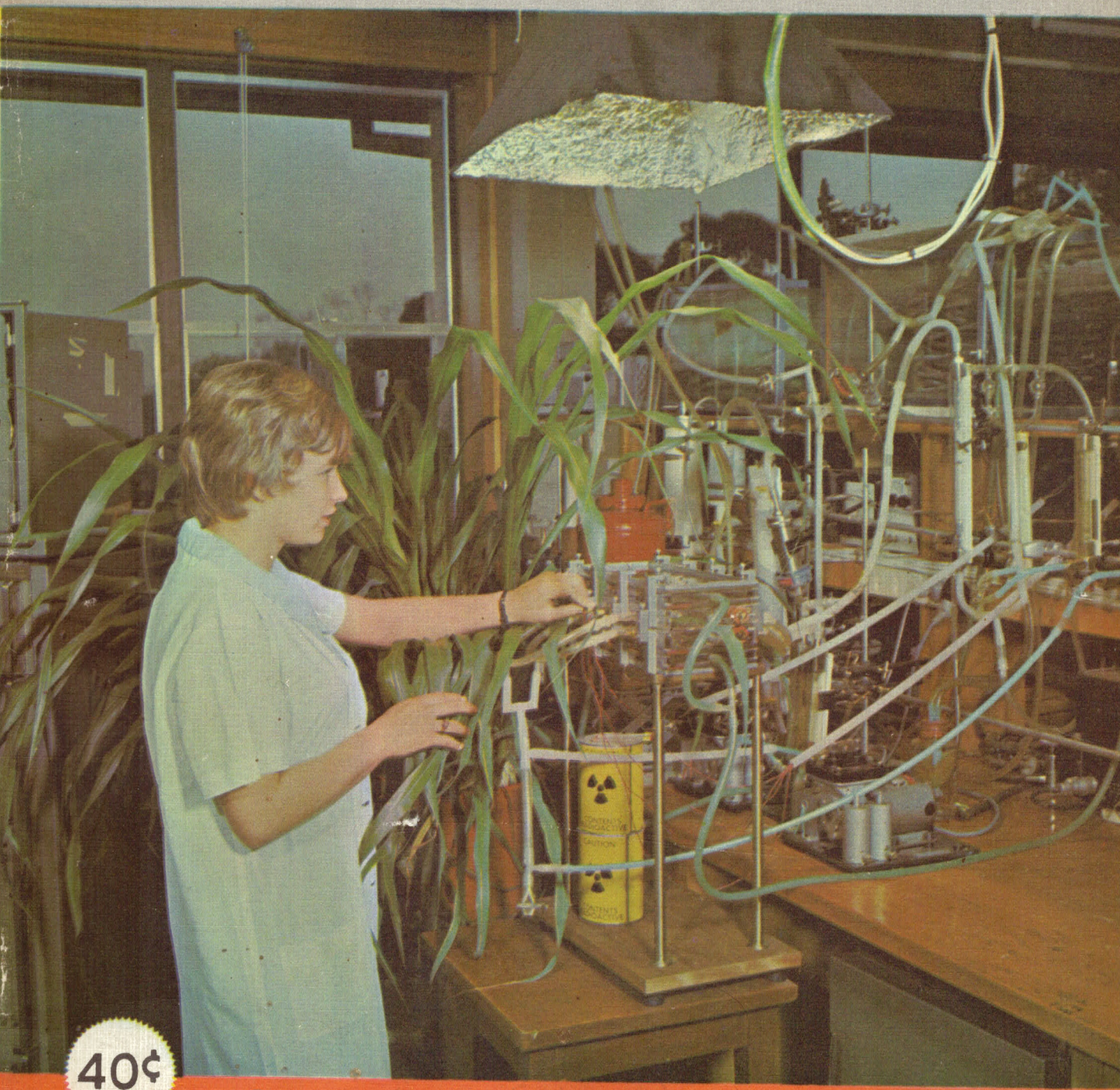
ELECTRONICS Australia

February, 1970



40¢

Plant research at the C.S.I.R.O., Canberra. (See page 10)

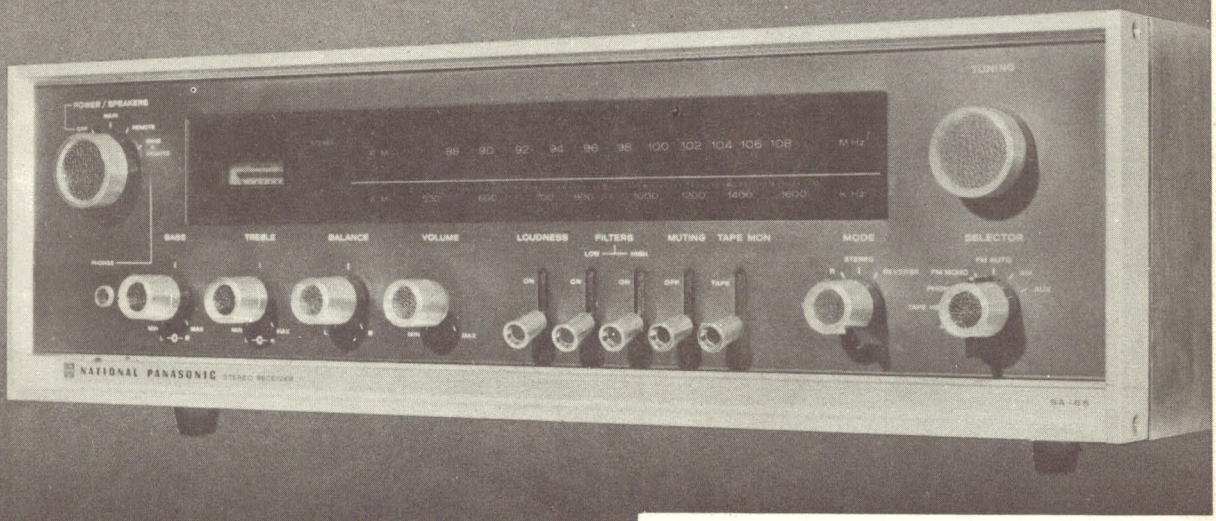
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ABC certified circulation in excess of 50,000

volume 31, number 11

FULLY AUTOMATIC LANDINGS: *The day when aircraft will land in "zero-zero" conditions, with perfect safety, is closer than most people imagine. The means already exist, the main job now being to prove the reliability of the various systems by means of many thousands of supervised automatic landings. A story on the present state of the art is on page 14.*

DIGITAL FREQUENCY METER: *The first of a short sequence of articles describing a new low-cost DFM design appears on page 44. It gives an easy-to-read introduction to the subject of digital frequency measurement.*

MODEL CONTROL: *A compact model control receiver which is simple to construct and adjust appears on page 54. A crystal-locked superhet, it features an IC and a ceramic filter, and is constructed on a printed wