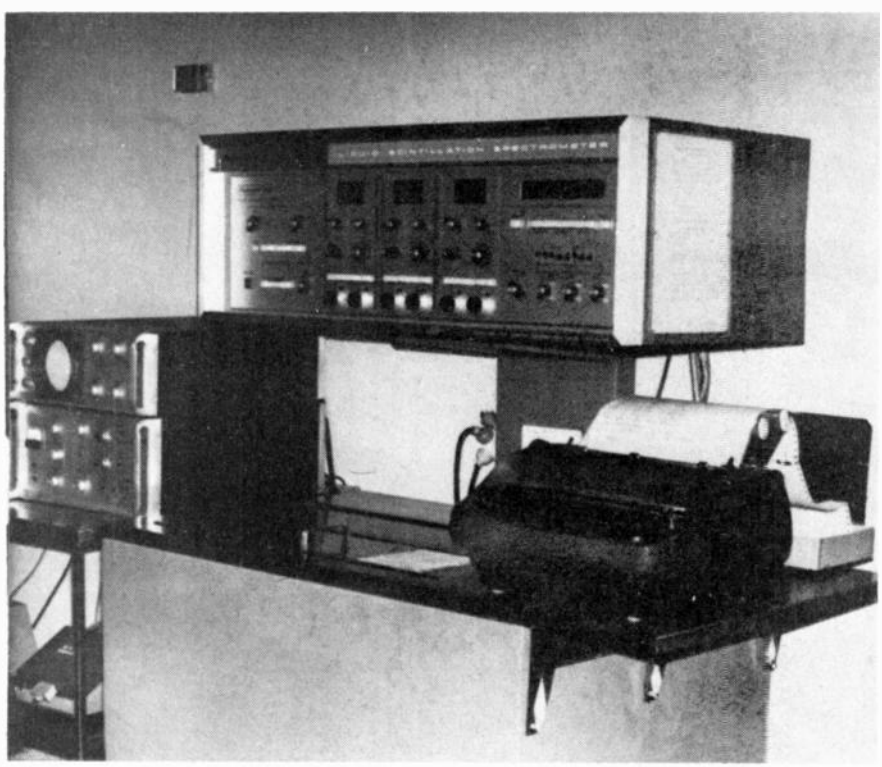

Fig. 9. This liquid scintillation counter system accepts 200 samples cycling them one by one through the differential detector.

Liquid Scintillation Spectrometer

The low energy of beta radiation from isotopes such as 14_C and 3_H prevents the particles passing through the windows of normal detectors. Solid scintillation crystals are not very effective for this radiation for similar reasons. To overcome this practical defect, yet retaining the sensitivity of the scintillation method, the sample to be measured is mixed with a suitable liquid the whole forming a liquid scintillating medium which acts in a similar manner as a solid crystal.

This much done, the necessary detection process still requires special techniques to reduce the effect of thermal noise inherent in the photo multipliers and to reduce the influence of background count: beta radiation is less energetic than gamma. By placing the liquid in a differential detection arrangement – see Fig. 8, common-mode background counts are largely eliminated. To further aid signal detection the detectors can be cooled with refrigeration to around -20°C to reduce their internal noise levels.

The Counting Laboratory has an automatic Tri-Carb Model 3375 unit, shown in Fig. 9, which accepts 200 samples. The liquid scintillation process varies in efficiency – this unit has inbuilt automatic standardisation of the measurement.

Gas flow detector:

Another method for detecting weaker radiations is to place the radio-activated sample inside the ionisation chamber proper rather than placing it outside. The chamber is set up as a proportional counter. This avoids the problems of signal attenuation caused by a window but adds a difficulty in that the chamber has to be assembled each time and the ionisation gas added. Figure 10 shows a diagrammatic cross-section of a gas flow detector. Gas flows continuously to ensure the chamber is adequately purged of previous gas and air.

Large-volume counter:

Some tests require the measurement of the radio-activity of quite large samples – a litre or more in capacity as, for example, in investigation of internal bleeding which is detected by faeces collection over a period of time. This poses different kinds of problems for the difficulties of shielding such a large volume can be expensive and weighty. The method used by the AEI designers concentrates on providing detection that incorporates the already mentioned common-mode rejection of stray background by employing two large scintillation crystals, 75 x 75 mm each, one above and one below as can

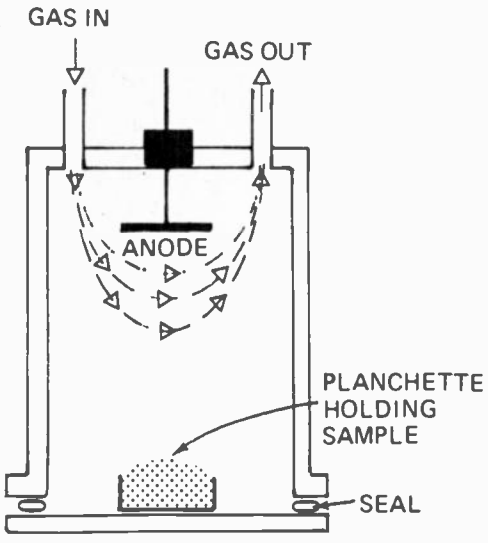

Fig. 10. In the gas flow detector gamma and beta radiation is monitored without the attenuation of windows.

be seen in Fig. 11. The sample bucket is placed in through the side door.

So much for machines that count radiation levels in samples. In another part of the IMVs Nuclear Medicine Division are screenable bays where another form of scintillation counter is used to count levels of radiation in selected parts of the body.

Scintillation probes:

A scintillation counter assembly (crystal plus photo multiplier) is mounted on an adjustable framework that enables the detector to be placed adjacent to the area of interest, as shown in Fig. 12. Once set, the probe takes a count of the radio activity in the region chosen — for example, a test for thyroid gland iodine uptake. These Philips surface counting systems are fitted with 50 mm diameter crystals.

Facilities exist that enable several such probes to be monitored simultaneously, enabling the observer to study differential effects such as renal uptake and clearance in a patient. It also enables changes in radioactivity to be monitored in the liver and spleen after radionuclide-labelled blood cells have been injected.

IMAGING

Rectilinear scanning

If a single detector scintillation head, such as that shown in Fig. 12, is made to move over the still patient it is quite feasible to build up a two dimensional picture of radiation distribution provided the radiation level in the patient is satisfactorily static.

In the scanner shown in Fig. 13, the patient lies on the table to provide the image attitude required. The tubular head, which contains the scintillation detector, is moved across the bed by a driven slide-way in the cross arm, the whole arm moving along the bed. Given enough time, for counting rates are not fast, the whole body can be imaged. This technique is known as rectilinear scanning.

The output form for this machine can be of two kinds. First, as a Teledeltos paper picture in which dots are made on special paper by passing high voltage through it on demand — the more intense the radiation the greater the dot density and the blacker the area on the picture. Figure 14a shows the system schematic for this. The second method provides a photograph which is exposed, using Polaroid film, by a cathode ray tube produced image formed from light dots — see Fig. 14b. A direct copy of a case study — that of cancer of the prostrate — made with the latter display is shown in Fig. 15.

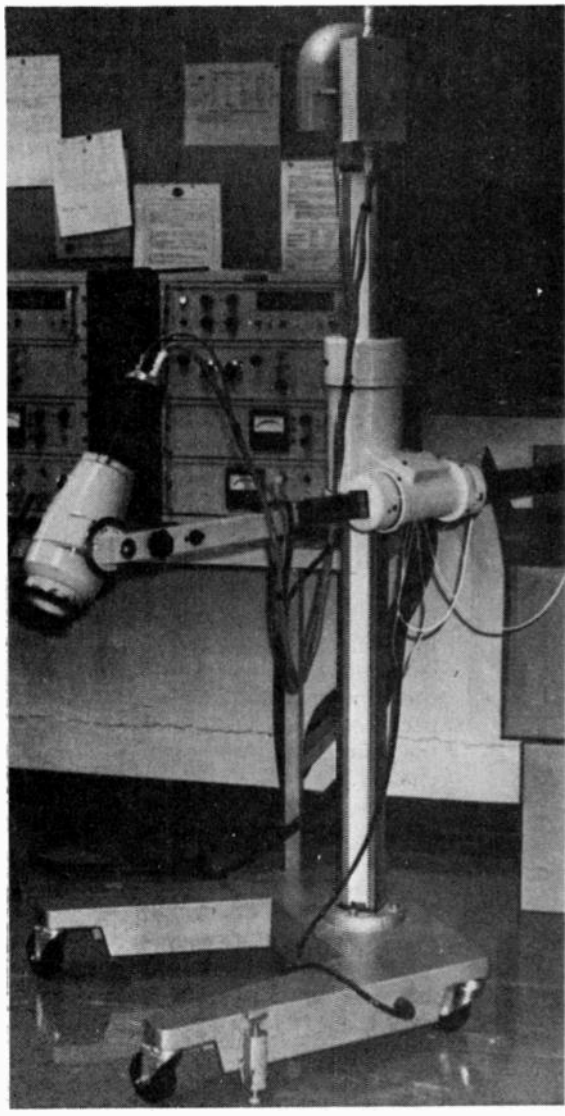

Fig. 12. The adjustable framework enables a sensitive scintillation counter head to be placed close to the area of interest.

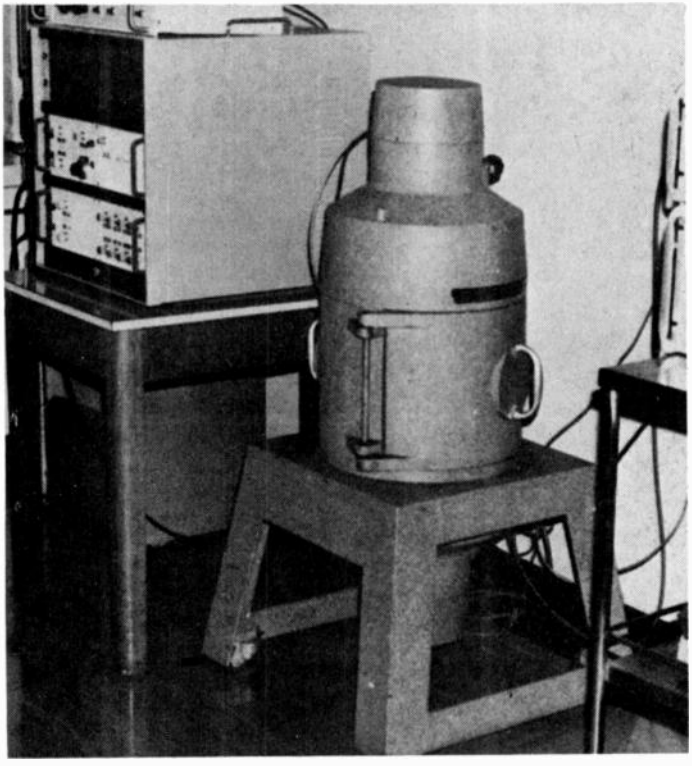

Fig. 11. The large volume scintillation counter has detectors above and below the sample region.

The gamma camera

The rectilinear scanner suffers from the major disadvantage that considerable time is needed to image an organ or the body. If more scintillation detectors were added, working simultaneously, this would reduce the time. This is the basis of the technique originally proposed by Dr. Anger which is now known as the gamma camera. His idea, however, is more profound, for the multiple

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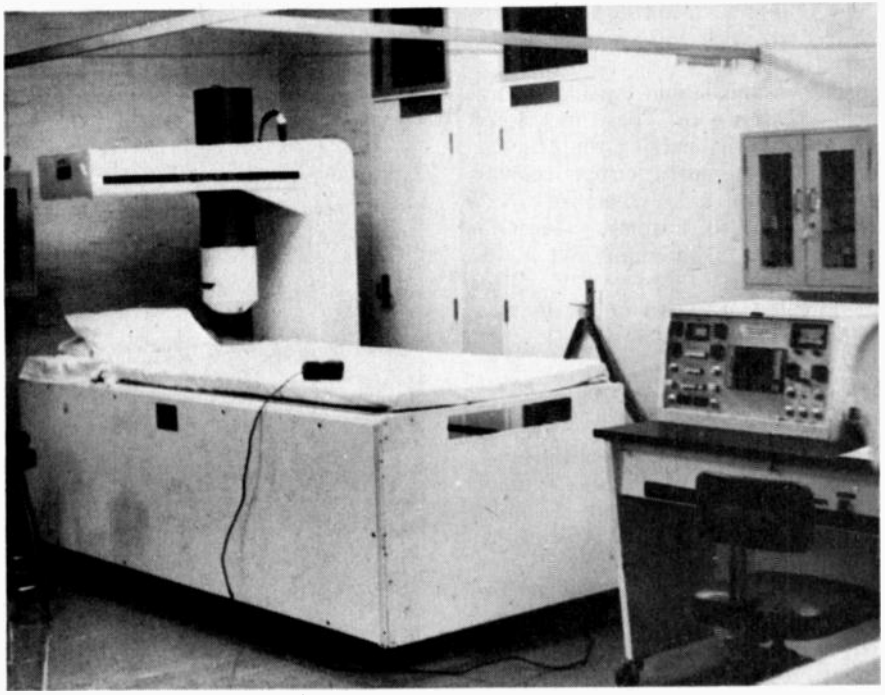

Fig. 13. This rectilinear scanner moves the single scintillation counter over the stationary patient. A typical scan could take up to half an hour.

sensors are combined to yield a 2-D display from a static array.

The "camera" is very large in size (close to a metre in diameter) and heavy (ships at just less than a tonne) – the IMVS use the Nuclear-Chicago models – shown in Fig. 16. Inside the 40 mm heavy steel and lead housing is one very large (300 mm x 12 mm) scintillation crystal which is sensed by as many photo-multipliers as can be fitted into the circle. Earlier models used 19 photo-multipliers, the latest have 37. A cross-section, given in Fig. 17, shows the arrangement. Note the collimator which, in the optical sense, ensures that the sensors see only rays emanating in a parallel direction from the source. The collimator shown is a lead disk machined with parallel holes through it.

Each photo multiplier has its own power supply and amplifier board mounted in the camera housing. The multiple channel information is combined with a resistor matrix on the basis that each sensor sees more than just its immediate frontal area – values are weighted for scintillations occurring anywhere in the crystal on the basis that their contribution falls off with distance. The combined "video" signal output leaves the camera as four lines which convey pulses and position information – not as a continuous signal form. The pulses are selected and sorted with the pulse height analyser (PHA), and other ancillary equipment to provide suitable drives for an oscilloscope display – this is shown in a simplified manner in Fig. 18. The output display is built from individual dots.

Gamma-cameras produce an image much faster than rectilinear scanners – a liver image takes only a minute compared with 30 minutes using the

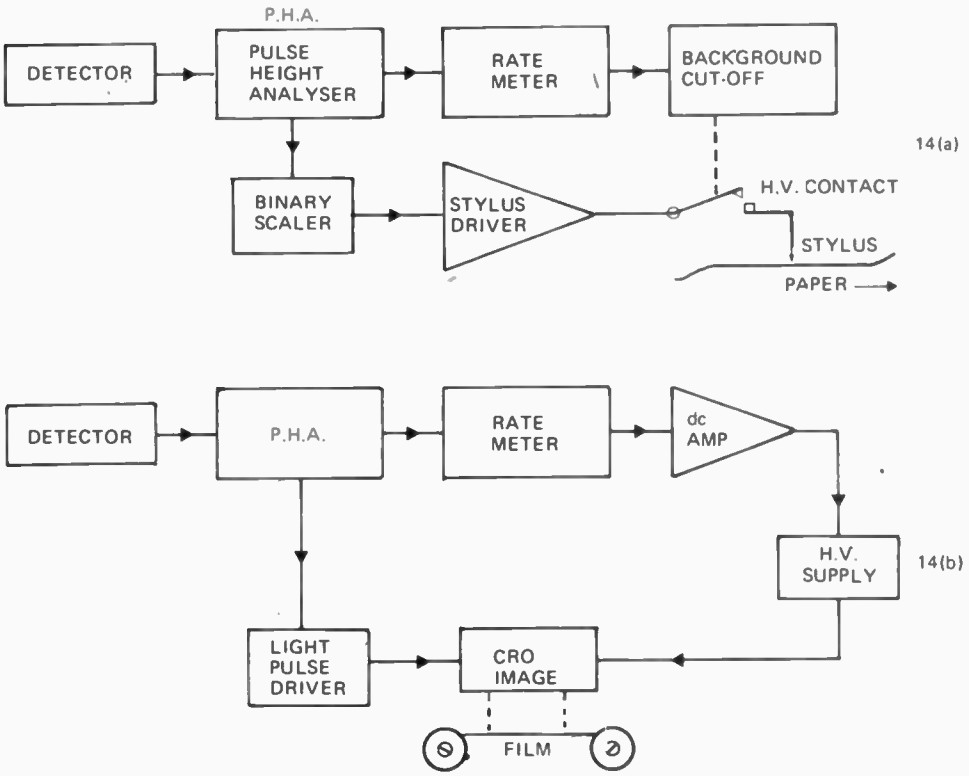

Fig. 14. The two methods used to produce an image from rectilinear scan data. (a) Dots are made on paper. (b) Dots are formed on a CRT.

Fig. 15. This photograph is copied from the original made with the rectilinear scanning system. The darker the colour the greater the concentration of radio isotope take-up.

scanner. With these short times it is far easier to exclude unwanted secondary effects such as a patient breathing which moves the organ relative to the camera.

The gamma-camera photograph, however, is still in the class of a fuzzy X-ray plate and correct interpretation is a matter of the clinician's skill. Providing the camera with improved resolution would not improve matters much for the organ is invariably masked by overlying body tissue; the radioactive emission process itself lacks detail. A typical image is shown in Fig. 19. This is from a study of the lung which is diagnosed to be multiple pulmonary emboli (blood flow obstructions). The label substance in this case was ^{131}I. It is usual to perform other tests to assist with the final diagonostic decision.

Whole body imaging:

The latest developments are to bodily move the patient past the stationary gamma-camera building up a whole body picture in the manner shown in Fig. 20. Electronic circuitry ensures that the scans are overlapped correctly to produce a total picture. Scanning is still, however, time consuming. The image shown in Fig. 21 took 19 minutes a side. Fig. 21b is of a person with metastatic meningioma (a tumour transferred from other parts of the body).

THE RADIO PHARMACY

Isotopes used as tracers in nuclear medicine have a short half-life, by necessity for the need to use only short-lived radiation sources in a patient's body. Furthermore, it is often the case that the isotope most suited, because it is naturally transported to the organ of interest, has short half-life. For example, Fluorine-18, one of the best for bone scanning, has T½ = 1.8 hours. As this must be produced originally in a reactor – the IMVS supplies mainly come from the Lucas Heights reactor near Sydney – the original dose loses three half-lives before it arrives at the IMVS – police escorts are used to speed up deliveries! Some isotopes come from as far as the U.S.A., U.K., Germany, Holland and India. In cases of short half-life a considerably stronger original amount is required to obtain the dose needed, when it reaches the patient.

Regular shipments of isotope to the IMVS include ^{51}Cr-sodium chromate for blood studies, ^{57}Co-vitamin B_{12} for vitamin absorption studies, ^{131}I-human serum albumin for blood volume studies, ^{197}Hg-chlormerodrin for renal scanning, ^{131}I-Rose Bengal for liver studies and ^{18}F for tumour detection in bones.

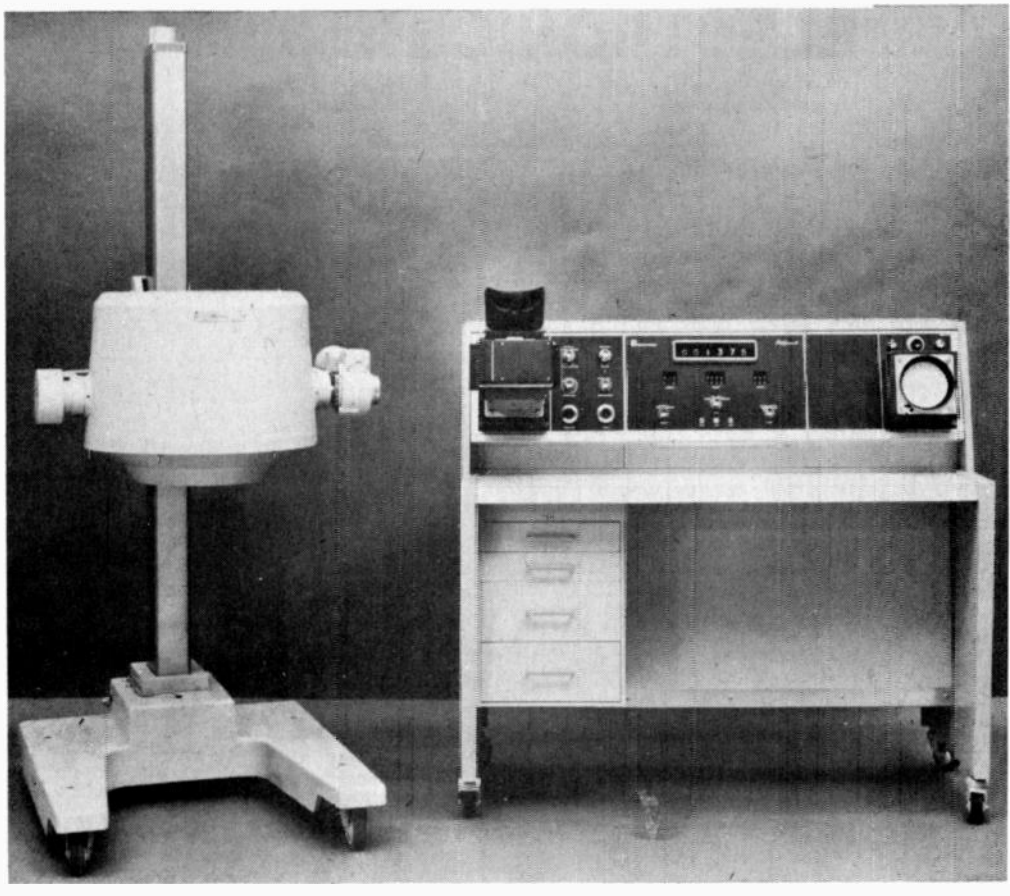

Fig. 16. Pho/Gamma III scintillation camera ready for use. These produce an image without need for scanning.

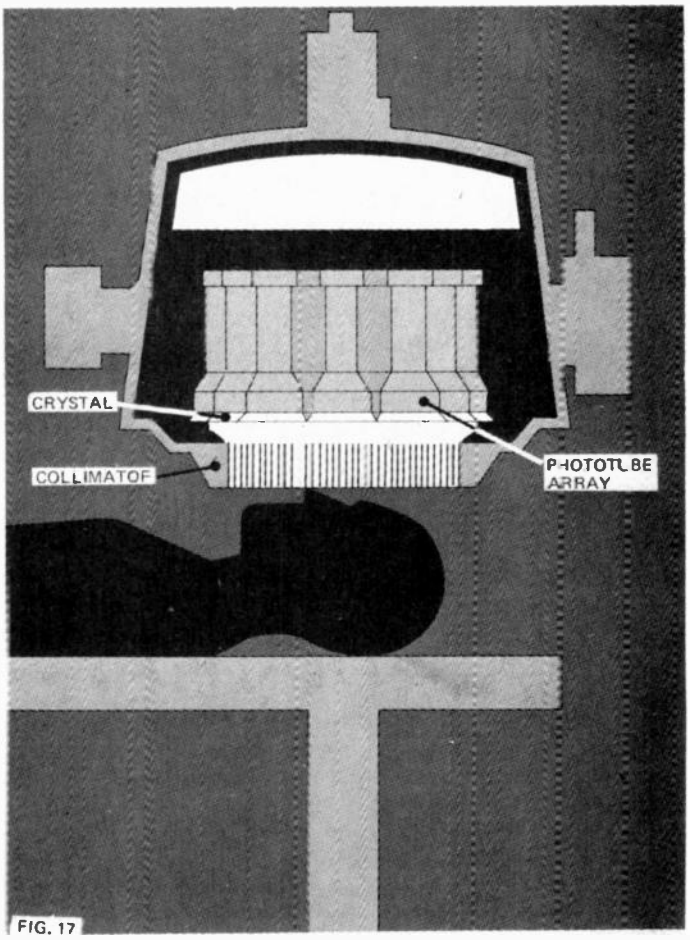

Fig. 17. Gamma cameras contain multiple photo multipliers viewing a single large diameter crystal. The outputs are combined to provide image data – see Fig. 18.

ELECTRONICS IN MEDICINE

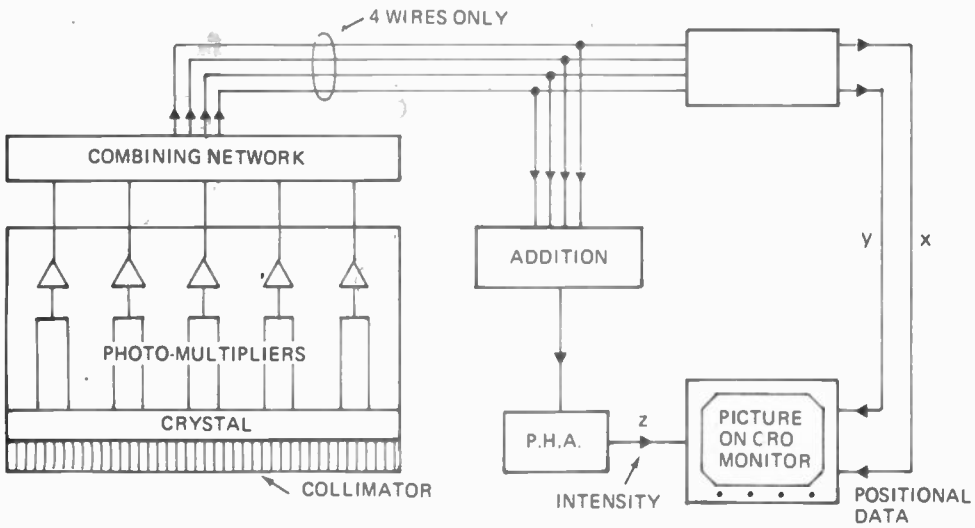

Fig. 18. Schematic of data handling in gamma camera system.

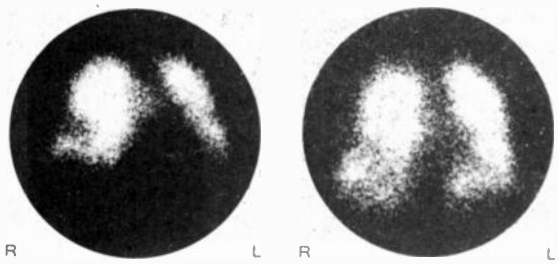

Fig. 19. Images produced with gamma camera – front and back view of labelled lungs.

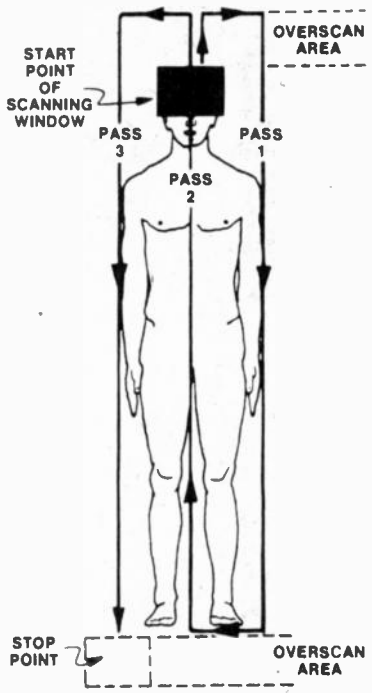

Fig. 20. The gamma camera is made to move relative to the patient (the patient is moved automatically) to expand the image size.

POSTERIOR

Fig. 21. Gamma camera scanned image (clinical case of metastatic meningioma).

One particularly interesting shipment is ^{99}Molybdenum-^{99m}Technetium (^{99}Mo-^{99m}Tc). The more useful isotope of the two is ^{99m}Tc but this has half-life of only six hours – direct shipment would be extremely costly. ^{99}Mo, however, has a half-life of 67 hours and it produces as part of its decay process the "daughter" isotope ^{99m}Tc. Separation is achieved by absorbing the parent ^{99}Mo on to an alumina column for which ^{99m}Tc has low affinity. When a saline solution is passed through the column it elutes the ^{99m}Tc as a pertechnetate ion of extreme purity. The column is called the "cow" which is "milked" each day to provide isotope for brain scanning.

Processes like the Techetium Cow are housed in a special purpose laboratory – a radio pharmacy. Another cow used is ^{113}Sn which has a half-life of 119 days. This yields ^{113m}In chemicals which have only 1.7 hour half-lives.

As well as being able to monitor radioactivity level and produce isotopes, the pharmacy must also be able to perform routine chemical analyses. For this purpose, it has an atomic absorption spectrophotometer and an ultra-violet spectrophotometer. The radio pharmacy is also used for research into new radio-pharmaceuticals.

In this two part feature we have looked at the internal workings of a well equipped clinical pathology centre.

We have not covered all of the measurement devices involved in the many thousands of tests made each day but we have we hope shown something of the great concentration of measurement effort involved in modern pathological medicine. ●

Electronics Today would like to thank the directors and staff of the Institute of Medical and Veterinary Science, Adelaide, for the very kind advice and assistance in the preparation and subsequent checking of this article.

Why you need 220 watts of power to listen to soft music.

SA-9900

Stated simply, Pioneer's new SA-9900 stereo amplifier was created to faithfully reproduce music at any volume you desire. At 110 watts RMS per channel, it doesn't matter whether you're trying to liven up a party or just warm up your sweetheart. Through a precision blending of Pioneer's advanced electronics, total harmonic distortion is never more than 0.1%. As a result, you hear all the sounds of all the music you play—clearly—even the soft ones.

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The SA-9900 stereo amplifier. Another example of technical know-how and constant research applied to meet the listener's needs. After all, isn't that what you've come to expect from Pioneer audio equipment.

At Pioneer, we uphold that trust with almost 40 years of exclusive commitment to audio excellence. And from our vast resources as one of the world's leading audio specialists, we are privileged at this time to offer the SA-9900 as the best in an entire line of outstanding stereo amplifiers. Stop by and see your local dealer for a complete demonstration.

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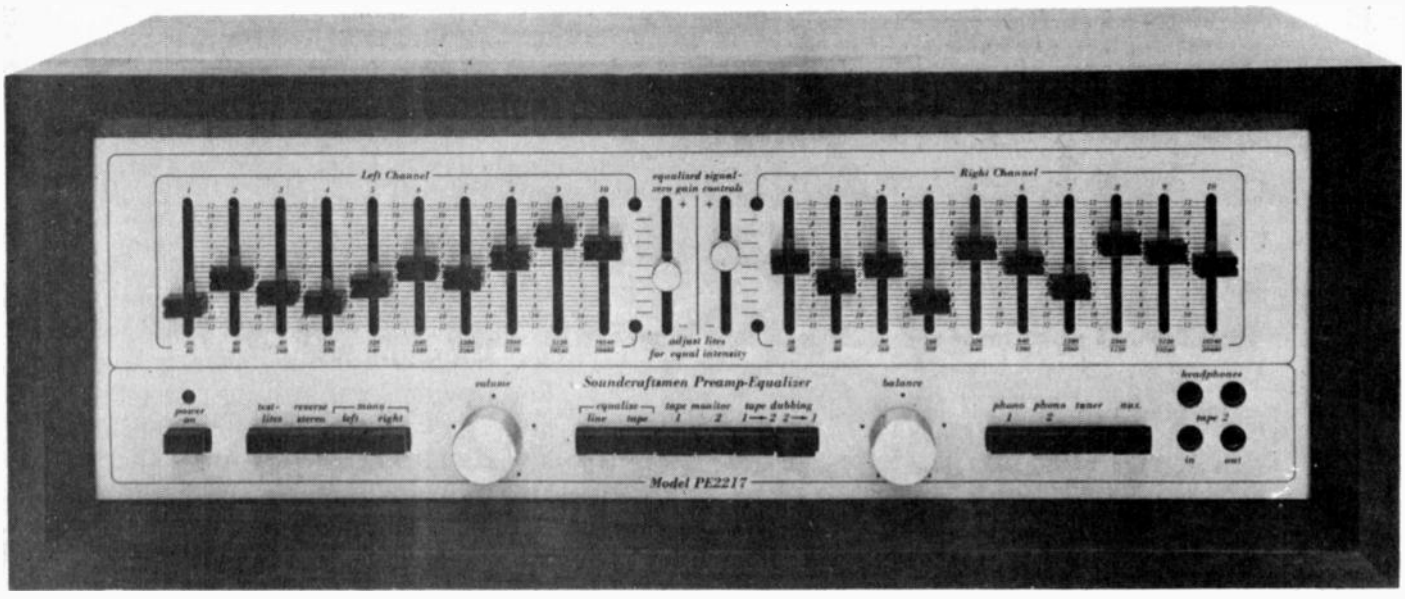

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FREQUENCY RESPONSE – Phono inputs: ± ½ dB, 20 Hz to 20 kHz (Typ. ± ¼ dB)
HARMONIC DISTORTION: less than .05% at 1 volt, (Typ. 01% at 1 volt)
IM DISTORTION: less than .05% at 1 volt, (Typ. .01% at 1 volt)
SIGNAL-TO-NOISE – Hi-level inputs: 1– dB below full output
SIGNAL-TO-NOISE – Phono inputs: 84 dB below a 10mv input
SIGNAL-TO-NOISE – Equalizer section: 90 dB below a volt input
GAIN – Phono: 57 dB
GAIN – Hi-Level: 15 dB
INPUT IMPEDANCE – Phono: 47,000 ohms
INPUT IMPEDANCE – Hi-level: 50,000 ohms
OUTPUT IMPEDANCE: 600 ohms
MAXIMUM OUTPUT: 5 volts into hi impedance, 2.5 volts into 600 ohms
EQUALIZER LEVEL: Zero-gain controls for left and right channels, continuously variable, for unity-gain compensation form – 12 dB to + 6 dB.
EQUALIZER RANGE: 12 dB boost and 12 dB cut, each octave centered at 30, 60, 120, 240, 480, 960, 1920, 3840, 7680 and 15,360 Hz.
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WARRANTY: 2 years parts and labor
SHIPPING WEIGHT: 28 lbs

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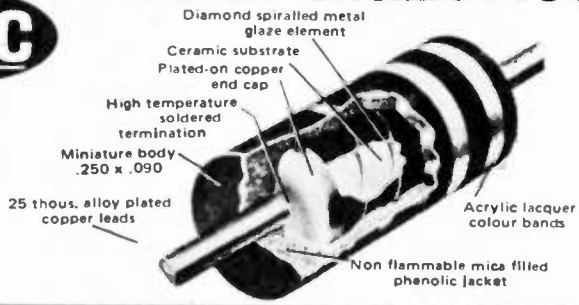

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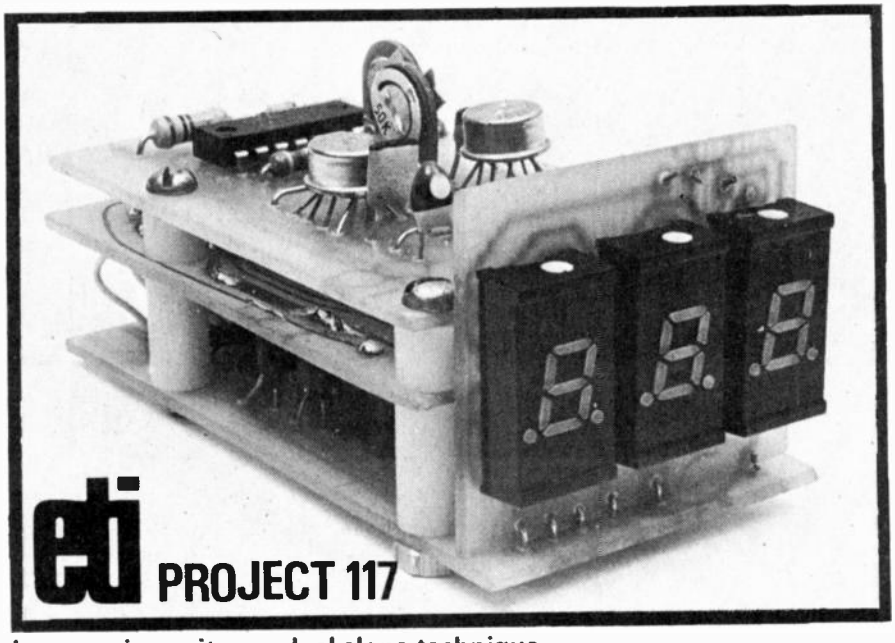
DIGITAL VOLTMETER



Inexpensive unit uses dual-slope technique

LAST MONTH we published details of a simple, three-digit display module which is readily adaptable to a wide range of applications and is inexpensive to build. This month we provide details of the first of a series of modules specifically designed to interface with the ETI 533 display module.

The first of these modules is a simple, yet accurate, dc digital voltmeter. Fundamentally we have described it as a single range unit which is economical enough to be mounted within other equipment as a panel meter. However an input switch may be readily added to convert the instrument for use on ranges from one volt dc full scale to 1000 volts dc full scale.

We have not described the mounting of the unit in a cabinet or box as individual requirements will vary widely.

CONSTRUCTION

The display-counter module ETI 533 should be built first using the instructions given last month.

Two additional boards are required to complete the voltmeter and the overlays and interconnections are given in Fig. 3. Check that all components, especially the metal case ICs are orientated correctly.

The interconnection wires should be long enough to allow the boards to fold together as shown above. The lower board ETI 533A has the components uppermost, the middle board ETI 117A has the components downwards while the top board ETI 117B again has the components uppermost. It may be necessary to juggle the components slightly on the lower two boards to allow them to fit together closely enough. These two boards are spaced apart with 12mm long spacers while the upper two boards are separated by 6mm insulated spacers. A piece of insulation material should be fitted between the top two boards to prevent the solder joints touching.

Power, 9-15 volts dc, is supplied to the lower board while the input connects to the upper board.

The unit can be either installed in a suitable box or within a piece of equipment. If range switches are required simply change the value of R12 as per Table 1. A suitable box for mounting the unit as a separate instrument is the type PC1 marketed by A & R.

CALIBRATION

Unfortunately to calibrate any voltmeter a known voltage reference or an accurate voltmeter is required for comparison. Two adjustments are provided, one for calibration and the other to compensate for the offset in the integrator IC. For input voltages of 10 V or more the offset potentiometer is not required as the error is within one digit.

This offset potentiometer should be adjusted first by applying a voltage of about one per cent (10 digits) of full scale and adjusting RV2 to give the correct reading. The calibration potentiometer RV1 can now be adjusted by applying an accurately known voltage near full scale.

The meter has a large overrange and voltages up to 250 per cent of full scale can be measured except that the first digit is lost and must be assumed, ie, if you are measuring a car battery on a 10 V range and it reads 3.52 V it is obviously 13.52 V.

MEASURED PERFORMANCE OF PROTOTYPE

Number of digits	3
Overrange	250% (no indication)
Dual polarity	No
Ranges	1, 10, 100 and 1000 V dc
Accuracy	As adjusted
Linearity	±1 digit
Power supply	9-15 V dc at 120 mA isolated
Input impedance	100 k/V
Overrange Protection	
1 V range	100 V limited by power
10 V range	500 V dissipation and
100 V range	500 V voltage rating of
100 V range	2500 V* R12
	* input switch permitting
Reference	5.1 volt zener at constant current.

DIGITAL VOLTMETER

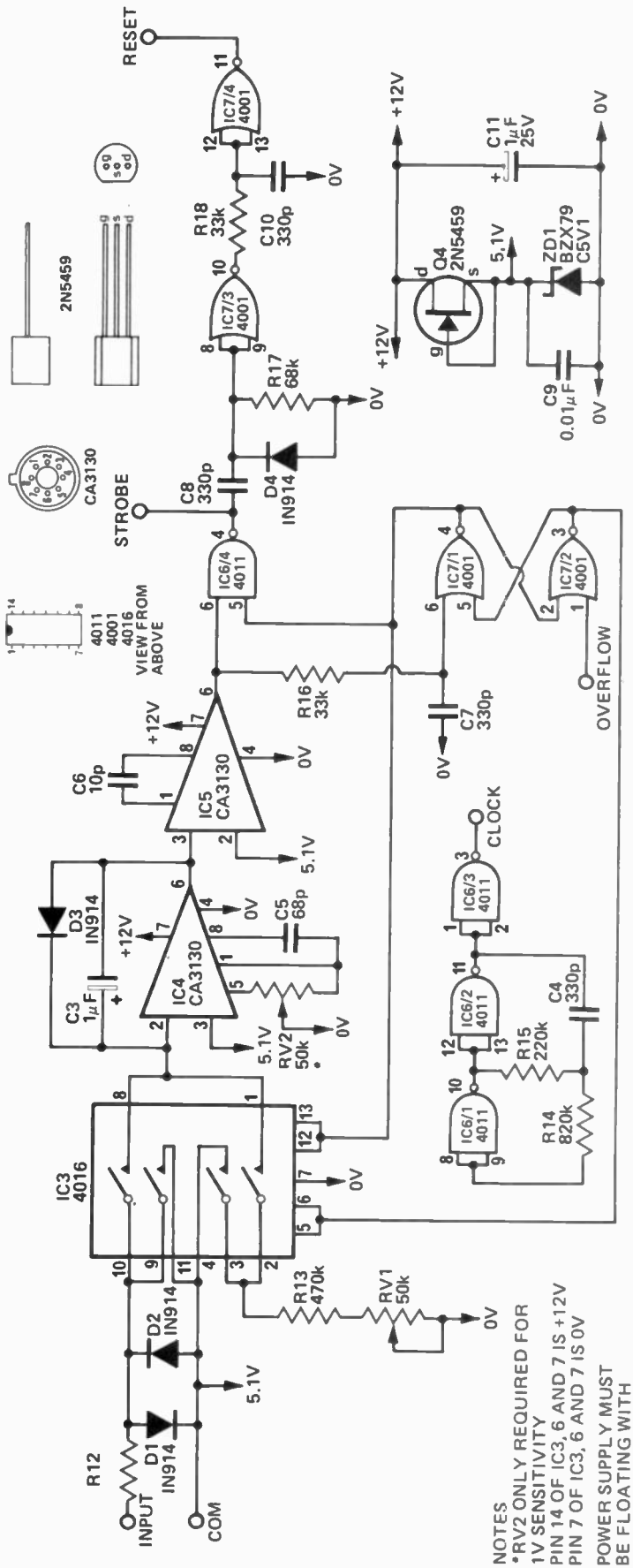


Fig. 1. Circuit diagram of the dual-slope analogue to digital converter. This circuit is used together with the ETI 533 display to make the complete voltmeter.

HOW IT WORKS

The method of analogue-to-digital conversion used is the popular dual-slope integration technique. A general explanation of this method was given last month in our multimeter survey and reference should be made to that article. We chose the dual-slope technique because it is relatively insensitive to component tolerances and gives very linear results with least amount of circuit complexity. The technique was developed by Weston and hence is covered by patents, however, there is nothing to stop individual constructors from using it, nor are there any royalties involved.

The circuit consists of an integrator (IC4 and C3), a comparator (IC5), an input selector (IC3), an oscillator (IC6/1,2,3) an RS flip flop (IC7/1,2), pulse generators for the reset and strobe outputs (IC6/4, IC7/3,4), a voltage reference (ZD1 and constant current source Q1), and (last month's) digital display module.

The 5 kHz output of the oscillator, which runs continuously, is connected directly to the clock input of the display module and the conversion proceeds as follows. Flip Flop IC7/2, drives IC3 such that it selects either the input voltage via R12 or the reference voltage via R13. The state of the flip flop is determined by the output state of the comparator IC5 (output high selects input voltage) and the overflow output from the display module (overflow selects reference voltage). If the input voltage is selected the output of the integrator will fall at a rate dependant on the input voltage, and, if the reference voltage is selected the input voltage will rise at a constant rate.

When the integrator output rises above 5.1 volts the comparator output goes high causing the output of IC6/4 to go low (as pin 5 of IC6/4

PARTS LIST

R16,18	Resistor	33k ¼w 5%
R17	"	68k " "
R15	"	220k " "
R13	"	470k " "
R14	"	820k " "
R12	"	See text
RV1,2	Potentiometer	50k Trim type
C6	Capacitor	10pF ceramic
C5	"	56pF "
C4,7,8,10	"	330pF "
C9	"	0.01μF polyester
C3,11	"	1μF 25V Tantalum
D1,2,3	Diode	IN914 or similar
ZD1	Zener diode	BZ x 79 C5 V1
Q1	Transistor	2N5459 or similar
IC3	Integrated circuit	4016 (CMOS)
IC6	" "	4011 (CMOS)
IC7	" "	4001 (CMOS)
IC4,5	" "	CA3130

PC Boards ETI 117A, ETI 1178

Display Board Complete — Project ETI 533 July 1975

is also high). After about 10 μseconds delay, due to R16 and C7, the flip-flop changes state and the output of IC6/4 goes high again Thus a pulse is generated which is used as the strobe to transfer whatever number is in the decade counters into the store, and hence, to the display. The strobe pulse also triggers a 15 microsecond monostable, IC7/3, the output of which is delayed by 10 microseconds and inverted by IC7/4. This new pulse acts as a reset pulse for the counters setting them to zero.

As the flip flop has now reverted to its original state the input voltage is reselected and the integrator commences to ramp down again repeating the cycle.

Whilst the input voltage is selected clock pulses are gated into the counter and after about 200 milliseconds (1000 clock pulses each 0.2 mS) the counter will be full. The overflow thus generated from the display changes the state of the flip flop and the reference voltage is selected. The voltage across the integrator (referenced to 5.1 volts) at this instant will be proportional to the input voltage. With the reference supply connected the output of the integrator will rise at a predetermined rate and on crossing the 5.1 volt reference level the strobe and reset pulses are generated, the flip flop toggled and the process started again.

The time taken to bring the integrator back to the reference level is proportional to the input voltage and hence the number in the decade counter at that instant is the required reading of input voltage.

The only components which are required to have good stability, if accuracy is to be maintained, are R12, R13 and ZD1. All other components, provided their short-term stability is good, can be almost any tolerance. The integrator capacitor, for example, can have any value between 0.5 microfarad and 2.0 microfarads without affecting accuracy. However variations in the value of this capacitor will affect the over-range capability. The clock frequency may likewise be altered without affecting accuracy however, if the time of 1000 clock pulses is a multiple of 20 milliseconds the voltmeter will automatically reject 50 Hz ripple on the voltage being measured. This however was not considered of great enough importance to warrant special adjustment of the clock frequency which is preset by R15 and C4.

The reference supply is a 5.1 volt zener diode and a FET connected as a constant current source. The 5.1 volts is used as the common and hence, the 12 volt supply for the voltmeter must be left floating and must not be connected to ground or to any other equipment.

Due to the simplicity of the circuit there are some features of the instrument which are not desirable but do not greatly affect the operation of the instrument. Firstly there is no over-range indication and thus if 15 volts is applied to the 10 volt range the instrument will read 5 volts. The unit remains accurate (except for the first digit which is lost) until the integrator clips on its negative swing (about 250% of full scale). The other point is that if the input voltage is negative the comparator, IC5, will remain high and no further strobe or reset pulses will be generated. The effect of this is to freeze the display at the last number. This is not normally a problem as the display goes to zero if the input is disconnected.

Fig.2. Circuit boards used for the converter.

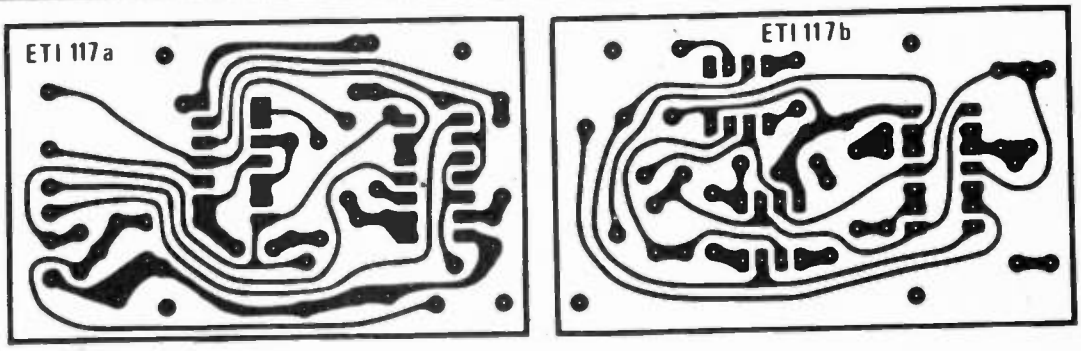


TABLE I

RANGE	VALUE OF R12	
1V	100k	5%*
10V	1M	5%*
100V	10M	5%*
1000V	100M (10 x 10M)	5%*

For multirange meters R12 must be 1% or adjustable.

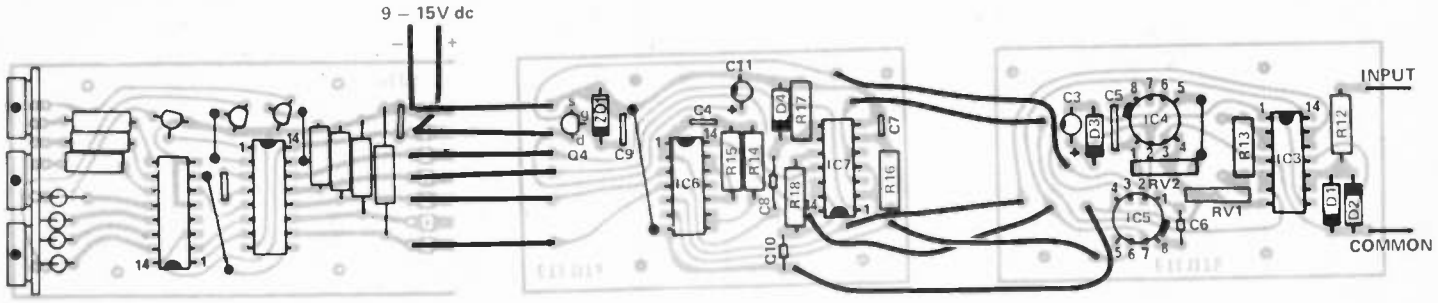


Fig.3. Component overlay of the complete voltmeter.

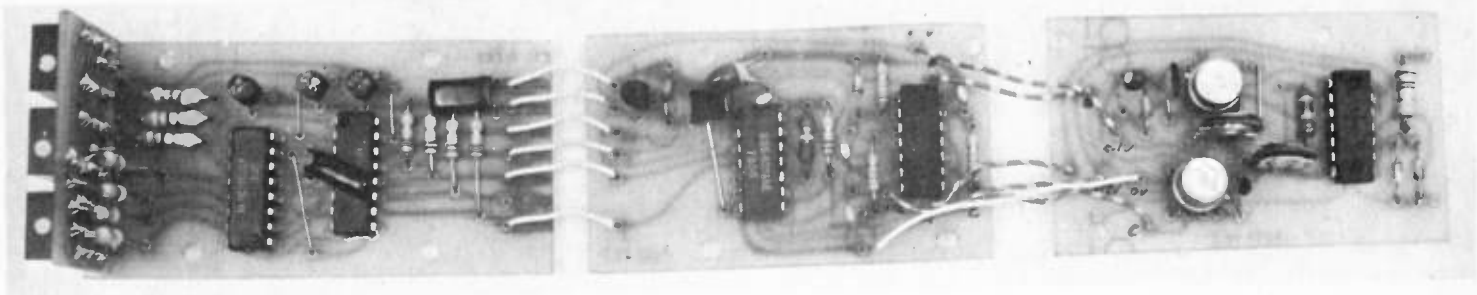


Fig.4. How the voltmeter appears before final assembly.

DIGITAL VOLTMETER

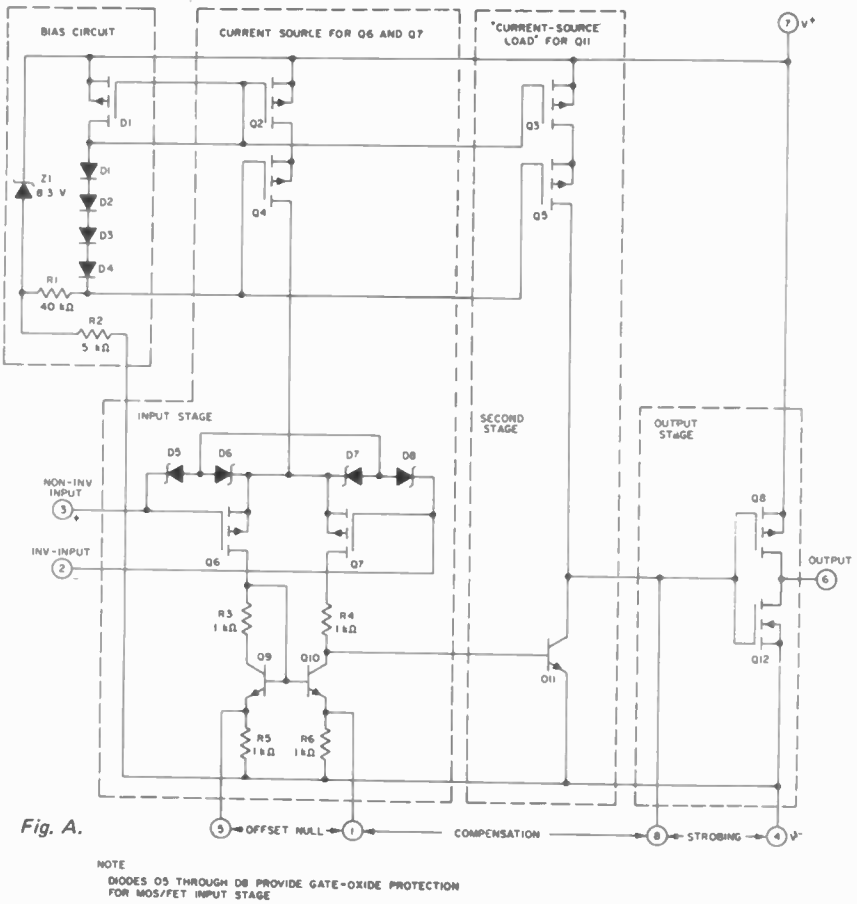


Fig. A.

NOTE

The MC14553 is manufactured by Motorola and distributed by Total Electronics. The MC14511, MC14016, MC14011 and MC14001 are also distributed by Total. However these latter devices are also available from other manufacturers under the numbers 4511, 4016, 4011 and 4001 respectively.

Distributors of these latter devices are Cema, National and AWA (RCA).

THE CA3130 OPERATIONAL AMPLIFIER

For those unfamiliar with this IC we have reproduced the internal circuitry in Fig. A. It is an economical FET input operational amplifier. This IC is unusual as it combines a FET input stage with a bipolar amplifier and a CMOS output stage, all on the one chip! It is a pin for pin equivalent for the 301/741 type of IC and needs a 68 pF capacitor between pins one and eight for compensation. The major differences are a maximum voltage of 16 V between the supply rails (± 8 V) and the extremely high input resistance of 1.5 TΩ (1 500 000 MΩ) and low input current of 5 pA.

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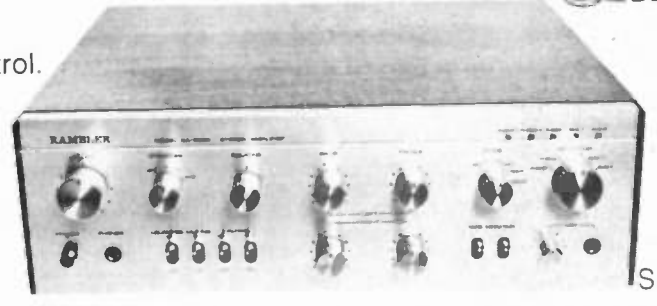

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10" The model B101/10LR is a 10" loudspeaker with a 2" voice coil working within a 10,000 guass magnet structure, total flux 100,000 maxwells. The free air-resonance of the loudspeaker is 25Hz thus making it suitable for a small sealed cabinet of between 1½ and 2 cu.ft.

Efficiency is higher than might be expected from a sealed cabinet and power handling is 20-25 watts r.m.s. **$34.50**

12" The model B122/10LR is a 12" bass speaker featuring a rubber suspension which allows a fundamental resonance of 17Hz in free air. This low-resonance, combined with a 2" voice coil working within a carefully selected magnet structure makes the speaker ideal for a sealed cabinet of about 2 cu.ft. capacity. Efficiency of the B122/10LR is surprisingly high for this type of loading and the speaker is ideal for amplifiers with an output of 20-25watts r.m.s. per channel at 8ohms. **$39.50**

12" The model B122/12LR, like the B122/10LR described above, is also suitable for sealed cabinets but because of its more powerful magnet structure a volume of about 3 cu.ft. is required to ensure the speaker gives its optimum performance. **$49.50**

15" The Fane model B152/12LR is a 15" bass driver with a fundamental resonance of 15Hz in free-air. Once again a sealed cabinet provides ideal loading for this unit and the volume can be varied from 3 to 5 cu.ft. The performance in 5 cu.ft. is particularly outstanding as the resonance is kept in the region of 30Hz. This results in firm, non-resonant bass without any of the "boxiness" often associated with conventional speakers. Efficiency is reasonably high and power-handling is up to 30watts r.m.s. at 8ohms. **$59**

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CHALLENGE FLH-1

10" Bass, 5" mid, 1" dome. Cabinet size: 25" (H) x 14½" (W) 12½" (D) frequency response: 30 — 20 kHz; power rating: suitable for amplifiers with a power output up to 30 watts rms per channel at 8 ohms, 1000Hz.

price: **$269** per pair

CHALLENGE FLH-2

12" bass, 5" mid, 1" dome. Cabinet size: 29" (H) x 17½" (W) x 12" (D). frequency response: 25 — 20 kHz. power rating: suitable for amplifiers with a power output up to 30 watts rms per channel at 8 ohms, 1000 Hz.

price: **$299** per pair

CHALLENGE FLH-3

15" bass, 5" mid, 1" dome. Cabinet size: 32½" (H) x 20½" (W) x 15 3/4" (D). frequency response: 20 — 20 kHz. power rating: suitable for amplifiers with a power output up to 35 watts r.m.s. per channel at 8 ohms, 1000 Hz.

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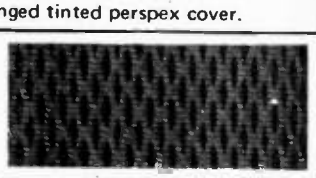

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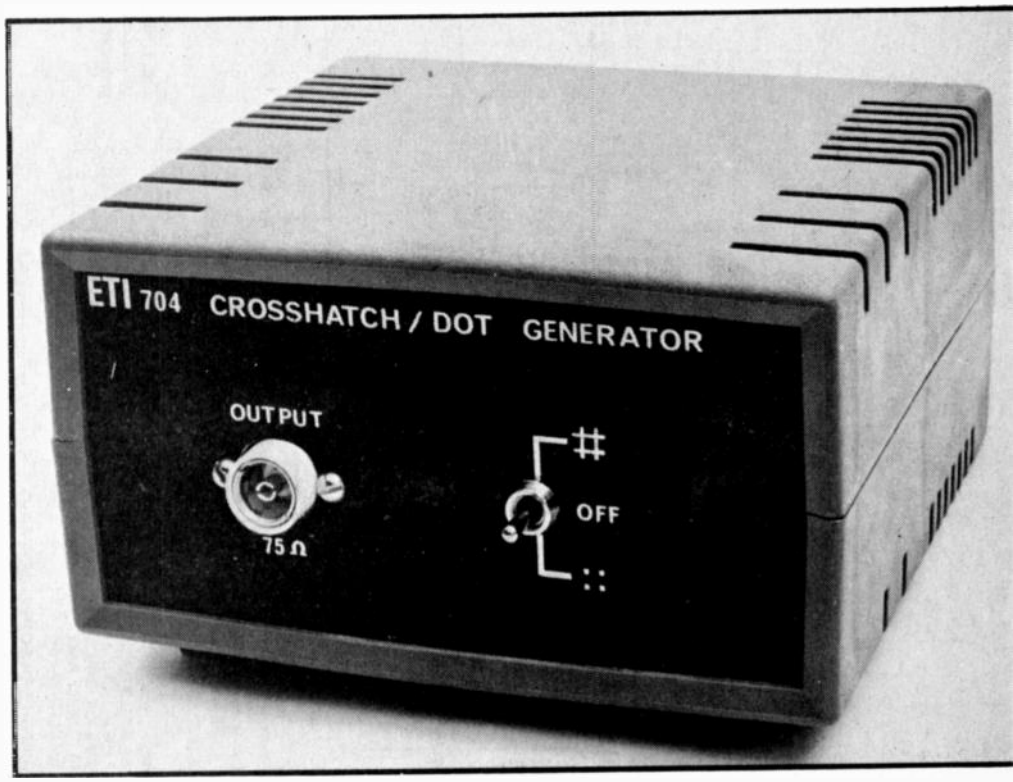
PROJECT 704

CROSSHATCH/DOT GENERATOR

Inexpensive unit for converging colour TV set.



THE COLOUR television picture is created in the receiver picture tube by three separate electron guns — one each for red, green and blue. As these guns cannot be in the same physical position they need to be converged into one spot on the screen.

The process of converging at the centre of the screen is called static convergence and is performed by magnets on the yoke assembly.

However, the screen of the picture tube is not everywhere coincident with the deflection plane and this causes errors when the beam is deflected away from centre. These deflection errors are corrected electronically by 12 or more controls and the process is known as dynamic convergence. The adjustment procedure being covered in the "Understanding Colour TV" course elsewhere in this issue.

An important part of the process is the use of a crosshatch generator to provide horizontal and vertical lines on the screen. Using the generator, the convergence errors are immediately apparent and the controls on the set are usually labelled with the effect each has on a crosshatch pattern.

In addition to setting up convergence the generator pattern may also be used to set up horizontal and vertical linearity and to orientate the deflection yoke coils on both black and white and colour sets.

Most of the inexpensive pattern generators, which are currently available, produce a video waveform, which must be injected into the correct place in the TV, and require a synchronizing signal from the TV set. Such generators are thus fiddly things to use.

The ETI 704 generator produces a combined horizontal and vertical-sync waveform and this, together with the crosshatch video, is modulated onto a carrier frequency operating in VHF channel 6 (175.25 to 180.75 MHz). Thus to use the generator one simply attaches it to the antenna terminals and selects channel 6.

CONSTRUCTION

Coil L1 should be constructed from 24 gauge B&S enamelled copper wire by winding 6 turns, close spaced, around a former, such as a knitting needle, so that the finished outside diameter of the coil is about 5 mm.

Coil L2 is constructed by winding 4 turns of 24 gauge B&S enamelled copper onto a miniature Neosid former which is fitted with a VHF slug and an aluminium can. Fit links to the board in accordance with Fig. 2 and then the above coils and other components can be assembled to the printed circuit board with the aid of the component overlay. Take particular care with the orientation of ICs and other polarized components. Assemble the CMOS devices to the board last of all and handle them as little as possible. Avoid touching the pins.

Assemble the output socket and switch to the front panel and connect the output of the module to the socket by means of a short length of 75 ohm coaxial cable. The connections to the switch and battery may then be made with ordinary hookup wire.

SETTING UP

Connect the unit to the antenna terminals of a television receiver and select Channel 6. Adjust the coil L2 to obtain the strongest signal on the screen. (This may be totally out of sync at this stage.)

Now adjust RV2 as you would a normal horizontal sync control to obtain vertical lines and then adjust RV1 for vertical sync. Then readjust L2 for clearest picture and make small adjustments to RV2 and RV1 to obtain the most stable crosshatch.

Finally adjust brightness and contrast of the set to obtain white lines on a black background. These adjustments need only be made on initial set up and henceforth the generator is simply attached to the antenna terminals and switched on.

CROSS HATCH-DOT GENERATOR

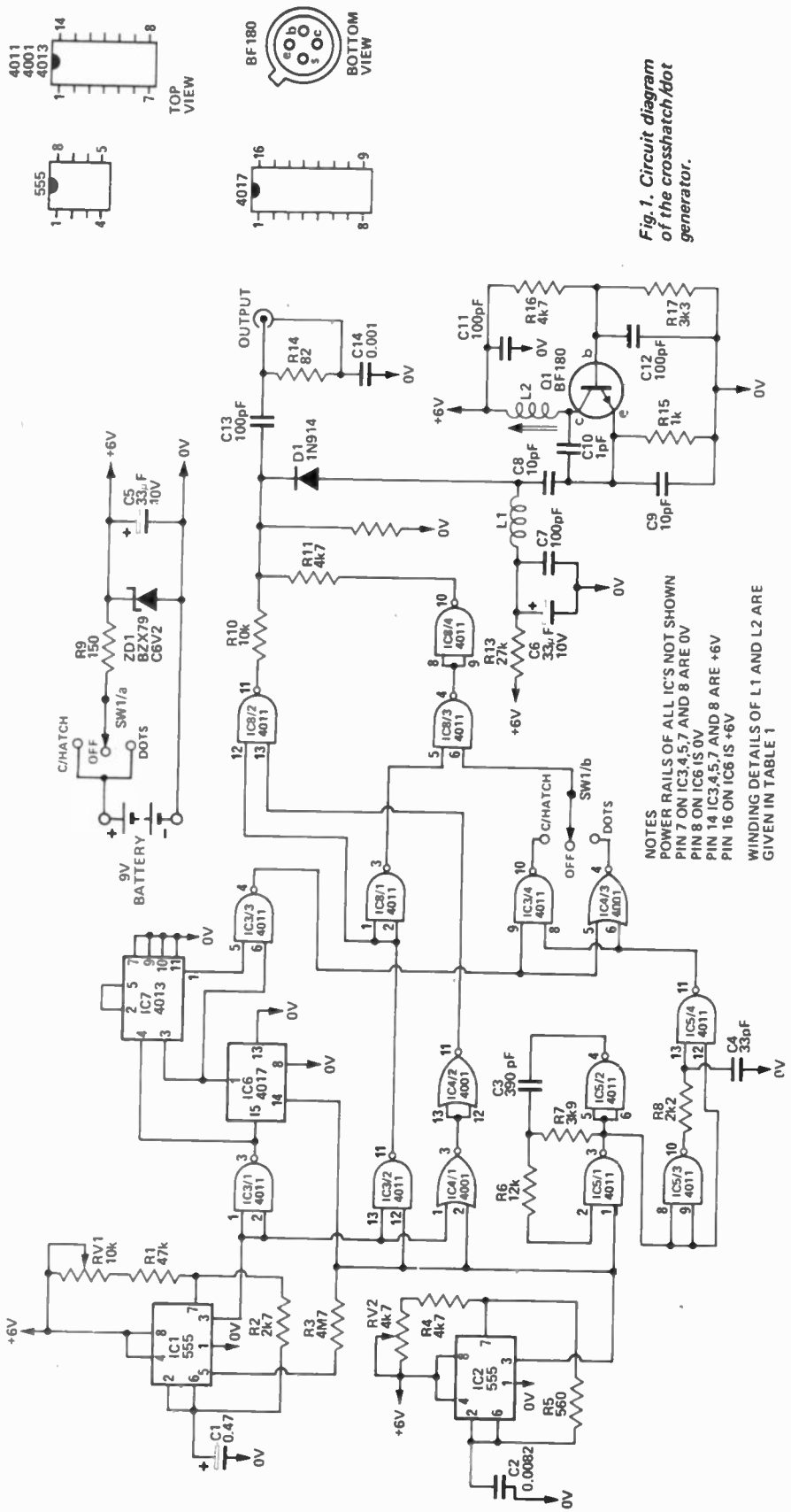


Fig. 1. Circuit diagram of the crosshatch/dot generator.

HOW IT WORKS – ETI 704

Two 555 timers, IC1 and IC2, are used as the frame and line sync pulse generators respectively. Integrated circuit IC1 generates one millisecond wide pulses at 20 millisecond intervals (50 Hz) and IC2 generates five microsecond wide pulses at 64 microsecond intervals (15625 Hz). Light synchronization of IC1 to IC2 is achieved by means of R3. Thus both oscillators have to be close to the correct frequency before locking will occur.

Gates IC3/2, IC4/1, IC4/2 and IC8/2 form an exclusive-OR function on these two sync-pulse trains to produce a combined sync-pulse train at the output of IC8/2.

At the end of each line-sync pulse an oscillator, formed by IC5/1 and 2 is gated on, and produces a train of pulses at approximately 240 kHz. The leading edge of each of these pulses triggers monostable IC5/3 and IC5/4 such that a 40 nanosecond wide pulse is generated. Thus approximately 14 40 nanosecond wide pulses are generated between successive line sync pulses. These pulses produce the vertical lines of the crosshatch.

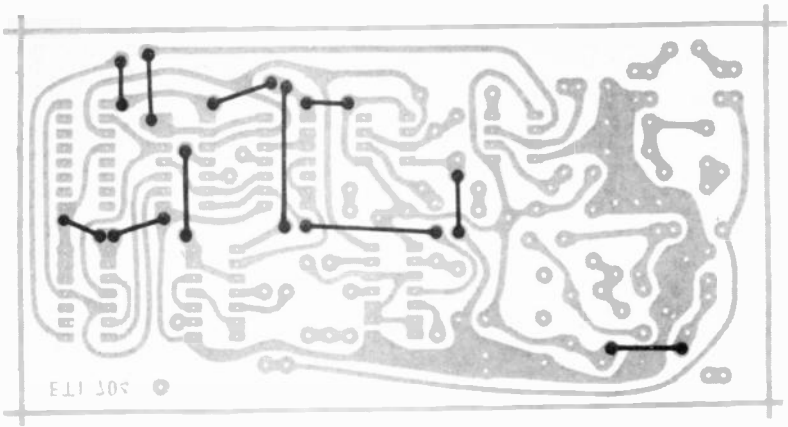
At the end of each frame sync pulse decade counter IC6 is enabled. This is a CMOS Johnson decade counter which provides an output at pin 1 every tenth line sync pulse commencing from the 5th pulse after the counter is enabled. This output is divided by two by IC7 and the output of IC3/3 is therefore low for the duration of every twentieth line period. This output is the horizontal lines of the crosshatch.

The vertical and horizontal crosshatch signals are NANDed and NORed by IC3/4 and IC4/3 respectively to provide either crosshatch or dots as selected by SW1/b. These outputs are inhibited during the line and frame sync periods via IC3/2, IC8/1 and IC8/3. The output from IC8/4 is thus the composite crosshatch video signal.

The composite sync from IC8/2 and the composite video from IC8/4 are summed into R12 by R10 and R11 and form a combined sync and video waveform which modulates the RF from oscillator Q1 via diode D1.

Transistor Q1 and its associated components form an oscillator which runs at around 180 MHz. The output from the generator is therefore a modulated RF signal at channel 6 frequency which is adjustable by tuning coil L2.

The unit is powered from a 9 volt battery which is only on when dots or crosshatch are selected. The 9 volts is regulated down to 6 volts by means of R9 and zener diode ZD1.



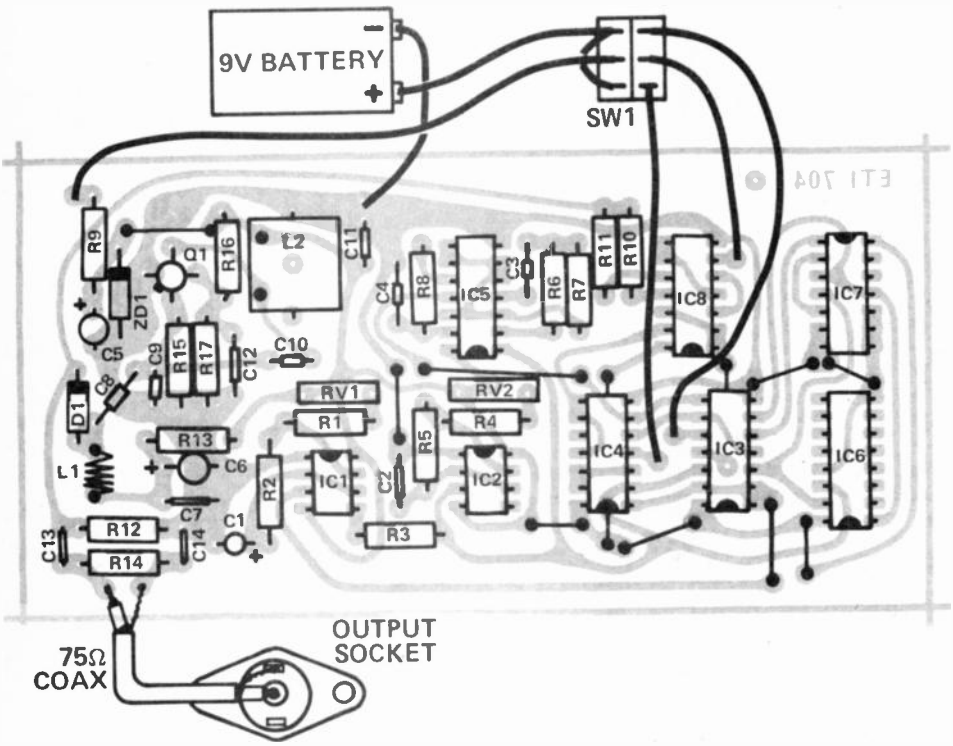


Fig.3. Component overlay.

PARTS LIST – ETI704

R1 Resistor 47k ½W 5%
R2 " 2k7 " "
R3 " 4M7 " "
R4 " 4k7 " "
R5 " 560 " "

R6 " 12k " "
R7 " 3k9 " "
R8 " 2k2 " "
R9 " 150 " "
R10 " 10k " "

R11 " 4k7 " "
R12 " 330 " "
R13 " 27k " "
R14 " 82 " "
R15 " 1k " "

R16 " 4k7 " "
R17 " 3k3 " "

RV1 Potentiometer 10k Trim type
RV2 " 4k7 " "

C1 Capacitor 0.47µF TAG Tantalum
C2 " 0.0082µF polyester
C3 " 390pF ceramic
C4 " 33pF "
C5 " 33µF 10V electro
C6 " 33µF 10V

C7 " 100pF ceramic
C8 " 10pF ceramic
C9 " 10pf ceramic
C10 " 1pF ceramic
C11 " 100pF ceramic
C12 " 100pF ceramic

ZD1 Zener Diode BZX79C6V2
D1 Diode 2N914

Q1 Transistor BF180

IC1,2 Integrated Circuit NE555
IC3,5,8 " " 4011 (CMOS)
IC4 " " 4001 (CMOS)
IC6 " " 4017 (CMOS)
IC7 " " 4013 (CMOS)

L1 Inductor see text
L2 Inductor see text

PC Board ETI 704

DPDT with centre off toggle switch
75ohm socket
9V battery and connector
Box PC1 or similar (A&R sonar)

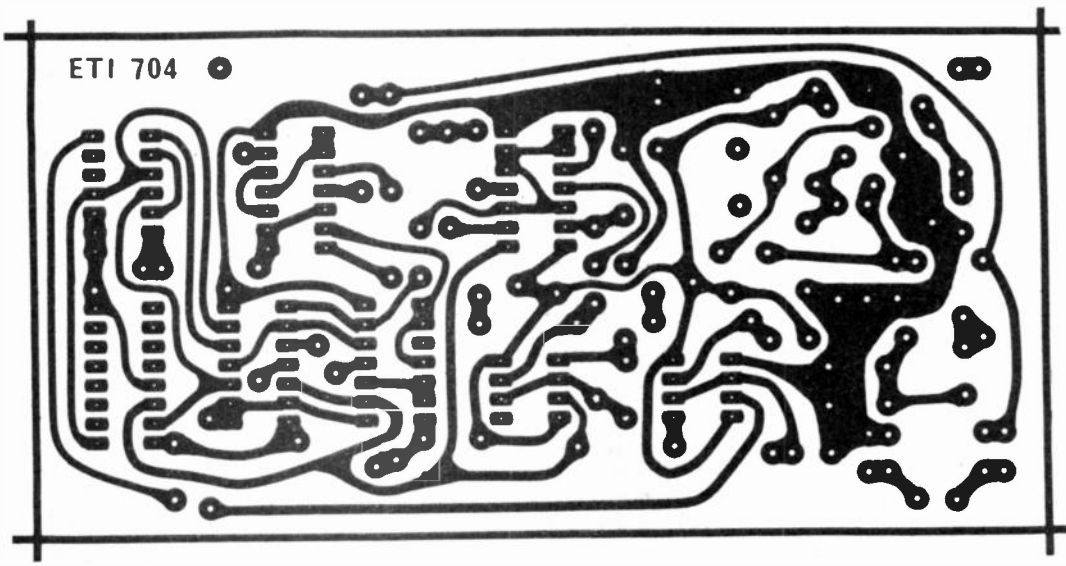
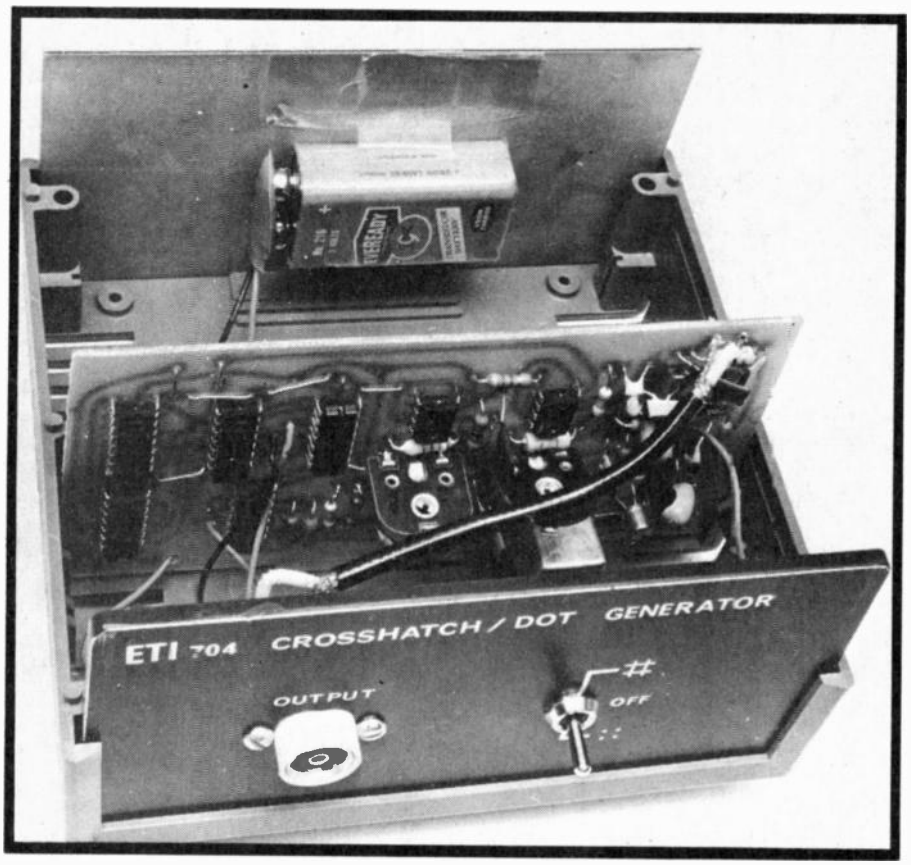


Fig.4. Printed circuit board layout.

CROSSHATCH/DOT GENERATOR



Internal view of the crosshatch generator showing how the board is mounted.

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Memory Kit 2102 **$8.95**

MM2102 1024 bit static RAM Build yourself add on memory. The 2102 is an incredible device featuring single positive 5V supply, DTL/TTL compatible inputs and outputs, static operation (No clocks or refreshing required) and low power (150 nw typical). MM2102 complete with 16 pin socket, data sheets and application notes.

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LM301A op Amp	mDIP	.70
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LM340 Series 1A Positive Regulator (Specify voltage required 5, 6, 8, 12, 15, 18, 24)	T0220	2.25
LM380 2W Audio Amp	DIP	1.75
LM382 Low Noise Dual pre amp	DIP	2.00
NE540L Power Drive Amplifier	T018	2.95
NE555 Timer	mDIP	.95
NE556 Dual 555 Timer	DIP	1.80
NE565 Phase Locked Loop	DIP	2.50
NE566 Function Generator	mDIP	2.75
NE567 Tone Decoder	mDIP	3.50
LM723C Voltage Regulator	DIP	1.00
LM741C Op Amp	mDIP	.65
LM3900 Quad Amplifier	DIP	1.10

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7404	.35	7474	.90
7405	.35	7475	1.00
7408	.35	7476	.80
7409	.35	7480	1.70
7410	.35	7482	1.80
7413	.85	7483	1.40
7420	.35	7486	.60
7430	.35	7490	.80
7437	.60	7491	1.20
7440	.35	7492	.80
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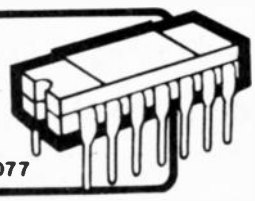

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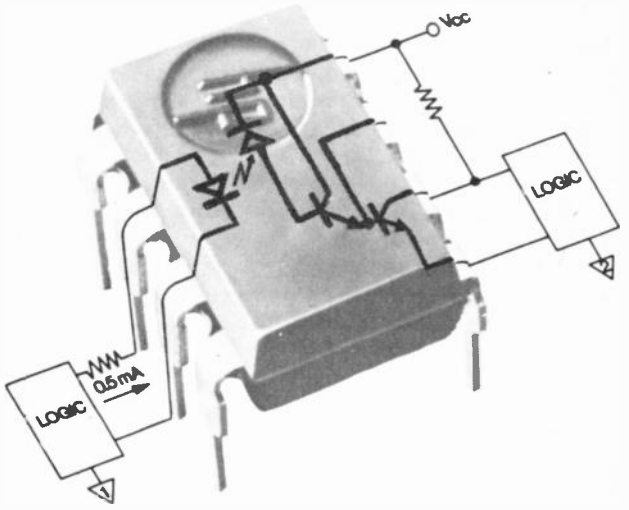

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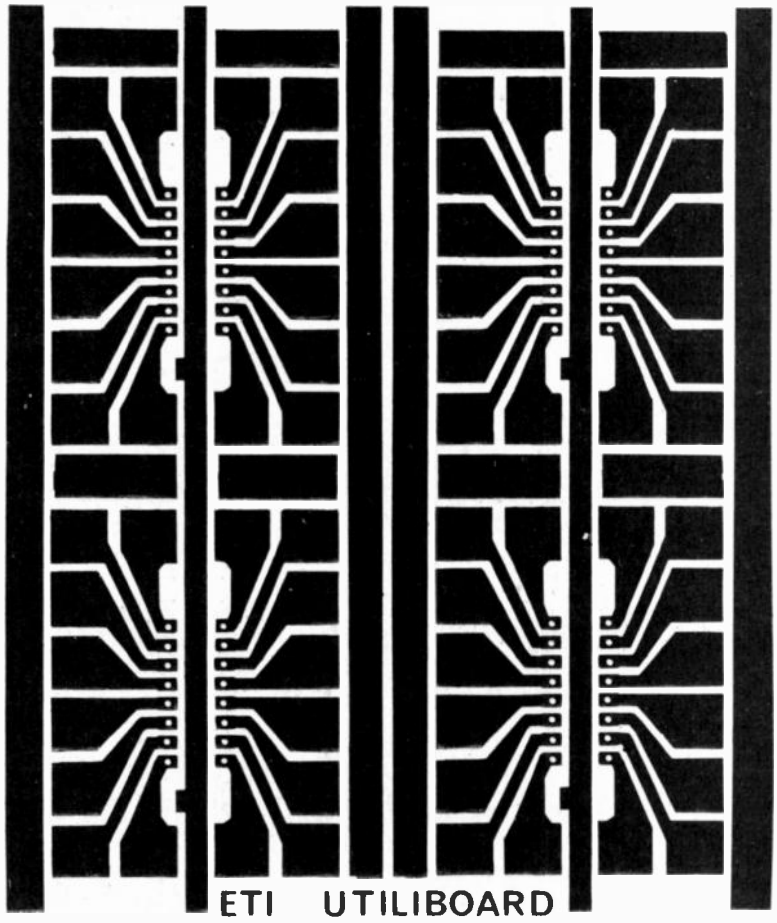
ETI UTILIBOARD



A versatile board for experimenters.

THE CONSTRUCTION of any project is always simplified by the use of a proper printed-circuit board. The neat and tidy appearance of a well made printed-circuit board, full of components, gives a professional look and is most satisfying. There are however some drawbacks. Each design requires a different board and you need a reasonable degree of knowhow and time to make your own boards.

Quite often it may be felt that the cost of a ready made printed circuit board, for a simple project, is unwarranted or it is just too much of a hassle to make a trip half-way across a city to obtain one.

There are several alternatives, such as Veroboard and Matrix board, and many people are now using specially designed general purpose boards which are specifically made for versatility in the construction of general circuitry.

This latter approach has several advantages. The finished board looks neat and professional, fairly-complex circuits can be quickly assembled, and the large pads available allow experimental circuits to be debugged with ease. Such boards allow the builder to change the circuit of a particular project to suit his personal needs or, to use physically-larger components (eg junk-box parts) than those specified.

There are many of these boards available but many of them are quite expensive and some are lacking in versatility. Hence we decided to design our own board for use in simple projects. We have in fact used the board for the code-practice oscillator described elsewhere in this issue.

USING THE UTILIBOARD

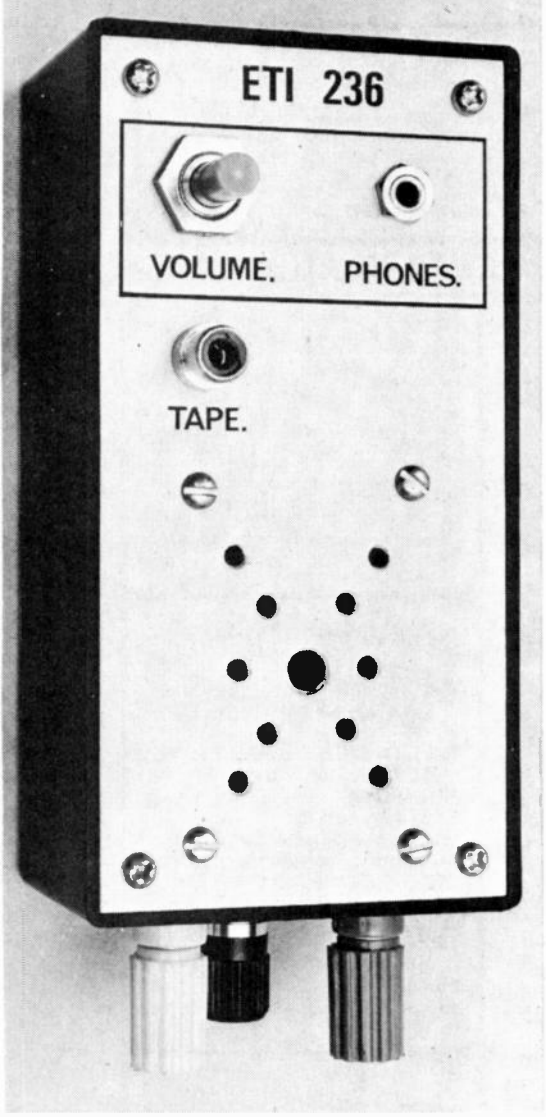
On conventional printed-circuit boards the components are always mounted on the non-copper side of the board and all our previous overlays have shown components in this way. However in experimental circuits it is more convenient to mount the components on the copper side. This allows components to be added, or shifted, without having to continually turn the board over. The code-practice oscillator is in fact built this way.

Note that the board consists of four individual 16-pin dual-in-line IC pad-groups, each pin of which has associated with it a large pad to which several component leads can be soldered without the need for holes.

The broad lines through the centre of the pads, and on either side, are suitable for supply or earth connections. They are continuous so that the group of pads can be used together or the board may be sawn up into single or 2-way sections as required.

The broad line up the centre has indicator marks which point to pin 1 of an IC when it is mounted on the non-copper side of the board and the dot marker on the IC points to indicator-mark end of the board. Note that this central line is broad enough so that individual pads may be connected to it by solder bridging.

Of course any of eight, 14 or 16 pin DIL IC's can be mounted as required, or, discrete transistors may be inserted into appropriate holes. You will find this board extremely versatile and easy to use. ●



PROJECT 236

CODE PRACTICE OSCILLATOR

Essential equipment for gaining Novice Licence

NOW THAT the Novice Licence has finally been introduced, many young readers will want to learn the Morse Code. This is so because one of the Novice Licence requirements is the ability to send and receive Morse at the rate of five words per minute.

The first step in learning Morse is to obtain a means of practicing the code and the ETI 236 Code-practice set is specifically designed for that purpose. It may be used for practicing alone or with a friend. Practice with a friend is strongly advised as it is not much use knowing the code but transmitting it in a way that no-one else can understand.

An excellent way of learning is to purchase the "Archer" code record or cassette. These are available from any Tandy store and take you step by step through from simple character-code groups and gradually extends to include all characters. Both tape and record offer speeds of from 7 to 15 words per minute and, of course, these speeds will be entirely adequate to obtain the requisite 5 words-per-minute.

An important aid to learning is to memorise the way a code group sounds. For example the letter A is represented by the code group ●—, this should be learned as the rhythmic sound didah — not as dot dash, or even as dit dah!

Finally there is no substitute for practice. Try to do at least half an hour to an hour a day. Don't worry about speed, this will come naturally, concentrate mainly on accuracy.

CONSTRUCTION

The oscillator is built onto one section of the ETI experimenter board as shown in the component overlay diagram. (This board is shown in detail on page 41 of this issue). Take particular care to correctly orientate the IC, the electrolytic capacitor and the diode. The whole unit was built into a 100 x 165 x 300 mm plastic box which had an aluminium lid. Almost any box will do of course, but make sure that it is large enough to house the speaker you intend to use. We mounted our small 50 mm speaker to the back of the aluminium front panel.

Drill holes in the end of the box, for J1, 2 and 3, and fit them. Drill holes to mount the speaker, the phone and tape sockets and RV1 on the front panel. Note that we used two of the screws which secured the speaker to also secure the printed circuit board and that some holes must be provided for the sound from the speaker. Mount the components to the front panel and the printed circuit board and interconnect them as shown in Fig. 2. Note that the aluminium panel is connected to zero volts via the phone socket, the tape socket and the screw supporting the board, and that this screw is part of the connection between pin one of IC1 and zero volts. The battery is held into the bottom of the box by a piece of adhesive tape.

Practically any speaker may be used that fits your box. It is recommended, however, that 3 or 4 ohm speakers not be used unless the supply battery is changed to 6 volts instead of 9 thus not exceeding the output stage rating of the IC.

The International Morse Code.

A	●—	N	—●	1	●————	=	—●●●—
B	—●●●	O	———	2	●●———	:	———●●●
C	—●—●	P	●——●	3	●●●——	;	—●—●—●
D	—●●	Q	——●—	4	●●●●—	( )	—●——●—
E	●	R	●—●	5	●●●●●	/	—●●—●
F	●●—●	S	●●●	6	—●●●●	Error	●●●●●●●●
G	——●	T	—	7	——●●●	Wait	●—●●●
H	●●●●	U	●●—	8	———●●	End of message	
I	●●	V	●●●—	9	————●		●—●—●
J	●———	W	●——	0	—————	Invitation to transmit	
K	—●—	X	—●●—	.	●—●—●—		—●—
L	●—●●	Y	—●——	,	——●●——	End of work	
M	——	Z	——●●	?	●●——●●		●●●—●—

HOW IT WORKS – ETI 236

The oscillator is constructed around a 555 integrated-circuit timing chip. To better understand how we make this chip oscillate we must refer to the block diagram of the chip, Fig. 3. The two circuit blocks labelled as comparators each give either full output or zero output depending on which of the two inputs is greater than the other.

One of the inputs of each comparator in the 555 is connected to a voltage divider consisting of 3 equal-value resistors, connected in series between Vcc and zero volts. Thus when the voltage at pin 2 rises, so that it exceeds one third of Vcc, comparator 1 will change state. Likewise comparator 2 will change state when the voltage at pin 6 rises above two thirds of Vcc. The outputs of both comparators will of course revert to their original states when the voltages at pins 2 and 6 fall below the thresholds set by the divider chain.

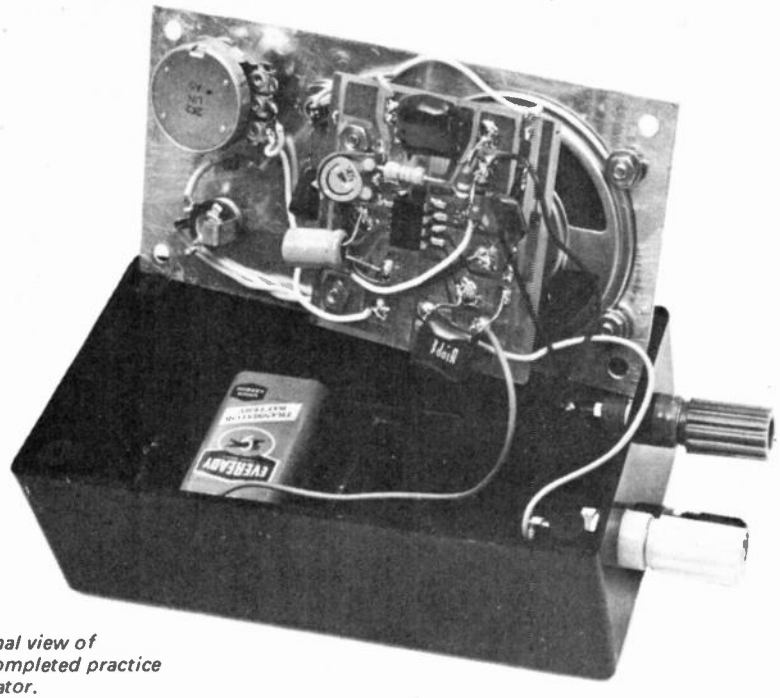
Both comparator outputs are fed to a flip flop which is forced into one state when the voltage at pin 2 falls below 1/3 Vcc and into the other state when the voltage on pin 6 rises above 2/3 Vcc. The output of the flip flop drives both a transistor and a high-level output stage in such a way that the transistor is turned off when the voltage at pin 2 is below 1/3 of Vcc. and on only when the voltage at pin 6 exceeds 2/3 of Vcc.

In our oscillator pin 2 and 6 are connected together and to capacitor C3 which charges via RV2, R3 and R2. When the voltage across C3 goes above 2/3 Vcc comparator 2 and the flip flop will change state turning on the discharge transistor. Capacitor C3 will be discharged (via RV2, R3 and pin 7) and when its voltage falls below 1/3 Vcc comparator 1 will change the state of the flip flop turning off the discharge transistor thus allowing C3 to charge again.

Thus the voltage across C3 will alternate between 1/3 and 2/3 Vcc with a frequency which depends on the values of RV2, R3, R2 and C3. With each change in state of the flip flop the output stage also changes state and since this is a relatively high current output we can extract sufficient power to drive a loudspeaker directly. Volume is controlled by RV1 and a phono socket is provided for private headphone listening.

Capacitor C2 provides filtering for the reference divider via pin 5 and an output for a tape recorder is taken from pin 7 and filtered and attenuated by R4 and C5 to produce a sawtooth output. Diode D1 is used to protect the oscillator from reversed battery connections when the unit is connected to other units operating on different supply voltages over a two wire circuit. If you intend to use your oscillator by itself only D1 may be omitted.

The Morse key is a normally-off switch. When it is pressed the Vcc circuit is completed and the oscillator functions. An ON/OFF switch is not included as power is only drawn when the Morse key is depressed.



Internal view of the completed practice oscillator.

PARTS LIST – ETI 236

R1 Resistor 10ohm ½W 5%
R2 " 10k " "
R3 " 33k " "
R4 " 390k " "

RV1 Potentiometer 2.2k
RV2 Potentiometer 50k trim type

C1 Capacitor 10µF 16 volt electrolytic
C2 " 0.1µF polyester
C3 " 0.022µF polyester
C4 " 0.1 µF "
C5 " 0.033µF "

D1 Diode EM401 or similar
IC1 Integrated Circuit NE555
Speaker 50 or 75 mm 8 ohm (to suit case).
J1,2,3 Binding posts 3 mm. RCA tape socket, 3mm jack socket, 9 volt battery, box to suit.

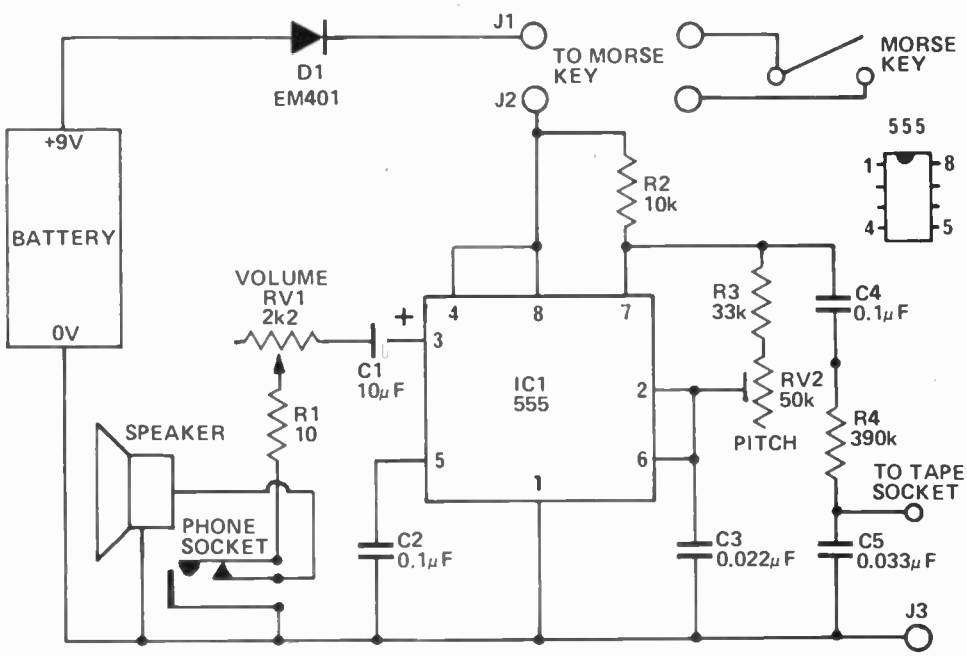


Fig. 1. Circuit diagram of the code practice oscillator.

CODE PRACTICE OSCILLATOR

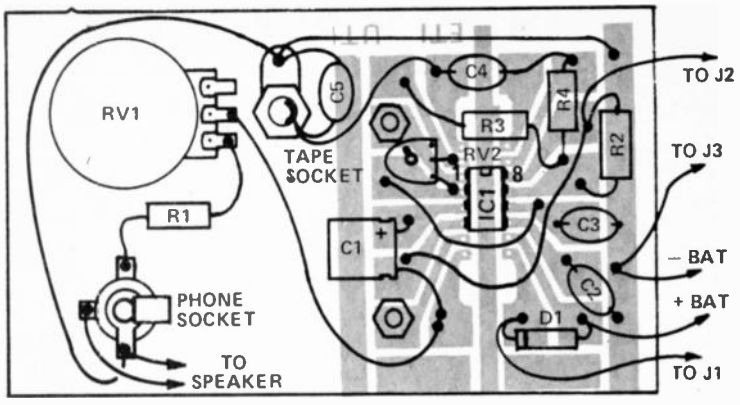


Fig. 2. Component overlay and interconnections.

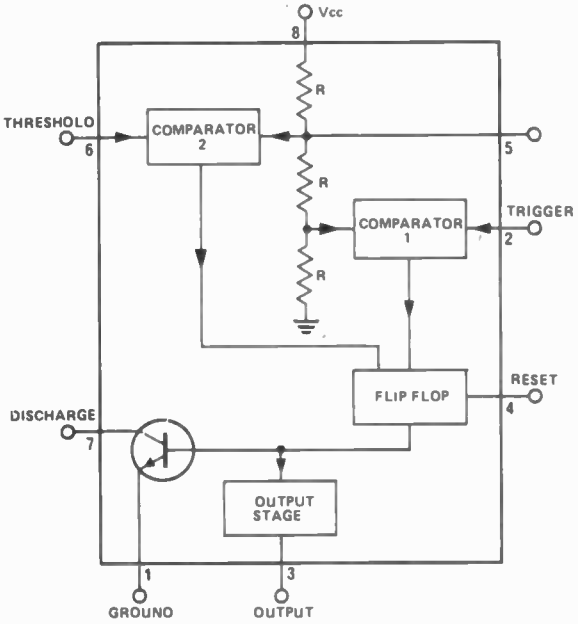


Fig. 3. Internal arrangement of the NE 555 timer IC.

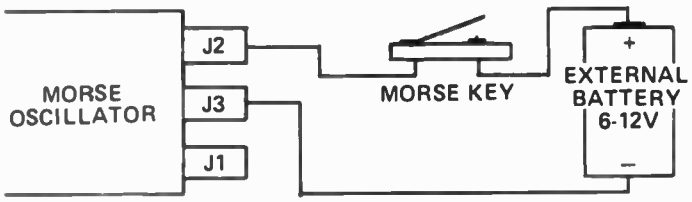


Fig. 4. Method of connecting an external battery to operate the oscillator.

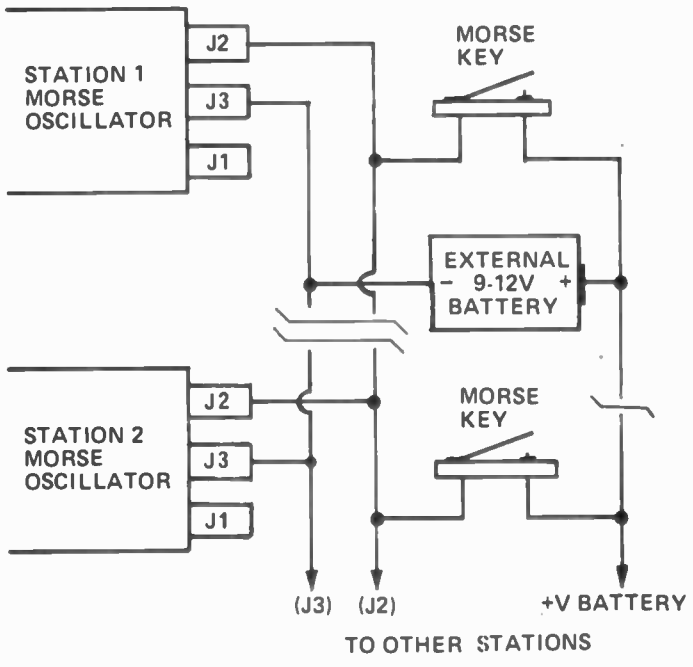


Fig. 5. For two way communication with a friend two oscillators are required connected as shown.

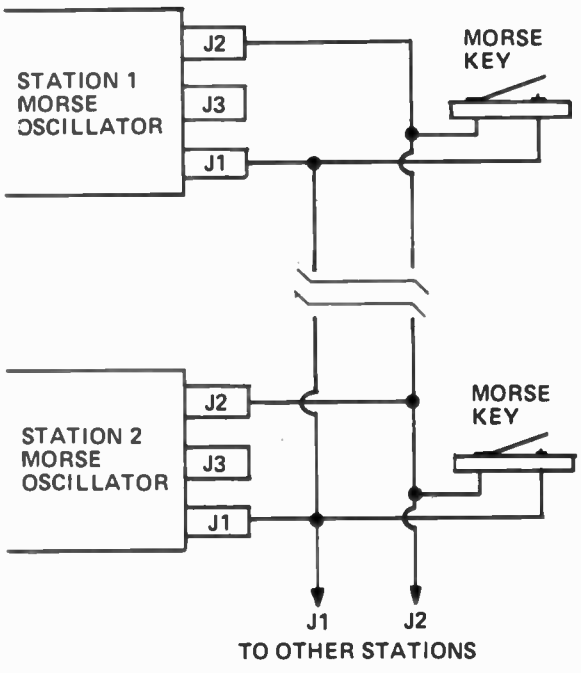
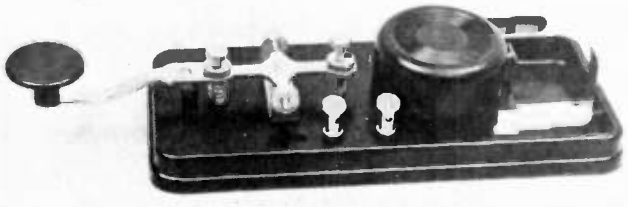
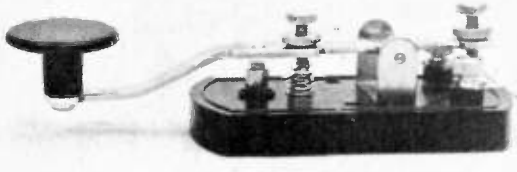


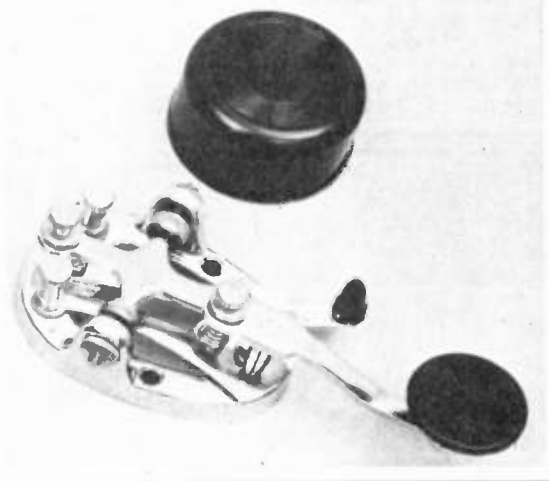
Fig. 6. Two way communication system using an external battery.

A range of Morse keys, buzzers and oscillators is available from many kit part suppliers.

▲
A code practice record or tape (available from Tandy Electronics) is a valuable aid to proper code transmission.







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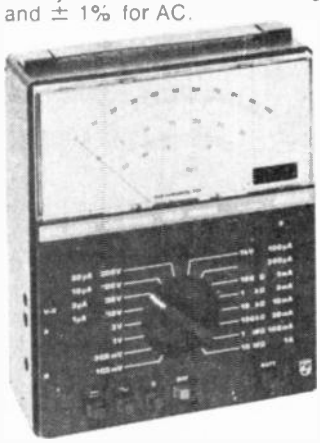

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INTERNATIONAL 3600 SYNTHESIZER

Constructing the case; and inter-unit wiring.

eti PROJECT

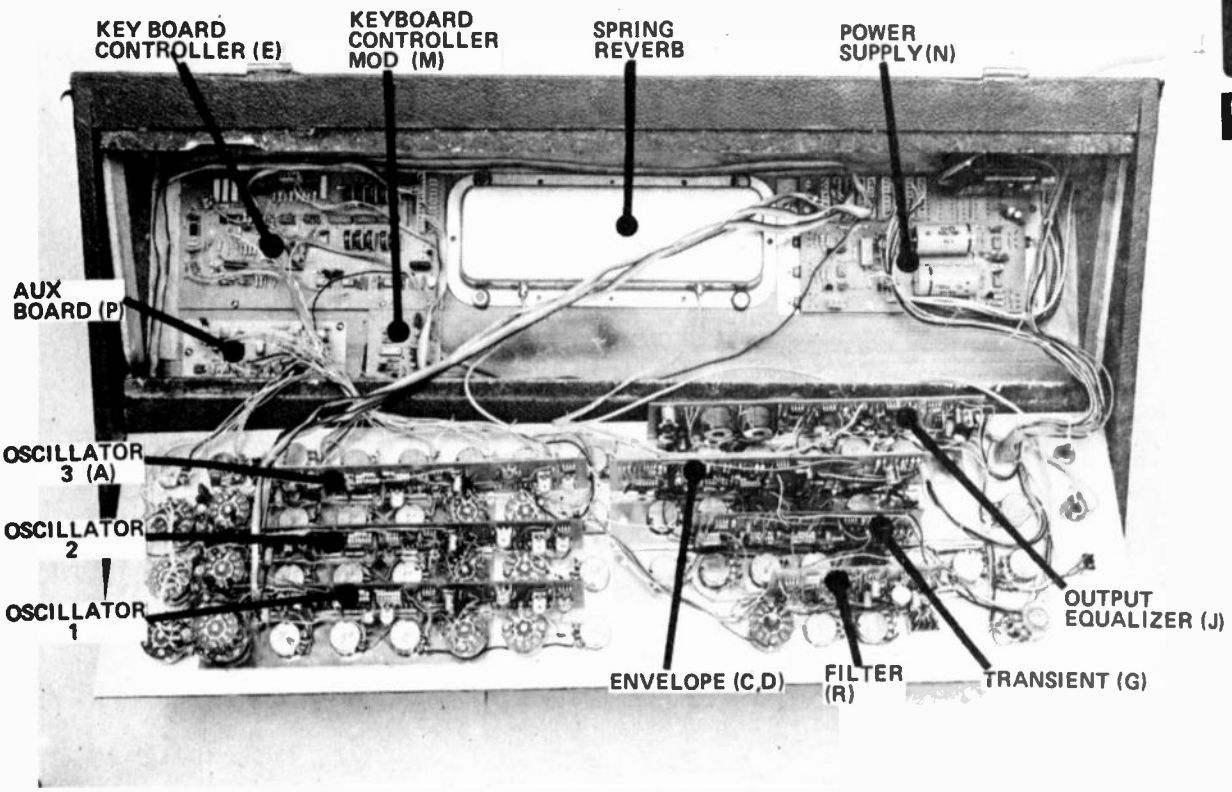


Fig. 1. Assembly of the modules within the box.

WE CONTINUE this month with details of the final four modules to be constructed. Details of cabinet assembly and interwiring of the synthesizer are also given.

TRANSIENT GENERATOR

Full details of the transient generator can be found in the February '74 issue of Electronics Today International. Note that a modification, published in July of 1974, reduced the value of R21 to 100 k.

In the 3600 synthesizer the exponential converter and the external trigger are not used. The following components are therefore not required.

R1, 2, 3, 5, 6, 9, 10 and 14.
Q1, Q3, D2, IC2.
C5, C6, RV3, RV4, SW1 and SW3.

Link points 13 and 14 together and take the trigger from the keyboard to point 5. It will be found that triggering reliability is improved by increasing C3 to 0.0068 μF.

The mounting bracket will need to be trimmed slightly in order to clear the level potentiometer of oscillator 2.

ENVELOPE CONTROL

This module was described in the January '74 issue and a modification was published in July of '74.

In the 3600 unit the external trigger is not used and R17, 18, Q3 and SW2 are therefore deleted. The trigger from the keyboard now goes directly to the hole number 13.

Increasing the value of C7 to 0.0068 μF makes triggering more reliable. The mounting bracket of this unit will also have to be trimmed in order to clear the level potentiometer of oscillator 3.

OUTPUT-EQUALIZER

This module was described in the April 1974 issue. In the 3600 unit the joystick and exponential converter are not used and the following components are therefore deleted.

IC7-10, Q1, Q2, RV10-15.
R23-32 and C18-22.

Note that the positions of front panel controls have been changed and connection details are now given in Fig 2 & 3. A different mounting bracket is also used being now the same as that used for the envelope control.

POWER SUPPLY

This module was described in the December '73 issue and modifications were published in the January and July '74 issues. For the 3600 unit only nine outlets are required.

KEYBOARD

The keyboard described for the 4600 cannot be used in the 3600 because of lack of space. A Kimber Allen keyboard was used in our prototype and these are available from JAYCAR Pty Ltd.

CONSTRUCTION

The general assembly of the box can be seen from the photographs and from Fig. 7. The individual pieces are shown in Fig. 8. Note that the

INTERNATIONAL 3600 SYNTHESIZER

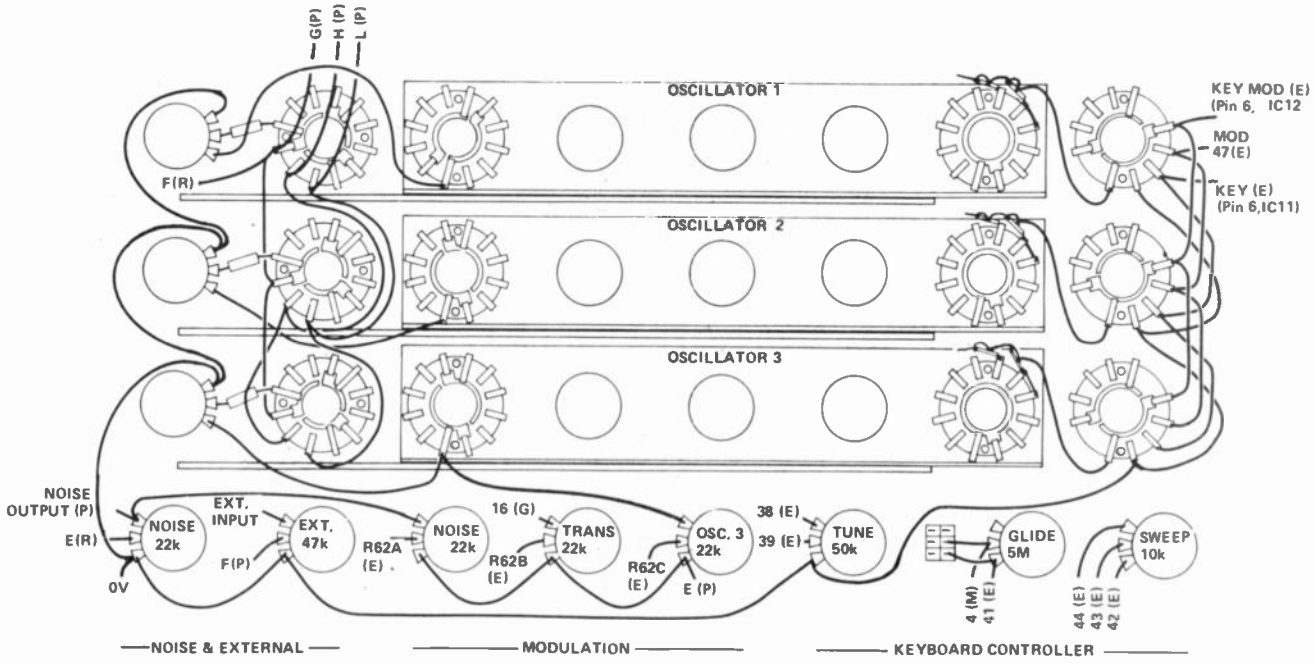


Fig. 2. Front panel interconnections – oscillator section.

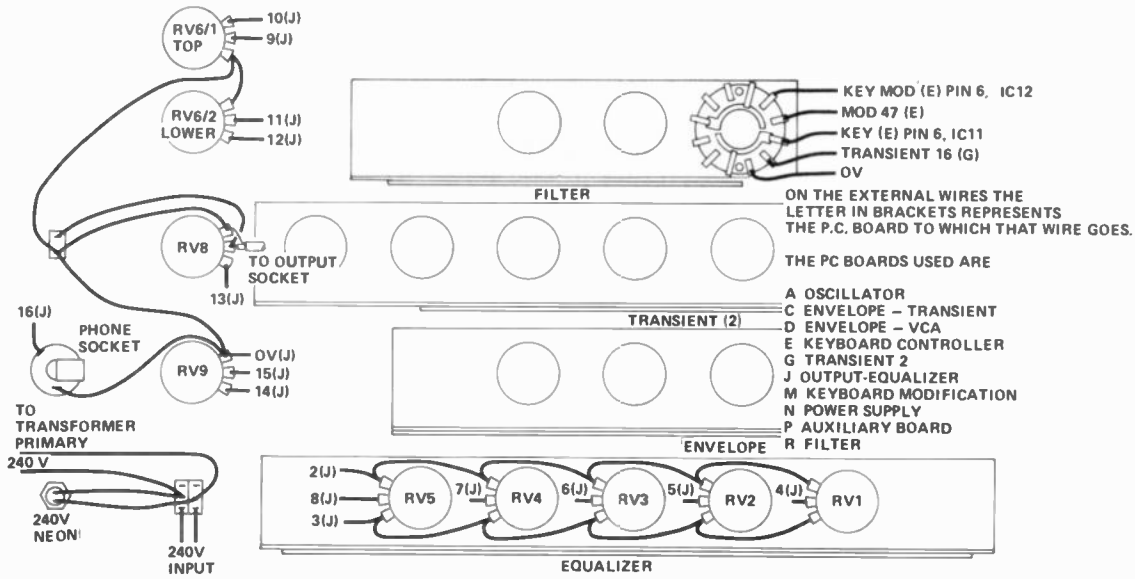
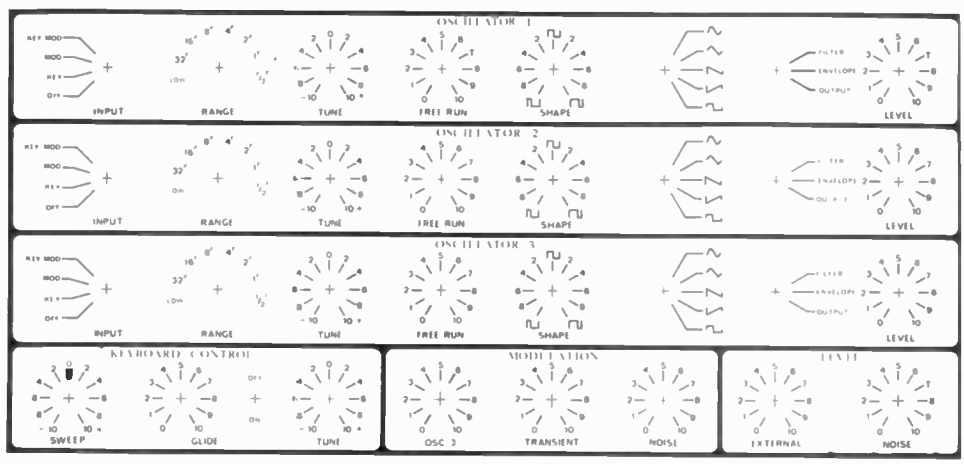


Fig. 3. Front panel interconnections – filter section.

dimensions given are for a timber thickness of 12 mm and for construction using all butt joints. Allowances will have to be made if other timber thicknesses or mitred joints are used. It is advisable to use small pieces of wood to strengthen corners.

We hinged the lid using dismountable hinges, so that the lid could be detached, and used suitcase-type catches on each side, towards the front, to hold the box closed. A handle is mounted on the front for carrying the unit. It is recommended that a strip of foam plastic be glued onto the lid to ensure a dust-proof seal when the unit



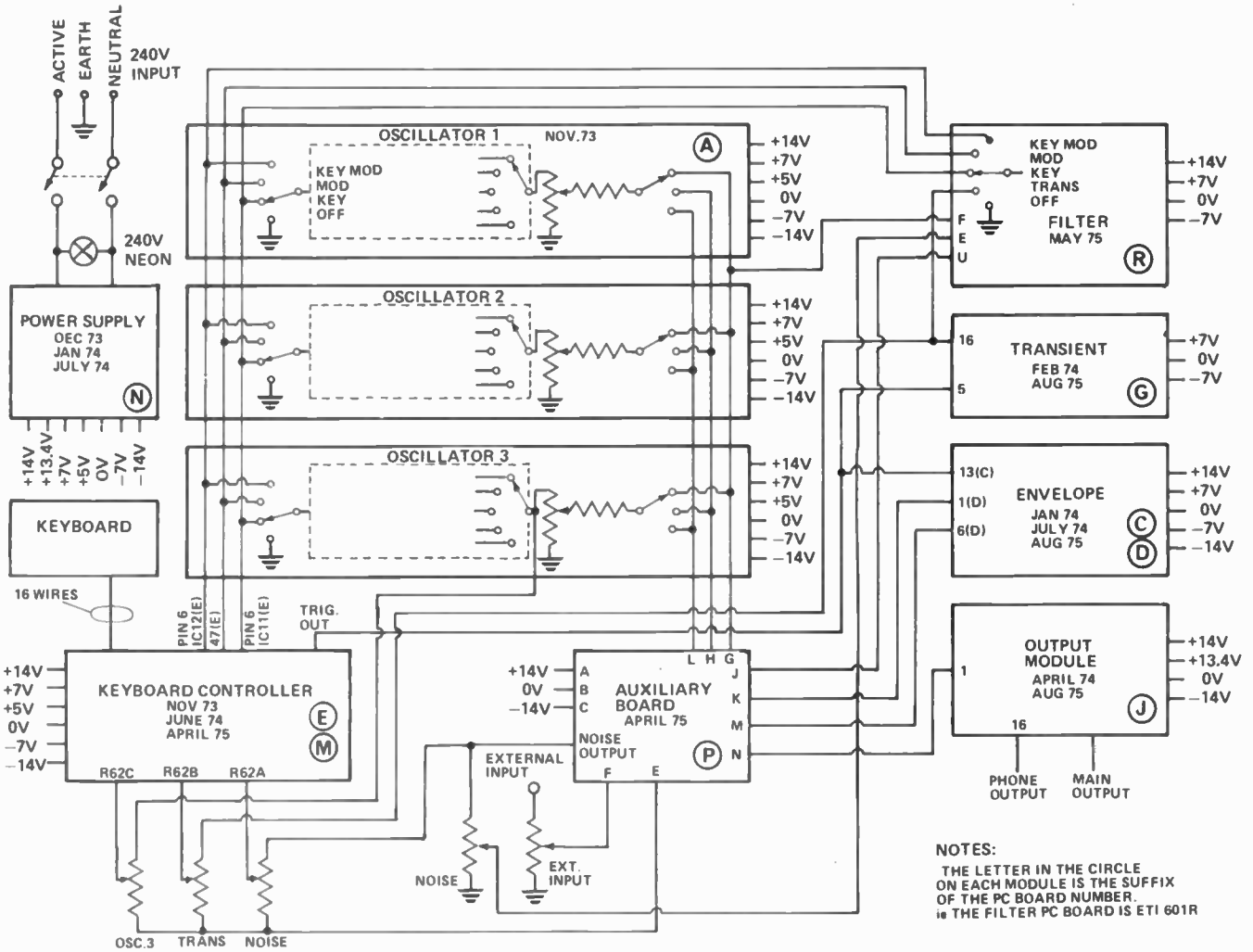


Fig. 4. Overall interconnection diagram.

is closed. The box may be covered with vinyl or veneered as required. Note however that the keyboard should be installed before the keyboard panels (pieces 7 and 8) are covered.

The small panel containing the mains-cord socket, the external-input socket and the output-socket can now be assembled, wired and mounted in place. Note that the wires to the input and output sockets should be in shielded cable.

The keyboard may now be wired up and installed as follows. The aluminium frame of the Kimber Allen keyboard extends beyond the ends of the keys. Use this portion to mount the keyboard by placing two pieces of wood on top of the ends of the frame. These pieces of wood should be of such thickness that the keyboard is held at the correct height when finally assembled. The keyboard is held in position by long self tapping screws which pass through the keyboard panels (7 and 8), through the pieces of packing wood and screw into the end frame. After checking alignment, and that the keyboard functions correctly, the keyboard panels may be covered or veneered as for the rest of the box.

The power supply, keyboard controller, auxiliary board and the spring reverb are all mounted inside the box on the base. The photo shows the relative positions of these modules. They should be installed fitted with wires that are long enough to reach their destination. The other modules and their associated potentiometers and switches can now be mounted on the front panel. Interconnections can now be made using the diagrams in Figures 2,3 and 4 as a guide.

A solid earth is required if noise is to be minimized. This is easiest done by earthing each module to the front panel. Solder the earth wire onto the back of a potentiometer (after filing off the plating). A solid-earth wire between the auxiliary board and the front panel is also necessary.

Finally, due to the size of the range switch on oscillator 1, it will probably be necessary to cut a section out of the front panel upper-support to provide clearance. ●

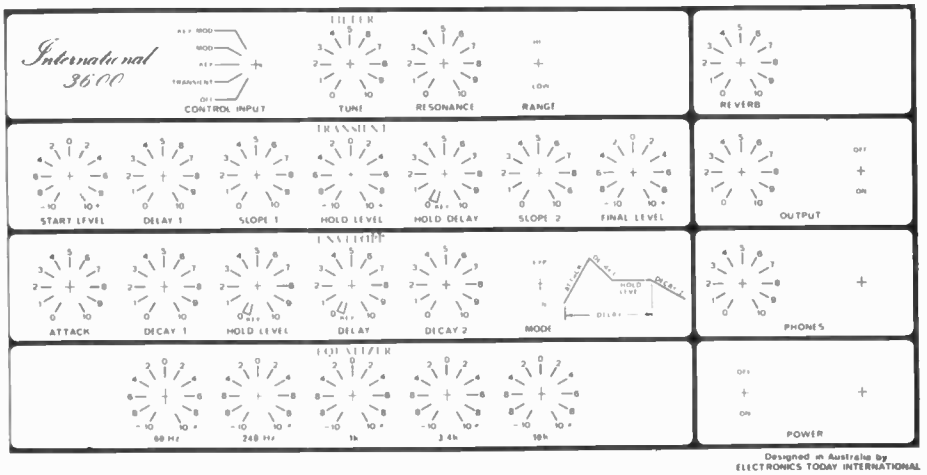
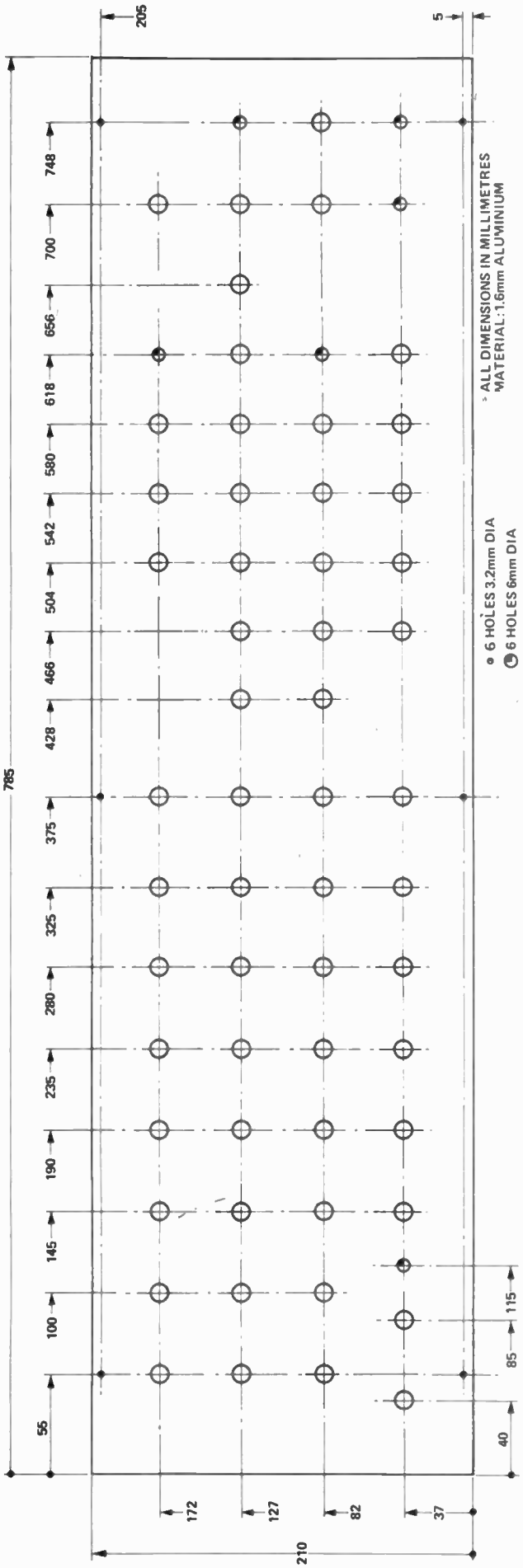


Fig. 5. Front panel artwork.

INTERNATIONAL 3600 SYNTHESIZER



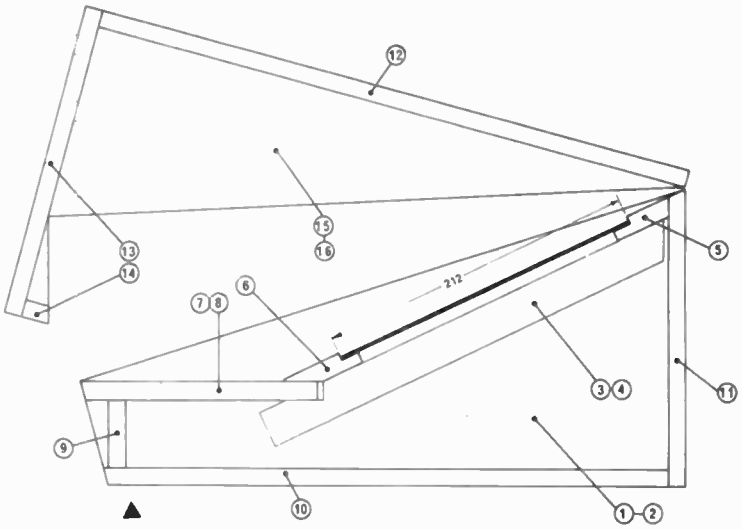
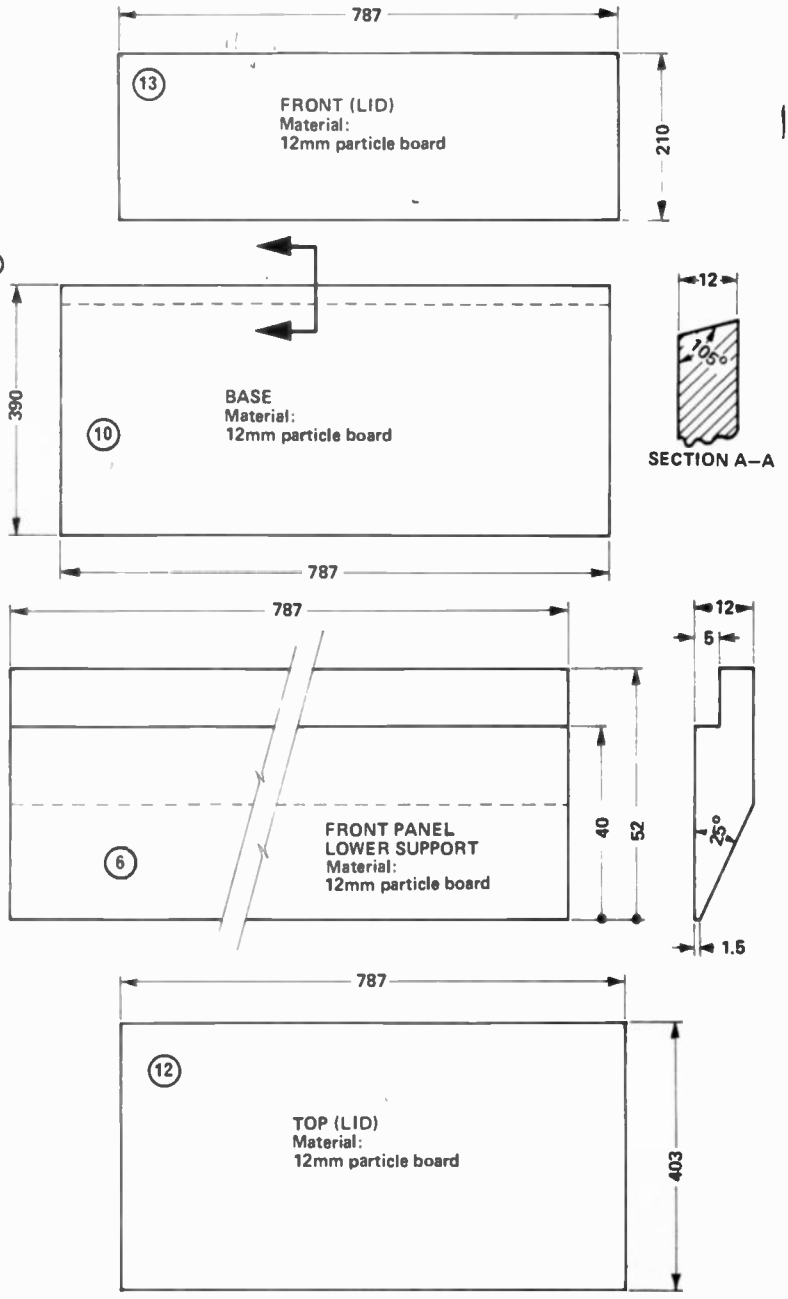


Fig. 7. Box assembly details. Numbers in circles are of individual pieces as numbered in Fig. 8.

◀ *Fig. 6. Front panel drilling details.*



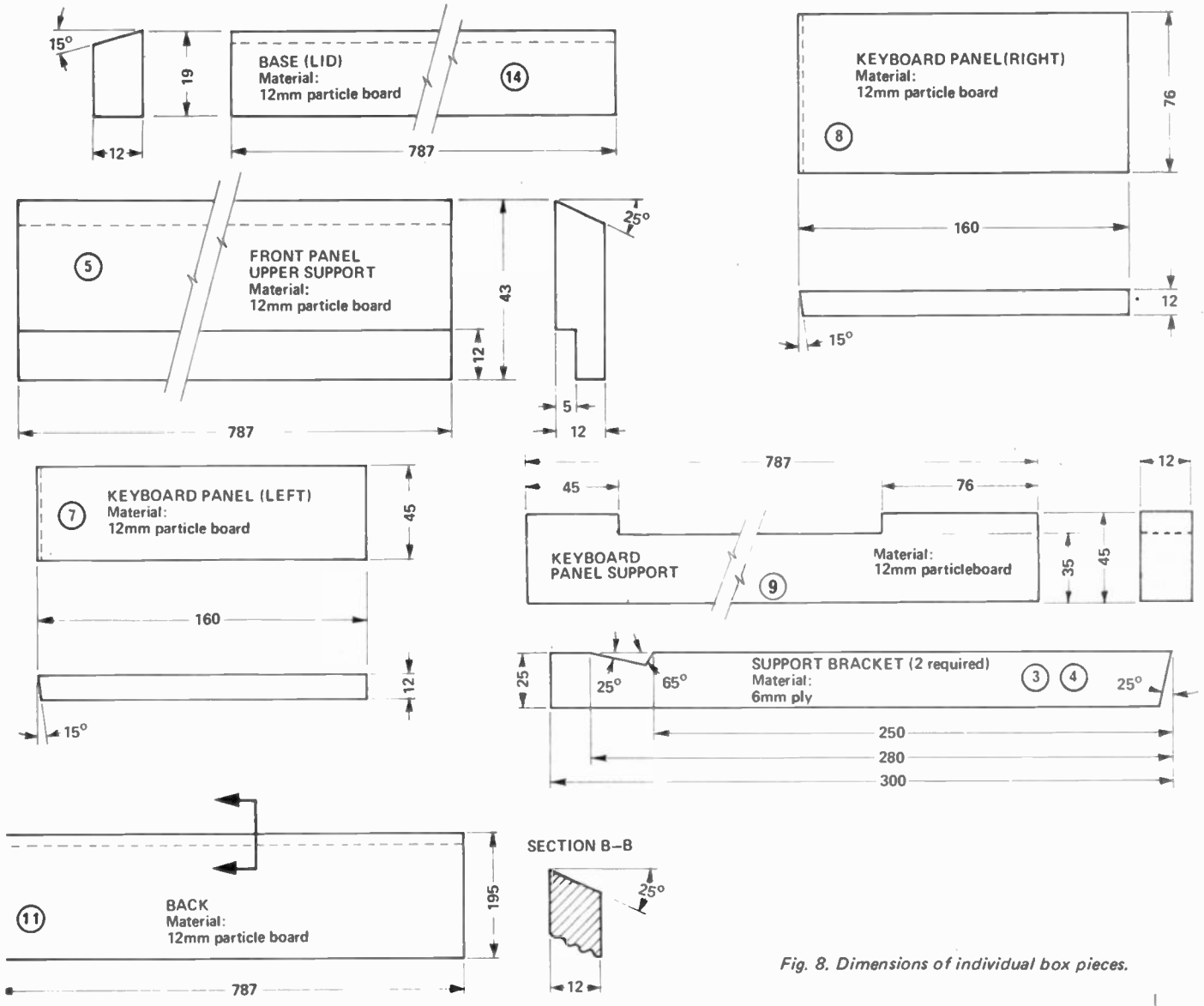
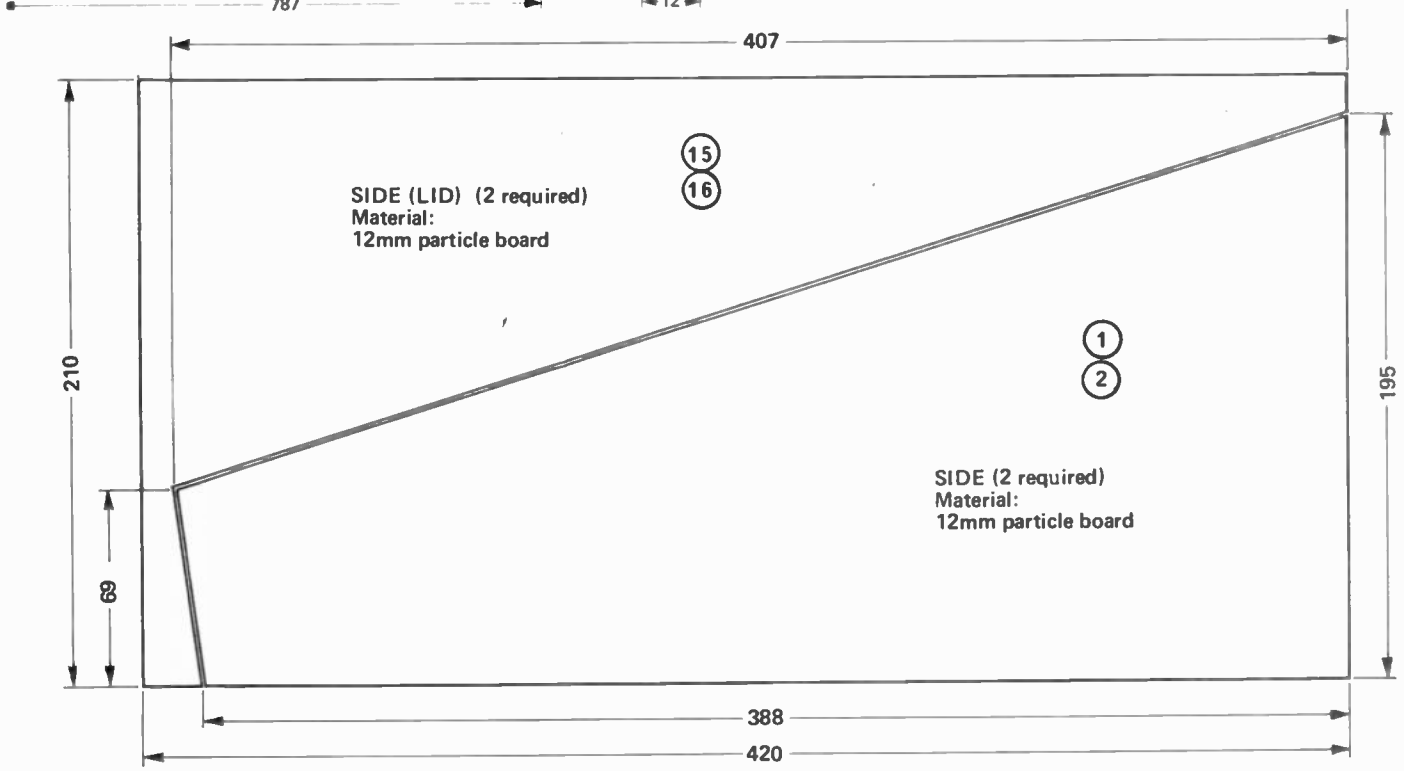


Fig. 8. Dimensions of individual box pieces.



KITSETS

HOT TIPS

Until recently, if you wanted a first-class hi-fi system, you had two ways to get it. You could buy a kit and build a system from scratch, if you were technically inclined, or you could buy ready made units which were expensive and dull. In fact the only pleasure you'd get would be the matching of your amp, speakers and turntable.

Now, for the first time, KITSETS makes possible a top quality system you build yourself without tears! It's the new MOD-AMP range — a comprehensive array of professional modules, fully wired and tested, designed and manufactured here in Australia.

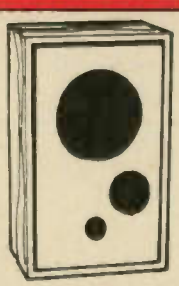
Choose from MOD-AMP'S selection of amps, preamps, tuners, tone controls, mixers and light displays to build the system you want, with the features you need. These are ideal for Hi-Fi, Public Address, and Rock Groups.

Simply decide which modules you want, house them, and connect up. No need to buy everything at once either. To update or expand your system, simply purchase modules to suit — perhaps a filter, tuner, decoder, light display, or quad system. Anyway, check out the rest of the details in the body of the ad., and speaking of bodies, what man hasn't an eye for a pair! . . . (I'm talking about speakers of course) . . . and what better way to add "body" to your Hi-Fi setup, than with the big sound of a pair (or two pairs) of 15" big ones. Take it from some-one who knows, the difference is unbellevable. In fact that's my tip of the month . . . a sneaky way to make your present system sound twice as good.

And if you're a do-it-yourselfer, you can save almost half by building up our new 15" kits.

Incidentally each issue from now on I'll be letting you in on some interesting and exciting new products . . . so look in next month.

UPDATE YOUR SPEAKER SYSTEM



For only a few dollars you can dramatically improve your present speaker system. Replace your old cone tweeters with horn or dome tweeters; or add tweeters to your existing system, and just listen to those clear high notes that were missing.

Does your system seem dead or muffled? Then add a dome midrange or cone midrange and listen to that extra presence — a midrange can do wonders, and for only a little extra cost, effectively give you a new speaker system.

We suggest that you add at HT49 tweeter, HM16 Midrange and HN15 Crossover to your existing large speaker to obtain the full performance from your system.

MOD-AMP AMPLIFIER MODULES

All modules include the heatsink. Power supply and fuses required.

STEREO MUTE MODULE

$12.50 P&P $1.00

This module is for reducing the noise generated by channels which are not being used — adjustable but automatic operation. Ideal when a number of inputs are being used.

Specifications: Gain reduction: 30 dB adjustable threshold; Response: Fast attack, slow delay; Power supply: 18-22V.

MONO FILTER UNIT

$12.50 P&P $1.00

This module contains adjustable turnover points, with the controls mounted on the boards.

Specifications: Low frequency turnover: adjustable 20Hz-200Hz; High frequency turnover: adjustable 5kHz-50kHz; Distortion: typically less than 0.1%; Response: 20Hz-50kHz —3 dB; Power supply: 18-22V.

AM/FM STEREO TUNER MODULE

$49.50 P&P $3.00

This module includes decoder. AM section has the same specifications as AM module. Power supply is 12V at 22mA. This is one of the highest quality prealigned modules available. Kitsets has looked at cheaper modules, but we found none that would give us the performance required for high quality stereo reception.

Specifications: Range: 88 to 108MHz; Sensitivity: 3.5μV; Signal to noise: 52dB at 100μV; Stereo separation: 25dB at 100Hz; Stereo indication: 100mA globe; Signal strength: 200mA meter required.

AM TUNER MODULE

$19.50 P&P $1.50

Best value for money.

Specifications: Range: 5351kHz-1.065MHz; Aerial: ferrite rod included; Sensitivity: 80μV; Signal to noise: 20dB at 80μV; Power supply: 9V at 4mA.

PREAMPLIFIER MODULES

$12.50 P&P $1.00

Each module has two channels so that it can be used for stereo, or for dual channels. Low-impedance microphone preamplifier is suitable for 600Ω input. Tape head preamplifier is suitable for 9.5 cm/sec, and one capacitor per channel can be altered for other tape speeds.

Specifications: Input: 100KΩ Output: 100mV; Distortion: typically less than 0.05%; Response: 25Hz-50KH, — 1dB; Power supply: 18-22V; Stereo magnetic cartridge: 2.0mV input; Dual lo-imp microphone: 0.2mV input; Dual Hi-imp microphone: 2.0mV input; Dual guitar preamplifier: 30mV input; Dual tape head preamp: 0.2mV input.

STEREO CONTROL UNIT

$25.00 P&P $2.00

This module includes the potentiometers mounted on the board, and an optional loudness control. It is a versatile unit which can be used with all the amplifier modules.

Specifications: Input: 100KΩ; Output: 1KΩ; Gain: 20dB; Response: 20Hz-50kHz ± 1dB; Max. output: 2.5V; Tone control: Base ± 14dB at 50Hz. Treble: ± 13dB at 10kHz; Loudness: Control at -30dB, +8dB at 50Hz, +3dB at 10kHz; Distortion: typically less than 0.05%; Power supply: 18-22V.

15 W MONO AND STEREO AMP MODULE

STEREO $29.50 P&P $2.00

MONO $19.50 P&P $1.50

Specifications: Power Supply: ± 16V — ± 20V; Response: 10Hz-50kHz ± 3dB; Load: 8Ω; Input 25KΩ; Gain: 33dB; Distortion: typically less than 0.1%.

30 W MONO AND STEREO AMP MODULE

STEREO $39.50 P&P $2.50

MONO $29.50 P&P $2.00

Specifications: Power Supply: ± 24V — ± 30V; Response: 10Hz-100kHz ± 3dB; Load: 8Ω; Input: 50kHz; Gain 30 dB; Distortion: typically less than 0.1%.

60 W MONO AMP MODULE

$39.50 P&P $2.50

Specifications: Power Supply: ± 32V-± 45V; Response: 10Hz-50kHz ± 3dB; Load: 4Ω or 8Ω; Input: 10KΩ; Gain: 30 dB; Distortion: typically less than 0.1%.

SQ DECODER MODULE

$12.50 P&P $1.00

Uses MC1312P Decoder IC.

Power Supply: 18-22V.

CAR ALARM MODULE

$12.50 P&P $1.00

Detects drop in battery voltage. No need for complicated switches. Relay output to drive car horn intermittently to save battery. 12V system only.

FUNCTION GENERATOR

$19.50 P&P $1.50

Uses 8038 and 709 integrated circuits. Gives variable frequency sine wave, triangular wave and square wave outputs. Power supply 18-22V.

NOT SUPPLIED WITH SWITCHES AND POTENTIOMETERS.

STEREO MIXER UNIT: 8 INPUT

$12.50 P&P $1.00

Any of the inputs can be used, just use as many 10K level potentiometers as required.

Specifications: Input: 100mV; Output: 100mV; Response: 25Hz to 50kHz ± 1dB; Input impedance: 5KΩ; Distortion: typically less than 0.05%; Power Supply: 18-22V.

STEREO VU METER AMP

$12.50 P&P $1.00

Drives 200mA VU meter from control unit output.

Power Supply: 18-22V.

7.5 W STEREO AMP MODULE

$19.50 P&P $1.50

Specifications: Power Supply: 24-32V; Response: 50Hz-100kHz ± 3dB; Load: 8Ω; Input: 100Ω; Gain: 39dB; Distortion: typically less than 0.1%.

120 W MONO AMP MODULE

$49.50 P&P $3.00

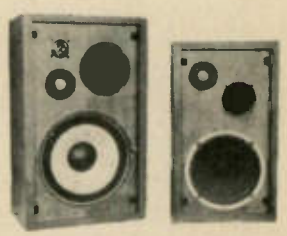
Specifications: Power Supply: ± 45V to ± 60V; Response: 10Hz to 50 kHz ± 3dB; Load: 4Ω or 8Ω; Input: 10KΩ; Gain: 30dB; Distortion: typically less than 0.1%.

15" SPEAKER KITS

(15" + 5" + 1") 73 litre Box $32.00 each.

15" 40W Speaker	$39.00
Dome Mid-range	$12.50
Tweeter	$11.50
Full Kit	$89.00 P&P $5.00

STEINTRON SPEAKER SYSTEMS



V80A — 8" Woofer; 1" Dome Tweeter; Super Tweeter; Handles 25W; 25Mz — 20 kHz; only $59.00 each. Freight $8.00 for two.

V100A — 10" Woofer; 5" Mid Range; 1" Dome Tweeter; Handles 35W; 20Hz — 20 kHz; Only $89.00 each. Freight $10.00 for two.

V120A — 12" Woofer; 6" Mid Range; 1" Dome Tweeter; 1" Super Tweeter; Handles 45W; 20Hz — 20 kHz; Only $119.00 each. Freight $12.00 for two.

V150A — 15" Woofer; 2 x 5" Mid Range; 2 x 1½" Tweeter; 2 x Super Tweeter; Handles 60W; 20Hz — 20 kHz; Only $169.00 each. Freight $14.00 for two.

DNEY: 400 Kent St. Sydney, 29 1005. 657 Pittwater Rd., Dee Why. 982 9790.
ELAIDE: 12 Peel St. Adelaide, 87 5505. **BRISBANE:**
3 St. Paul's Tce. Fortitude Valley, 52 8391. **MELBOURNE:** 271 Bridge Rd.
ımond (Gallery Level, Church St. entrance) 42 4651; 985 Whitehorse Rd., Box Hill,
3371. **PERTH:** 557 Wellington St. Perth (Opp. new bus terminal) 21 3047.

STOP PRESS

TRANSFORMERS

PF3577 56VCT @ 2A **$14.00** P&P $1.50.
PF2851 12.6VCT @ .15A **$6.50** P&P 75c
PF2876 64VCT @ 1A **$12.40** P&P $1.50
2155 6.3/7.5/8.5/9.5/ 12.6/15V @ 1A **$6.50** P&P $1.00
5503 17/11.5V @ 4A **$14.50** P&P $1.50
6672 15/17.5/20/24/ 27.5/30 @ 1A **$11.25** P&P $1.60
9129 30V CT @ 1A **$8.50** P&P 75c
PL12/20VA 2 x 6V @ 1.7A **$7.00** P&P 75c
PL18/20VA 2 x 9V @ 1.1A **$7.00** P&P 75c
PL30/20VA 2 x 15V @ 0.69A **$7.00** P&P 75c
PL50/20VA 2 x 25V @ 0.41A **$7.00** P&P 75c

PEAK SPEAKERS

TWIN CONE TYPE — *6A7A 6" 55-15,000 5W $10.50; *8A7A 8" 50-15,000 8W $12.50.
COAXIAL TYPE WITH FREE EDGE' CONE & HORN TWEETER — *HS201 8" 50-20,000Hz 20W $38.00; HS-250 10" 40-20,000 25W $44.00: HFS-300 12" 30-20,000 30W $54.00
COAXIAL TYPE W/- TWO CONE TWEETERS — HS-300 12" 40-16,000 20W $51.00 P&P $1.50.
HI-PERFORMANCE TYPES — Woofer — L.305 12" 30-5,000 25W $23.50. MID-RANGE DOME TYPE — HM-16 5½" 1000-10,000 30W $12.50. MID-RANGE CONE SPEAKER — HM-2 5" 300-10,000 30W 12.50. HORN TYPE TWEETER-CERAMIC MAGNET — HT-16 2½" 5000-20,000 20W $8.50; HT-52 120x60mm 2000-18,000 30W $12.50. TWEETER DOME TYPE (METAL DOME) — HT-49 3½" 2000-18,000 50W $11.50 P&P $1.50.
NOTES: Available speaker impedances are: * Either 8 ohm or 16 ohm. 6A7A, 8AA, HS-201 All other models 8 only.
DIVIDING NETWORKS — HN-14 2 way network 8 ohm. $4.50; HN-15 3 way network 8 ohm $7.50, P&P 60c

PHILIPS SPEAKERS

From the fine Phillips range we have chosen the following four speakers and crossover networks. With these speakers you can make up any of four different speaker box systems. Full details of how to construct the speaker enclosures are contained in the Philips Publication "High Fidelity Loudspeakers and Enclosure Design" — available from us for $1.50 All speakers are 8 ohm impedance.

AD 0160/T8
1" High Fidelity Dome Tweeter

The Phillips 1" Dome Tweeter features an outstanding "all-round" sound performance ensuring natural reproduction of frequencies from 1500 Hz to over 20 kHz in multi-speaker systems.
The polar response curve at 10 kHz is typical of the "all-round" sound coverage of the speaker.
POWER HANDLING CAPACITY: 20W rms with 1600 Hz cross-over filter. ADF 1600/8, 40 W rms with 4500 cross-filter. ADF 500/4500/8. 8Ω IMPEDANCE: RESONANCE FREQUENCY: 1 kHz. FREQUENCY RANGE: 1.5 kHz-22 kHz

AD 5060/SQ8
5" High Fidelity Mid Range

POWER HANDLING CAPACITY: 40W rms. IMPEDANCE: 8Ω; FREQUENCY RANGE: 50Hz-4.2kHz.

AD 8066/W8
8" High Fidelity Woofer

POWER HANDLING CAPACITY: 40 W rms. IMPEDANCE: 8Ω RESONANCE FREQUENCY: 28 Hz. FREQUENCY RANGE: 35 Hz-1.8 kHz.

AD 12100/W8
12" High Fidelity Woofer
POWER HANDLING CAPACITY: 40 W rms. IMPEDANCE: 8Ω RESONANCE FREQUENCY: 19 Hz. FREQUENCY RANGE: 40 Hz-1.2 kHz.

1" dome tweeter AD0160/T8 Price each $12.50; 5" mid range AD5060/SQ8 Price each $15.00; 8" woofer AD8066/W8 Price each $17.50; 12" Woofer AD12100/W8 Price each $42.00.

SUGGESTED SYSTEMS (Details in Phillips Book) 3A 8:: Woofer and 1" Tweeter; 4A 8" Woofer, 5" mid-range and 1" Tweeter; 7A 12" Woofer, 5" mid-range and 1" Tweeter

PHILIPS CROSSOVER NETWORKS
The Philips 2 and 3 way crossover networks, although designed for use with Philips speakers are however ideal for general purpose usage. ADF1600/8 Two way for woofer and tweeter $9.50; ADF500/4500/8 Three way for woofer, mid range and tweeter $14.50.

ADF 1600/8
2-Way Cross-Over Network

RATED IMPEDANCE: 8Ω CROSS-OVER FREQUENCY: 1600Hz; POWER HANDLING CAPACITY: 20 W rms; SLOPE, LOW PASS: 6 dB/Octave, HIGH PASS: 12 dB/Octave.

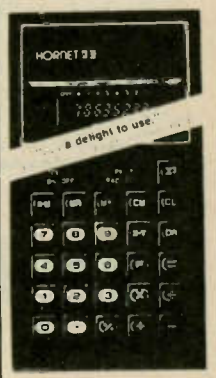
ADF 500/4500/8
3-Way Cross-Over Network
RATED IMPEDANCE: 8Ω; CROSS-OVER FREQUENCIES: 500 and 4500 Hz; POWER HANDLING CAPACITY: 40 W rms; SLOPE, LOW PASS: 6 dB/Octave, BANDPASS (mid-range): 6 dB/Octave, HIGH PASS: 12 dB/Octave.

KITS AVAILABLE

KIT	PRICE	P&P
PM140	$149.00	3.00
PM143	$ 75.00	3.00
PM144	109.00	3.00
ETI 420	149.00	3.00
ETI 422	129.00	3.00
ET Reverberation unit	59.00	2.50
ET Graphic equalizer	109.00	3.00
Musicolour II	59.00	3.00
Moodcolour IV	85.00	3.00
E/A '70 C.D.I.	25.00	1.50
ETI CDI	55.00	2.00
Push button Dimmer E/T	17.50	1.00
Drill Speed control e/a	17.50	1.00
Transistor Tester e/a	19.50	1.00
ETI Ic Power Supply	27.50	1.00
EA Dual Power Supply		3.00
EA breakdown tester	35.00	2.00
ET car alarm (simple)	12.00	1.00
'75 Radar intruder alarm	65.00	2.00
Simple intruder Alarm	22.50	1.50
Glide Tone Generator	9.75	1.00
5 state logic probe	15.00	1.00
Warble Dauble	25.00	1.50
200 Mh$_2$ DFM (e/a)	139.00	2.00
R.C. Bridge e/a	65.00	1.50
Educate section I	239.00	5.00

Due to huge demand and bulk buying we can now offer this scientific calculator at this incredible price.

Not just an arithmetical calculator but a professional scientific toll: You will be asked to pay $100 and more for similar instruments. The Hornet SR30 is an algebraic-mode, 8-digit unit with the normal +, —, X and functions plus Memory with 4 operations (M+, MR, X—M, CM) and 6 command functions (+ /-, F, DR, X—Y, rad/deg, CL). 12 Scientific functions. These are 1/X, ex, Ln, log, sin-1, cos-1, tan-1, sin, cos, tan x, and xy. Trig and log functions are calculated to 6 dec. places. The unit comes complete with batteries (4 penlight cells) and handbook. A socket is fitted for external DC power. Supply is limited, and orders will be filled in strict rotation. Price includes registered post and packing cost. NOTE: This unit has a blue fluorescent display.



$39.50
P.&P. $2.50

MAIL ORDER

KITSETS
P.O. Box 176,
Dee Why, Sydney.

These offers only while stocks last, equivalents may be supplied and prices may be changed without notice.

A HOW MANY	B NAME OF GOODS AND CODE NUMBER IT GIVEN	C PRICE EACH	D P & P EACH	E SUB TOTAL
	If you want your order sent registered (advisable) add 75c			
	← ITEM TOTAL add column A		REMITTANCE TOTAL Add Column E →	

Apollo-Soyuz space link

TRANSMISSION DETAILS

121.75MHz	70 kHz voice FM
259.7 MHz	Intership voice AM
296.8 MHz	AM voice link to ground satellite stations.
922.75 MHz	Beacon and telemetry signal from USSR earth satellites.
2287.5 MHz	Apollo transmission. Unified S band centre frequency.

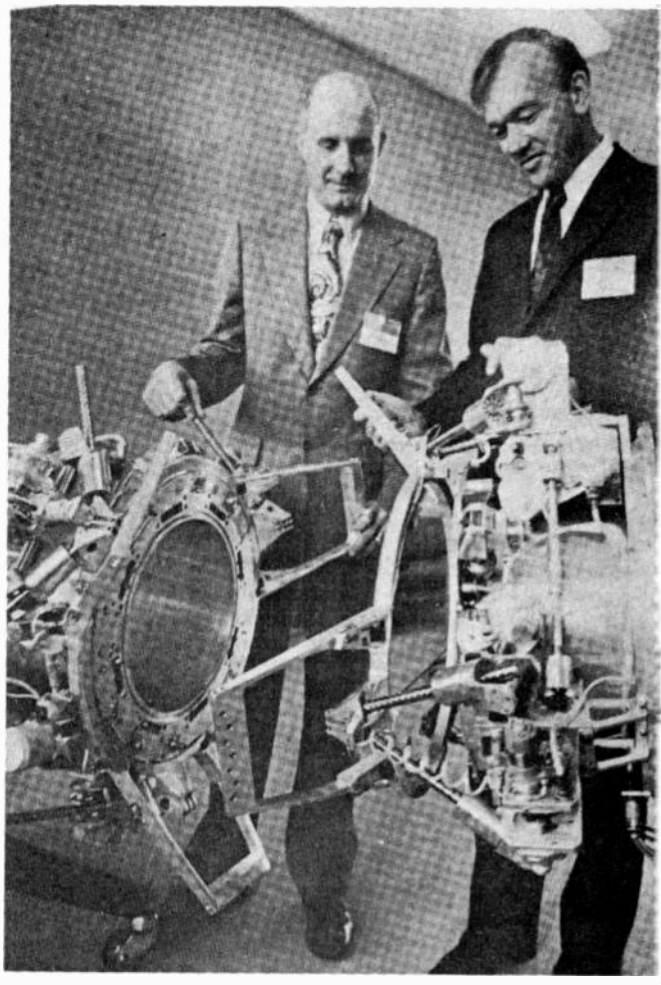
IF ALL GOES according to plan, the first space mission involving major USSR and USA co-operation will get under way at 12.20 GMT on July 15.

At that time a manned Soyuz space craft will be launched from the Russian space centre at Tyuratam. This will be followed some seven or so hours later by an Apollo craft launched from Cape Canaveral.

Both craft will meet and dock together on July 17 (at 16.15 GMT).

It should be possible for radio amateurs — or indeed even ordinary mortals — to listen in to the transmissions from the two craft.

Monitor the radio link with your FM receiver.



Cosmonaut Aleksei Eliseev and astronaut Thomas P. Stafford examine the details of the docking device produced in the Soviet Union.

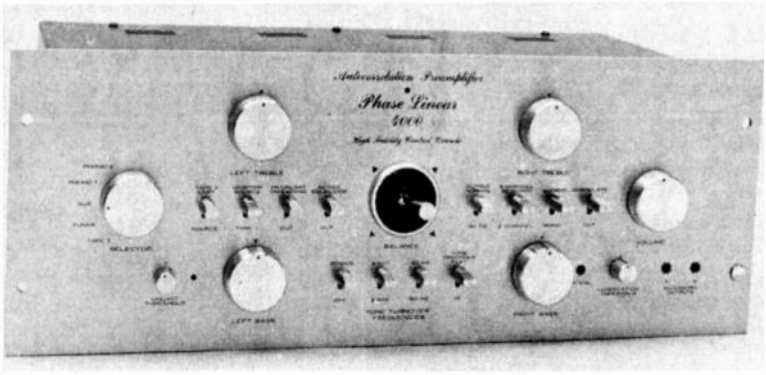
Several frequencies will be used and these are shown in the Table published on this page. For most people the easiest transmission to pick up will be on the 70 kHz bandwidth voice-FM transmitted on 121.75 MHz. Transmissions from the USSR spacecraft will be linearly polarized — that from the USA spacecraft will be right-hand polarized.

It should be reasonably possible to pick up the signals on any FM radio covering the 121 MHz band. A simple dipole antenna may be adequate, but to be more certain it is advisable to use a low-noise antenna pre-amp, plus an antenna giving about 10 dB gain.

The planned flight details are as follows: Soyuz will fly on an orbit of 88.7 minutes period. Inclination will be 51.5° to the equator. The spacecraft is scheduled to cross the equator at 41.6° headed northwest. It will then cross the equator again, 88.7 minutes later, (32.54° west longitude). From then on each successive crossing will be at 22.54° further west.

(Sorry! you'll have to get out a globe and work out the schedule for yourself. It's not reasonably possible to show the details in a drawing!). ●

PHASE LINEAR 4000 AUTO-CORRELATOR PREAMPLIFIER



Recommended Retail price $780.

Distributor: Megasound Pty Ltd, 220 West St, Crows Nest. NSW 2065. Telephone: 922-3423.

ALTHOUGH HI-FI equipment quality continues to improve, it is ironical that the quality of recorded programme has not kept pace. In fact many people hold that record quality is progressively becoming worse.

There are two major problems in recorded material – dynamic range and signal-to-noise ratio. The two factors are interrelated because, to keep signal-to-noise ratio high, recording engineers compress the peaks and raise the level of quiet passages – thus substantially limiting the recorded dynamic range. Apart from this, whilst recording techniques have vastly improved, the quality of record pressings has not. Shorter press cycle times, recycled vinyl and increased number of pressings from the one master degrade the residual surface noise on a pressing.

Thus whilst recorded musical quality may be higher than ever before, the quality of records in terms of hiss, clicks and pops is widely variable – even within different pressings of the same record.

Whilst it should be theoretically possible to improve the noise performance of records it must be faced that most record companies are unlikely to do so. Even if surface noise *is* dramatically lowered – it will still be a problem, and the limited dynamic range which can be accommodated on records may still make dynamic compression necessary during recording.

The same problems exist in tape recording but a great improvement in signal-to-noise (up to 10 dB) has been made possible by the introduction of the Dolby noise reduction process. However tapes must be recorded via a Dolby encoder and then replayed via a similar decoder. Thus Dolby is a two-step process – it *cannot improve the signal-to-noise ratio of material that has not been Dolby encoded.* Although Dolbyized tapes *are* available, as yet records have not been similarly processed.

A DIFFERENT APPROACH

A number of different units are available which can improve the signal-to-noise ratio of *existing* records. Perhaps the most well known of these is the dbx 117 Dynamic Range Enhancer which does precisely what its name implies; it increases dynamic range thus allowing lower volume settings to be used – resulting in a subjective improvement in hiss level.

What is needed then is a means of restoring the dynamic range of the original music and of reducing the hiss level without sacrificing high-frequency response. A tall order but these are precisely the problems that Phase Linear have tackled in their new model 4000 stereo pre-amplifier.

Bob Carver of Phase Linear Corporation researched the necessary techniques and is responsible for the basic design of the pre-amplifier. His aim – to obtain excellent signal-to-noise and distortion performance from the pre-amplifier itself, and to provide facilities for overcoming the record defects outlined above.

The design approach is different from the conventional, although some of the conceptual approaches were investigated by Beranck et al in the 40's. Bob Carver expounded his approach in a paper presented to the 51st Convention of the Audio Engineering Society, the title of the paper being *"An Autocorrelator Noise Reduction System"*. A feature of note is the inclusion of what Bob Carver describes as 'peak unlimiting'. This circuitry not only expands signals which are *greater* than a presettable level but also compands (reduces gain) signals *below* a fixed level, the mid-level signals being unaffected. This circuit thus increases dynamic range *and* reduces subjective noise.

A second and perhaps more significant circuitry proposal is the use of a correlation technique and correlation co-efficient estimation to detect the presence (or absence) of uncorrelated distortion products. It should however be appreciated that the 'Auto-Correlator' pre-amplifier described in this review does not actually incorporate an auto-correlator circuit – rather the noise reduction circuit indirectly estimates the value of the correlation co-efficient. The end result is very effective but we must query Phase Linear's use of the term 'Auto-Correlator' in this context. (A parallel is describing a weighing machine as a 'Volume Measurer' if it is used to monitor liquid volume by weight).

The Phase Linear 4000 Stereo Pre-amplifier is a four-channel SQ plus logic decoder pre-amplifier capable of driving four amplifier channels, or two, as desired by the user.

To cope with this requirement the unit features a joystick type balance

PHASE LINEAR 4000 AUTO-CORRELATION PREAMPLIFIER

control right in the middle of the front panel.

MECHANICAL DETAILS

Measuring 482 mm wide (19" standard rack mounting) by 178 mm high and 254 mm deep, this unit is the largest hi-fi pre-amplifier that we have seen since type 80 rectifier valves went out in the early 40's. The reason for its size appears to be Bob Carver's desire to have a unit which matches the size of a 700B or 400 Phase Linear Amplifier.

The pre-amplifier has two tape recorder inputs with unusual switching arrangements which enable the user to monitor the output of one of them whilst recording from the second machine, even if one desires to listen to a completely separate third programme whilst this is taking place!

On the lateral centre line of the unit set between the six large knobs are a set of lever key switches which provide facilities from left to right of: Tape 2-Copy or Source; Monitor-Source or Tape 1; Peak Unlimit and Downward Expander-in or out; Active Equaliser-in or out; and on the right hand side of the four channel joystick balance control is an attenuator output normal or –20 dB; Four-channel SQ+Logic or Two Channel; Stereo or Mono; and Correlate-in or out.

On the bottom row, at the left hand side of the unit, is a small rotary knob for peak unlimit and downward expander threshold selection together with its adjacent solid state bezel light. In between the left bass and right bass control are the power on-off switch, the turnover frequency switches for treble (at 8 kHz or 2 kHz) and bass (at 40 Hz and 150 Hz). On the right hand side of this is a switch which cuts all tone controls out of circuit. On the right hand side of the right hand bass control is an aperture for providing access to a present potentiometer. This is for initially calibrating and adjusting the threshold setting of the low frequency dynamic filter to match the output of the phono cartridge. Next to this is a small knob which adjusts the 'auto-correlation' threshold. This only needs to be set by ear for large changes in the source background noise level.

The Phase Linear 4000 Stereo Pre-amplifier has a number of unusual controls. We will deal with each of these in turn. First the Peak Unlimiter and Downward Expander. The Peak Unlimiter provides a maximum of 4 dB increase in output relative to input for signals which exceed the zero level threshold set by the Unlimit Threshold control knob. Such a control is intended to provide part of the performance that a device such as the dbx 117 Dynamic Range Enhancer provides. Whilst not as flexible as the dbx our subjective and instrument measurements showed that it achieves what it is supposed to.

At the other end of the dynamic range the downward expander once again emulates a small proportion of the dbx's performance by providing maximum attenuation of 5 dB to compensate for gain increases deliberately introduced by the recording engineer to improve signal to noise ratio during low level passages.

The second major control activates the 'correlator' circuitry. It is here that we think the title 'auto-correlation' is misused, for whilst the proposed Type A Phase Linear Pre-amplifier is apparently a true correlator, the Type B or consumer version is not. Whilst the average man on the street has no concept of what a correlator is, professionals and serious amateurs may well do, and we think that the choice of the term 'auto-correlation pre-amplifier' for the consumer version is a misuse of a professional term. There are major differences from a purely technical viewpoint between the proposed professional Type A Phase Linear Pre-amplifier and the consumer unit. The most important of these is undoubtedly in the means by which the noise minimisation is achieved in the two different circuits. Without delving into the theory of operation of either of the two versions, it is necessary to point out that differences exist and that small but nonetheless measurable and subjective differences must result.

We would however like to make it quite clear that we are in no way condemning the Phase Linear 4000 or its performance but rather pointing out that the title given to it, and some of the literature presented with it do not accurately portray its true mode of operation.

The system which we used for the subjective evaluation consisted of an Elac 50H Record Player fitted with an Elac D44E Cartridge, a Phase Linear 4000 Stereo Pre-amplifier driving a Phase Linear 700B Amplifier, and two pairs of speakers – Fisher ST550's and ESS amt 1s.

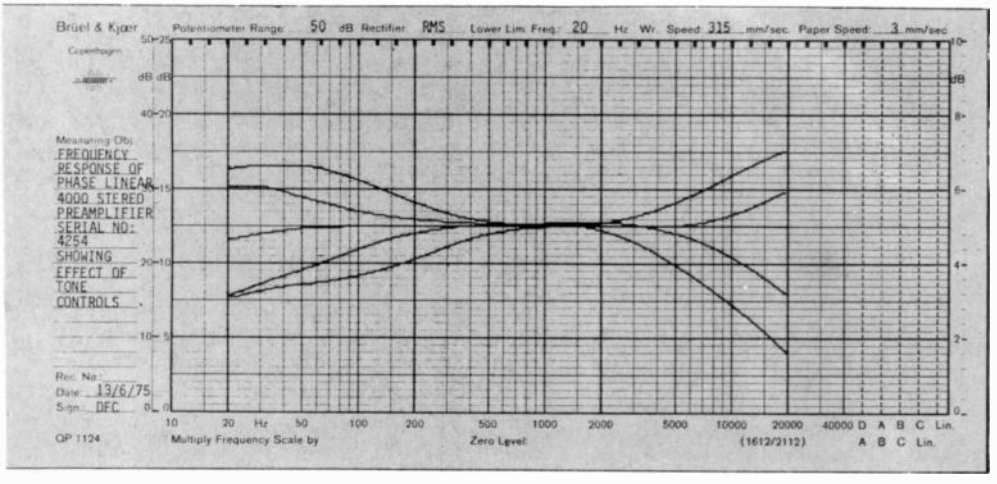
The combination was selected to provide a highly critical combination capable of highlighting any possible factor which would show up the limitations of the pre-amplifier. (We had previously tried to evaluate the pre-amplifier driving an amplifier with lesser performance than the Phase Linear 700B, and the results were not entirely to our satisfaction).

We carried out our major subjective evaluation at night time after children had gone to bed and with a background noise level in the listening room close to the normal threshold of hearing. Under these conditions the background level produced by the amplifier and pre-amplifier, with the volume control set at our peak listening level, without programme content, was about 25 dB(A). With good clean records and a peak music level close to 105 dB(A) the background noise level on the blank tracks did not exceed 28 dB(A)! – an almost indiscernable increase! This was most heartening and indicative of the sort of performance of which the pre-amplifier is capable.

We took special care in setting up the major controls on the pre-amplifier, most particularly the unlimit threshold, correlation threshold, and the low frequency calibration setting.

This operation was painless and certainly well within the capabilities of the below average user: it is adequately described in the fourteen page handbook provided.

In the quiet conditions of our test environment the switching in and out of the peak unlimiter provided a most satisfactory expansion of the dynamic range, although not as good as that



MEASURED PERFORMANCE OF PHASE LINEAR 4000 STEREO PREAMPLIFIER SERIAL NO: 4254

Maximum Output:	8 volts rms
Frequency Response:	–2 dB 20 Hz
Reference 1 kHz	–1 dB 20 kHz
Gain:	16 dB auxiliary input
Noise:	–75 dB re 2 volts output
Auxiliary input	–89 dB A-weighted
Total Harmonic Distortion:	
(1 volt rms output maximum gain)	100 Hz .16%
	1 kHz .01%
	6.3 kHz .25%
(8 volts rms output maximum gain)	100 Hz .13%
	1 kHz .08%
	6.3 kHz .15%
Cross-Talk:	20 Hz –34 dB
	1 kHz –49 dB
	20 kHz –26 dB

achievable with the dbx. Notwithstanding, we were pleased with the result and felt that it was adequate for the majority of listening situations and programme content that the average user would call for.

One limitation, however, was that when correctly set up, the peak unlimiter responds noticeably, if not savagely, to scratches on records providing a totally unwanted dynamic expansion of something which would obviously be better compressed! We noticed this when forced to play two childrens' records just before the children went to bed, and the condition of these were typical of most childrens' records. It was obvious to us that the downward expander is intended for normal scratchy records but never conceived as a cure for badly scratched records.

The first serious record which we played was *Sheffield Lab-1 (SL5/SL6) "Lincoln Mayorga Volume III"* which has a dynamic range greater than any other record which we know. The background noise level on this record was completely inaudible when compared with the natural amplifier noise level in the absence of signal input. Under the conditions of our test the dynamic range which we achieved was in excess of 80 decibels and obviously superior to any other subjective evaluation which we have ever conducted. With the peak unlimiter set to respond to just the absolute peaks of the programme content, the clarity of sound achievable was quite outstanding.

We played a number of other records recorded in the conventional manner, including *E.M.I. Q4.Two.400 "Mandingo"* which is a record featuring over forty instruments, of which more than half are percussion instruments. The results were electrifying, and the record, which we had previously appreciated, took on an entirely new and much wider perspective.

The next round which we used for evaluation was an electronically synthesized record. Surprisingly, at first this did not sound substantially better when played through the Phase Linear 4000. The reasons for this are not hard to find in that the manner in which the music is produced is totally dissimilar to conventional recorded content. Bob Carver himself highlights the difference in his A.E.S. Paper. This is primarily a result of very fast rise and decay times, which are generated by conventional acoustic instruments in a normal recording environment. The circuitry of the Phase Linear 4000 offers little benefit when playing such music and cannot respond adequately to such music nor does the smaller dynamic range of such records benefit from the peak unlimiter and downward expander.

So if your musical taste begins and ends with synthesizers – forget this unit!

MEASURED PERFORMANCE

The total distortion, with voltages of less than one volt output is better than .02% at all frequencies between 50 Hz and 10 kHz. The signal to noise ratio on phono input (which we regard as the most important one) is substantially better than 85 dB. The tone controls offer a smaller degree of control than we have become used to in other pre-amplifiers and combined pre-amplifier-amplifiers, but are nonetheless more than adequate.

The active equaliser provides a 6 dB per octave boost below 50 Hz and certainly flattens out the low frequency response below 30 Hz of the speakers that we were using.

The peak unlimiter works remarkably well and certainly provides a maximum peak unlimited performance gain of +5 dB above the adjustable threshold limit.

The inside construction of the unit is very very interesting. The large numbers of printed circuits, which are all interconnected back into a mother board via printed circuit sockets, hold 45 transistors, 9 integrated circuits, and 57 signal diodes.

Each of the cards has obviously been individually calibrated and checked out during the manufacturing process to optimise performance and provide the promised results.

With regard to mechanical construction we should comment on the method chosen for printed circuit card restraint which is simply two large blocks of urethane foam glued to the inside oftthe top cover and which deform to prevent lateral card movement.

Also, we were surprised to note on removing the cover, the presence of unprotected live terminals on a relay in the power supply circuit, which were remarkably close to the side panel.

In all other respects the unit is well made and offers many more facilities than the average user will call for.

Subjectively, the auto-correlator (so called) noise reduction system works remarkably well, but we were unable to devise a measurement technique satisfactorily to quantify the performance.

We spent considerably more time on the subjective evaluation of this pre-amplifier than we have ever spent on any other piece of electronic equipment which we have reviewed – this was undoubtedly one of the most pleasant tasks that we have had in a long time!

Our overall impression of the Phase Linear 4000 Stereo Pre-amplifier is of a unit which offers unparallelled performance. When coupled to an amplifier of the calibre of the Phase Linear 400 or 700B, fed by a good programme source, and driving good speakers, the unit's performance is truly outstanding.

AUTO-CORRELATION

ETI's Technical Editor Brian Chapman explains . . .

CORRELATION is a measure of the similarity between two quantities. As applied to electronic waveforms it is a statistically based process of recovering signals buried in noise.

Until fairly recently the use of correlation has been complex – involving data recording and computer analysis, and the technique has therefore been limited to such esoteric applications as recovering signals from noise in deep-space communications.

Auto-correlation is a technique in which a signal is multiplied by a time-delayed version of itself to produce an output called the correlated function. If the signal is noise-like there will be no correlation, ie similarity, between the two waveforms – and the correlation function will be low. However if the

signal is sinewave-like the two signals will be highly correlated and the correlation function will be high. The averaged correlation function may now be used as a control signal to alter the gain of an amplifier such that noise signals are attentuated and wanted signals are passed with full gain.

All sounds that occur in nature have a correlation function somewhere between '0' (no correlation) and '1' (100% correlation is pure sine wave). Examples of high-correlation sounds are the sound of a harp, a plucked guitar, a piano and some vocal sounds.

Examples of sounds that have a low correlation are sibilance, the hiss of air through your teeth, wire brushes, multitudinous handclapping, waves crashing against a beach and the sound of rushing water.

The correlation function of music is thus a function which varies from moment to moment and it is necessary for the processing circuits to continuously determine the value of the correlation function.

Correlators intended for scientific use cost tens of thousands of dollars and can recover signals buried deep in noise (even a −60 dB signal buried in +10 dB of noise). The Phase Linear Auto-correlator cannot do that, but it can considerably enhance the signal-to-noise ratio from conventional disc recordings.

There are two versions of the Phase Linear Auto-correlator, an 'A' version which is intended for professional applications and which we understand is not yet on the market, and a 'B' version intended for domestic applications — incorporated in the Phase Linear 4000 Preamplifier.

THE 'A' VERSION

The block diagram of the 'A' version (one channel only) is given in Fig. A. It can be seen that the incoming audio is split into two paths, one path goes to the programme circuits, the other to the control circuits. The correlation function is estimated by the sample-and-hold gates and differencing amplifier. The sample-and-hold gates store the signal amplitude for 50 microseconds after successive zero crossings of the signal. The difference between these two signals is proportional to the correlation function. The correlation function is then used to control the gain of an amplifier (VCA) to the signal which has been high-pass filtered and compressed logarithmically in the spectral weighting compressor.

The output of the VCA then goes to 9 bandpass filters followed by non-linear peak detection to produce a push-pull control voltage for each bandpass region. These control signals control associated notch filters in the programme signal path.

The system effectively examines the incoming signal and, when a fundamental note is present, opens gates for the harmonics of the fundamental. If a fundamental is not present the harmonic gates remain closed thus reducing the hiss level by up to 10 dB.

THE 'B' VERSION

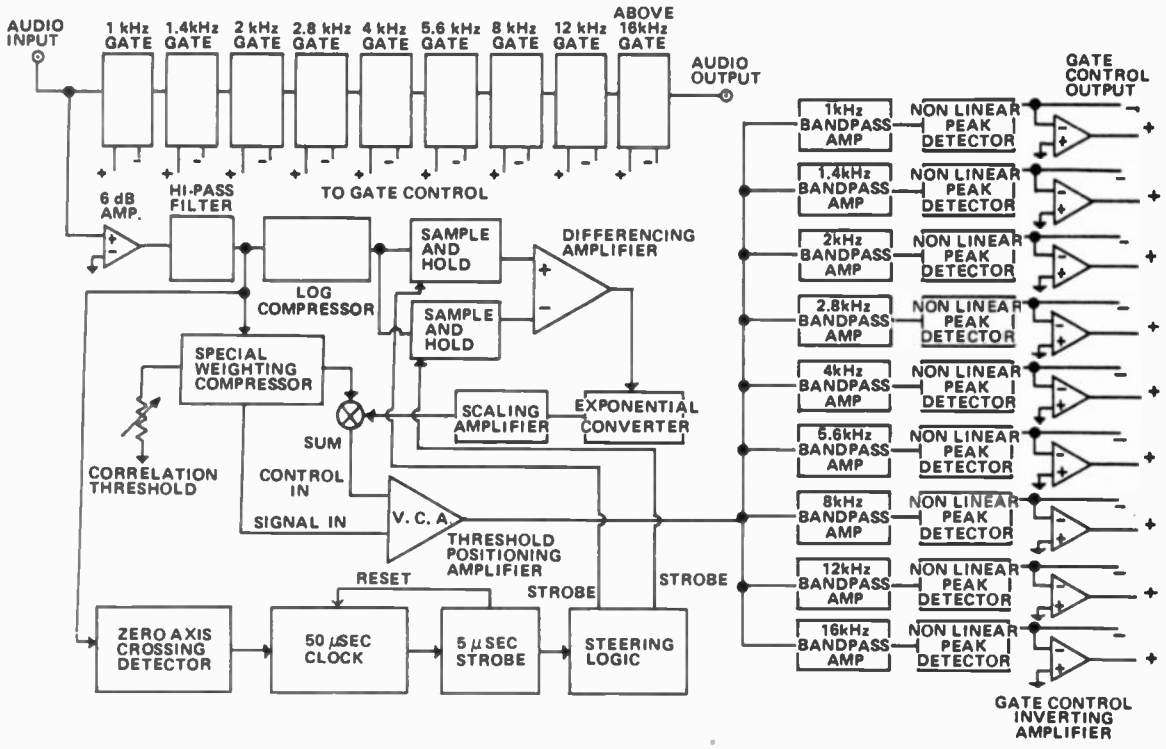
In the consumer version, as fitted to the Phase Linear 4000 Preamplifier, only four, one-octave wide gates are used which results in somewhat reduced resolution.

In addition the complex correlation function estimating circuit has been simplified. The sample-and-hold gates, differencing amplifier, zero crossing detector, clock and steering logic have all been omitted. The system now relies on the fact that the spectral energy of music *approximates* its correlation coefficient. Additionally only one control circuit is used which is common to both channels.

The 'B' version thus does not track as well as the 'A' version, that is, it mistakes noise for music and music for noise on occasions. These effects are minimal however and must be listened for very carefully in order to be heard.

Note however that the simplification of the system has been taken so far in the 'B' version that it cannot really be called an auto-correlator. Nevertheless the system does effectively reduce hiss without sacrificing high frequency content. ●

PHASE LINEAR AUTOCORRELATOR NOISE REDUCTION SYSTEM 'A' VERSION



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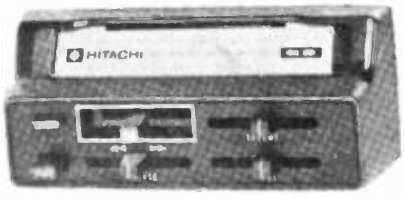

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No. 4 Piece de Resistance - the results

Winner — David L. Craig,
134 Victor St., Holland Park, Qld 4121.

IT NEVER fails to amaze us just how much people like to torture themselves with problems such as this. Must be something perverse or masochistic in human nature.

As usual the ways of solving the problem were as numerous as were the entrants. Generally, however, the methods used fell into the five categories shown in Table I. By far that most commonly used was logical simplification. Frown on it though the purists may, we feel that the application of pure logic to any problem invariably simplifies the calculation finally required.

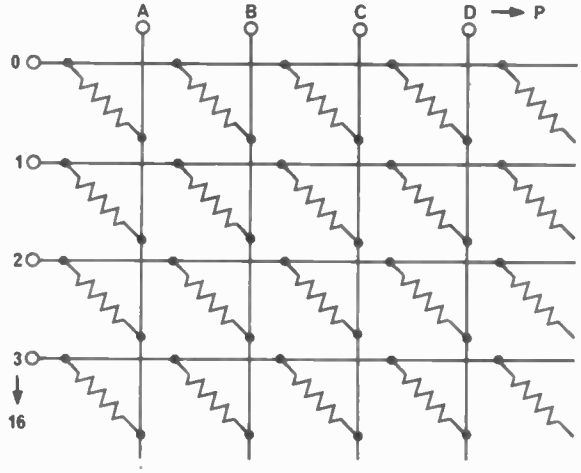
Our winning entry from Mr David Craig gave us a mathematical solution, based on Kirchoff's laws, which is a model of brevity. He coupled this with an equally well explained logical approach to arrive at the same general equation for an n x n matrix. Although many people (75% of all entrants) arrived at the correct answer, very few gave a derivation of the general equation and even fewer explained the problem neatly, as concisely as did our winner. So congratulations David — your free subscription will commence from our September issue.

We have also published the front section of an entry from Mr. J. Forte, who supplied his answer in 70 lines of iambic-pentameter (or something) which would have given the shudders even to McGonnegal. As if the problem itself was not enough!

Somehow, in the printing, our 16 x 16 matrix became a 16 x 17 matrix. However this does not materially alter the problem and those people who calculated the answer on this basis, including Mr Forte, were not penalized.

Hats off to the lonely hero who tackled the problem using star-delta transformation — must have taken him almost the whole month to do it. However no marks at all to the equally lonely reader who tackled the problem with a computer and got it wrong.

Just goes to show you — computers do *not* make mistakes it's the input device that is the main problem.



A 16 x 16 matrix has 10 ohm resistors connected across intersections as shown in our partial drawing.
What is the resistance between lines 8 and F?
How does resistance change if any other pair of lines are chosen instead?

SOLUTION TO PIECE DE RESISTANCE No. 4

1. Resistance between lines 8 and F = $1\frac{27}{28}$ ohms.

2. Resistance does not change if any other row and column are chosen.

The 16 x 16 matrix with 10 ohm resistors is a special case of the general n x n matrix with R ohm resistors. For the n x n matrix the resistance between any row and column

$$= \frac{(2n-1)}{n^2} R$$

Two methods are given below solving the n x n matrix: the first is a straightforward application of Kirchoff's law which says that the sum of currents at a node equals zero; the second uses a more intuitive approach to derive a simple equivalent circuit for the matrix.

Method 1

Suppose a voltage V_s is applied between any row 'a' and any column 'b' of an n x n matrix with resistors R. Then the resistance between the driven row and column is

$$R_s = \frac{V_s}{I_s} \text{ if } I_s \text{ is the current into the network.}$$

The current through any resistor is

$$\frac{(V_i - V_j)}{R}$$

Applying Kirchoff's law to the rows and columns of the matrix gives:

(i) For the undriven rows, i.e., i=1,2, . . . n but i≠a

$$\sum_{j=1}^{n} \frac{(V_i - V_j)}{R} = 0$$

$$nV_i - \sum_{j=1}^{n} V_j = 0$$

$$V_i = \frac{1}{n} \sum_{j=1}^{n} V_j$$

i.e., the voltages on all undriven rows are the same.
(ii) For the undriven columns, i.e., j=1,2, . . . n but j≠b similarly to (i)

$$V_j = \frac{1}{n} \sum_{i=1}^{n} V_i$$

i.e., the voltages on all undriven columns are the same.
Using the results of (i) and (ii)

$$\sum_{j=1}^{n} V_j = (n-1)\, V_{j\neq b} = nV_{i\neq a}$$

and $$\sum_{i=1}^{n} V_i = V_s + (n-1)\, V_{i\neq a} = nV_{j\neq b}$$

i.e., $$V_{j\neq b} = \frac{n}{(n-1)} V_{i\neq a} \text{ and } V_{i\neq a} = \frac{(n-1)}{(2n-1)} V_s$$

(iii) For the driven row, i.e., i=a

$$I_s + \sum_{j=1}^{n} \frac{(V_s - V_j)}{R} = 0$$

$$I_s R + nV_s - \sum_{j=1}^{n} V_j = 0$$

$$I_s R + nV_s - n \frac{(n-1)}{(2n-1)} V_s = 0$$

i.e., $$R_s = \frac{V_s}{I_s} = \frac{(2n-1)}{n^2} R$$

Clearly the row and column chosen make no difference to this result.

Method 2

Again consider a voltage applied to the selected row and column.

Since the network consists of the same number of identical branches whichever row and column are selected,

(i) the resistance of the matrix is the same whichever row and column are selected,
(ii) the voltage at each of the undriven rows is the same,
(iii) the voltage at each of the undriven columns is the same.

Because of (ii) all the undriven rows can be connected with a short-circuit without affecting the resistance of the network.

Similarly, because of (iii) all the undriven columns can be connected.

By connecting the undriven rows and columns as above, the n x n matrix reduces to an equivalent 2 x 2 matrix. The resistor values in the equivalent circuit are the paralleled values of resistors placed in parallel by connecting undriven rows and columns.

The resistance between row 'a' and column 'b' is the parallel combination of

$$R \text{ and } \left(\frac{2}{n-1} + \frac{1}{(n-1)^2}\right) R$$

i.e. $$R_s = \frac{(2n-1)}{n^2} R$$

Fortunately this agrees with the answer obtained by Method 1.

Submitted by David L. Craig, 134 Victor St., Holland Park, Qld, 4121.

Due to lack of space the drawings associated with these proofs could not be published.

SIR ELECTRON DE GROBLEMS

I approached my good friend Sir Electron de Groblems,
Who excels in the elegant solution of problems.
"Electronics Today" has a beauty, I said;
And so to him the problem I read.

After twiddling his whiskers and musing,
He said "THIS is far too confusing!"
"Let us redraw the circuit in a much simpler way"
(I copied it down from Electronics Today).

He went on explaining that to drop down line "8"
And move out row "F" was – "the key to it mate".
"We now have a matrix symmetrical you see,
With equal resistors, all 10 ohms they be."

"The symmetrical matrix I'll surround with some dots,
While we look at the problems around other spots.
You'll see I removed resistor F8 to one side.
We'll consider it later – for now it can hide."

"I know of a fellow named Kirchoff he said,
Who's laws will let me solve this in my head.
In column F let one amp flow quite evenly,
And divide into 16 resistors all equally"

One sixteenth amp will flow in each circuit
(Marked current A to help me explain it)
This will divide again – now you will see
Into 15 more paths (marked B if you please)"

"This current is equal to one fifteenth of A,
Then B is one over two forty amperes this way
I can do the same trick for the rest of the columns
And from this we can solve the rest of the problems."

"This current called B no longer divides,
It combines sixteen times, coming in from all sides.
I've shown it as C and its equal I'm sure
To one fifteenth amp, no less and no more."

"To complete the full circuit there just is no doubt,
The current going in must surely come out!
So we have fifteen resistors (at 8 they do sum),
With one fifteenth amp in each – that returns us to one."

"We know all resistors to be at 10-ohm,
So voltages now can easily be shown.
Current A times 10 will give us V_A
(V_B and V_C can be found the same way)."

"If we add these all up and divide it by one,
You'll find it's a resistance we have as the sum.
I calculate this to be 4 over 3
I'm sure you can see this as plainly as me."

No. 4 Piece de Resistance

"This resistance I will name for convenience 'R' proved,
And we now can consider R_{F8} I removed.
This is in parallel with R proved it is plain
And on combining the two we will come back again.

To R_X that we want, and then we can see
One and three seventeenth ohms the answer to be.
But this is not all! We have further to go
There are some more things we must endeavour to show."

"Because our matrix in dots remains still,
We can interchange letters or numbers at will,
This means in a nutshell, wherever we choose,
The resistance is constant whatever number and letter we use."

"The resistance between letters is easy to get;
We have 17 numbers and on this I will bet,
If a voltage is placed between letters you'll see,
All number rows equi-potential will be."

"This makes the problem so easy, my friend,
As 17 parallel paths are the end,
This I have drawn so all can bemoan,
Resistance between letters is one and three seventeenths ohm."

"Now between those fair numbers the answer is different,
As sixteen paths are plainly evident,
This gives us between numbers an answer quite clear,
Of one and one quarter ohms (exactly I fear)."

"So there is the answer, enough has been said,
With such mental exercise I'll now go to bed."

Submitted by I. Forte, 8 Warubi Avenue, Ingle Farm, 5098.

BREAKDOWN OF ENTRIES

Correct	65%
Incorrect	35%
Methods Used:	
Logical simplification	77%
Matrix analysis	5%
Kirchoff's Laws	14%
Star-Delta Transformation	1 only
Computer analysis	1 only (incorrect)

Most common incorrect answers in order of frequency 10 ohms, 0 ohms, 5.5 ohms, 1.33 ohms.

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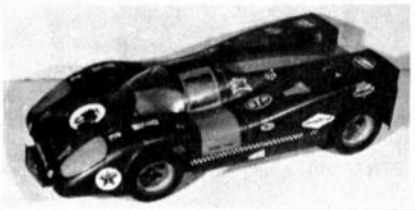

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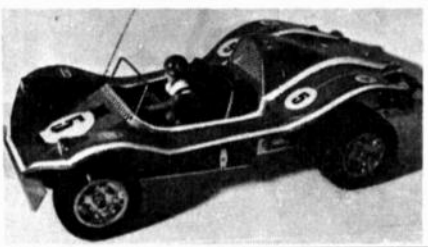

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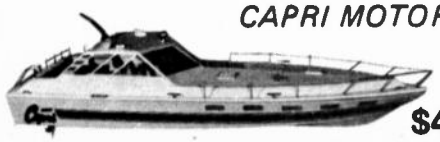

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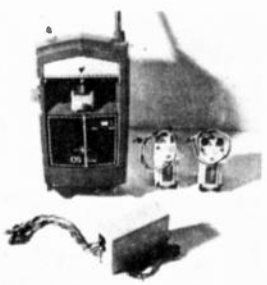

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UNDERSTANDING COLOUR TV

Picture quality adjustments

by Caleb Bradley B. Sc.

A PAL colour television with conventional shadowmask display tube is capable of giving an astonishingly 'true to life' colour picture but this depends on correct setting of a large number of preset adjustments. Since a very large proportion of the colour serviceman's (expensive) time is spent on these adjustments, which for best results should be rechecked at intervals, an electronics-minded viewer can find it worthwhile to tackle some or all of them himself. With unhurried work he can bring his set's performance close to that of a high quality studio monitor.

CONTROLS COMMON TO MONOCHROME SETS

The following adjustments, the first few of which are accessible to the viewer, need no explanation since they are familiar from monochrome receivers:

ON/OFF – VOLUME
BRIGHTNESS
CONTRAST
VERTICAL (FRAME) HOLD
HORIZONTAL (LINE) HOLD

(Because of the critical timing functions of the colour receiver line output stage this control must be set more carefully to the centre of its 'flywheel' lock-in range than is necessary on monochrome sets.)

VERTICAL SHIFT
HORIZONTAL SHIFT
HEIGHT (FRAME AMPLITUDE)
VERTICAL LINEARITY
FOCUS
WIDTH (LINE AMPLITUDE)
AND/OR E.H.T. VOLTAGE

(This control should only be adjusted with reference to the manufacturer's data which generally calls for use of a special e.h.t. meter to ensure that the tube third anode supply never exceeds a specified voltage, typically 22-25 kV.)

SPECIAL CONTROLS FOR COLOUR

Surprisingly the majority of these are best assessed and set up on *monochrome* pictures although they all contribute to the colour picture. They arise from the basic shadowmask tube principle of creating a picture by combining three primary-coloured images on the same screen. The images are produced by three separate electron guns whose beams are made to scan by a common deflection coil assembly over three separate arrays of phosphor dots. This process depends for its success on precise positioning of the three beams relative to the shadowmasked screen and the adjustments to achieve this are grouped under the titles PURITY and CONVERGENCE. Some are electrical adjustments and some are mechanical; the mechanical adjustments on the tube neck are identified in Fig. 47.

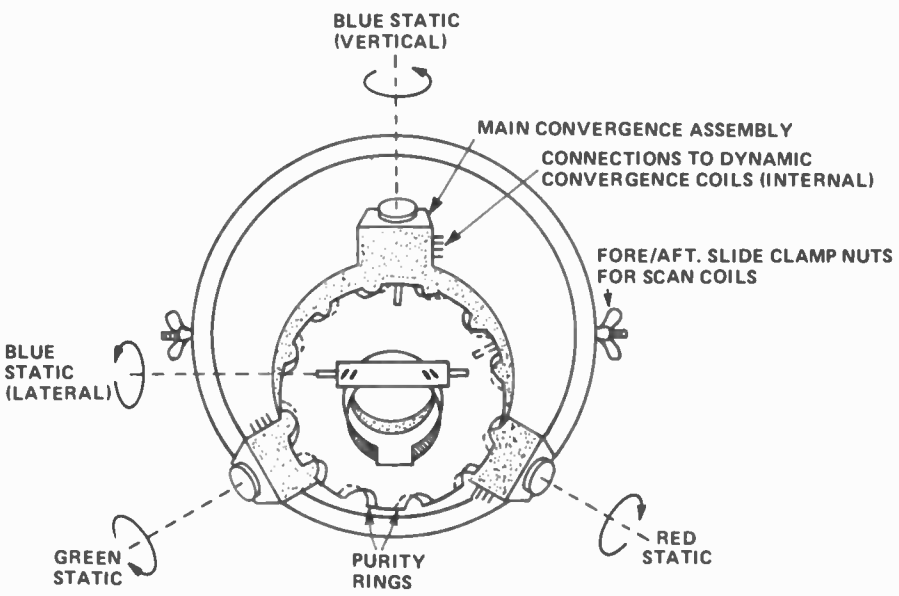


Fig. 47. The usual purity and static convergence adjustments located on the tube neck – viewed from the rear of the set.

This subject was dealt with in Part 7. To summarize, the shadowmask is only able to direct the three electron beams correctly to their corresponding phosphor dots over the whole screen area if the effective beam deflection centres are correctly located. The 'purity' adjustments available to achieve this are two flat ring magnets on the neck of the tube and a fore-and-aft sliding movement of the scan coils.

The state of purity of a receiver is best checked by switching off two of the three beams by means of the first anode cutoff switches provided and inspecting the remaining image for uniform colour. It is best to inspect the red image since any spurious tinges of blue or green are easily spotted. If the contrast can be fully reduced to give a plain red raster the job is even easier.

An uncritical viewer is unlikely to notice minor purity errors. Here is a guide to their effect on normal programme pictures. Colours of objects (which should be constant) vary – depending on their position on the screen. Large areas of uniform colour which occur occasionally in programmes (such as expanses of blue sky or backgrounds to captions) will show up any areas of impurity. On a monochrome picture a serious purity error shows as a large stationary blemish of *different* colou tinge from the rest of the picture and is the same for all pictures.

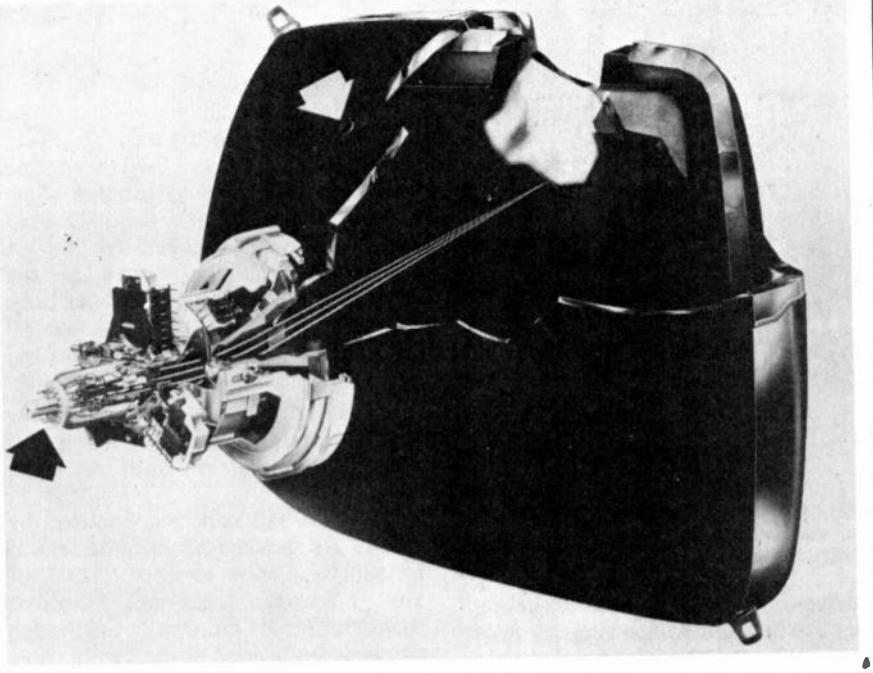
Having detected some purity error, heed a note of caution: if the purity adjustments are touched the convergence adjustments described later will certainly need to be retrimmed as well.

If you decide to forge ahead, set up a red raster, preferably plain, as

CAUTION

Very high voltages – up to 25 kV – are common in colour TV receivers. Do not attempt to undertake the adjustments described in this article unless you are very experienced in handling equipment that operates at such potentials.

The main danger areas are indicated by the two arrows shown on the picture tube (right).



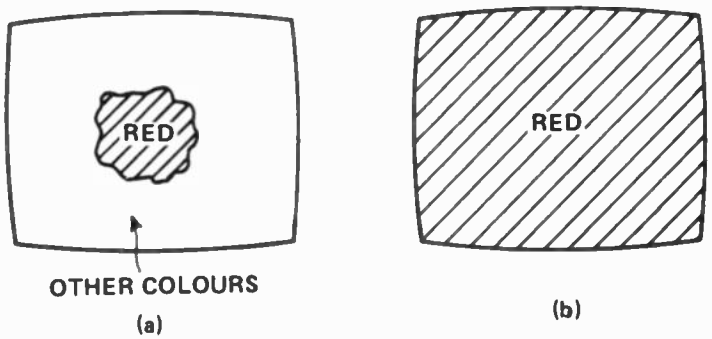


Fig. 48. Purity adjustment is done with the red gun only working. With the scan coils pushed fully forward, the purity rings are used to position the beam deflection-centre horizontally and vertically, to obtain central red spot as in (a). The scan coils are then brought backwards sufficiently to obtain a pure raster as in (b).

described. Note the positions of the purity rings (Fig. 47) – they always have identifying tabs or slots. Experimentally rotate them together and singly, noting the effect on the red raster. With large sets a mirror makes this much easier. Probably the red raster can be 'purified' in this way; if not follow the full procedure involving the scan coils as follows.

Loosen the clamp wingnuts and push the coils fully forward so they hit the tube flare. Then adjust the purity rings for pure red at the *centre* of the screen – Fig. 48. Overall red cannot be obtained at this stage. Then gradually pull the coils backward. The red area should expand to fill the whole screen. If the coils are brought back too far the purity worsens again. The 'perfect' position should not be hard to find and the rings can be retrimmed if necessary. Having purified red, check the blue and green rasters separately. These should also be pure.

If purity absolutely cannot be obtained the shadowmask may somehow have become magnetised. Check that the set's automatic degaussing (Part 7) really works; if so, treatment with a portable degaussing coil may be needed.

CONVERGENCE

This aspect of the adjustments can also be called registration since it is concerned with superimposing exactly the three colour images. In practice it is rare for a colour set to show no registration errors at all. They are most evident on monochrome pictures. Inspect the outlines of sharply defined objects in these pictures. Convergence errors cause black-to-white edges to have coloured fringes . If there is error over the whole screen, do the relatively simple STATIC adjustments (see below) which may be sufficient; if the errors occur in some parts of the picture more than others the more demanding DYNAMIC adjustments need attention.

STATIC CONVERGENCE

The static convergence adjustors are rotatable magnets mounted on the tube neck by which the three pictures can be individually shifted to achieve registration. There are three radial

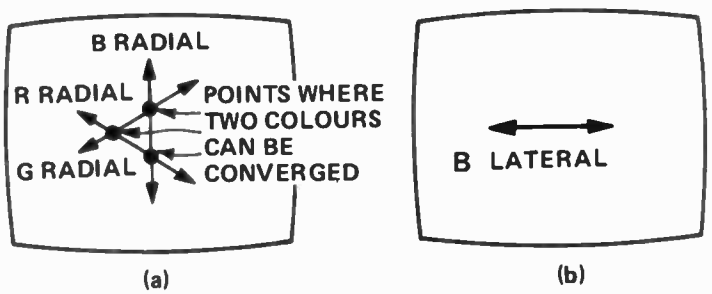


Fig. 49 (a). The R, G and B picture shifts produced by the radial static adjustors (on the main convergence assembly).
(b). The shift given by the blue lateral static adjustor which is necessary for complete convergence of R, G and B.

UNDERSTANDING COLOUR TV

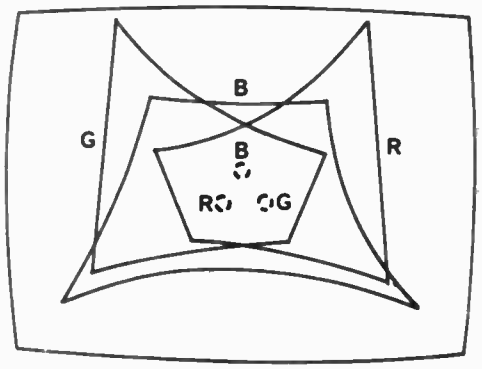


Fig. 50 As the three guns are not mounted on the tube axis, and the length of the beam paths alter over the screen area, the rasters are distorted as shown (exaggerated).

adjustors (Fig. 47) whose magnetic fields are brought to the tube by pole pieces inside the convergence assembly and focused on the electron beams by ferrous plates inside the tube. Their effects on each image are shown in Fig. 49a; alone they enable any two images to be converged, but not all three. To achieve this a fourth adjuster on one beam, conventionally a blue lateral adjuster is needed – Fig. 49b).

It is very hard to do static convergence on moving pictures and it is best to wait for a stationery test pattern transmission. Most patterns include something like a white cross or dot at the centre of the screen to make this adjustment easy. Switch off the blue gun which leaves a red + green (equals yellow) picture. Adjust the red and green radial magnets for perfect convergence at the centre of the screen. Switch on blue and use both the blue radial and blue lateral adjusters to bring all three pictures together at the centre.

Purity and static convergence are slightly interdependent so it may be necessary to retrim both of them again.

Sit back and consider whether the results are satisfactory because now is an excellent point to stop! Look over the whole screen showing monochrome pictures. Although convergence is good at the centre there may be errors elsewhere. Their cure involves the dynamic convergence adjustments whose purpose should be well understood before tackling.

DYNAMIC CONVERGENCE

In a simple world the screen and shadowmask would be shaped as part of a sphere centred on the beam deflection centre. In practice viewers demand near-flat screens and with colour there are three deflection centres at slightly different positions.

The result is that the rasters which should be rectangular are distorted as shown in Fig. 50. Dynamic convergence is an electronic process of 'counter distorting' each raster back to rectangular shape, without which overall convergence is obviously impossible. It is achieved by circuits which feed special current waveforms – mixtures of sawtooth and parabolic currents at both line and field frequencies – through coils wound on the internal pole pieces of all four static adjusters in Fig. 47. Thus the magnetic field applied to each beam comprises both a steady flux contributed by the static magnet and a complex alternating component.

The distortion of each raster in Fig. 50 is a combination of two effects. The first is pure 'pincushion' distortion caused by the flatness of the screen. Looked at another way it is caused by the increase in beam length towards the edges of the raster. This increase follows a parabolic law. Correction is possible by supplying the dynamic convergence coils with a parabolic current in the opposite sense. Correction in the vertical sense

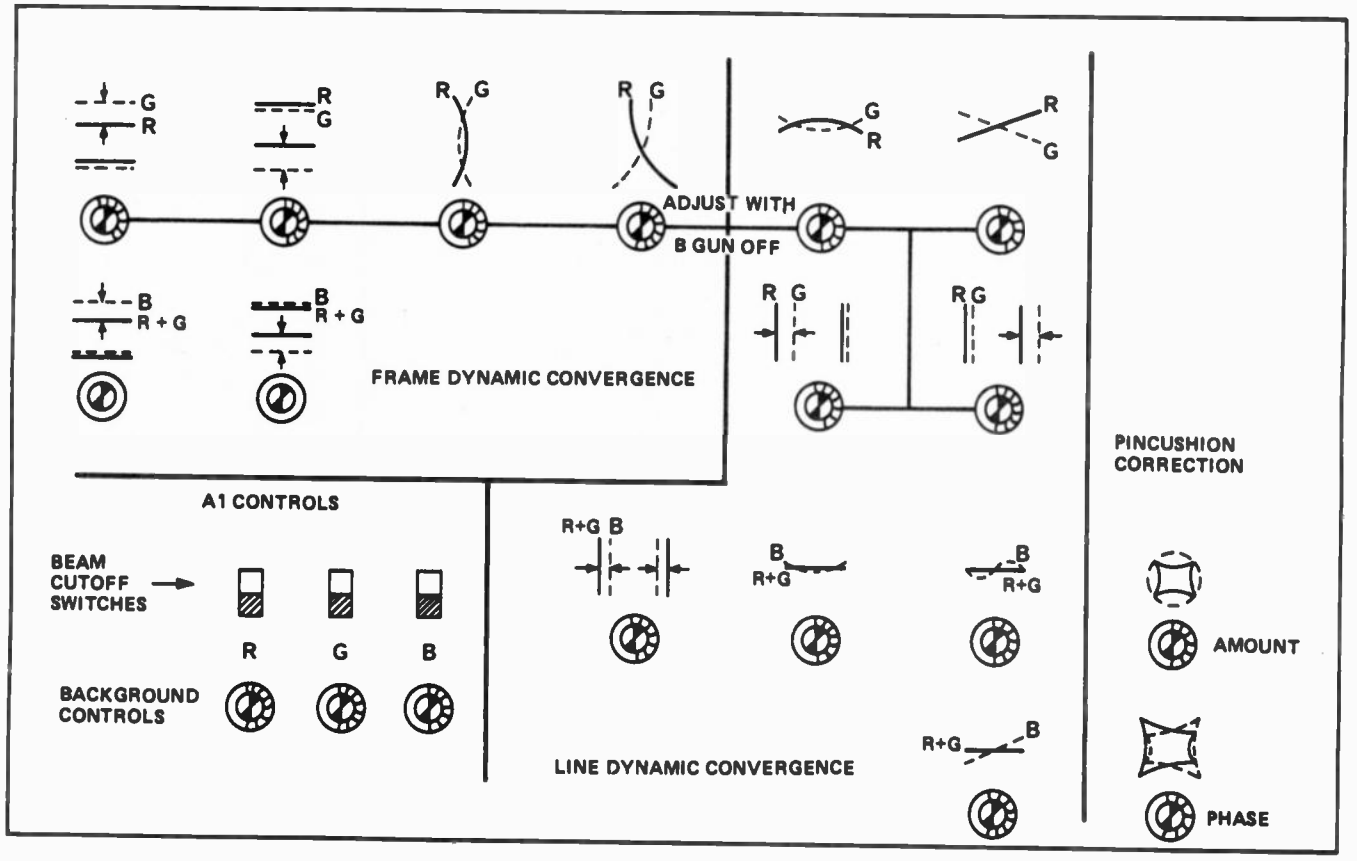


Fig. 51. Convergence control panel of a typical domestic receiver. This also includes pincushion and A1 (first anode) controls.

requires a parabolic current at field frequency and correction in the horizontal sense requires a parabolic current at line frequency.

The second distortion is asymmetry caused by the unavoidable displacement of each gun from the tube axis. This is countered by sawtooth currents, again at both line and field frequencies.

Dynamic convergence circuits therefore consist of networks of resistors, capacitors and inductors which derive from the main line and field scan waveforms (sawtooth shaped) the necessary mixtures of sawtooth and parabolic waveforms for each dynamic coil. The parabolic waveforms are obtainable by integrating sawteeth.

Most of the components are variable presets to enable the optimum convergence to be set up and the total number of controls may be more than a dozen. Circuits vary greatly between manufacturers and it is not really necessary to understand them in detail because the function of each control should be clearly marked. A typical arrangement is shown in Fig. 51.

CROSSHATCH PATTERN

It is hopeless trying to adjust the dynamic controls on a normal programme picture. What is needed is a stationary monochrome pattern designed to show up any convergence errors. Transmitted test patterns are usually far from ideal. The perfect pattern is a crosshatch of thin vertical and horizontal lines as shown in Fig. 52. Until lately this could only be obtained from expensive workshop equipment (any colour service workshop should be equipped with generators for this pattern and the colour bars pattern for decoder alignment) which provides an r.f. signal suitable for feeding to the aerial sockets of receivers. A low-priced crosshatch generator project is included in this issue of ETI. This unit enables any owner to bring his colour set to ideal convergence.

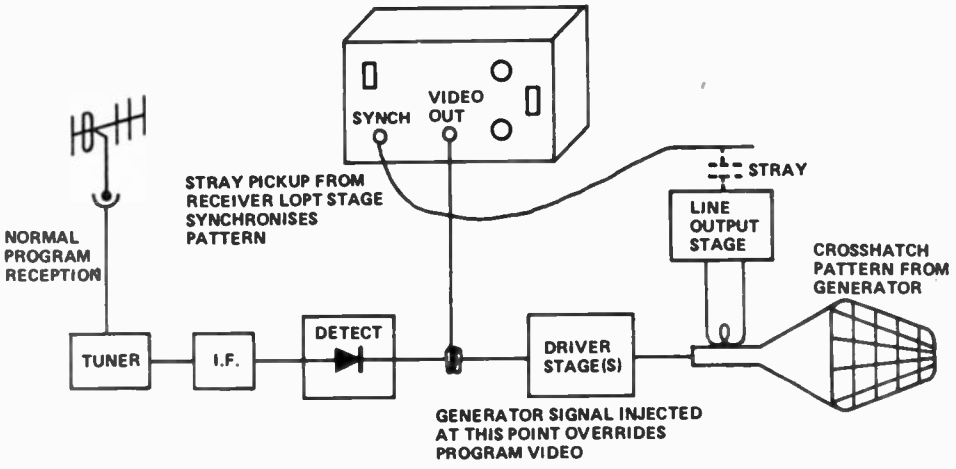


Fig. 53. Connection of direct-injection crosshatch generator to a receiver.

ADJUSTMENT

Having obtained a crosshatch pattern on the screen the dynamic errors can be investigated and compared with the markings on the convergence controls. These will be found concealed somewhere on the set, often lurking behind a 'secret' panel. The correct procedure is to switch off the blue gun and concentrate on converging red and green, the aim being a yellow crosshatch without red or green fringes. Do not turn controls at random; instead make a mental note of what each control actually does e.g. 'bends red verticals to the left' or 'contracts red horizontals at bottom'. Then plan each new adjustment before making it. Soon you will find which controls are interdependent and which errors cannot be completely eliminated, only 'traded off' against errors in other parts of the picture.

Switch on blue and use the blue controls to approach the ideal white fringe-free crosshatch. The static magnets can be trimmed at any time if necessary.

SECRETS OF GOOD CONVERGENCE

There is a degree of skill in converging which becomes second nature after one has converged two or three sets. The following adjustments affect convergence in varying degrees and should be finalized *before* convergence adjustment: Height, Width, Linearity, Focus, EHT Voltage, Purity. However the controls for contrast, brightness, grey scale (to be described), tuning and decoder adjustment have no effect on convergence so can be moved at any time.

During adjustment keep a clear view of the entire screen at all times — it is so easy to over-concentrate on removing an error in one part at the expense of the rest. Go through the interdependent adjusters several times moving each control slightly *less* than seems necessary. If the variable inductor for converging the blue verticals goes to one end of its range the wires to the blue lateral coil may need interchanging. Every dynamic

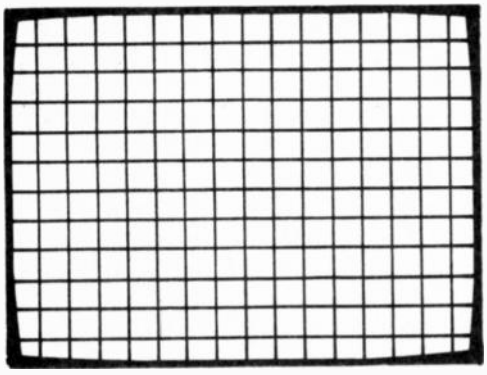
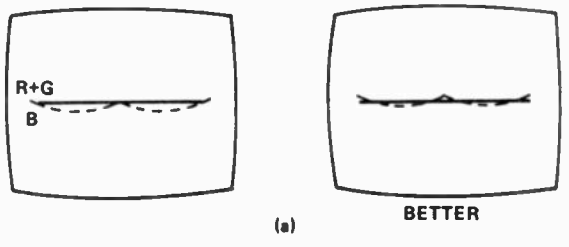


Fig. 52. The crosshatch pattern of white lines on a black background which is virtually essential for dynamic convergence adjustment. It enables any error to be related to the typical control set up shown in Fig. 51.



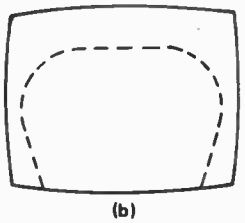


Fig. 54. Tips for good convergence. (a) If two colours cannot be perfectly converged it is better to distribute the residual errors, with less attention to the edge of the screen, than to insist on perfect convergence at the centre. (b) The viewer is more likely to notice convergence errors inside the area shown. Thus small corner errors can usually be tolerated.

UNDERSTANDING COLOUR TV

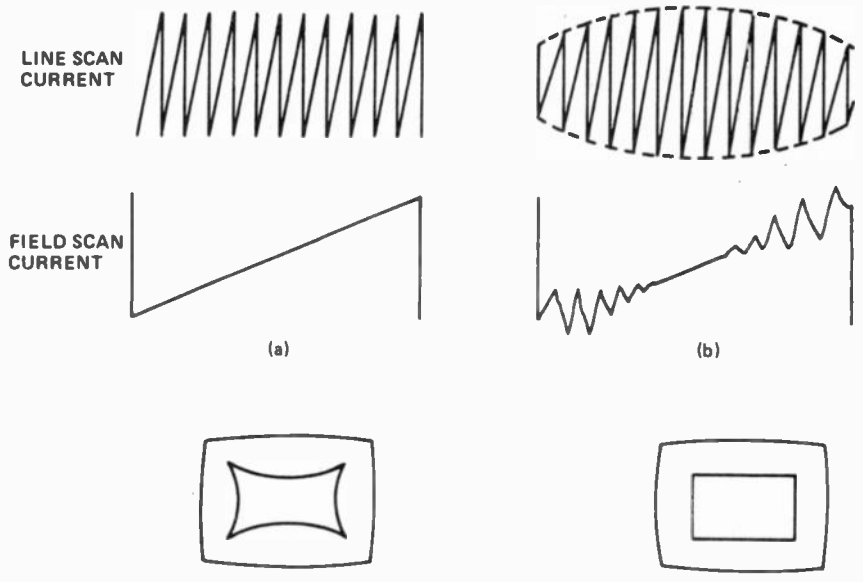


Fig. 55 (a). Line and field scan currents without pincushion correction.
(b). Pincushion correction obtained by cross modulation in transductor – see text.

control should have a visible and progressive effect on the crosshatch pattern and failure to do this suggests a fault in the convergence circuit. If a wirewound potentiometer has an abrupt effect at one point of its travel it may have burnt out – regrettably these components are often over-run.

It is rarely possible to achieve perfect convergence over the whole screen including the corners and the real skill lies in distributing the residual errors so they are not noticeable to the viewer. Fig. 54 should be helpful here. Once converged as finely as possible a colour set should ideally not be moved since merely rotating it through 90° relative to the earth's magnetic field can have a minute upsetting effect.

GENERAL RASTER CORRECTION

A certain amount of pincushion distortion is common to all three rasters and is usually corrected by a special transformer called a transductor. This consists of three windings on the limbs of an E-shaped Ferroxcube core. The two outside windings are in series and are connected in shunt with the line scan coils; the middle winding is connected in series with the field scan coils. The transductor causes a degree of cross modulation between the line and field scan amplitudes due to progressive saturation of the E-shaped core with increasing flux. The effect is shown in Fig. 55. Usually there are one or two controls associated with the transductor to allow the form of correction to be varied to obtain a truly rectangular raster. ●

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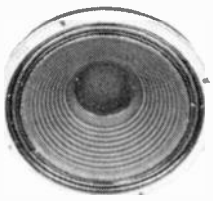

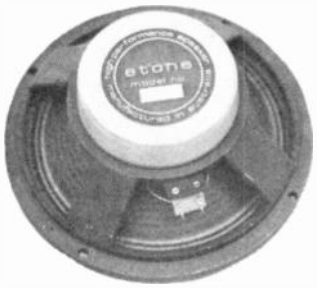

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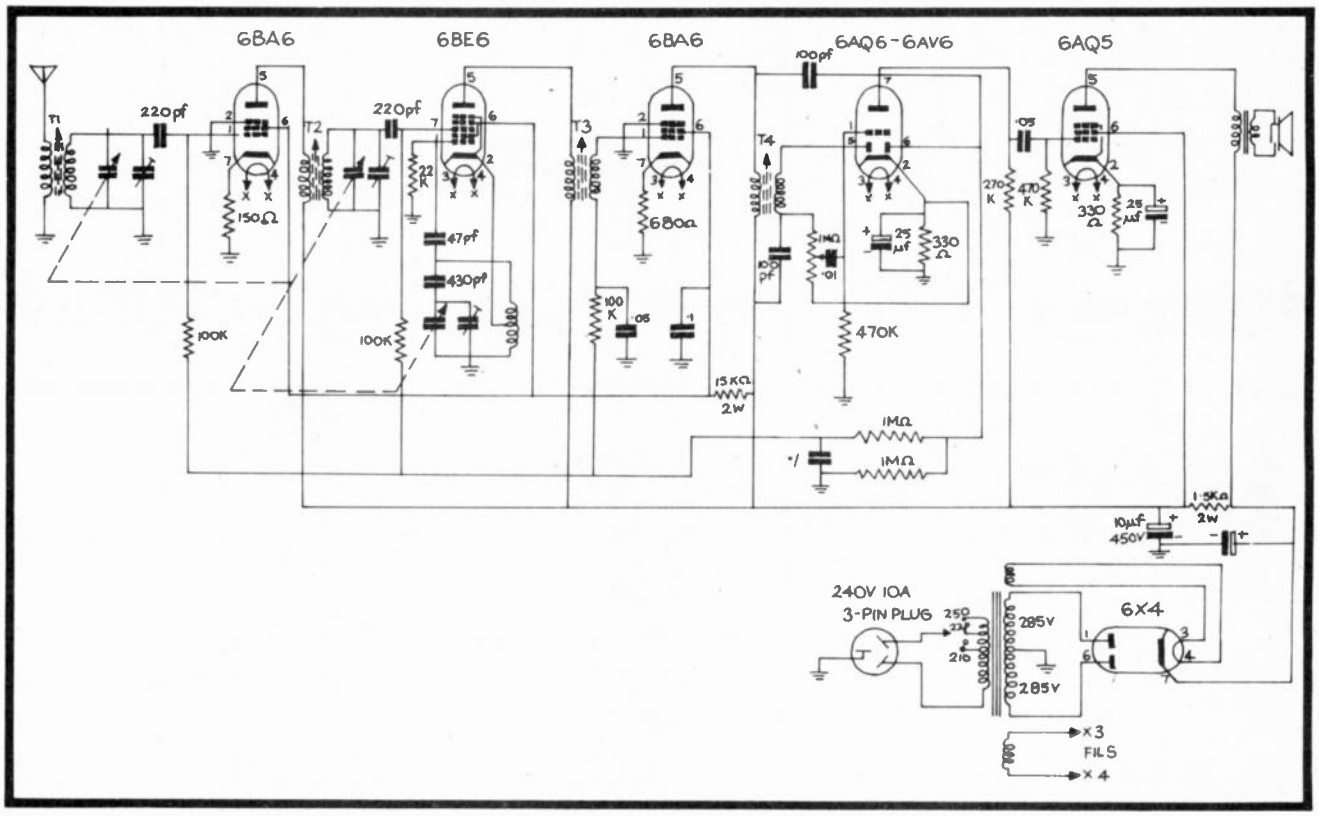

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PART 21

Introducing Digital Systems

WE BEGAN this course with a discussion of electronic systems in general; what they do, how they do it and how we can progressively break down a complex system into fundamental building blocks. The example chosen then, a TV system, uses, in the main analogue signals. These we know from other parts of the series are those signals that contain information in the form of many continuously changing levels of an electrical voltage (or current).

Although we have already introduced the concept of the on-off, or digital kind of signal, the course so far has concentrated almost entirely on the linear, analogue circuits used in electronic systems. The time has now come to study an alternative philosophy and practice, by which tasks can be accomplished in another manner — the digital electronic approach.

DIGITAL OR ANALOGUE SIGNAL APPROACH?

By itself a purely electronic system has no real value until it is applied to the real world we exist in. At the input of a system physical variables are measured by sensors that convert the information, from the original form of energy, into an electrical signal. This electrical-input signal is then conveyed, through the system being modified, and converted in different ways as required. The output signal from the system is fed to actuators which convert this signal back to real-world variables at the output. It is the differences between two basic means of transmitting and converting information that we are concerned with now.

We have seen in the earlier part dealing with information that both analogue and digital signals can convey the same information between two points. It is a matter of how the information is coded on the signal. It is not possible to state categorically that one signal form is better than the other. Each has its advantages depending upon the application. Analogue systems can process the same information using far less components, than their digital counterparts, but they are unable to provide anywhere near the same ultimate accuracy, precision and long-term stability. In some uses, such as precise mathematical computation, digital techniques are a must. The same holds true for measuring equipment needing better than around 1 percent, or perhaps 0.1 percent, accuracy.

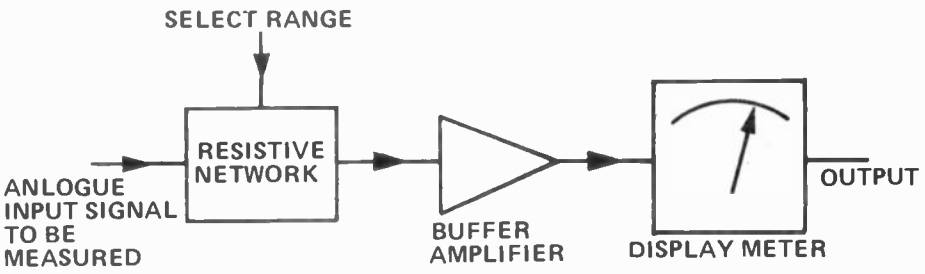

Fig. 1. Schematic representation of analogue multimeter system.

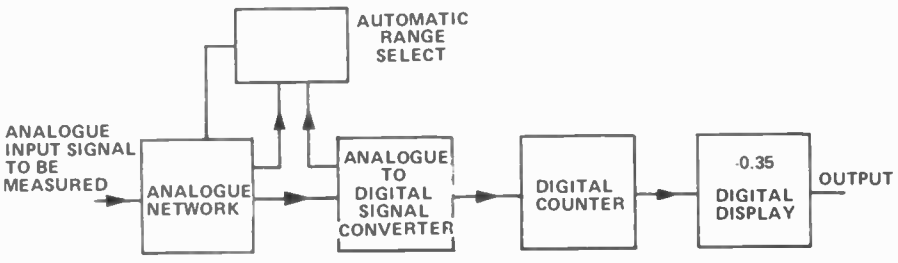

Fig. 2. Digital multimeters contain black boxes that operate with digital rather than analogue signals.

Other factors that decide the choice of signal form are the cost of components needed, the size of equipment and power supply demands. Today, the enormously large-volume production of digital circuits, especially when marketed as large-scale integrated systems, coupled with the tremendous effort that has been expended on digital techniques for computing markets, has now tipped the balance heavily in favour of using digital methods. This is now true even for what have traditionally been analogue applications. It may well now be cheaper to use a mass-produced digital assembly for a more unusual analogue requirement, even when analogue circuits could easily supply the need.

Take, for example, the choice confronted when purchasing a good quality multimeter. The traditional multimeter can be represented as a resistive network driving a display meter — see Fig. 1. The signal level can be ascertained by the degree of pointer deflection seen on the meter. High input impedance units incorporate a linear amplifier to buffer the signal source against a relatively low-impedance meter movement. Apart from the selector switch which has discrete settings, all components work with analogue signals and this means they must be linear in operation and adequately stable with time. Some components — the ballast and shunt resistors, for instance — must be made to tolerances that require expensive hand-made manufacture. We can summarize the situation as one where only a few components are needed but they are inherently expensive.

The alternative is to use a special circuit that we will discuss in detail in a later part. This is called an analogue-to-digital converter (or just A-to-D converter). As represented in the schematic of a digital multimeter given in Fig. 2, it converts the analogue input level into a digital signal form that is then used to drive a digital readout display. These units display the output value as a decimal number rather than as the position of a pointer as is used in totally analogue systems. We will see, as we delve more deeply into how such a system works, that the digital alternative uses literally dozens of active elements and many

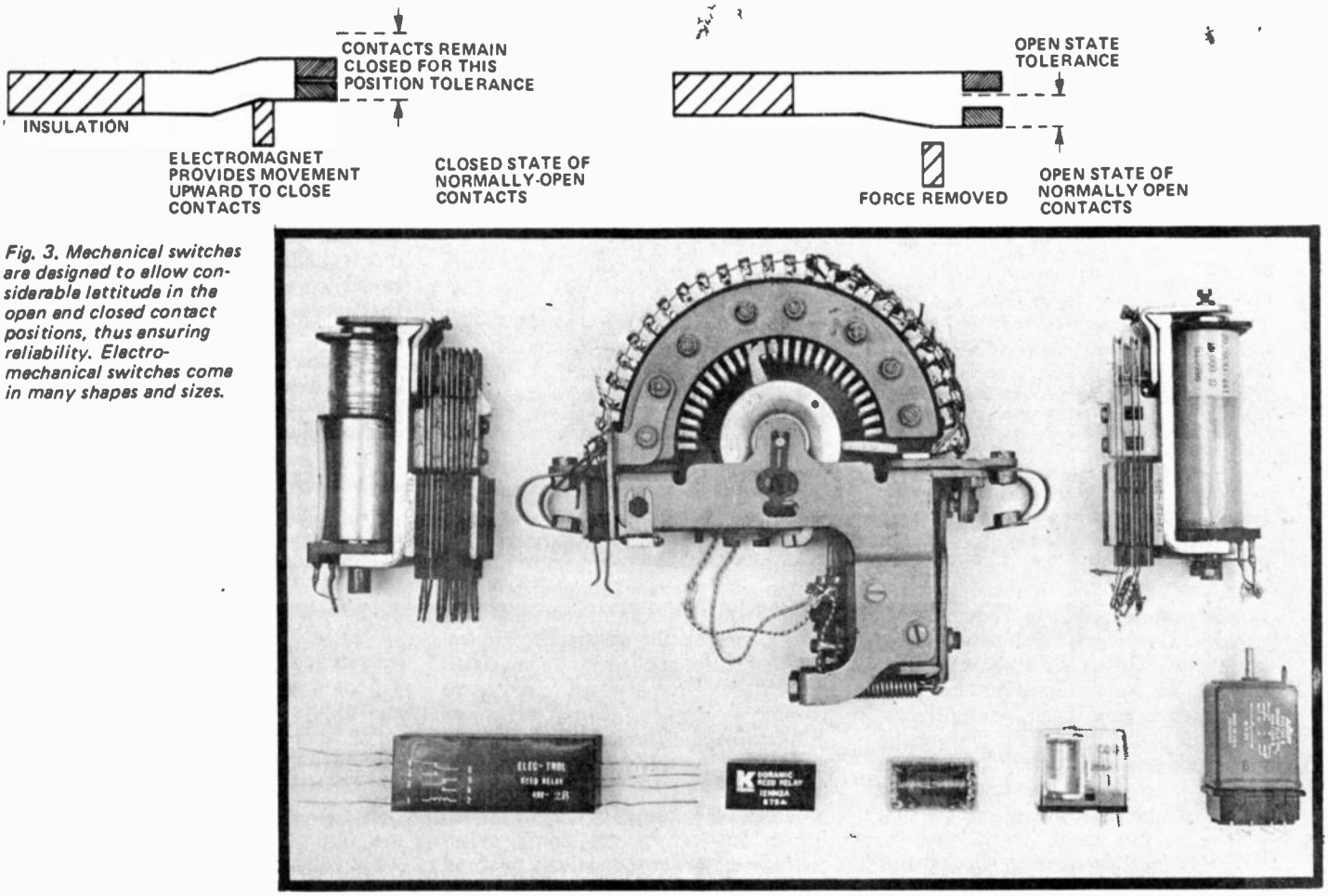

Fig. 3. Mechanical switches are designed to allow considerable lattitude in the open and closed contact positions, thus ensuring reliability. Electro-mechanical switches come in many shapes and sizes.

many more passive components than an analogue type of multimeter. Yet, today, there is little difference in the cost of either alternative for the same accuracy. The digital scheme, however, can be made considerably smaller, may be made more accurate, uses no more power and may even have circuitry that automatically selects the most appropriate range for itself.

Another example is found in computing. We have seen how operational amplifiers — those that perform linear arithmetic inherently — can be used to solve equations and do complicated arithmetical operations in what are called analogue computers. These can provide extremely powerful solutions of mathematical problems for quite small outlays. But only if the problem does not require high-accuracy — then digital computation is needed. Another instance where digital method is a must is when the problem involves logical type operations where yes-no decisions are needed. Digital computers can sort information into groups and decide which way to proceed at a decision junction. This will become clearer when we discuss the mathematics of logic which is quite unlike normal algebra.

As with the multimeter example, digital computers also involve many more components than the analogue units that would perform similar tasks. Yet, somewhat strangely, they can be far less expensive, much more accurate and more reliable. Undoubtedly the trend in electronic systems is toward more use of digital solutions — but this does not mean that analogue systems have no place in electronics.

One dominant reason why digital systems can be so reliable and positive to design is that the signal operations involve switching rather than continuous-mode action. We, therefore, begin our study of digital systems by looking at the design merits of various switching devices, starting with the mechanical kind.

MECHANICAL SWITCHES

The ON-OFF switch has only to define two states of circuit operation and hence the tolerances associated with each state can be very wide. Consider the basic mechanical switch having two contacts as shown in Fig. 3. When the contacts are disengaged it matters little how much further the designer separates them; the further they separate the less the chance of a spurious make-condition occurring. Conversely, when closed the spring action will ensure contact over a wide range of relative positions. The harder the two contacts are pressed together the better the reliability, but there will be negligible electrical change in the circuit-made state.

Continuing with the mechanical switch example we can also easily see that a switch with heavily over-travelled contact pressure or excessive opened distances will be slow-

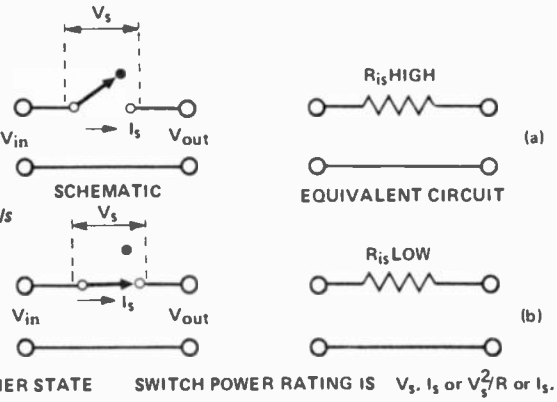

Fig. 4. Switches can handle large power signals with little loss (a) open (b) closed.

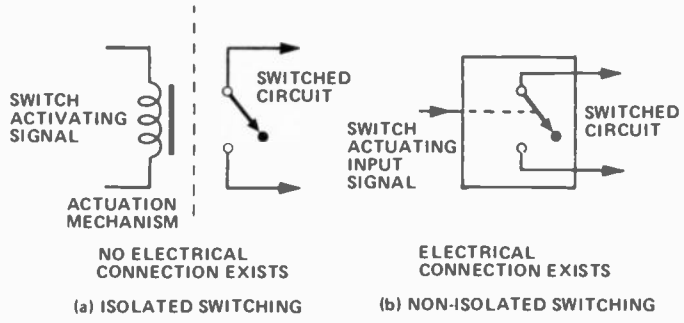

Fig. 5. Unlike electro-mechanical switches, most solid-state electronic switches do not provide ideal isolation between the actuating signal source and the controlled source.

to change to the opposite mode because greater force, or more travel, is needed to effect the change.

Another feature of the two-state switching circuit is that the switch's power rating can be very small compared with the load power being controlled. This arises because in each of the two states the switch has only to dissipate very small power losses. When open, see Fig. 4(a), the voltage across the switch is maximum but the current minimum. The power rating needed of the switch (neglecting arcing effects in this case) whilst open is, therefore, the product Vs.Is, and this is always very small, for only leakage currents flow when the switch is open. When closed, the situation is reversed; the current is now of the maximum value but the voltage drop is merely that due to resistive losses in the made contact (which can be very small). In practice the change of state from one condition to the other is so rapid that we can consider the switch as only ever being in the fully-off or fully-on case. This low-loss feature is used to effect in power-supply switching regulators where the "made" to "not-made" times of a vibrating contact are varied to pass the required amount of average power.

SOLID-STATE SWITCHES

Originally digital circuits did indeed use electro-mechanical switches; the relay as we know it. These are still used in some circumstances today but their size, cost, slowness of switching and possible unreliability now make them a poor choice, for logic applications, compared with solid-state switching alternatives.

A switch by definition, is a device that provides either a satisfactorily high or low resistance between two points, with the state being rapidly reversed by an external control input. It can be used in series or shunt to effect control. The degree of isolation provided is decided by the open-state resistance; the power rating is decided by the made-state switch resistance. What is high or low is purely relative, depending upon the impedances of the circuit elements connected to the switch. A perfect switch provides infinite open-circuit resistance and zero closed-circuit resistance. Typical resistances encountered in a small relay are from many megohms (contacts open) down to mere milliohms (contacts closed) thus giving excellent switching characteristics. Solid-state switches normally do not provide such large resistance ratios (some special devices come close) giving around a megohm to a hundred ohms change which is adequate for most logical tasks performed by digital systems.

Another disadvantage of most solid-state switches is that, as we will see below, the circuit connected to the switching part of the solid-state switch is not completely isolated from the circuit actuating the switch mechanism. This concept is shown in Fig. 5. At times this is most inconvenient and

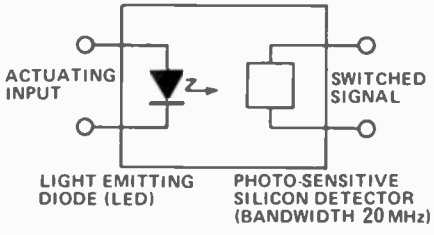

Fig. 6. Opto-electronic switches such as HP5082 series can provide a very close approximation to the low-power mechanical switch and are much faster in operation.

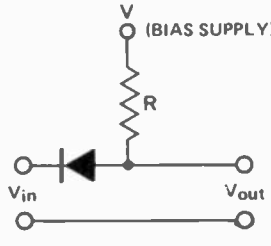

Fig. 7. Diode wired to provide switching action between input and output.

the development of workable solid-state switching systems has been influenced by the need to make-do with this shortcoming. A relatively recent newcomer to the solid-state switch, which overcomes the last disadvantage, is the solid-state opto-electronic isolator, shown in Fig. 7. This uses the actuating input to energise a solid-state light-emitting diode (LED); this, in turn, deduces the resistance of a light sensitive detector that acts as the 'contact'. This device is used in a minority of switching operations involved in digital circuitry where extremely high isolation is required between the switching and the switched circuits.

The two most commonly used solid-state switching techniques are those using two-terminal diode designs and three-terminal active element designs based on devices such as the transistor and other solid-state amplifying devices.

Let us first look at a diode wired to provide a switching function. In Fig. 7 a diode is connected to a bias supply V and to the input as shown. When the input voltage Vin is more negative that the bias voltage V the diode is forward-biased providing a quite low resistance path between the input and the output terminals. In this state Vout will be closely equal to Vin. If the bias voltage (or the input voltage) are changed to make Vin more positive than V the diode becomes reverse-biased placing a high-resistance between input and output. Thus, by changing V from positive to negative we have produced a switching action between input and output terminals.

A similar action is provided if the diode is wired in shunt across the line rather than in series as shown in Fig. 8. The state of V decides whether the diode shunts the line (when forward biased) or not (when reverse-biased).

In either design it is important that the diode resistances in the two states, the output impedance (R_S) of the preceding stage connected to the input, the load impedance (R_L) connected to the output and the

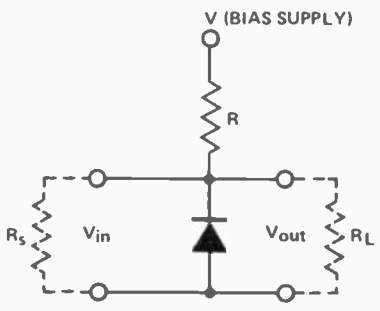

Fig. 8. Diode wired to provide shunt switching action.

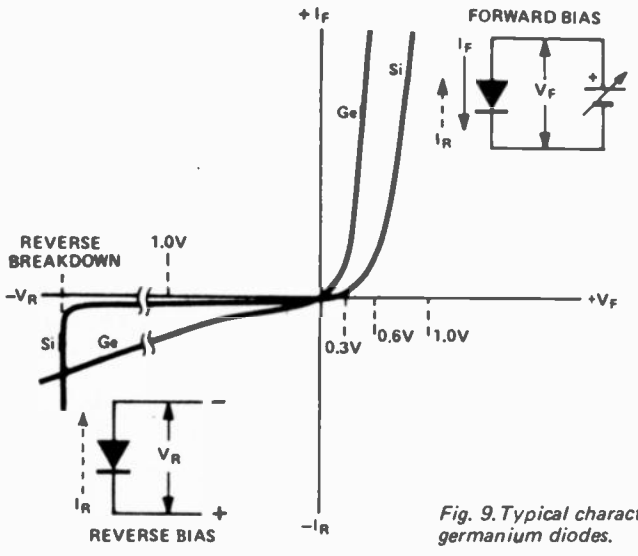

Fig. 9. Typical characteristics of silicon and germanium diodes.

bias-resistor value (R) are all chosen to have the right ratios in the two switching states. Adequate switching action will not result if the bias input is allowed to dominate the values being switched.

It is important that the bias voltage actually developed across the diode is sufficient to produce a diode forward-current greater than a value around the knee of the I_F against V_F characteristic — see Fig. 9. For a silicon diode this requires at least 700mV, a germanium diode at least 350mV: these values vary little with make or shape of particular device, being a parameter of the semiconductor material itself. Note how a quite large change in forward current hardly changes the dynamic resistance once the knee is passed. (Dynamic resistance is the slope of the characteristic which is reasonably constant beyond the knee). This reliable and constant loss switching (but not zero-loss) results over a very wide range of bias current conditions.

In its reverse-biased state the diode provides a larger resistance. Fig. 9 shows that germanium diodes do not provide as high an 'open' resistance as do silicon diodes — this is because the slope of the germanium characteristic is not as horizontal as that of silicon. Nevertheless both slopes represent higher resistance than in the forward-biased case, proving that resistance of the diode changes markedly. Again, we see that both reverse-biased curves are closely linear meaning constant resistance or, in other words, constant "open circuit" switch resistance.

When selecting the value of switching bias to apply it can be seen from Fig. 9 that too high a value for silicon devices will cause breakdown at the zener point, providing instead, a made-state that could cause total failure of the device.

The speed at which diodes can switch is a function of circuit values and the characteristics of the diode. It is routine practice with diodes to switch at tens of megahertz rates or higher. Mechanical switches are limited to less than 1 kHz at the very best.

Later in the course we will see how these basic diode switches can be used to perform logical operations by connecting more than one diode to the same bias source. Such connections are called gates.

Now to the use of three-terminal devices, transistors for instance, as switches rather than as linear amplifiers. This can be explained using the I_C versus E_C characteristics of a typical transistor, as is given in Fig. 10. The two switching states occur when I_b is either large or small. A chosen collector resistance value (in common emitter configuration) establishes the load-line on the characteristic. In a switching-mode the transistor operates around points A or B. At A, I_b is large; the transistor is, therefore, switched on with V_{CE} being very close to zero volts. At B I_B is small (practical circuits may apply a reverse polarity to ensure this); the transistor is switched off with V_{CE} being virtually at the supply voltage. In the on-stage the transistor provides a low-resistance path between its collector and emitter: when off, a high-resistance path.

The transistor switch, unlike non-amplifying diodes and mechanical contacts, does not directly pass the input signal but instead replicates a signal current in its base by providing an equivalent change in collector current or voltage. In reality a large proportion of digital circuits regenerate in this way with the output signal change closely following that of the input.

At either of the circuit operating points A or B the transistor is operated well within its allowable power dissipation. As we should expect, a given transistor used in a switching mode can handle a greater power than if operated as a linear amplifier. A little thought will also show that the load line can, in switching use, intercept the maximum dissipation curve, the reason being that the transistor does not dwell long enough in states other than A or B to produce deleterious heating. It is vital, however, in such designs to ensure that the switching action is rapid between states, and that the device never dwells on the way through. A ramp input signal may well destroy a stage designed to switch!

The above explanation is most basic — reality requires other criteria to be recognised to obtain more ideal switching. Like the over-travelled mechanical switch, a transistor switch with too much reverse-bias base current (off-state) or too much on state base current will be slower to operate than one not driven so hard. This is because the charge associated with the base current must be removed to alter the state and the more the charge there is to move, the slower will

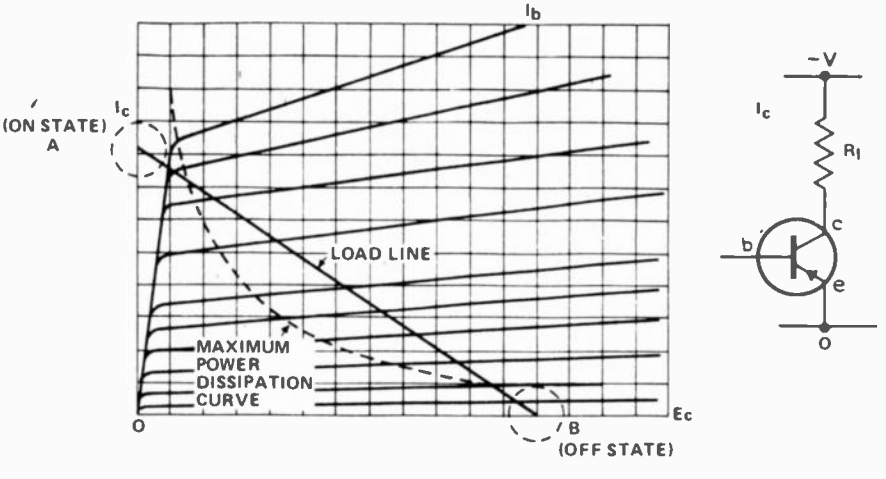

Fig. 10. In the switching mode the transistor is operated at either end of the chosen load line.

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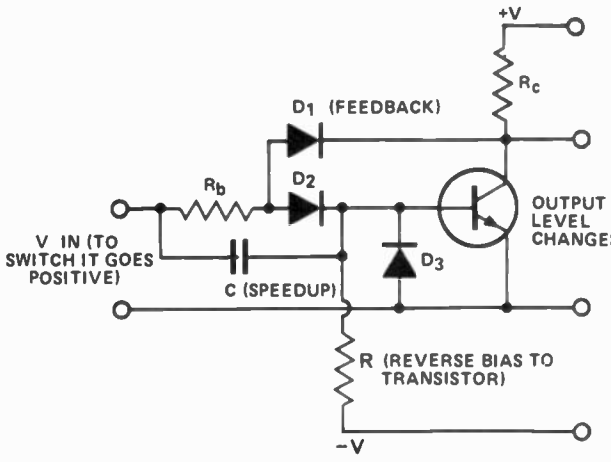

Fig. 11. High-speed switches are designed to remain non-saturated. This circuit employs feedback D1 with D2 providing a voltage supply needed. The speed-up capacitor is C. Diode D3 assists reduce the delay time.

be the switching time. Solid-state switches operated very positively by use of large drive currents are said to be working in a saturated state.

Certain circuit devices can be added to the basic solid-state switch to speed up the response. The first is to supply a much larger input signal than would be needed to just turn it on. This speeds up the charge movement but would take the device into deep saturation unless clamps are added that hold the circuit nodes at given values. Diodes acting as switches are often used to hold a point at a given voltage. A second circuit addition is the speed-up capacitor. This is a small value capacitor placed across the resistor feeding the input of the switching stage. When fast switching signals occur the capacitor provides a low impedance path around the resistor which must be of a reasonably high value to supply correct dc signal level requirements. Yet another technique is to use feedback between the collector and the base to speed up the switching transition yet hold the stage in a non-saturated state once switched. Fig. 11 is a non-saturating switch circuit — one of many possibilities. It shows how the basic transistor needs the addition of more components to realise fast switching in discrete designs.

The integrated-circuit revolution has provided us with inexpensive, ready-made digital circuits of great sophistication. These are extremely basic yet super fast — see Fig. 12. Rarely does one now have to consider the in-depth design of switching circuits. The task is usually one of devising a system using a few basic, digital system building blocks which have been so developed as to facilitate their ease of connection into systems.

The reliability of the switching state of an electronic circuit is one reason for the widespread use of digital techniques. There is another equally important reason for the use of digital signals and that is that philosophers and mathematicians of the past have developed powerful ways to process logical information by way of special algebra and techniques. This is employed to design complicated switching circuits and other digital systems with the simplest possible circuitry. In the next part we look at these philosophical concepts in readiness to return to a discussion of the basic, digital-system building blocks.

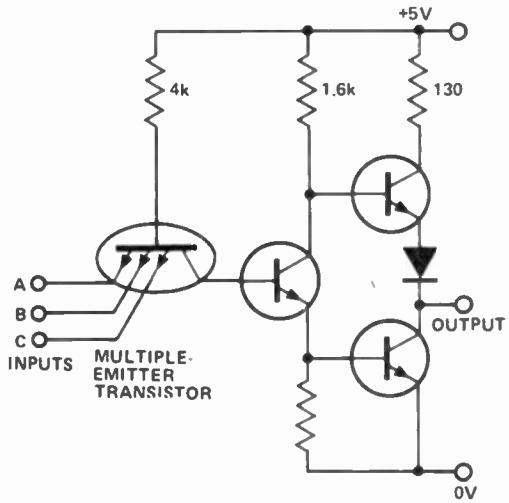

Fig. 12. Transistor-transistor logic, TTL is a commonly accepted integrated circuit manufacturing method. This gate combines up to three inputs switching with a delay of only 10 ns. The whole circuit is integrated on a common chip.

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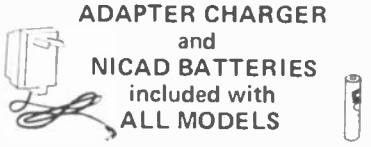

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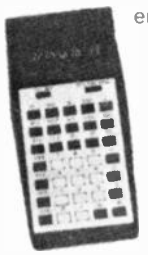

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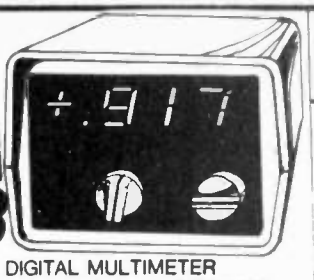

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Large 6in heavy duty 8W flush-mount speakers with chrome grill. Ideal for vehicle door or rear shelf mounting. Also ideal for home use in ceiling etc. Big ferrite magnet, 100 - 10kHz response. 4 ohm. Only requires 2¼ in space.

$12.00 (P&P $1.00)

JUST IN...

Metrosound Dolby Calibration Tape

Contains a free modulated tone. Corresponding to 185 below DIN.

Cassette level approx

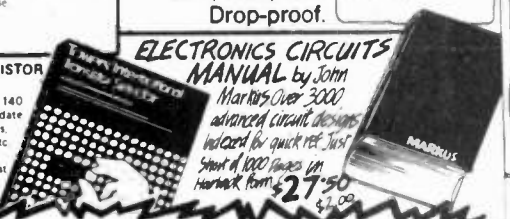
$7.25 prp

TOWERS' INTERNATIONAL TRANSISTOR SELECTOR. (T. D. Towers)

Our latest data book from Foulsham has over 140 pages of computer listing (for the most up-to-date print out!) of over 10,000 transistors – ratings, characteristics, identification, manufacturer etc. UK listing with addresses CV numbers etc. Essential for the professional or keen hobbyist at $11.25

ELECTRONICS CIRCUITS MANUAL by John Markus

Over 3000 advanced circuit designs indexed for quick ref. Just short of 1000 pages in Hardback Form $27.50 $2.00



KITS

See EA Dec 73

200MHz COUNTER KIT

Special purchase of components enables us to REDUCE the price of this kit. Presented in two stages.

Basic 20MHz Canter has 4½ decade LED readout with leading zero suppression. Crystal timebase for self calibration or ext. cal. IM 50pf input impedance and 50mV to 10V rms sensitivity. There can't be a better, cheaper instrument anywhere. Now reduced to $98.00

200MHz Prescaler extends the capability of the basic 20MHz by a factor of ten. Well worth buying the complete kit for just $120.00

NOTE: All our kits use top quality components, where possible to the specs. given in articles. Occasionally we are forced to substitute alternative components because of availability problems, but these are checked out with magazines concerned.

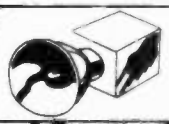
See E.T. MAY 75

KIT 79 ET 702 Radar Intruder Alarm

Uses microwaves to detect movement within 10M range by the Doppler principle. Now you can build a unit that operates on the same principle as the professionals use. Even works through timber and plastic wall panels and screens!! Operates from mains or batteries (extra). Complete kit $54.00 (p&p $1.00). CL 8960 Radar module $32.00 (p&p $1.00). ET 702 PCB $1.75

DON'T FORGET OUR AMP KITS

Playmaster 143 $69.90 ET1422 $118.00 (no rear panels now)



KIT 56 High Power Strobe (E.T. Aug 71/25 Top Projects). Ideal for parties, dances etc. to create dazzling effects. Uses large 7" satin finish reflector exactly to original specs. Single tube can easily be converted for 2 tube operation. Don't confuse with cheap, less powerful units. Now only $22.50 (p&p $1.00). Strobe Caps 6.5 uf 250V a.c. $3.50 each.

MINIATURE TRANSFORMER

Ideal for small transistor power supply etc. (P.S. will give either 6 or 9 volt output) Special insulation between primary & secondary.

3cm D x 6W approx $2.75

100 only available

BE ON THE LEVEL!

Make sure your Hi-Fi stereo, Display Turntables, Scales, Machine Tools etc. are horizontal with this Bulls Eye Level $1.90

27 MHz BASE AERIAL

High-gain base loaded Vertical DSE-GP. This magnificent aerial with an overall height of 18 ft. Features a gain of 4 DB. The matching stub places it at D.C. ground potential which substantially lowers the residual noise level and results in gains as high as 19 DB in signal to noise ratio $59.00 road Freight

CENTRE LOADED ROOF ANTENNA

Only 18 in high but works as well as a full quarter wave or 108in. All parts chrome plated on brass or stainless steel spring included & supplied with coax cable & connector.

p&p $1.00 $19.50

311 CENTRE LOADED GUTTER CLIP ANTENNA

Clips on the rain gutter of any vehicle. Can be installed or removed instantly without tools!! 18in high & supplied with coax & plug.

$17.50

G.F.A. CENTRE LOADED TRUNK MOUNT FIBRE GLASS ANTENNA

Ideal long range antenna for the person who does not wish to drill holes in is vehicle. simply clamps to boot or bonnet lip 48in long & supplied complete with coax & plug.

$27.00

NEW C.D.I KIT (See E.A. July 75)

The only kit with a PRE-PUNCHED HEAVY DUTY ALUMINIUM BOX (saves a lot of hard work!!!) We also give you a prewound secondary to simplify Transformer winding... Transistor sockets for easy servicing. Build it & fit it in an evening. HURRY we anticipate tremendous demand at

$22.50 p&p $1.00

KIT including Heavy Duty Ducon Capacitor $26.00 p&p free

MODEL FS 30 / 15 Watt SOLDERING IRON

This fantastic little iron operates from any 12 volt AC or DC source (car battery or 12 volt 1.2 amp. Transformer). Complete with plated tip & 9ft lead. Ideal for Transistor servicing & general home repairs.

$3.90 p&p 50c

WHY PAY $10?

CIGARETTE LIGHTER PLUG to suit 50c

SPARE TIP to suit 50c

NEW LOWER PRICES FOR OUR DIGITAL CLOCK KIT (over 1500 sold)

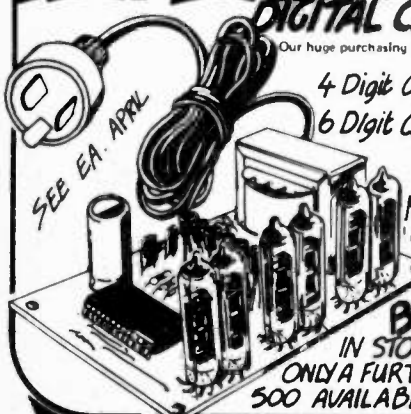
Our huge purchasing power enables us to REDUCE our prices yet again!!

4 Digit Clock $19.95

6 Digit Clock $24.90

prp $1.25

Attractive Case see next column $8.50



SEE EA. APRIL

NOW WITH 6mm read-out

BUY NOW IN STOCK, BUT ONLY A FURTHER 500 AVAILABLE!

QC-8 QUARTZ CRYSTAL MODULE KIT

Complete with 3mHz crystal & divider IC - gives 50 cycle output to operate virtually any digital clock. Takes only 10 minutes to build - highly accurate (within seconds a month). Operates on 9 to 15 volts D.C. $12.50 p&p 50c

Yes with the above module your Dick Smith clock will operate in your car, boat or plane at chronometer standards.

If you are running your clock off 240V A.C. and would like it to continue to operate for up to 48 hours when the power fails, simply use the module with a 9 volt transistor radio battery. It will change over automatically.

Full details in September E.A. or send S.A.E.

MINIDRILL

PC drill runs off 4 UM3 cells or 6V dc at 600mA runs at 2500 rpm drilling holes from 0.0236 to 0.059. Ideal for all PC drilling, model makers, jewellers. This is a new line at $15.75 (P & P 75c)

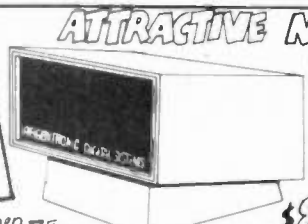
AND NOW! STD-50 MINI DRILL STAND make your own mini STAND DRILL

$8.50 prp 75c

FANTASTIC LITTLE MULTI-METER EXTENSION LEADS

allows you to connect your meter probes to any circuit with alligator clips. PAIR RED & BLACK 60c

ATTRACTIVE NEW CASE for our Digital Clock Kit



prp 75c $8.50

BIG DICK POWER SUPPLY

So many people have been asking for a bigger supply than our popular Dick. So here it is. Two ranges 0-12V-24V with a max. current of 1.5A. 3 transistor 7 diode circuit with meter readout of Voltage and Current. Voltage selector and variable control. Measures 185 x 105 x 85 cm weighs 1.5 kg (it's that well made!!) Specially designed for instrument supply and the service bench. Fully regulated. Simply connect leads directly into Big Dick or mount and connect terminals supplied. Value at $39.50 p&p $3.00!

See you at stand 89, IREE Exhibition

TRANSISTORS FOR E.T.I. 440 amp! LOOK AT THESE PRICES!

BC639	75c
BC640	75c
BD266A	$1.95
BD267A	$1.95

Dick Smith Electronics Pty Ltd

Associated Companies: Dick Smith (Sales) Pty Ltd, Dick Smith Wholesale Pty Ltd
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Tel 439 5311 (5 lines)
Telex STD 439 5344

Dear Amateurs, Just back from overseas and look at all the goodies I've found you. Check below – you'll want the lot!! Dick.

JABEL ALIGNMENT TOOL PACK No. 2

A handy set for the serviceman and specially intended for colour TV work. Two non conductive tools, one with two screwdriver blades, the other with hex head type keys, to fit most cores. Supplied in case at only $1.25

TMA8 STEREO MONO MIXER AND PRE AMP $44.85

Easy to operate with slider controls for 4 mic inputs which can be individually switched from 600 ohm to 50k. Also has phono magnetic input. Response from 30 to 20,000 Hz. Battery powered (2 x 216). Use as 4 channel mono or 2 channel stereo mixer. Only $44.85

p&p $1.00

BOSUN Multicore

3-Core Solder-Extra Post-Extra Active $1.00

JUST IN

TD1300 TAPE RECORDER SWITCH

AUDIOPHILES & TAPE ENTHUSIASTS GRAB ONE OF THESE !!

YES THIS LITTLE UNIT IS THE ANSWER TO YOUR PRAYERS

No need for messy patch cords here. Now you can simply switch between your audio gear. Switch directly from Tape No.1 into Tape No.2 for record, Tape 1 to Tape 2 as well. Also amplifier into Tape No.1 or Tape No.2. One amp only is required. This is handy for disc recordings onto tape. In addition to all of these handy features you have playback control for Tape No1 and 2.

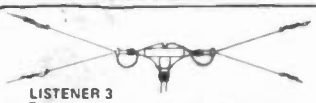
The unit comes in a brushed anodised attractive looking aluminium case fitted with 3 Professional DIN type sockets in the rear. The six long life push button switches are in smart black plastic and automatically cancel each other out when another switch position is selected.

p&p $2.00

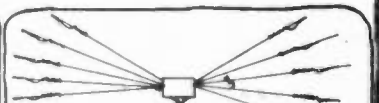
$12.50

ANTENNATION! FAMOUS RAK ANTENNAS

LISTENER 1 "V" TYPE ANTENNA
Covers 3 to 30mHz with special trap — completely assembled and ready for installation. Ideal for "DX" reception. $18.75 p&p $1.00



LISTENER 3
The ultimate long range, long wire dipole antenna 3–30mHz supplied complete with Balun, feed wire (45') VHF plugs, insulators, extremely large gauge aluminium wire and nylon support rope. Originally designed for professional use, but ideal for the serious short wave listener who requires the best. $42.50 p&p $2.00



A–58QN
Deluxe multiband transmitting & receiving antenna – Yes this is the ideal system for the amateur who is not convinced that beams are best. Covers all bands from 3.5mHz to 28mHz with a VSWR of better than 1:2. Full 2kW pep rating. The massive aluminium wire dipoles supplied ensure fantastic efficiency. $39.75 p&p $2.00. Note: Requires BL–50A Balun for 52 ohm operation.

HAM HIGH QUALITY LOW NOISE FET RF AMP MODULES
These units are designed to be simply connected between the aerial and receiver of any 10, 6, or 2 metre unit. You can even mount them right at the aerial if you require maximum performance. Input impedance 50-75 ohm, noise factor 5-6 db gain 20-30 db, operating voltage 9–12 VDC @ 15 MA, dimensions, 70mm x 30mm x 15mm. Fully wired & tested. Circuit supplied, only 4 connections required.

ERB–27 (CB)	27–29 mHz
ERB–6	50–54 mHz
ERB–2	144–146 mHz

$18.50 ea. p&p 75c

GO ON – Hot up your rig with one of these!

NOTE large goods can be sent ROAD FREIGHT payable by you (ROAD FREIGHT ON) please nominate

HAM 6 & 2 METRE FET CRYSTAL LOCKED CONVERTERS
These beautiful little high performance low noise converters are supplied completely wired and tested with high stability crystal to give tuneable I.F. output on 28–30 mHz (use any communication receiver). Extremely stable and excellent specs; 50-75 ohm input. Noise factor 5db, gain 30 db, operating voltage 9-12 VDC @ 15 MA. Dimensions 70mm x 30mm x 15mm. Completely tested and pre-aligned. However tuned circuits may be simply re-peaked to top end of band if you wish to do so. Supplied complete with circuit.

EXC–6	50–52 mHz
EXC–2	144–146 mHz

$27.50 ea p&p 75c

NON-INDUCTIVE 50 ohm LOAD RESISTORS
This type of resistor is normally found in high quality power meters selling for over $100.00. Both are high tolerance, high power devices with virtually no inductance. They are large (they have to be to dissipate the power). Ratings shown are continuous. Intermittant rating will obviously be far higher. Ideally suited for dummy loads or power meter applications.

50 watt unit (20mm diam x 100mm long) $10.50
100 watt unit (20mm diam x 200mm long) $19.75

Make your own power meter – save a Fortune

SW–3CO 3 POSITION COAX SWITCH
High quality gold plated contacts give a maximum rating of 1.5 kW with an insertion loss of only 0.03db at 50mHz. Incredibly low VSWR, over 60 db isolation, operates up to 1000 mHz – a real micky mouse unit. Also features safety "pull to turn" systems which prevents "fiddlers" blowing things up.

$22.00 p&p $1.00

FAMOUS SHINWA RF. TVI FILTER 1003
This hand calibrated and adjusted low pass filter is supplied with a spec. sheet showing attenuation and VSWR for each individual unit. Typical attenuation is less than 1 db at 28 mHz and more than 25 db at 32 mHz. 52 ohm impedance and a power rating of 100W CW supplied complete with VHF sockets.

$19.75 p&p $1.00

ECONOMY GUTTER MOUNT
GM–1 chrome plated gutter mount will take virtually any aerial – complete with mounting screws.

$2.75 p&p 75c

AMIDON TOROIDAL KILOWATT BALUN KIT
Make your own Balun with this beautiful American product. Supplied complete with massive 2" diam. Toroid, enamelled heavy gauge copper wire and explicit instructions to make 1:1 balun, 4:1 balun and matching to 36, 52, 72 & 600 ohms.

$12.00 p&p 75c

CX110P 12V COAX RELAY
Don't be misled by the price. This unit has high quality gold contacts which gives an insertion loss of less than 0.2 db up to 500 mHz. Very low VSWR and 1000 watt power rating. Designed to mount directly inside the smallest transceiver.

$9.75 p&p 75c

RAK BL50A 50 ohm Balun (1 to 1 Ratio)
Enormous 4 kW maximum rating, fully weatherproof, 1.8 to 30mHz band width, VSWR 1.3:1 high 250kg tensile strength, VHF socket supplied.

$17.40 p&p 75c

LEADER RF IMPEDANCE METER
At last, an accurate, calibrated impedance meter for aerial & transmission line work. Measures impedance from 0 ohm to 1K ohm with accurate markings at 50, 75 & 300 ohms. Frequency range 1.8 – 150 mHz. Simply use in conjunction with any RF signal source (G.P.O. sig gen, transmitter etc.) for accurate impedance measurements. Operates from internal 9 volt battery (supplied). Dimensions 175H x 65W x 60D (mm). Supplied complete with 50 ohm calibration resistor and circuit.

$72.50 p&p $2.00

AS–HOPE–2R MINIATURE 2 METRE HELICAL ANTENNA
This fantastic little antenna (under 9" long) screws into any VHF socket and then performs as well as a standard ¼ wave antenna. Ideal for mobile use where height is a problem and for walkie talkie operation. Made of heavy duty fibre glass with chrome on brass mounting plug.

16.50 p&p 75c

KSA–2 FLEXIBLE 2 METRE ANTENNA
¼ wave long – designed especially for KEN KP202 but can be used with any 2 metre unit – aerial made from ¼" wide spring steel folds down to less than 4" high – ideal for bush use as it will not break.

$10.50 p&p 75c

KATSUMI MC701 MICROPHONE COMPRESSOR
Yes – up to double your signal strength with very little loss in clarity with this F.E.T./I.C. compressor. Operates from 6 internal penlite cells and is designed with slim vertical look to mount beside equipment. Works by the principle of reducing audio peaks of voice modulation, thus allowing a higher average level of audio to be used. Specs as follows: 1 x 1C (UPC 566H low noise compressor AMP) 1 x FET 2 x transistors; 2 x diodes. Compression level 25 db max fully variable. Mic impedance 100–50K ohms, distortion 1% or less. 10 db output. Freq. response 100–7 kHz ±2db (300–3kHz with audio filter on). S/N ratio – 60 db. Power 9 volts @ 15 MA max. Dimensions 50mm W x 170mm H x 110mm D.

Complete with circuit and instruction book.

$39.50 p&p $2.00 Batteries extra.

AIR DUX COILS
Now there's no excuse! You can easily make antenna loading units and high power linears with our high quality air dux coils. Each coil is separately boxed with an incredibly simple chart which shows at a glance the turns No/inductance/capacitance necessary for resonance at any frequency. If you would like a photo copy of these charts before buying, simply send 25c per chart and we will post them to you. All coils are 155mm long (6") and are bright tinned copper wire.

No.	Diam. (mm)	Wire Diam. (mm)	Pitch per Turn	Price
200816	20	0.8	1.6	$3.40
401016	40	1.0	1.6	$4.60
402042	40	2.0	4.2	$4.95
602042	60	2.0	4.2	$6.50

p&p 75c

TANY TRS–2 2 METRE ANTENNA – BARGAIN PRICED
This fantastic 144–148 mHz antenna is supplied complete with deep chromed gutter mount bracket (saves drilling holes in your car), over 4 metres of 52 ohm low loss flexible coax cable, PL259 plug and stainless steel whip which is easy to disconnect from the gutter mount.

Why pay over $20? when the TRS–2 is only

10.50 p&p $1

SPECIAL NI-CAD BATTERIES
Standard Pen-Lite Cell size & RECHARGABLE!
Normally $2.25 ea

Now $1.75 ea

or 10 for $15.00 (gives 12 Volts)

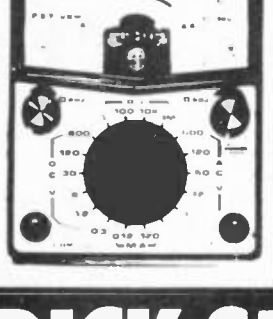
NEW TAX FREE PRICE LIST NOW AVAILABLE (yes BC108 Trans from 9c) SEND S.A.E.

8 ONLY AT $35.00

JAYEM MODEL L–55 FET MULTITESTER
Fully solid state FET VOM, the ideal instrument for field service engineers for Radio, Television, Communications & Electronic equipment maintenance. It offers portability & high accuracy at low cost.

DCV: 0.3/1/2.5/10/30/120/600V. ACV: 3/12/60/120/600V (10K ohm/V). INPUT IMP: 10 Megohms all ranges. DC MILLIAMPS: 12/120mA. OHMS: 0.1K ohms (10 ohms centre scale) 0-100K ohms (1K ohm centre scale) 0-10 Megohm (100k ohm centre scale) 0-1000 Megohm (10 Megohm centre scale). BATTS: 1x Eveready 216, 1x Eveready 915. Meas. 130x90x50mm. Includes 10 Megohm Isolation Probe & Vinyl Case.

p&p $2.00 $43.50 Leather



DICK SMITH ELECTRONICS CENTRE

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Gore Hill N.S.W. 2065
tel: 439 5311

Also at

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tel: 29 1126

BANKSTOWN
361 Hume Hwy
tel: 709 6600

EQUIPMENT NEWS

FOUR-CHANNEL OSCILLOGRAPHIC RECORDER

Claimed for this four-channel ink-writing recorder is that it is first with standard 60:1 speed reducer, first with four event markers and first with flip-of-a-switch change from four channels to two double-width channels.

Using plug-in signal conditioners, this new Hewlett-Packard Model 7404A Oscillographic Recorder comes with 12 chart speeds as standard: 5, 10, 25, 50, 100 and 200 millimetres per second and millimetres per minute. All are remotely controllable by contact closure or TTL. Four remotely-controlled event markers, including a left-hand event marker/timer are also standard.

Four analogue channels can be recorded simultaneously. For a wider record, the two right or two left channels can be combined easily by the operator.

Rugged stainless steel pens with carbide tips write with a clear, uniform trace. The pens are designed to last the life of the recorder and, it is said, will not be damaged by any frequency input signal.

Ink drys instantly, even at maximum chart speeds, resulting in a smudge and blot-proof permanent record. An ink level gauge is on the front panel.

Five interchangeable plug-ins are available to adapt the Model 7404A to a wide variety of applications. A high-gain preamplifier, Model 17400A has a sensitivity of 1 microvolt per division; Model 17401A has a 1 millivolt per division sensitivity of 20 millivolts per division. An ac Carrier Preamplifier, Model 17403A is used with passive transducers requiring excitation, such as strain gauge devices. It supplies 5 volts at 2.4 kHz to the transducer and receives the returning transducer output.

Just added to the line is the Model 17404A dc Bridge Amplifier. It provides excitation of 5 volts dc, internal bridge completion and a differential amplifier for use with resistive transducers. Seven input sensitivity ranges from 0.1 millivolt per division to 10 millivolts per division can be selected from the front panel.

For further information contact Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St., Blackburn, Victoria 3130.

DIGITEC OFFERS 3-1/2 DIGIT MULTIMETER WITH dB

DigiTec has introduced another instrument in the new HT Series (High Technology), the Model 2180 Digital Multimeter. The Model 2180 is said to be the first, low-cost, 3-1/2 digit bi-polar instrument with all five standard multimeter functions, plus five decibel measurement ranges extending from −60 dB to +56 dB. A basic accuracy of 0.1% and resolution of 100 μV is claimed.

Totally portable at only 1 kg, and operating from either the ac line or internal rechargeable batteries, this instrument is ideally suited for field or bench applications.

The functions of the Model 2180 are pushbutton selected and include ac volts, dc volts, ac current, dc current, resistance and decibels. Its 31 measuring ranges are selected by rotary switch with an additional battery check position that allows the internal battery condition to be monitored. The automatic integral battery charging circuit will maintain the batteries at full charge as long as the instrument is connected to the ac line.

Consistent with the design standards of the HT Series, reliability and serviceability are emphasized. DigiTec's "HT Converter" A-D conversion technique, coupled with the use of proprietary LSI is said to have enabled significant reduction of components; thereby providing the basis for high reliability. All circuit boards, ICs and displays are "plug-in" for easy maintenance. the 3-1/2 digit display employs large, easy-to-read Monsanto MAN 72 LEDs for extended, trouble-free operation.

The Model 2180 is housed in an attractive, contemporary enclosure made of high impact Lexan (R), the case provides maximum protection while retaining its rugged, compact, lightweight convenience.

Further details from: N.I.C. Instrument Company, Matthews Ave., Airport West, Victoria 3042.

LUMINANCE PROBE

Tektronix, Inc., of Beaverton, Oregon, has announced the J6523 1° Luminance Probe for the field-proven J16 Photometer/Radiometer.

The J6523's 1° acceptance angle expands the J16's capability. The probe is especially useful for measuring a very small spot – as small as 8 mm at 457 mm from the probe – or a small, distant area of light. Now it's possible to measure one letter on a highway sign, illuminated by automobile headlights, from a distance, or to measure the luminance of a small area on a cathode ray tube.

The J6523 has a measurement range of 0.1 to 19,900 fl or 1 to 199,000 candelas/m^2 (nits). Focus range is 450 mm to infinity (closer with commercially available lenses). It also has an optical sighting system with a 9° field of view. Its silicon photodetector incorporates accurate photopic spectral correction.

The J6523 is highly compact (119 x 66 x 234 mm) and weighs only 1135 grms (2.5 kilos total with the J16). It may be attached to the J16, used with an optional extender, or mounted on a tripod or optical bench.

Further details from: Tektronix Australia Pty Limited, 80 Waterloo Rd., North Ryde, NSW 2113.

CRT DISPLAY

Anderson Digital Electronics (ADE) has announced a price reduction on their Teleray 3311 CRT display.

The Teleray is said to have become the industry standard in Teletype compatible CRT terminals throughout Australia. It offers plug compatibility with the ASR-33 in both RS-232 and current loop interfaces.

By far the largest users of the Teleray are the Educational Institutions including Universities, Institutes of Technologies and Colleges.

The Teleray 3311 offers 24 lines by 80 characters per line high resolution display. It utilizers a wall-effect all electronic keyboard and has all logic mounted on a single card. In addition to this all IC's are mounted in plug-in sockets for maintainability.

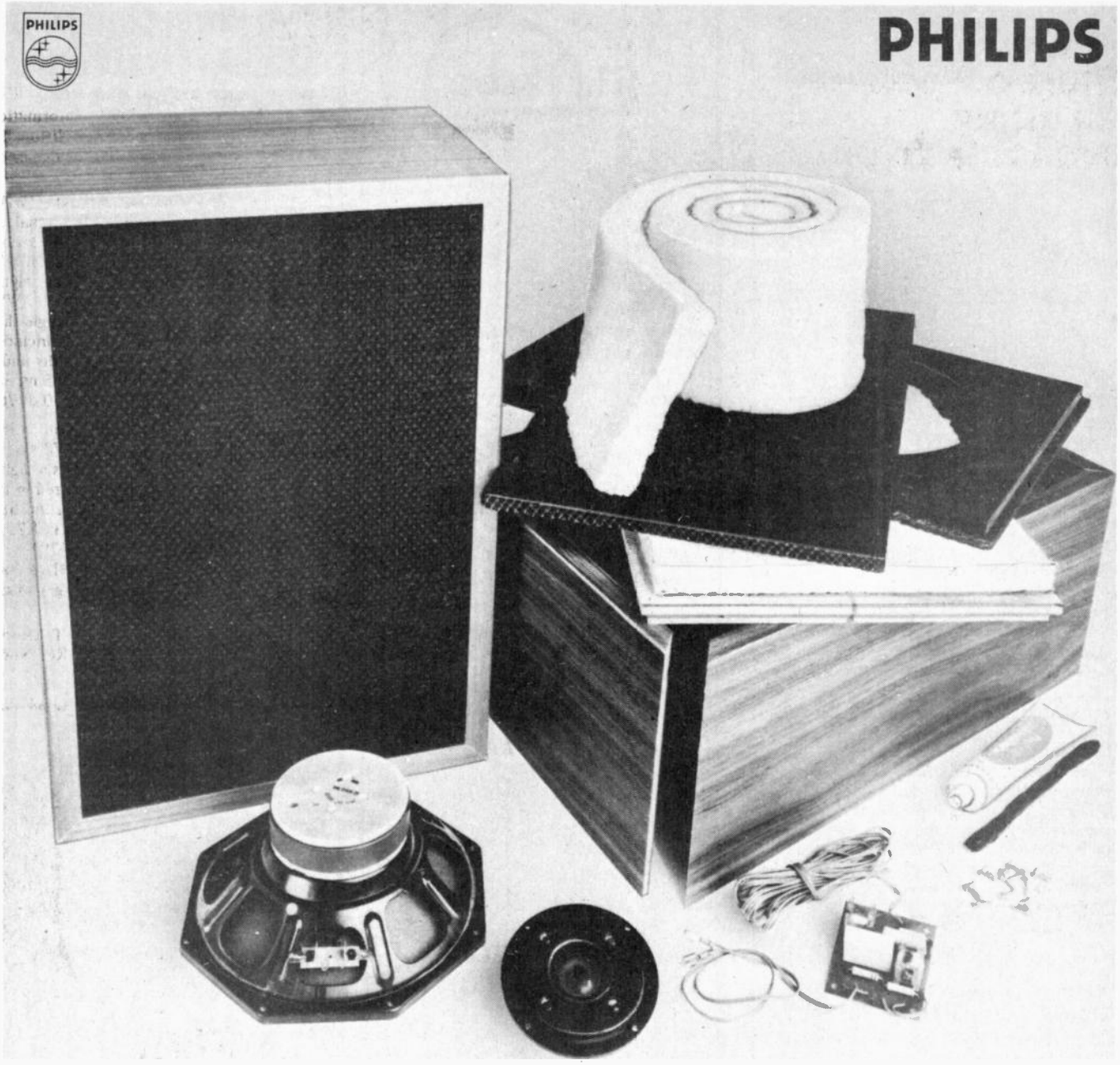
For further information contact: Anderson Digital Electronics, P.O. Box 322, Mt Waverley, Vic. 3149.

SIGNAL ACQUISITION SYSTEM

Two series of high-performance Textronix signal acquisition instruments, Digital Processing Oscilloscopes and Waveform Digitizing Instruments, now feature an interface to the CAMAC standard for modular electronic data-handling equipment. Now, data acquired by these Tektronix instruments are available for computer processing via CAMAC. The interfacing is accomplished with a Tektronix CAMAC Control Module. It is designed to CAMAC Dataway Specifications EUR 4100 and TID-25877, and was developed through consultations with CERN, the European Organization for Nuclear Research. CERN is responsible for the design and development of the CAMAC standard.

The new Tektronix CAMAC compatible instruments are: The WP1051 Digital Processing Oscilloscopes (DP0), and the WP2051 and WP2052 Waveform Digitizing Instrument (WDI) configurations.

The WP1051 DP0 is a flexible, wide-band digitizing laboratory oscilloscope. It features unmatched signal acquisition flexibility through compatibility with plug-ins used with the Tektronix 7000-Series oscilloscopes. Any displayed, repetitive



A screwdriver and about ½ an hour is all you need to build this 40 watt Philips speaker system.

Philips make it easy and inexpensive for you to own a professional speaker system. Assemble it yourself in about 30 minutes and you have 40 watt (RMS) capacity speakers to complement your hi-fi gear.
The AD8K40 Speaker Kit includes:

• 2 pre-cut, pre-finished wood grain cabinet enclosures with pre-painted baffle boards. • 2 mounted grill cloths with pre-painted baffle boards. • 2x8" woofers. • 2 x1" dome tweeters • 2 x 2 way crossover networks with leads and fastons fitted. • Innerbond lining • Wood screws. • Wood glue • Caulking compound.

Plus full assembly instructions. Check the column opposite this page for the dealer nearest you, or send coupon for a free brochure.

ELCOMA

To: ELCOMA, P.O. Box 50,
Lane Cove, N.S.W. 2066.
Please send me your fully illustrated brochure on the Philips AD8K40 Speaker Kit.

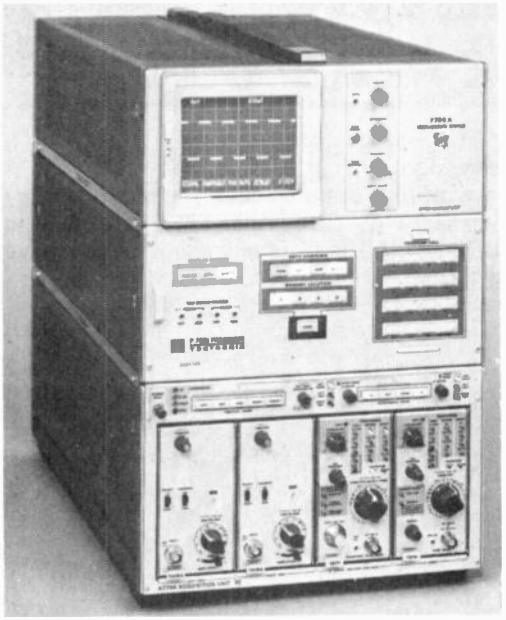
Name . . . . . .

Address . . . . . .

. . . . . .

Postcode 153.97

EQUIPMENT NEWS



signal can be digitized, stored, and made available via CAMAC to a computer for processing.

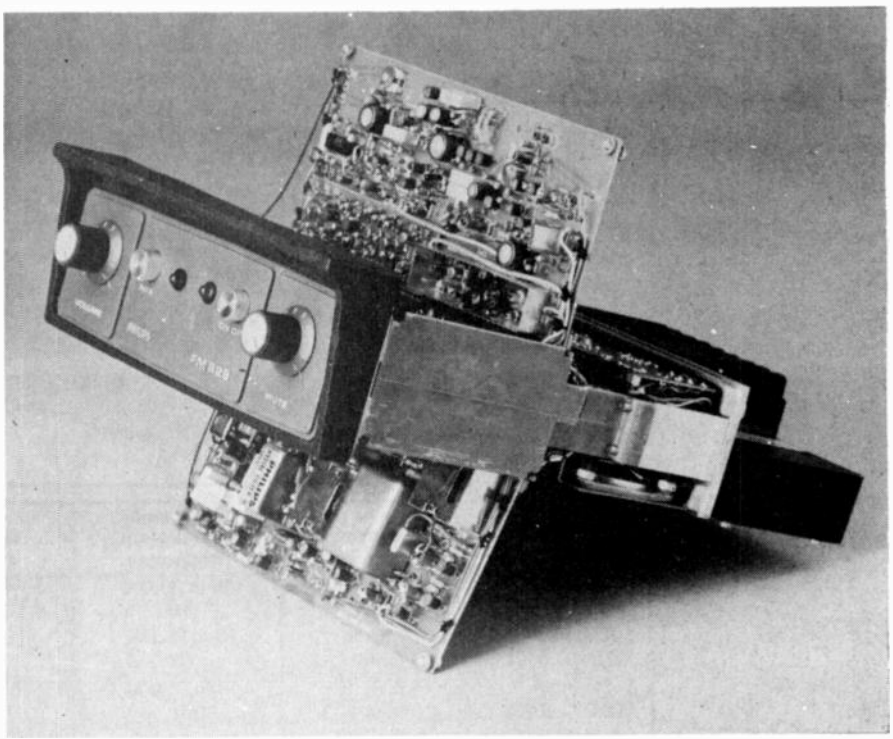
The crt display readout feature of the DP0 makes waveform parameter information available for processing. Additionally, messages to the operator can be displayed on the scope crt.

Waveform Digitizing Instruments (WDI) are designed to acquire for analysis extremely fast transients and short-duration, low-repetition-rate signals. Tektronix R7912 Transient Digitizers are used as signal acquisition units in these WDI configurations. With the R7192, single-shot performance capabilities claimed include: bandwidths of 500 MHz at 10 mV/div and 1 GHz at 4 V/div, sweep speeds to 0.5 ns/div, and a storage writing speed of 8,000 div/μs.

Two WDI CAMAC compatible configurations are available. The WP2051 is a single channel instrument. It uses a digital display monitor to view signals stored in the R7192 memory. The WP2052 is a multiple channel instrument (from one to six R7912 Transient Digitizers). One R7912 is supplied; the additional R7912's are available as options. It uses a large, bright video monitor as a display unit.

Further information from: Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde, NSW 2113.

NEW VHF MOBILE 2-WAY RADIO



Continuous transmitter operation is one of the features of a new VHF mobile 2-way radio launched recently by the Melbourne-based Radio Division of Philips-TMC. Known simply as the Philips FM 828, the new unit can run "button down" indefinitely. The unit also features a "transmit limit timer" and "call received indication" as standard.

Designed for local or remote control, the FM 828 can be mounted on the vehicle floor, dashboard, bulkhead or boot – in fact anywhere, in any vehicle. The chassis is contained in stainless-steel covers, giving an attractive and non-corrosive finish.

The printed glass fibre circuit boards are hinged for convenient and easy maintenance, and solder-resist plated for

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- Each cartridge equipped with a "DUSTAMATIC" assembly for automatic cleaning. "DUSTAMATIC's" independant action never interferes with tracking force.

SPECIFICATIONS Model No.	Stylus Radius	Tracking Force	Nominal Frequency Response	Nominal Output	Nominal Channel Separation	
XV-15/1200	Elliptical .0002 × .0007	¾ ± ⅛ Gram	10 to 30,000 Hz	4.4 mV	35dB	
XV-15/750E	Elliptical .0003 × .0007	1 ± ½ Gram	10 to 25,000 Hz	4.4 mV	35dB	
XV-15/400E	Elliptical .0004 × .0007	1½ ± ½ Grams	10 to 25,000 Hz	5.5 mV	35dB	
XV-15/350	Spherical .0007	2 ± 1 Grams	10 to 25,000 Hz	6.0 mV	35dB	
Accessory Stylus For L.P. Records	L.P. Monophonic Records	Spherical .001	4 ± 1 Grams	10 to 17,000 Hz	8.0 mV	Monaural
Accessory Stylus For 78 r.p.m. Records	78 r.p.m. Monophonic Records	Spherical .0027	5 ± 2 Grams	10 to 17,000 Hz	8.0 mV	Monaural

Fred A. Falk (Sales) Pty Ltd., 28 King Street, Rockdale, NSW. 2216. 597 1111

EQUIPMENT NEWS

humidity rejection. Operations are clearly indicated by light-emitting diodes.

The unique transmitter phase-locked loop exciter facilitates tuning and reduces spurious radiation dramatically.

Multi-channel operation facility, no unnecessary channel monitoring, accurate tuning, minimum outside noise and feedback, extra range and sensitivity and good steady power are standard performance features claimed for the Philips FM 828.

Power from the unit is kept at a maximum by the BNC aerial connector which keeps losses to a minimum. In fact, under the most hazardous conditions the FM 828 will operate at the maximum power output allowed by the PMG. It operates with a supply range of 10.8 to 16.1 volts and, because it draws such a low current, will function satisfactorily under almost flat battery conditions. Temperature variations are also claimed to be no problem to the FM 828 and it can transmit continuously from −10 degrees C. to +60 degrees C. – from Kosciosko in winter to the Nullabor Plains in summer.

The FM 828 has the facility for multi-channel operation – a choice of 1,3 or 10 channels. In-built selective calling cuts out unnecessary channel monitoring and noise interference is reduced to a large extent by the single conversion receiver. The Mute Control incorporated into the FM 828 is said to give it greater range and additional sensitivity compared with many other mobiles being marketed at the present time.

To add to the unit's flexibility, a number of optional devices are available for incorporation into or onto the unique extendable chassis. For difficult installations a Microphone Compression Amplifier can be fitted to improve the average level of speech to the transmitter. Other devices include a Transmit Inhibit and Limit Timer for minimal hold up and interference on any one channel, and an in-built loudspeaker for easier installation.

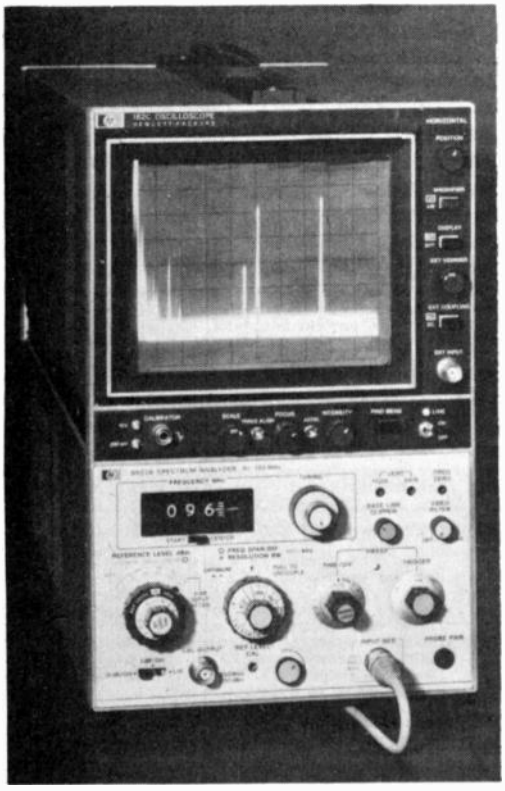
The FM 828 is designed for driver safety both from an operational and accident hazard point of view – in line with current safety regulations. Fingertip controls, recessed behind a rubber surrounded front panel, enable easy operation without driver distraction. The size, shape and configuration of the unit also allow installation in safe positions without affecting ease of operation. A security locking device keeps the unit firmly in position.

The design of the FM 828 has allowed for the possibility of short circuit or open current situations in the aerial without any additional protective circuitry being necessary. Additional circuitry incorporated in the unit obviates damage by reversal of the supply voltage.

Further details from Philips 95-99 York St., Sydney.

350-MHz SPECTRUM ANALYSER

A new 350-MHz fully-calibrated Spectrum Analyser, Model 8557A from Hewlett-Packard, emphasises ease of use with lab-grade performance. Its simplified operation (usually just three controls) suits it well for production use by technicians and for field service purposes. Its accuracy satisfies most lab bench applications and its price (complete with display), makes it a practical candidate for everyday lab use. Frequency response claimed is ±0.75 dB, overall absolute amplitude-measuring accuracy is ±2.25 dB, and frequency readings are said to be correct to ±3 MHz. Dynamic display range exceeds 70 dB.



The new instrument is a plug-in for HP 180-series oscilloscope mainframes. Especially suitable is the large-screen Model 182T.

For most measurements, only three controls are used: TUNING sets either the centre-frequency or the start-frequency of the display, indicated on a digital readout. FREQUENCY SPAN then sets the width of the frequency window to be viewed. The analyser now automatically selects the optimum resolution (1 kHz to 3 MHz) and sweep time; these choices may be over-ridden if desired. REFERENCE LEVEL setting then directly calibrates the display in absolute power units; the setting is the absolute power level of a signal that reaches the top of the display. The range is −110 dBm to +20 dBm.

The analyser indicates optimum and maximum power input level for the chosen amplitude setting, minimising the possibility of overdriving.

Further information may be obtained from Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Vic. 3130. ●

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DATA SHEETS ARE PROVIDED FOR EACH ITEM PURCHASED

7400 SERIES TTL

		DIP
7400	Quad 2-input NAND gate	$ .20
7401	Quad 2-input NAND gate	.20
7402	Quad 2-input NOR gate	.22
7404	Hex inverter	.22
7405	Hex inverter*	.20
7406	Hex inverter buffer/driver*	.35
7408	Quad 2-input AND gate	.22
7410	Triple 3-input NAND gate	.20
7420	Dual 4-input NAND gate	.20
7430	8-Input NAND gate	.20
7440	Dual 4-input NAND buffer	.20
7442	BCD-to-decimal decoder	.80
7447	BCD-to-7 segment decoder/driver.	1.00
7448	BCD-to-7 segment decoder/driver.	.80
7450	Expandable dual 2-wide 2-input AND-OR-invert gate	.20
7451	Expandable dual 2-wide 2-input AND-OR-invert gate	.20
7472	J-K master-slave flip-flop	.30
7473	Dual J-K master-slave flip-flop.	.40
7474	Dual D-type edge-triggered flip-flop	.40
7475	Quadruple bistable latch	.75
7476	Dual J-K master-slave flip-flop with preset and clear	.40
74L78	Dual J-K master-slave flip-flop.	.40
7483	4-Bit binary full adder (look ahead carry)	.80
7489	64-Bit read-write memory (RAM)	3.00
7490	Decade counter	.90
7492	Divide-by-12 counter (divide by 2 and divide by 6)	.60
7495	4-Bit right-shift left-shift register	.75
74193	Synchronous 4-bit binary up/down counter with preset inputs	1.00

*With open collector output

LINEARS

NE540	70-Watt power driver amp	$1.00
NE555	Precision timer	1.00
NE560	Phase lock loop DIP	2.00
NE561	Phase lock loop DIP	2.00
NE565	Phase lock loop TO-5	2.00
NE566	Function generator TO-5	2.00
NE567	Tone decoder	2.50
NE5558	Dual 741 op amp MINI DIP	.90
710	Voltage comparator DIP	.60
711	Dual comparator DIP	.25
723	Precision voltage regulator DIP.	1.00
741	Op amp TO-5/MINI DIP	.55
747	Dual 741 op amp DIP	1.00
748	Op amp TO-5	1.00
CA3018	2 Isolated transistors and a Darlington-connected transistor pair	.75
CA3045	5 NPN transistor array	.75
CA3026	Dual differential amp	.75
LM100	Positive DC regulator TO-5	.50
LM105	Voltage regulator	1.00
LM302	Op amp voltage follower TO-5	1.25
LM311	Comparator DIP	1.00
LM370	AGC amplifier	1.00
LM703	RF-IF amp epoxy TO-5	.25
LM1595	4-Quadrant multiplier	1.00

8093-8094	Tri-state quad buffer DIP	$1.00
8850-9601	One-shot multivibrator DIP	1.50
8811	Quad 2-input MOS interface gate 15V open collector DIP	.30

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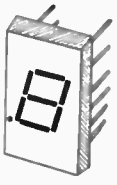
LSI CALCULATOR ON A CHIP

This 40-pin DIP device contains a complete 12-digit calculator. Adds, subtracts, multiplies, and divides. Outputs are multiplexed 7-segment MOS levels. Input is BCD MOS levels. External clock is required. Complete data is provided with chip (includes schematic for a complete calculator).

Complete with data $7.00
Data only $1.00

SLA-1 OPCOA



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Mounts on .4" centers.

Left-hand decimal point.

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100 Ohm	10K	250K
200 Ohm	20K	500K
500 Ohm	25K	1 Meg

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Please specify P or L (PCB or wire leads). Order NOW, these won't last!

COUNTER DISPLAY KIT—CD-2

This kit provides a highly sophisticated display section module for clocks, counter or other numerical display needs.

The RCA DR-2010 Numitron display tube supplied with this kit is an incandescent seven-segment display tube. The .6" high number can be read at a distance of thirty feet. RCA specs. provide a minimum life for this tube of 100,000 hours (about 11 years of normal use).

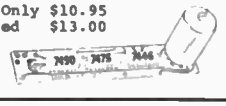
A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven-segment decoder driver. The 7447 accomplishes blanking of leading edge zeroes, and has a lamp test input which causes all seven segments of the display tube to light.

Kit includes a two-sided (with plated through holes) fibreglass printed circuit board, three IC's, DR-2010 (with decimal point) display tube, and enough Molex socket pins for the IC's.

Circuit board is .8" wide and 4 3/8" long. A single 5-volt power source powers both the IC's and the display tube.

CD-2 Kit Complete Only $10.95
Assembled and Tested $13.00

Board Only $2.50



RCA DR2010 NUMITRON

RCA DR2010 Numitron digital display tube. This incandescent five-volt seven-segment device provides a .6" high numeral which can be seen at a distance of 30 feet. The tube has a standard nine-pin base (solderable) and a left-hand decimal point. Each $4.00
SPECIAL 4 for $17.50

COUNTER DISPLAY KIT—CD-3

This kit is similar to the CD-2 except for the following:

a. Does not include the 7475 quad latch storage feature.
b. Board is the same width but is 1" shorter.
c. Five additional passive components are provided, which permit the user to program the count to any number from two to ten. Two kits may be interconnected to count to any number 2-99, three kits 2-999, etc.
d. Complete instructions are provided to pre-set the modulus for your application.

CD-3 Board Only $2.25
IC's, 7490, 7447 $2.75
RCA DR2010 tube $5.00

Complete kit includes all of the above plus 5 programming parts, instructions, and Molex pins for IC's. Only $9.25

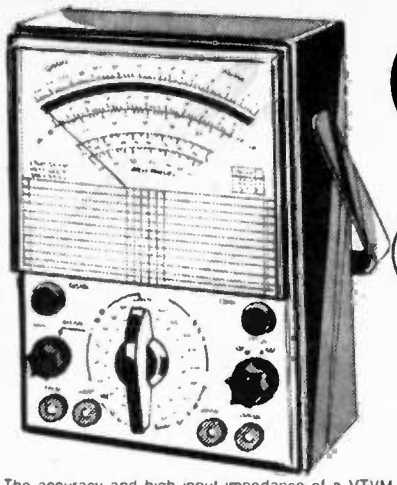
LM309K: 5-VOLT REGULATOR

This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof. It is designed to shut itself off with overload of current drain or over temperature operation. Input voltage (DC) can range from 10 to 30 volts, and the output will be five volts (tolerance is worse case TTL requirement) at current of up to one ampere.

Each $1.50 5 for $7.00

Babylon Electronics Inc.

Post Office Box J, Carmichael, California. 95 608 U.S.A.



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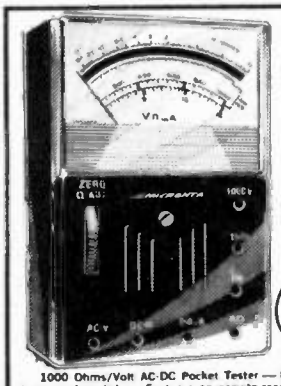
- *1% Precision Resistors!*
- *Burnout Protected!*
- *5" Mirrored Scale!*
- *Battery Check Switch!*

The accuracy and high input impedance of a VTVM now in a portable FET VOM. Ultra-sensitive 40uA meter has "Double Overload Protection" to guard against burnout. Mirrored scales eliminate error-causing parallax for exact readings on ALL ranges. Also features a polarity reverse switch, zero adjust, single-knob range selector. DC Volts: 0-3-30-100-300-1000 at 10M ohms/volt. AC Volts: 0-3-30-100-300-1000 at 10K ohms/volt. DC Current: 0-100 uA, 3-30-300 mA. Resistance, Rx1, Rx10, Rx1000, Rx10K, Rx1M (10 center scale). Decibels: −20 to +62 in 5 ranges. Accuracy: ±3% DC; ±4% DC. 7 x 5½ x 3⅛". With leads, batteries, instructions. **22-206**



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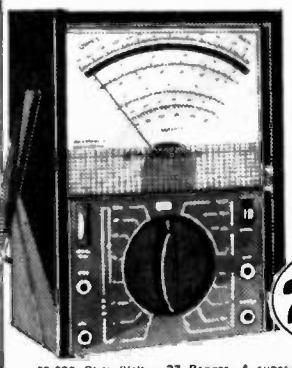
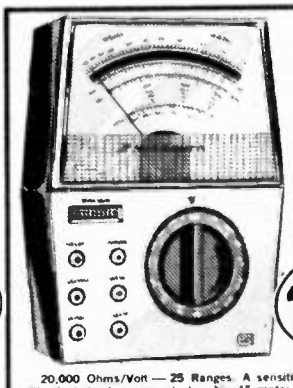
1000 Ohms/Volt AC-DC Pocket Tester — 8 Ranges. Handy for home and workshop. Features an easy-to-read 2" meter, a 2-color scale that's mirrored to prevent parallax, a thumb-set zero adjustment, and pin jacks for all ranges. AC and DC Ranges: 0-15-150-1000. DC Current: 0-150 mA. Resistance Rx1000 (100,000 ohms full scale). Accuracy is ±3% on DC ranges and ±4% on AC. Uses 1% precision resistors throughout. Ultra-compact black bakelite case is only 3½x2¾₁₆x1¼" deep. Complete with leads, battery, instructions. **22-027**



29.95

30,000 Ohms/Volt — 27 Ranges. A super-sensitive VOM for high-accuracy measurements. Color-coded 4" meter, four banana jacks including output jack, polarity-reverse switch, thumbwheel zero adjust, combined carry handle/stand. Ranges: DC Volts, 0-0.3-1-3-10-30-100-300-1000 at 30,000 ohms/volt; AC Volts, 0-10-30-100-300-1000 at 10,000 ohms/volt; DC Current, 0-100 µA, 3-30-300 mA, 10 amps; Resistance, Rx1, Rx10, Rx1000, Rx10,000 (10 center scale); Decibels, −10 to +62 in 5 ranges. Accuracy, ±3% AC, ±4% DC. Size, 6½x4½x1¾". With leads, battery, instructions. **22-203**

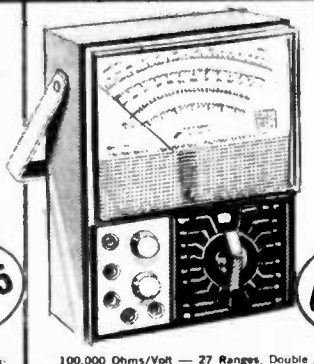


24.95

20,000 Ohms/Volt — 25 Ranges. A sensitive, full-range VOM with single-knob range selector, big 4" meter with mirrored and color-coded scales. Has 6 pin jack connections including an output jack. Ranges: DC Volts, 0-0.6-3-15-60-300-600-1200 at 20,000 ohms/volt; AC Volts, 0-15-60-150-600-1200 at 10,000 ohms/volt; DC Current, 0-60 µA, 3-30-300 mA; Resistance: Rx1, Rx10, Rx100, Rx1000 (24 center scale); Decibels, −20 to +63 in 5 ranges. Accuracy is ±3% DC and ±4% AC. Size, 5½x3½x1½". With leads, battery, instructions. **22-202**

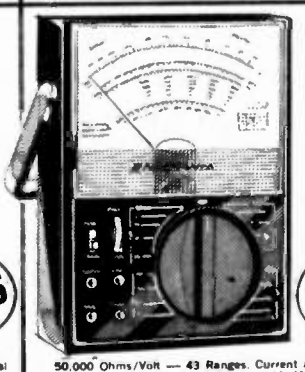
18.95

20,000 Ohms/Volt — 18 Ranges. A low-priced VOM with "expensive" features. Single-knob range selector with separate "off" position, 3" meter with easy-to-read color-coded scales, four pin jack connections including an output jack. Ranges: DC Volts, 0-5-25-125-500-1000 at 20,000 ohms/volt; AC Volts, 0-10-50-250-1000 at 10,000 ohms/volts; DC Current, 0-50 µA, 0-250 mA; Resistance, Rx1, Rx10, Rx1000 (24 center scale); Decibels, −20 to +62 in four ranges. Accuracy is ±3% on DC ranges and ±4% on AC ranges. Large thumbwheel for easy zero adjust. Size, 5¼x3½x1⅞". With leads, battery, instructions. **22-201**



49.95

100,000 Ohms/Volt — 27 Ranges. Double jeweled D'Arsonval 5" meter, mirrored scale, reverse polarity switch, overload protected meter. Carry handle tilt stand. DC Volts: 0-0.5-2.5-10-250-1000 at 100k ohms/volt. AC Volts: 0-5-10-50-250-1000 at 10k ohms/volt. DC Current: 0-10 µA, 500 µA, 5-50-500 mA, 10 A. Resistance: Rx1, Rx10, Rx1000, Rx10,000, Rx100,000 (2 center scale). dB: −20 to +62 in 5 ranges. Accuracy ±3% DC, ±4% AC. 8⅜x5¾₁₆x3¼". With leads, batteries, instructions. **22-205**



32.95

50,000 Ohms/Volt — 43 Ranges. Current and voltage "Range Doubler" — great for low-voltage work! 4½" mirrored scale, single-knob function switch with "Off", overload protected meter. DC Volts: 0-250 mV, 2.5-10-50-250-1000 at 50 k ohms/volt. 0-125 mV, 1.25-5-25-125-500 at 25k ohms/volt. AC Volts, 0-10-50-250-1000 at 10k ohms/volt. 0-5-25-125-500 at 5000 ohms/volt. DC Current: 0-50 µA, 5-50-500 mA, 10 A at 50k ohms/volt. 0-25 µA, 2.5-25-250 mA, 5 A at 25k ohms/volt. Resistance: Rx1, Rx10, Rx100, Rx1000, Rx10,000 (10 center scale). dB: −20 to +62 in 8 ranges. Accuracy: ±3% DC, ±4% AC. 6¼x4⅞x2⅛". With leads, batteries, instructions. **22-204**

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CONTROL NEWS

LIQUID CRYSTAL DISPLAYS WITH FIELD EFFECT TECHNOLOGY

Siemens is expanding its line of liquid crystal displays with types which operate in accordance with the field effect principle, and are particularly suitable for "mobile" applications by virtue of their low operating voltages. At "Electronics 74" a 21 mm wide display (FAN 4054 R) specially designed for watches was on show. A 5-digit, 18 mm high display for measuring instruments was also exhibited. Further new developments are a single-digit display with a height of 30 mm for elevators and a 4-digit display for clocks with a height of 13 mm. The complete range of Siemens standard displays, previously marketed only in the dynamically scattering versions, is now also available in field effect technology.

The "mini" display for watches, FAN 4054 R, has a 4-digit digital indication and a typical operating voltage in the region of 8 V ac. With this voltage (symmetrical, square wave) and a frequency of 32 Hz the overall current consumption is 0.6μA. The contrast ratio is 50:1, the activating and deactivating periods are nominally 150 and 250 ms. Its storage temperature is -15^{o}C to $+60^{o}$C, and its operating range 0 to 50^{o}C.

All the liquid crystal displays in field effect technology newly incorporated into the sales programme have dark symbols on a light background and are suitable for reflection operation. All liquid crystal displays in field effect technology feature high contrast ratios, low operating voltage and low power drain. Such features allow the displays to be driven by integrated circuits, for example CMOS circuits.

For further information contact Siemens Industries Limited, Melbourne, Sydney, Brisbane, Perth, Newcastle and Wollongong.

NEW MICROPROCESSOR

Recently released in the U.S. is the new Fairchild F8 Isoplanar-N Microprocessor – a versatile two-chip 8-bit microprocessor system aimed at applications which encompass over 80 percent of the microprocessor market.

Also released were four additional circuits which will become available for use with the basic CPU and Programme Storage Unit circuits by mid-1975.

Called the F8, the new N-channel Isoplanar microprocessor is heavily I/O oriented to maximise flexibility and minimise external parts requirements.

In the minimum two-chip F8 system, the CPU and PSU chip each provide two 8-bit bidirectional I/O ports, resulting in a total of 32 available I/O bits. This allows the two-chip system to accommodate directly, virtually all common I/O devices such as keyboards, printers, readers, displays, modems and magnetic devices.

Potential systems use of the F8 spans simple equipment such as appliance controls, all the way up to very sophisticated point-of-sale systems. Other applications include interactive intelligent terminals, floppy disk controllers, electronic games and vending machines, and a variety of automotive systems.

A system consisting of one CPU and two PSU chips would provide two timers, two interrupts, an inboard clock, inboard power-on, and 48 bidirectional I/O bits. Such a system could be used for traffic light control, for example, providing monitoring of traffic in four directions from in-road vehicle detectors for both through traffic and left and right turn lanes, as well as providing an interrupt capability for pedestrian control buttons on each corner of an intersection.

The communications interface circuit (USART) also available by mid-year, is a peripheral device programmed by the CPU to operate using virtually any serial data transmission technique currently in use. It will have a speed of 4 megabits per second for synchronous operation and 250 kilobits per second for asynchronous operation.

Evaluation quantities of the F8 CPU (3850) and PSU (3851) are available now on six-week delivery from Fairchild. Production quantities will be available in the third quarter of 1975.

In addition to the circuits, systems simulation boards and software for development purposes are being prepared. The first such simulator, the F8M, consists of the F8 with additional memory and logic and is now available from Fairchild. This system can be used with teletype equipment and efficient programme development.

Further details Houston Advertising and Marketing Services, 57 Orchard Drive, Croydon, 3136.

DUAL-IN-LINE SWITCHES

Siemens has just brought out a family of miniaturized switches tailored for printed-circuit application. There are three types, with either four, five or even eight unipolar on/off switches housed side by side in a dual-in-line case. The separate switch unit is 2.5 mm wide and has an overall height of 6.5 mm. All the terminals are within the dimensions of the reference grid (2.50 of 2.54 mm), and there is no problem providing the spacing between PC boards which is customary when integrated circuits are used.

These new mini switches are suitable for programming and for address and code modification, as well as setting operational statuses and changing over functions in electronic circuits.

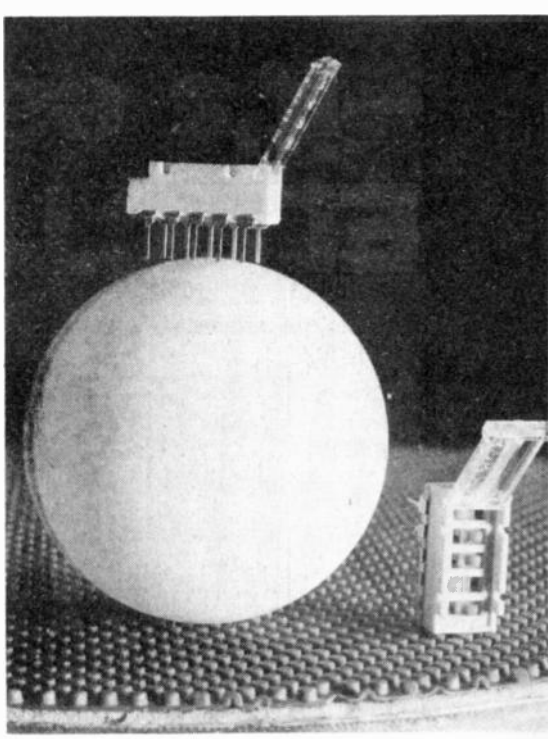
At the base of the tub-shaped case there are two fixed contacts in each of the switch chambers. These are sealed at one end in the plastic base and, like the solder terminals opposite them, are electrically connected by a link which is moved by means of sliders. This connecting link is designed as a resilient sliding contact and is nickel and gold plated, as are the fixed contacts. This ensures reliable contacting even in a critical environment.

The sliders are actuated by tiny lugs, which are only accessible when the hinged lid is open. A blocking strip on the underside of the lid fixes the sliders in the requisite switching position. The blocking strip and actuating lugs are designed in such a way that any sliders which have inadvertently not been pushed far enough are forced into their correct position when the lid is snapped into place.

The tops of the lids are divided along the longitudinal axis into a transparent and a non-transparent section with indented code numbers identifying the individual switch chambers. When the lid is closed, all the switches in the "on" position are visible through the transparent section. The sliders on the "off" position are covered by the non-transparent section. This means that the position of the switches can be checked quickly and accurately. Eight-unit switches have different-coloured sliders arranged in groups to present a clear picture of the situation even when the lid is open.

Draft standard DIN 866 (Cases for Integrated Circuits) was extensively used as a basis for the design of the switch case, so the high packing density on the PC boards which is a customary feature of IC technology is not affected by the mini switches. Nor does their use entail any limitation regarding such aids as unsoldering devices, sockets, test terminals and devices for mechanically equipping PC boards.

Further information Siemens Industries Ltd, 383 Pacific Highway, Artarmon, 2064.



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7406	.35	7470	.30	74161	1.25
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7408	.19	7473	.35	74163	1.39
7409	.23	7474	.35	74164	1.59
7410	.16	7475	.57	74165	1.59
7411	.26	7476	.39	74166	1.49
7413	.55	7483	.99	74170	2.30
7415	.35	7485	1.10	74173	1.49
7416	.35	7486	.40	74174	1.62
7417	.35	7489	2.48	74175	1.39
7420	.17	7490	.62	74176	.89
7422	.26	7491	.97	74177	.84
7423	.29	7492	.71	74180	.90
7425	.27	7493	.60	74181	2.98
7426	.26	7494	.94	74182	.79
7427	.29	7495	.79	74184	2.29
7430	.20	7496	.79	74185	2.29
7432	.23	74100	1.30	74187	5.95
7437	.35	74105	.44	74190	1.35
7438	.35	74107	.40	74191	1.35
7440	.17	74121	.42	74192	1.25
7441	.98	74122	.45	74193	1.19
7442	.77	74123	.85	74194	1.25
7443	.87	74125	.54	74195	.89
7444	.89	74126	.71	74196	1.25
7445	.89	74141	1.04	74197	.89
7446	.93	74145	1.04	74198	1.79
7447	.80	74150	.97	74199	1.79
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74L04	.25	74L72	.39	74L95	1.69
74L06	.25	74L73	.49	74L98	2.79
74L10	.25	74L74	.49	74L164	2.79
74L20	.33	74L78	.79	74L165	2.79
74L30	.33	74L85	1.25		
74L42	1.49	74L86	.69		

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74H08	.25	74H40	.25	74H62	.25
74H10	.25	74H50	.25	74H72	.39
74H11	.25	74H52	.25	74H74	.39
74H20	.25	74H53	.25	74H76	.49

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8123	1.43	8551	1.39	8831	2.19
8130	1.97	8552	2.19	8836	.25
8200	2.33	8554	2.19	8880	1.19
8210	2.79	8810	.69	8263	5.79
				8267	2.59

9000 SERIES

9002	$ .35	9309	$ .79	9601	$ .89
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Data sheets supplied on request
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4000A	$ .39	4019A	$ .69	4066A	$1.19
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4007A	.40	4024A	1.45	4072A	.40
4008A	1.98	4025A	.39	4073A	.40
4009A	.69	4027A	.98	4075A	.40
4010A	.69	4028A	1.69	4078A	.40
4011A	.39	4030A	.79	4081A	.40
4013A	.69	4035A	1.89	4082A	.40
4014A	1.98	4042A	1.89	4528A	1.60
4015A	1.98	4049A	.79	4585A	2.40
4016A	.69	4050A	.79	4047A	2.75
74C00	$ .22	74C74	$1.04	74C162	$2.93
74C02	.26	74C76	1.34	74C163	2.66
74C04	.44	74C107	1.13	74C164	2.66
74C08	.68	74C151	2.61	74C173	2.61
74C10	.35	74C154	3.15	74C195	2.66
74C20	.35	74C157	1.76	80C95	1.35
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2048 bit programmable ROM UV erasable **$14.95**

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CLOSEOUT ON CALCULATOR CHIPS

These early model calculator chips have been superseded and are now offered at this lowest price ever. Complete with data.

CT5001 12 digit display and calculate, 4 function, chain operation, fixed dec. 40 pin package **$1.95**
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7448	BCD - 7 seg Decoder/Driver (30V)	$ .89
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74107	Dual J-K flip-flop	.33
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380	2 watt audio amplifier	$1.09
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5 function plus constant — addressable memory with individual recall — 8 digit display plus overflow — battery saver — uses standard or rechargeable batteries — all necessary parts in ready to assemble form — instructions included

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1103	1024 bit RAM MOS	3.95
2102	1024 bit static RAM	5.55
5203	2048 bit UV eras PROM	17.95
5260	1024 bit RAM	2.49
5261	1024 bit RAM	2.69
5262	2048 bit RAM	5.95
7489	64 bit ROM TTL	2.48
8223	Programmable ROM	1.69
74200	256 bit RAM tri-state	5.90

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5001	12 DIG 4 funct fix dec	$3.45
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5005	12 DIG 4 funct w/mem	4.95
MM5725	8 DIG 4 funct chain & dec	1.98
MM5736	18 pin 6 DIG 4 funct	4.45
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MM5739	9 DIG 4 funct (bitry sur)	5.35
MM5311	28 pin BCD 6 dig mux	4.45
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MM5313	28 pin 1 pps BCD 6 dig mux	4.45
MM5314	24 pin 6 dig mux	4.45
MM5316	40 pin alarm 4 dig	5.39

LED's

MV10B	Red TO 18	$ .22
MV50	Axial leads	.18
MV5020	Jumbo Vis. Red (Red Dome)	.22
	Jumbo Vis. Red (Clear Dome)	.22
ME4	Infra red diff. dome	.54
MAN1	Red 7 seg. .270"	2.19
MAN2	Red alpha num .32"	4.39
MAN4	Red 7 seg. .190"	1.95
MAN5	Green 7 seg. .270"	3.45
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MAN8	Yellow 7 seg. .270"	3.45
MAN64	.4" high solid seg.	2.95
MAN66	.6" high spaced seg.	3.75
MCT2	Opto-iso transistor	.61

SHIFT REGISTERS

MM 5013	1024 bit accum. dynamic	mDIP	$1.75
MM 5016	500/512 bit dynamic	mDIP	1.59
MM 5058	1024 bit static	DIP	3.45
SL S-4025	Dual 64 bit static	DIP	1.39

DTL

930	$ .15	937	$ .15	949	$ .15
932	.15	944	.15	962	.15
936	.15	946	.15	963	.15

LINEAR CIRCUITS

300	Pos V Reg (super 723)	TO-5	$ .71
301	Hi Perf Op Amp	mDIP TO-5	.29
302	Volt follower	TO-5	.53
304	Neg V Reg	TO-5	.80
305	Pos V Reg	TO-5	.71
307	Op AMP (super 741)	mDIP TO-5	.26
308	Micro Pwr Op Amp	mDIP TO-5	.89
309K	5V 1A regulator	TO-3	1.35
310	V Follower Op Amp	TO-5 mDIP	1.07
311	Hi perf V Comp	mDIP TO-5	.95
319	Hi Speed Dual Comp	DIP	1.13
320	Neg Reg 5.2, 12, 15	TO-3	1.04
322	Precision Timer	DIP	1.70
324	Quad Op Amp	DIP	1.52
339	Quad Comparator	DIP	1.58
340T	Pos Volt Reg (5V-6V 8V-12V-15V-18V-24V)	TO-220	1.79 1.04
370	AGC/Squelch AMPL	TO-5 or DIP	.71
372	AF-IF Strip detector	DIP	2.93
373	AM/FM/SSB Strip	DIP	.53
376	Pos. V. Reg	mDIP	2.42
377	2w Stereo amp	DIP	1.16
380	2w Audio Amp	DIP	1.13
380-8	.6w Audio Amp	mDIP	1.52
381	Lo Noise Dual preamp	DIP	1.52
382	Lo Noise Dual preamp	DIP	.71
550	Prec V Reg	DIP	.89
555	Timer	mDIP	1.49
556A	Dual 555 Timer	DIP	1.49
560	Phase Locked Loop	DIP	2.48
562	Phase Locked Loop	DIP	2.48
565	Phase Locked Loop	DIP TO-5	2.38
566	Function Gen	mDIP TO-5	2.25
567	Tone Decoder	mDIP	2.66
709	Operational AMPL	TO-5 or DIP	.26
710	Hi Speed Volt Comp	DIP	.35
711	Dual Difference Compar	DIP	.26
723	V Reg	DIP	.62
739	Dual Hi Perf Op Amp	DIP	1.07
741	Comp Op AMP	mDIP TO-5	.32
747	Dual 741 Op Amp	DIP or TO-5	.71
748	Freq Adj 741	mDIP	.35
1304	FM Mulpx Stereo Demod	DIP	1.07
1307	FM Mulpx Stereo Demod	DIP	.74
1458	Dual Comp Op Amp	mDIP	.62
1800	Stereo multiplexer	DIP	2.48
LH2111	Dual LM 211 V Comp	DIP	1.70
3065	TV-FM Sound System	DIP	
3075	FM Det-LMTR & Audio preamp	DIP	.62 .71
3900	Quad Amplifier	DIP	.35
7524	Core Mem Sense AMPL	DIP	.71
7534	Core Mem Sense Amp	DIP	.71
8864	9 DIG Led Cath Drvr	DIP	2.25
75150	Dual Line Driver	DIP	1.95
75451	Dual Perepheral Driver	mDIP	.35
75452	Dual Peripheral Driver	mDIP	.35
75453	(351) Dual Periph. Driver	mDIP	.35
75491	Quad Seg Driver for LED	DIP	.71
75492	Hex Digit Driver	DIP	.80

The prices as listed are in Australian dollars. Send bank cheque with order. If international postal money order is used send receipt with order. Shipment will be made via air mail — postage paid — within three days from receipt. Minimum order — $5.00.

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COMPONENT NEWS

GAS-DISCHARGE DISPLAY INTERFACE CIRCUITS

Many present interface schemes for gas-discharge displays, such as the Burroughs Panaplex, Beckman, Cherry, etc., require both a considerable amount of printed wiring board space and large numbers of components (very often more than 100) for a MOS to gas panel interface.

With the introduction of Sprague's new UDN-6144A, UDN-6164A, UDN-6184A, UDN-7183A, and UDN-7186A display drivers, substantial reductions in component count and, therefore, overall system cost can be realised, it is claimed, in MOS to gas panel interface schemes.

These new monolithic integrated circuits have been designed to replace ALL of the present system requirements for discrete components or discrete/IC combinations. The most basic application will require a digit IC and a segment IC with the MOS, display, and power supply. All of the functions, such as pull-up and pull-down, current limiting, level shifting, and necessary off-state output voltage bias, are contained in their new circuits. These new IC's will provide interfaces with PMOS, CMOS, NMOS, DTL, TTL, and other low-level logic devices and gas-discharge display elements.

Up to now, gas discharge displays have been largely limited to the calculator market, but they are now moving into many other areas of application. New applications are opening up in digital clocks, intrumentation (DVM's, DPM's, etc.), point-of-sale terminals, automotive dashboards, entertainment tuning, electronic cash registers, appliances (electronically controlled ranges), etc.

The growth in the use of gas-discharge displays, it is claimed, has been primarily restricted by the inadequacy and high cost of present interface schemes. Sprague's introduction of the new series of display drivers should improve this situation.

For further information contact Namco Electronics, 239 Bay Street, North Brighton, 3186, Vic.

NEW C & K SWITCH CATALOGUE

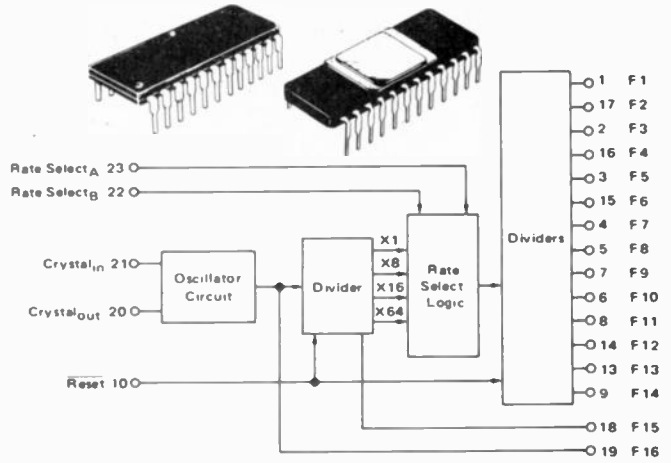
A new, updated 24-page illustrated catalogue of the range of switches made by C & K Components Inc, Massachusetts, has just been issued.

The informative catalogue updates earlier issues and includes new lines in the range of sub-miniature toggle, rocker, illuminated rocker and paddle-handle switches and sub-miniature and micro-miniature pushbutton switches.

Wiring diagrams are included with the illustrations.

Plessey Australia is the official distributor in Australia of C & K products.

Copies of the catalogue may be obtained by application to the Professional Components Section, Plessey Australia, Christina Road, Villawood, NSW, 2163.



BIT RATE GENERATOR

Developed for the data communications industry, Motorola has introduced the MC14411, a CMOS device that generates the baud-rate clock frequencies that are required by today's data communications systems. Sixteen clock frequencies are available simultaneously from low power-TTL compatible buffered outputs.

The MC14411 contains a crystal oscillator circuit, a programmable rate-select circuit and divider chains. When controlled by a 1.8432 MHz crystal, and at a X1 rate factor, fourteen frequencies in the range of 75 Hz to 9600 Hz are produced at the outputs. The oscillator frequency and a signal at half the crystal frequency provide the fifteenth and sixteenth buffered outputs.

The rate-select logic, which controls all outputs except the 15th and 16th, can multiply the frequencies by factors of 8, 16 or 64, thereby expanding the total number of distinct frequencies available. The output waveforms have a 50% duty cycle.

The MC14411 operates from a single 5.0 volt supply and can be used in conjunction with the MC6850 Asynchronous Communications Interface Adapter to form a software-controlled serial/parallel data link. This Bit Rate Generator may also be used with the MC2257 Terminal Transmitter and MC2259 Terminal Receiver for hardware-controlled data links.

The MC14411 is offered in either a ceramic (L) or plastic (P) 24 pin DIP. The operating temperature for both versions is -40°C to +85°C.

Further details from: Motorola Semiconductor Products 37 Alexander St, Crowsnest 2065.

DRY REED RELAYS

The Components Division of Plessey Australia is marketing a series of dry reed relays of the 14-pin DIL package type compatible with TTL driver integrated circuits.

Manufactured by OKI Electrical Industry, Japan, the relays incorporate a miniature reed insert switch and coil assembly magnetically shielded for multiple mountings in close proximity without interaction.

The URD-1600 is a Form A (normally open contact) relay suitable for applications such as sequence control between electronic circuits, input/output control for operating amplifiers and digital control circuits and for switching circuits with high output/input ratios.

The URB-1600 is a normally closed, Form B (break contact) relay in which the contacts are made or broken by excitation. It suits applications such as current flow detectors and switching circuits requiring normally closed relays.

DUAL-CHANNEL OPTICAL ISOLATORS

Two optical isolators in one package give the user increased packing density, better thermal tracking of two channels, and lower cost per channel. Major applications for these Hewlett-Packard Model 5082-4354/55 Dual High-Speed Optically-Coupled Isolators are logic circuit interfacing and as line receivers. They are also useful in analogue circuits that require two channels.

Two detectors with common ground and common supply voltage pins, and two LEDs are in an 8-pin package. Dc electrical insulation between input and output is 2500 volts. Separate connections for the photodiode bias and output transistor collectors reduces base-collector capacitance, thus increasing the speed up to 100 times that of a conventional phototransistor isolator.

Model 5082-4354 is intended for use in TTL/CMOS, TTL/LTTL or wide bandwidth analogue application. Current transfer ration (CTR) is 7 percent minimum for an input current I_F of 16 milliamperes.

Model 5082-4355 is intended for high speed TTL/TTL logic applications. CTR of the -4355 is 15 percent minimum at an I_F of 16 milliamperes. It will handle one TTL load plus a pull-up resistor.

For further information contact Hewlett-Packard Australia Pty Ltd, 31-41 Joseph Street, Blackburn, Vic. 3130.

COMPONENT NEWS

ETCH RESIST PEN

The DALO 33PC marking pen, available from Royston Electronics, has been designed specifically for preparing printed circuits.

It incorporates a special valve-controlled ink dispenser which prevents evaporation of the etch-resist ink. Ink-soaked wads are not utilised.

The ink resists the action of etchants such as ferric chloride, and the procedure is simply to draw the desired circuit lines directly on to the copper clad laminate. Errors can be erased with a readily available solvent. After 15 minutes drying, the board is dipped into a cold etch solution, after which the ink is removed with the solvent.

Royston Electronics can also supply solvent, solvent dispenser, and both paper phenolic and glass epoxy copper clad laminate.

Further details from Royston Electronics Pty Ltd, 22 Firth St, Doncaster 3108.

FIREPROOF OXIDE RESISTOR

Welwyn Electric Limited have announced the introduction of a range of Fireproof Power Oxide resistors.

The new range, Series F, is available in three sizes and two mounting styles (axial and pluggable). The specification fully describes the predictable fusing characteristics and they are suitable for applications which must meet BS415 "Safety requirements for mains operated household and vision equipment."

The protective coating is inherently non-burning and open circuit occurs, without sustained arcing, in a maximum of 30 seconds with an applied 'fault condition' voltage 4.5 times maximum normal operating condition voltage. When mounted according to manufacturer's instructions, fail safe operation occurs within the requirements of BS415.

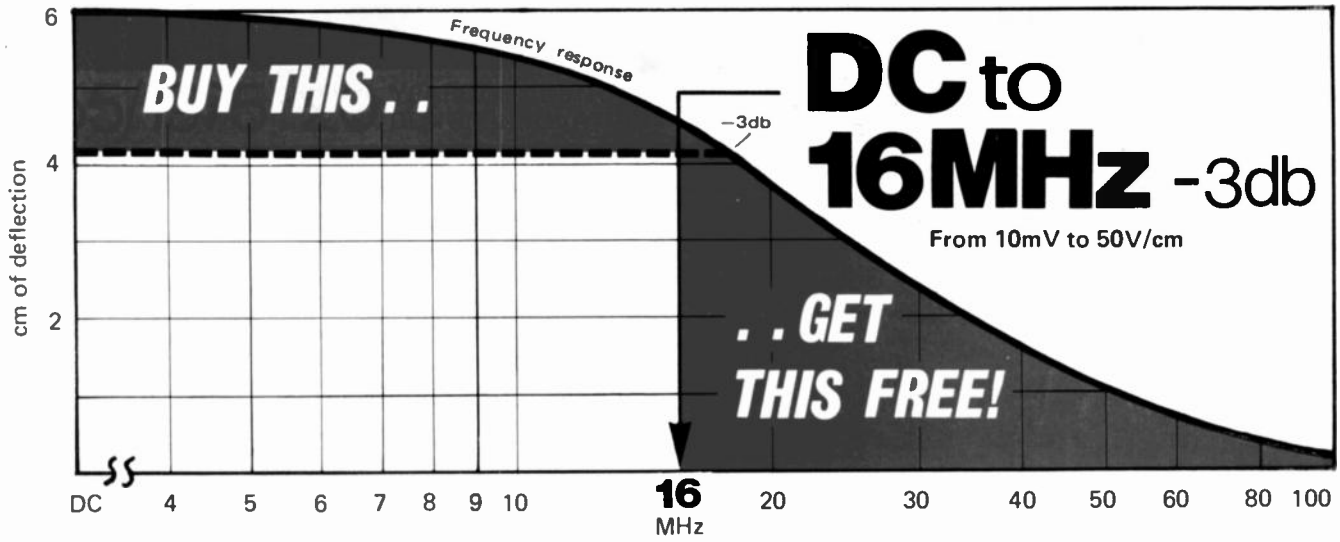
For further information contact Namco Electronics, 239 Bay Street, North Brighton, 3186 Vic.

COMPACT LOAD CELLS

Lebow Associates' newest Compression Load Cell Model 3678 features high performance, compact size and low price. Sealed construction and low deflection makes the 3678 especially suited for multiple cell weighing systems. Repeatability of 0.02%, creep of less than 0.03% and a combined non-linearity and hysteresis of less than 0.1% are claimed for these units.

Further information from N.I.C. Instrument Company, Melbourne 338-3111; Sydney 51-8931; Brisbane 44-2111; Adelaide 51-4935; Perth 65-4655. ●

When you buy the Dual Trace 539B, you get



Model
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This is the tip of the performance range. Like the iceberg, there's a lot below the surface . . . and when you buy a bwd539B for its performance to 16MHz, you get the measuring capability to beyond 50MHz for nothing.

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- Sensitivity: 10mV/cm DC to 16MHz
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  ≈ 100mV/cm at 50MHz
  ≈ 500μ V/cm 3 Hz to 30kHz cascaded
- Time Base Range: 100n Sec to 2.5 sec/cm
- Trigger Range: <5Hz to beyond 30MHz
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Diodes of either GaP, GaAs or GaAsP are encapsulated in a variety of plastic or glass packages and are available in Red, Green, Yellow, Infrared, Clear or two colour (red/green) light emitting styles. Panel mounting adaptors are available to suit all types together with a range of panel mounting indicator lamps employing built-in L.E.D.'s.

All L.E.D.'s from Plessey are vibration and shock resistant and I.C. compatible. They are readily adaptable to a multitude of applications including opto-isolators, photo switches, photo choppers, photo detectors, solid state displays, etc.

PLESSEY

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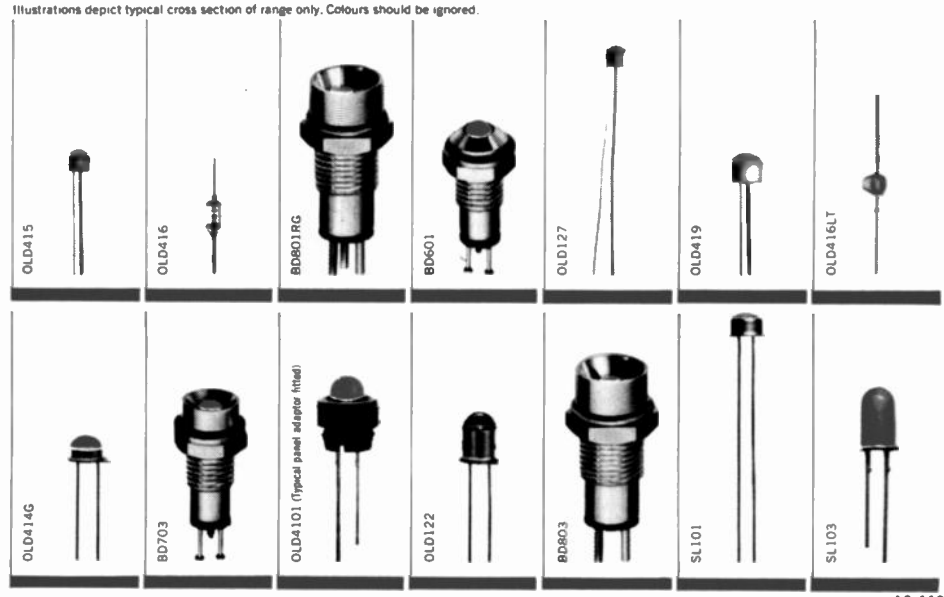
MELB. Zephyr Products Pty Ltd 56 7231. **ADEL.** K. D. Fisher & Co 223 6294. **BRIS.** L. E. Boughen & Co 70 8097. **PERTH** H. J. McQuillan Pty Ltd 68 7111. **N.Z.** Henderson (N.Z.) 6 4189.

Illustrations depict typical cross section of range only. Colours should be ignored.



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3A	$ 57.00	$21.00
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AD 1065/M8	$23.00
AD 10100/W8	$40.00
AD 12100/HP8	$43.00
AD 12100/M8	$40.00
AD 1265/M8	$24.00
AD 1265/W8	$25.00
AD 12100/W8	$40.00

CROSSOVERS

ADF 1600/8	$ 7.00
ADF 500/4500/8	$12.00

ETI speaker design is also available.

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6 CHANNELS **$139.50** Crystals Extra)

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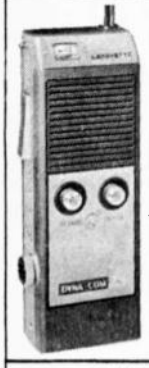

5 WATTS 12 CHANNELS
DYNA-COM 12A
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A powerful 5-Watts input power in a hand-held transceiver! Excellent sensitivity and selectivity. Ruggedly designed for extra reliable performance. This high-power walkie-talkie operates from internal batteries (rechargeable Ni-cad batteries available) or an external 12V source.

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1,000's of LAFAYETTE HA-310 walkie-talkies in use in Australia, 100,000's throughout the world attest to their superior qualities. A professionally designed, sturdily constructed, commercial quality unit for top performance and long term reliability. Rechargeable Ni-cad batteries are available to suit.

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This 24-hour Digital Clock Radio is completely electronic — no moving parts — 100% solid state. You can listen to FM or AM, wake up to music or alarm, or preset the radio program. It can be used as an accurate stopwatch. And there is even an indicator that blinks whenever there has been an AC power interruption.

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Unique products. Superb sound. The ESS Heil Air Motion Transformer is now available in a range of loudspeaker models from **$299** pr. to **$1600** pr.

There are two Phase Linear "super power" amplifiers, the Model 400 at **$660**, the Model 700B at **$998**, and the Model 4000 autocorrelation preamplifier at **$780** which has to be not heard to be believed!

Send in the coupon if you would like lots of information about these "state-of-the-art" components.

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AUDIO FACTS

Computer model optimises cone design

OPTIMISING LOUDSPEAKERS

ALTHOUGH the quality of loudspeakers has been considerably improved in recent decades, their design has been hitherto more a question of intuition and practical experience than of quantitative understanding of the behaviour of loudspeaker cones, especially at the higher audio frequencies.

In the Philips Research Laboratories in Eindhoven, The Netherlands, a computer model has been developed with the aid of which it is now possible when designing loudspeakers to choose the geometry and material of the cone in such a way as to obtain the required frequency response.

The theoretical analysis of loudspeaker behaviour has been carried out by F.J.M. Frankort, a member of the above-mentioned laboratory. He set up twelve simultaneous differential equations to describe this behaviour, and with the aid of a computer solved them numerically for a large number of frequencies and for various types of loudspeaker cone. In this way it proved possible, for example, to calculate the frequency characteristics of the sound pressure and the radiated sound power as a function of the geometry and properties of the cone material.

To verify the theoretical results experimentally, the mechanical vibrations of the cone were visualised holographically (see photographs). In addition, the velocity of the coil, the sound pressure and the sound power levels of the loudspeaker were recorded as a function of frequency.

The experimental data agree well with the theoretical values. It may be concluded that the new approach will lead to further improvements both in the method of design and in the quality of loudspeakers.

(The result described refer to laboratory experiments; they do not necessarily imply a follow-up in production or marketing). ●

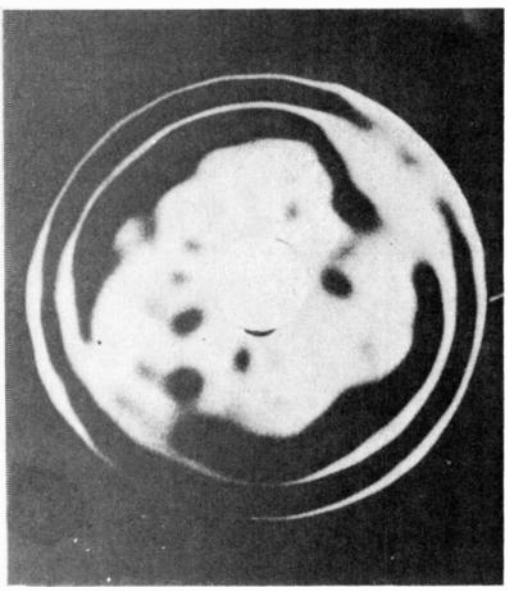


Fig. 1.

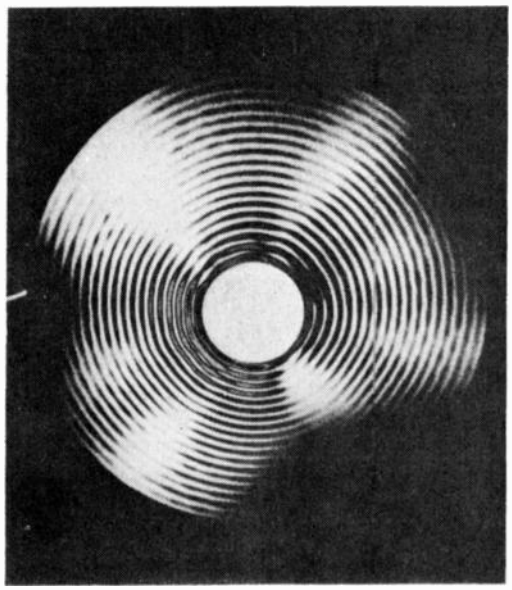


Fig. 2.

At low frequencies the cone vibrates as a rigid entity. Above a certain frequency, standing waves appear on the cone surface. These can clearly be seen in Figs 1 and 2. Fig. 1 is an interferogram obtained holographically of a cone driven at a frequency of 2000 Hz; at this frequency, nodes and antinodes begin to appear along the periphery of the cone. In Fig. 2 the drive frequency was 9000 Hz; the whole surface of the cone is now covered with patterns of nodes and antinodes, and the cone radiates little sound.

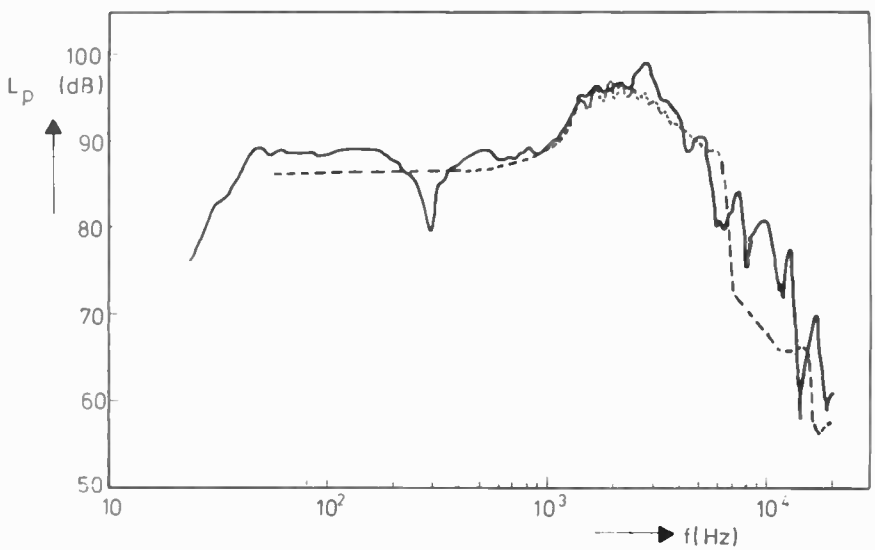
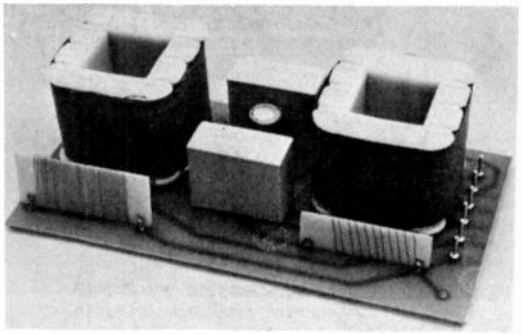


Fig.3. This graph illustrates the satisfactory agreement between the measured and calculated frequency response of the sound pressure level L_p on the axis of 200 mm loudspeaker in a box (solid line: experimental; dashed line: theoretical).

ETI 400 CROSSOVER



George Hawthorn Electronics are marketing a ready-built crossover for the ETI 400 speaker system.

This crossover is constructed to the specifications given by Electronics Today. Top quality components are used throughout and are mounted upon a fibreglass printed-circuit board.

The units are $11.98 each — plus postage.

Further details from: George Hawthorn Electronics, 966 High Street, Armadale, Vic, 3143.

BI-AMPLIFICATION

To an extraordinary extent, loudspeaker and amplifier manufacturers each behave as if their respective products were the beginning and end of a hi-fi system. As if they didn't have to be interfaced with other components in the system.

An amplifier manufacturer, for example, must produce products that will drive acoustic transducers varying in electro-acoustic efficiency from less than 0.05% to a possible 3% plus — and with an impedance, which may be inductive or capacitive, varying from less than a couple of ohms to a possible 40 ohms or more and with natural resonant frequencies 20 Hz to 100 Hz or more.

The speaker manufacturer has even bigger problems. His product is an incredible collection of acoustic compromises many of which could be overcome by 'tailoring' the response curve of the amplifier to the individual speaker.

It's almost like inventing the motor car before the wheel and then complaining about the resultant scraping noises!

There are many factors in speaker design that govern the quality of the resultant sound — many of these factors are, as yet, far from totally understood. But what *is* known is that the enclosure must have a frequency response that is linear over an extended range — and that phase relationships between the various drive units be rigidly controlled.

By very careful design and attention to detail it is possible to obtain linear response over a restricted range — say 100 Hz to 10 kHz or so — but beyond that major compromises generally have to be accepted.

Control over phase relationships is even more difficult, for with conventional (passive) cross-over networks it is virtually impossible to retain any meaningful control of inter-unit phase relationships within the cross-over region.

However by using active cross-over networks (after the preamplifier), and separate power amplifiers, for each main group of drive units, it becomes possible to 'tailor' amplifier characteristics to match the characteristics of the drive units and enclosures. If for example the bass driver's response falls off between 80 Hz and 130 Hz it is relatively simple to boost the associated bass amplifier output across this range.

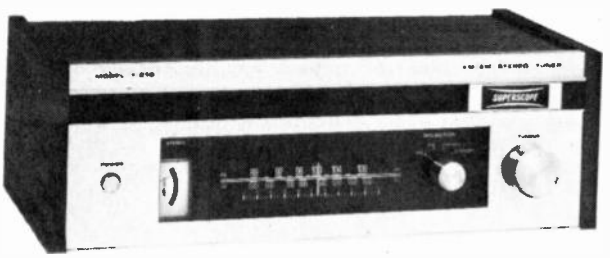
Control over phase relationships is still far from simple but at least it is possible.

This technique, which is often known as bi-amplification (or tri-amplification if three amplifiers are used for each channel) is currently being very thoroughly investigated by most leading hi-fi equipment manufacturers. Companies such as Philips and Infinity already produce complete integrated systems using this principle. Others, such as Sony, McIntosh, Pioneer, Matsushita and Kensonic are reliably reported to have tuner/preamplifier combinations under development — these will of course interface with future active-crossover/power-amplifier/speaker combinations. Pioneer have a new electronic crossover unit specifically intended for bi-amplification (model number is SF 850).

In the long term we may well see a swing away from the conventional single unit integrated amplifiers driving separate speakers. In their place we could realistically expect to find compact versatile preamplifiers or tuner/preamplifiers interfaced with speakers each having its own active crossover network and matching power amplifier especially designed so as to produce optimum performance from that drive unit/enclosure combination.

Electronics Today's own development laboratory has been working on such a system for the past year or so — we hope to be able to bring you the results — in constructional project form before very long. The results so far are most impressive!

SUPERSCOPE IN AUSTRALIA



Superscope, manufacturer of Marantz stereo receivers, components and speakers have introduced a totally new line of high fidelity home entertainment products, to be marketed world-wide under the 'Superscope' brand name and distributed in Australia by Allans Music Australia Limited.

The new line will encompass all categories of High Fidelity products, including components, receivers, compact systems, speakers, and a complete line of Superscope tape recorders.

Superscope, Inc.'s Australian distributor Allans Music Australia Limited, is based in a new warehouse at Smith Street, Collingwood, Melbourne.

PA AMPLFIER HAS INBUILT MIKE

A new compact, solid state PA amplifier with an inbuilt microphone has been released by Plessey Communication Systems. The new unit (model PA3A18) has 10-watts rms output which can effectively drive up to 10 extension speakers, making it ideal for smaller systems in office, warehouse and similar businesses. An inbuilt "Electret Condenser" microphone simplifies operation and eliminates the need for additional cords and separate desk top microphones — although the unit is equipped for an optional external microphone.

The Plessey model PA3A18 is built to meet most requirements and has an auxiliary input to accommodate background music sources.

The unit is suitable for PA applications as well as background music.

AUDIO FACTS

Pioneer Electronics' new Prelude 600 system, made up of a turntable, amplifier and speakers, replaces the Prelude 500, which for almost two years has largely dominated the $200 to $400 hi-fi system market in Australia.

The Prelude 600 has a recommended retail price of $299 — the same its predecessor had when it was launched in June 1973.

The new system has improved speakers, a new turntable and a different amplifier equipped with a wide range of facilities.

NEW DEVELOPMENT IN SPEAKER CONES

A new development to improve the sensitivity and tonal quality of high fidelity speakers — carbon fibre blend cones for woofers — are incorporated in three new Pioneer speaker systems introduced into Australia recently.

The systems are the CS-F51 (50 watt), the CS-T61 (60 watt), and the CS-T8 (80 watt).

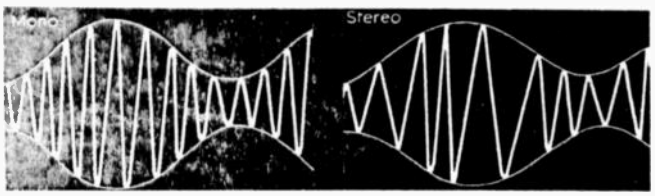
The new speaker cones were developed jointly by Pioneer Electronics, and Japan's Toray industries.

The exacting process by which carbon fibre is manufactured gives it a wide range of properties in demand in the aerospace and other industries, including high elasticity, low density and adequate inner loss.

These properties make it ideally suited as a blend material in woofers as it ensures a full-presence bass response without blurring or distortion.

The CS-T8, which is the top of this new range, features an acoustically balanced three-way speaker system featuring a 300 mm carbon fibre blend low distortion woofer, duraluminium dome midrange and titanium dome tweeter for improved transient response.

AM STEREO RADIO



America's RCA corporation are currently demonstrating an AM stereo broadcasting system using a phase and amplitude modulated carrier. So far few technical details are available.

Another FM stereo broadcasting system has however just been patented by Leonard Khan (British Patent 1 379 698 and 970 051). Khan's method is to modulate the upper and lower sidebands of a single carrier with the two components of the stereo signal.

An ingenious technique has been devised to ensure compatibility with mono receivers. Basically the left hand and right hand signals are summed and used to amplitude modulate the carrier in the normal way. Thus mono radios process the signal in the normal way.

An additional signal, which is the difference between the left and the right hand signals, phase modulates the main carrier. This phase modulated carrier is then processed in the receiver, and the separate left and right hand signals retrieved.

Automatic stereo switching is achieved by a 15 Hz tone transmitted with the left plus right signal.

POWER FOR PRICE

In a move that is expected to have extremely wide impact on the Australian amplifier market, Pioneer Electronics, have replaced their line-up of amplifiers with six new models providing an improved "power for price" ratio.

Doug Bell, marketing services manager of Pioneer in Australia, said today that the new range of amplifiers, with power outputs from 20 watts per channel to 110 watts per channel would fill all requirements from first-time buyers up to hi-fi enthusiasts.

"In Australia, as in America, the main criteria used in buying amplifiers is 'power for price', so our new range will be very competitive". "In addition we are introducing three new tuners, each of which is designed to match two of the new amplifiers.

Pioneer's new amplifier range is priced for $159 to $929 (recommended retail prices).


2000 AXT
INFINITY
THE WAVE OF THE FUTURE
SO TECHNICALLY ADVANCED IT SHOULD HAVE BEEN INVENTED TOMORROW

SPECIFICATIONS

Frequency Response:
30 to 21 KHz 3.5 db

Crossover Frequency:
500 Hz, 5000 Hz

Nominal Impedance:
8 ohms

Maximum Amplifier Power:
200 watts/channel program

Minimum Amplifier Power:
20 watts. RMS/channel

Dimensions:
27¾" high, 20" wide, 14" deep

The reviewers of Hi Fi Newsletter had this to say about the Infinity 2000A:

". . . The Infinity people have demonstrated with the 2000A that they know their way in the problematic and highly controversial speaker world. Their representative, then, deserves our highest rating, and until something better comes along it remains our standard in its price category."

Infinity is proud to announce that something better has come along – the 2000AXT. It is better because it is smoother in frequency response, has much better dispersion and has about 5 db added efficiency.

It is smoother in frequency response because we use three new drivers, each developed for its smoothness of frequency response and low distortion. It has better dispersion principally due to our patented wave transmission line tweeter. Finally, it has higher efficiency due to the application of our original research into the physics of transducers as applied to speaker systems.

The Infinity 2000AXT has the advantage of being used with various medium priced receivers as well as the super-power amplifiers of today.

THE TWEETER SECTION

The wave transmission line tweeter is probably Infinity's most stunning achievement. It's neither a cone nor a piston drive, not an electrostatic, not a ribbon and not an ionic device. In fact, it really doesn't appear in any textbooks on acoustics.

This Walsh tweeter, acting as a vertical, pulsating cylinder, is a purely coherent source of sound radiation – directly analogous to the light emitted by a laser beam. Therefore, it is transient perfect – a feat which no other speaker has achieved.

The drive mechanism of the tweeter is a voice coil in a very intense magnetic field. This drive mechanism was selected for its simplicity and inherent reliability, although any drive system could be used inasmuch as the cone is only plucked at the base.

Sound velocities much higher than the speed of sound in air are propagated up the metallic cone. Sound is emitted on various parts of the cone corresponding to the temporal and spatial scheme of Figure 1. Thus, each bit of audio information fed into the device is emitted intact at the same instant of time. This is true around the entire device so that 360° coherent radiation is a reality.

THE MIDRANGE SECTION

The midrange speaker is a very high efficiency 4.5" cone utilizing a large Alnico V magnet, the cone of which is treated for five times the stiffness to mass ratio of conventional speakers. The sound quality of this device is big and open with excellent transient response due to its low time delay distortion.

THE BASS SECTION

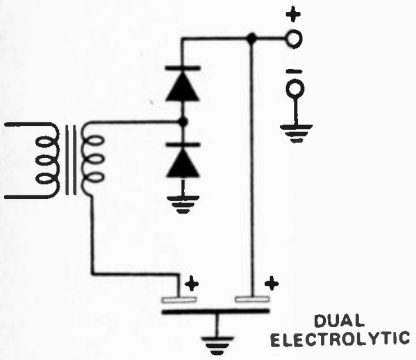
The bass driver is a 12" woofer with a full *one inch* movement capability. Its cone is treated twice – once to increase the stiffness to mass ratio by a factor of three, while the second treatment ensures proper cone damping to complement the added stiffness. The woofer is loaded into the "Infinity transmission line" enclosure for superb bass transients. It accurately reproduces the very lowest fundamental bass frequencies with excellent transient response and very low harmonic distortion.

The infinity fine family of speakers available from

INSTROL – CNR PITT & KING STREETS, SYDNEY; 91a YORK STREET, SYDNEY; 375 LONSDALE STREET, MELBOURNE • **MIRANDA HI-FI** – SHOP 67 MIRANDA FAIR, 525-7800 • **QUANTUM ELECTRONICS** – HOBART • **TRUSCOTTS** – ADELAIDE

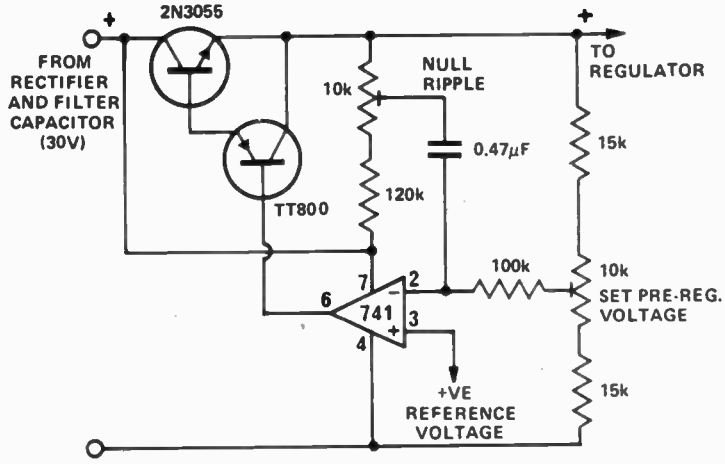
IDEAS FOR EXPERIMENTERS

DUAL ELECTROLYTIC IN VOLTAGE DOUBLER RECTIFIER



This re-arrangement of the voltage-doubler rectifier circuit permits the use of a dual electrolytic having the can as the common negative electrode. Large-value dual electro's can be salvaged from old TV sets or often obtained from Government surplus and industrial surplus stores at very cheap prices.

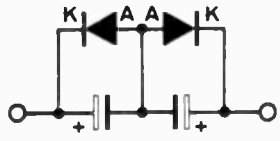
ZERO-RIPPLE REGULATOR



A portion of the ripple voltage from the rectifier output is fed back into the non-inverting input of the 741 op-amp. This is fed into the pass transistor in antiphase to the incoming ripple, resulting in ripple cancellation. The NULL preset potentiometer is adjusted for minimum null at maximum output current. Use a CRO to monitor output ripple.

This circuit could of course be used as a regulated supply itself.

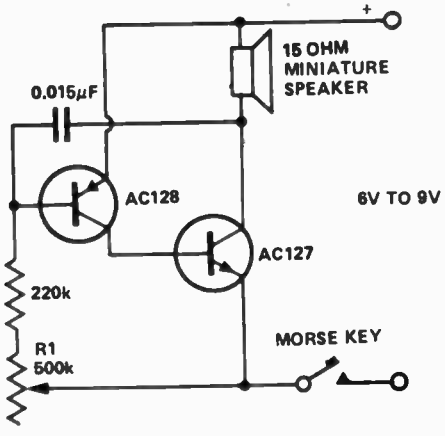
IMPROVING NON-POLARIZED ELECTROLYTIC CAPACITORS



Connecting electrolytics back-to-back is a popular way of obtaining a large value, non-polarized capacitor. But, one has to use electro's twice the value of the capacitance required. This small problem can be overcome, and the action of the combination improved by connecting two diodes as shown.

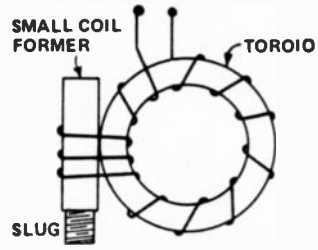
Adding two diodes to an existing arrangement will improve it also.

CODE PRACTICE OSCILLATOR



The complementary pair of germanium transistors AC127/AC128 are cheap and well suited to this circuit. Basically it is a non-inverting amplifier with capacitive feedback between output and input. The tone is varied by R1. Morse key contacts can be placed in parallel for a send-receive two station situation — only, don't both send at once! An alternative pair of transistors would be AC187/AC188.

ADJUSTING A TOROID COIL



Inductances wound on a ferrite toroid are not readily adjustable. The usual method is to push the turns together, or pull them apart. This is difficult if the coil occupies most of the available space on the toroid.

To overcome this, when winding the coil, tape or glue an appropriate sized slug-tuned coil former on one side and wind some of the turns over it. Adjusting the slug will vary the inductance. The more turns (within reason) wound over the slug-tuned former, the greater the inductance variation possible. Surprisingly, the Q is not greatly affected, provided you choose a slug for the frequency range of interest.

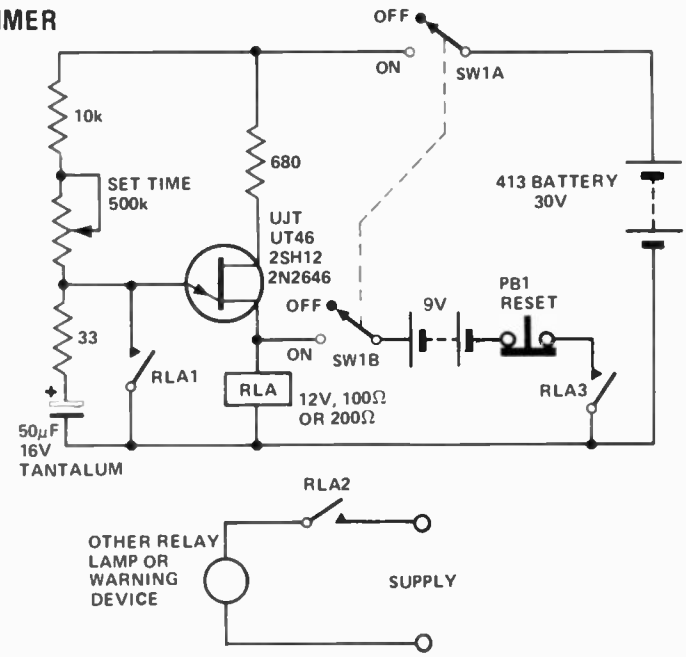
As the name of this section implies, these pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory.

Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.

Electronics Today is always seeking material for these pages. All published material is paid for — generally at a rate of $5 to $7 per item.

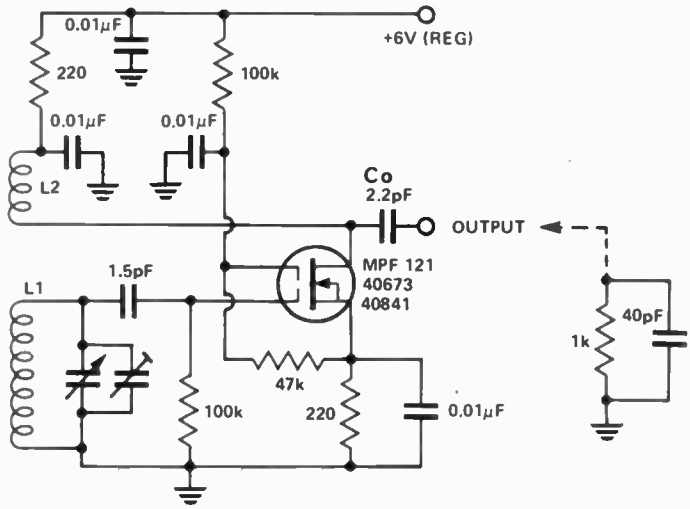
IDEAS FOR EXPERIMENTERS

UJT TIMER



This battery operated timer provides time delays from 1 to about 60 seconds. Switch S1 initiates the period and a normally-closed push-button switch, S2, resets the timer. The relay needs to be a sensitive type for reliable operation. Contact A2 can be a normally-closed contact for photographic work. If it is desired to control 240 V ac mains, contact A2 should energize another relay having appropriately rated contacts.

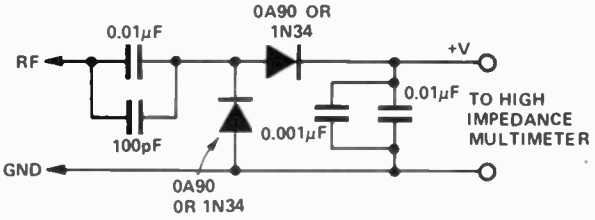
HIGH PERFORMANCE SIMPLE, FET VFO



A dual-gate FET makes an excellent RF oscillator. L2 is a feedback winding coupled to the earthy end of L1. The number of turns and the proximity of L2 to L1 should be just sufficient to provide reliable starting. This precaution improves stability. At 16 MHz, following a half hour warmup, this oscillator had less than ± 200 Hz drift per hour. Output was 220 mV peak-to-peak into 1 k in parallel with 40 pF load. No pulling was evident when load was connected. The circuit suits a wide tuning range for applications in signal generators, general coverage receivers etc, the output being flat within ± 10 mV across a 2:1 tuning range.

If Co is increased, more output is available, but load isolation is degraded. Harmonic content of the output is very low, the second harmonic being at least 50 dB down.

RF PROBE

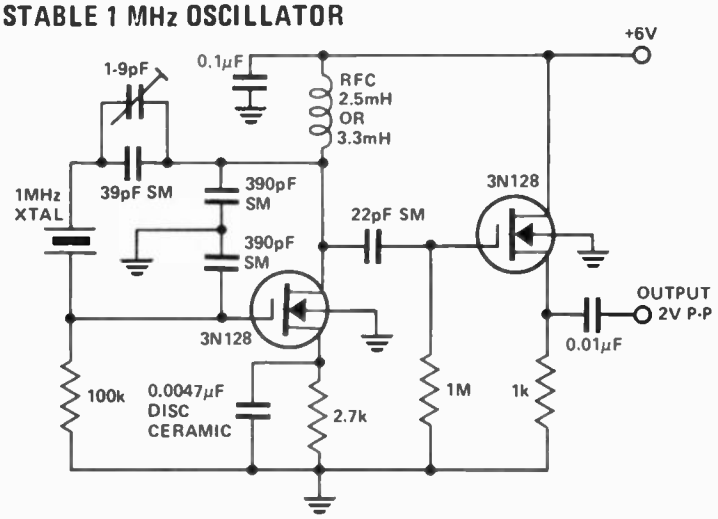


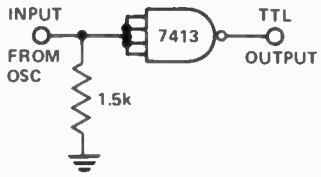
Germanium diodes have a forward condition voltage of about 200 mV or less and their use is necessary to achieve best sensitivity in an RF probe. 0A90's are very cheap (10c from 'specials' suppliers). A dollars' worth will net some that best suit RF work with a little prior selection for lowest forward conduction voltage and current.

To select the diodes put a microammeter in series with the diode, and use a high-impedance multimeter to measure the forward conduction drop. A variable DC power supply provides current through a 10 k resistor for the test. Select the two diodes that have least forward voltage drop for least current.

The low value capacitors in parallel with the input and output capacitors ensure good RF performance at VHF as the higher value capacitors are often somewhat inductive. Type IN34 diodes if obtainable are very good, right through the VHF range.

HIGHLY STABLE 1 MHz OSCILLATOR

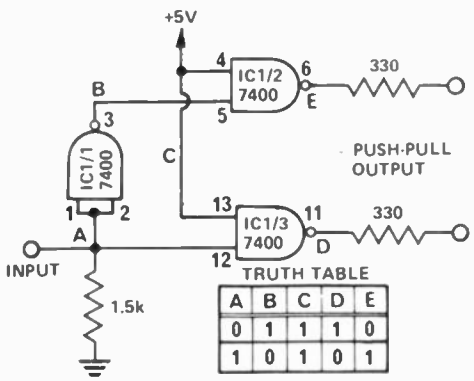




With reasonable construction, this oscillator can have excellent stability. If the crystal is oven mounted performance is even further enhanced. Supply voltage variations of ± 3 V varies the frequency less than 1 Hz.

For use as a counter clock standard, half a 7413 Schmitt trigger will interface the output to TTL levels. The supply voltage should then be set at 5 V.

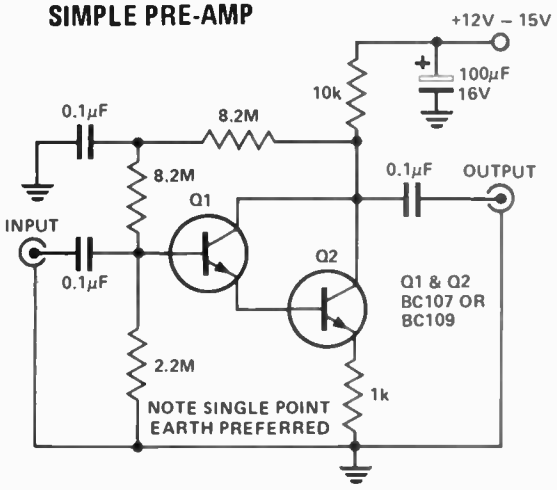
SINGLE-ENDED TO PUSH-PULL CONVERSION FOR SQUARE WAVES



A	B	C	D	E
0	1	1	1	0
1	0	1	0	1

This is self-explanatory. The input must be TTL-compatible. Push-pull output at the same frequency is obtained. Half of a 7413 could be used to interface to a pulse or signal generator not having a sufficiently high output level.

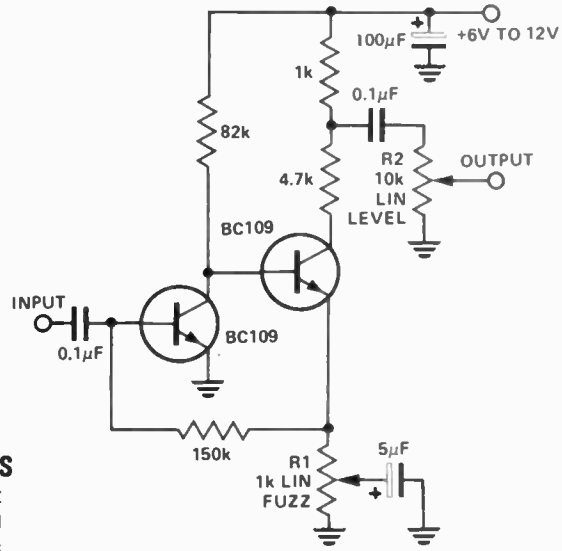
SIMPLE PRE-AMP



This simple pre-amp circuit exhibits high gain, high input impedance and is suitable as a microphone pre-amp for low level crystal or dynamic microphones, or crystal and ceramic pick-ups. If using a ceramic pick-up, a 680 pF capacitor should be placed in parallel with the input. If the output level of the microphone pick-up is excessive, a 1.5 M to 3.3 M resistor in series with the 0.1 μF input capacitor will reduce distortion.

Two BC107's were used and showed no noise problems. Alternatively BC109's can be used. Useful transistor substitutes are 2N3565, 2N3564, 2N5770, BC182L, BC108 BC548, SE1002, SE1010. Some adjustment of the 8.2 M resistors may be necessary with substitutes.

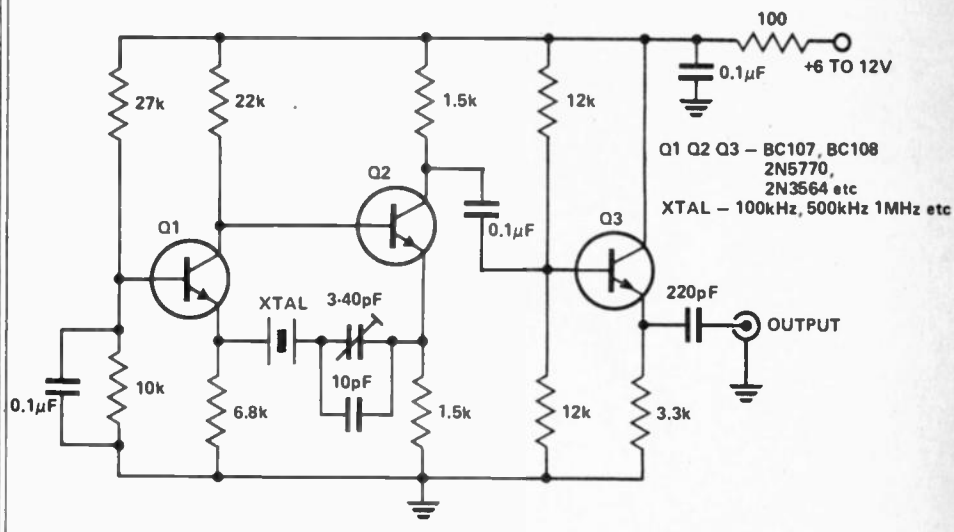
FUZZ GENERATOR



'Fuzz' for electric guitars or other electronic-musical instruments can be generated by inserting the above circuit between the pre-amp/mixer and main amplifier of the instrument. The ac gain is varied by R1, causing the amplifier to clip, producing the Fuzz sound. The output level is adjusted by R2.

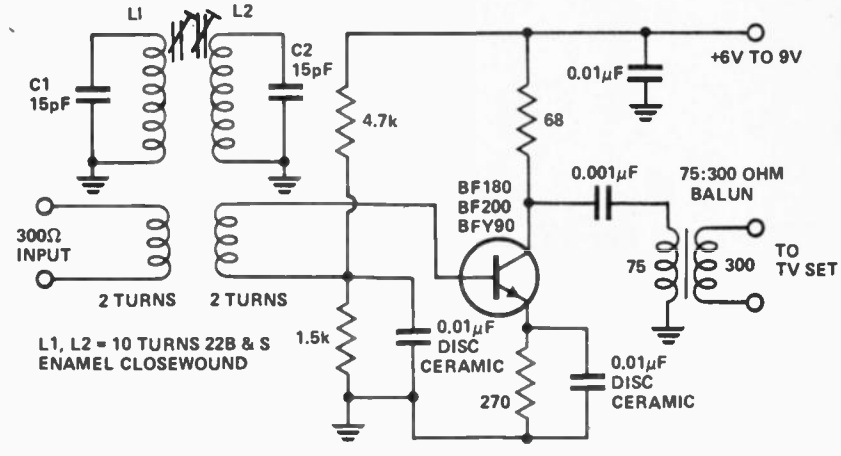
IDEAS FOR EXPERIMENTERS

CALIBRATOR FREQUENCY MARKER



This simple frequency-marker generator provides strong harmonics right through the HF spectrum to 30 MHz. A crystal from 100 kHz up to 4 MHz can be used. It should be calibrated against VNG (4.5 MHz, 7.5 MHz, 12 MHz) or WWV (5 MHz, 10 MHz, 15 MHz, 20 MHz) the standard frequency stations. For crystals below 1 MHz the feedback may need to be increased. This is achieved by increasing the capacitance across the trimmer which is in series with the crystal.

LOW CHANNEL TV DX PRE-AMP



Channel 0 signals and New Zealand Channel 1 signals can be received at very good strength and for long periods during the summer months. This is the time of peak activity in the Sporadic E layer of the ionosphere, when it will propagate signals well into the VHF region. Coils L1 and L2 are wound on a Neosid double assembly comprising two 722/1 formers, one 5200/8PLB base, one 7300 can and two 4 x 5 x 10/F29 slugs. The input and base windings are wound around the bottom, that end of the coils (L1 and L2) being earthed. Tune up can be done using a GDO or signal generator and an RF voltmeter across the 75 ohm winding of the output balun. Place a 330 ohm resistor across the output. Tune L1 to the low-end of the channel frequency for a peak in the output and tune L2 for a peak at the high end. This is rough but gives acceptable results. A sweep generator and spectrum analyser is the best method. Keep all leads short and layout straightforward.

For Australian Channel 1 or Channel 2, L7/C2 and L2/C2 are eight turns and 8.2 pF respectively.

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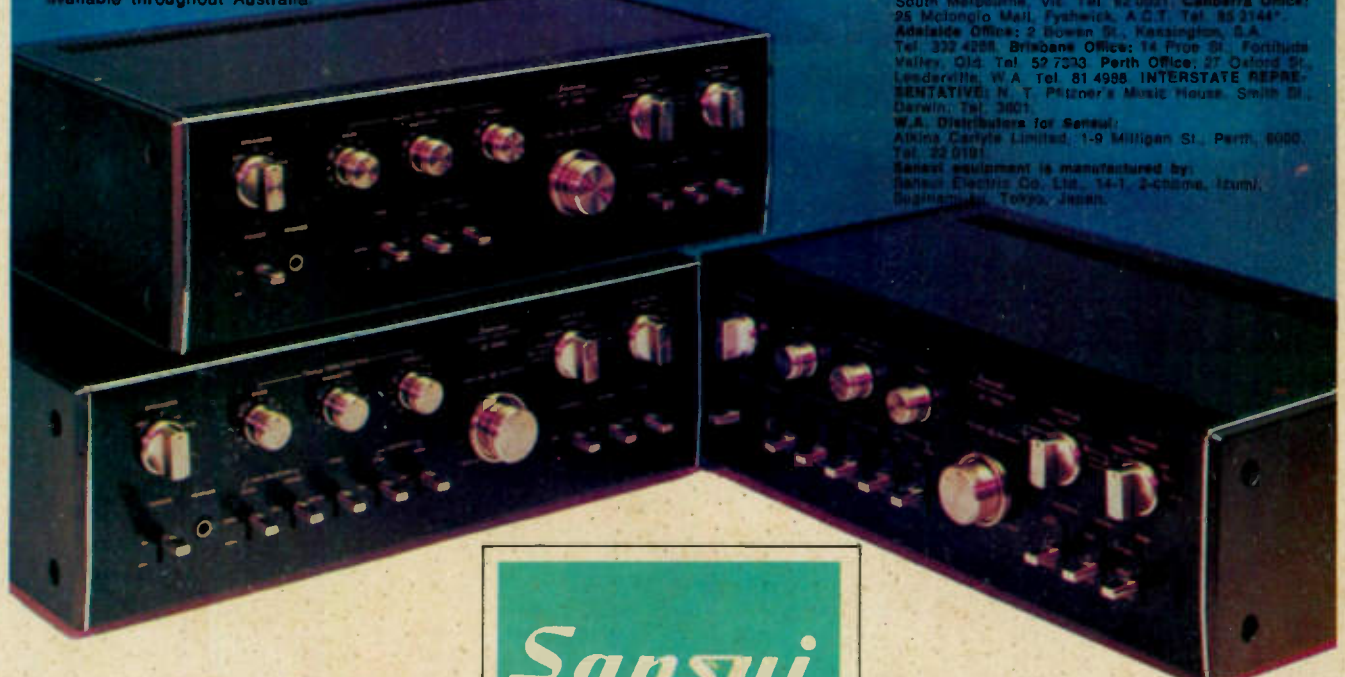
SANSUI — AU-5500.
Output: 35 watts RMS per channel into 8 ohm speaker systems. **THD:** Less than 0.15%. **Frequency response:** 10-35,000 Hz. +0.5, −1 dB. Sensitivity suits magnetic cartridges, tuners, tape decks, etc. **Recommended list price:** $419.

SANSUI — AU-6600.
Output: 45 watts RMS per channel into 8 ohm speaker systems. **THD:** Less than 0.15%. **Frequency response:** 10-40,000 Hz. +0.5, −1 dB. Sensitivity suits magnetic cartridges, tuners, tape decks, etc. **Recommended list price:** $469.

SANSUI — AU-7700.
Output: 55 watts RMS per channel into 8 ohm speaker systems. **THD:** Less than 0.1%. **Frequency response:** 10-50,000 Hz. +0.5, −1 dB. Sensitivity suits magnetic cartridges, tuners, tape decks, etc. **Recommended list price:** $549.

TWO YEAR WARRANTY. All Sansui amplifiers carry a full 2 year warranty. Effective service facilities are available throughout Australia.



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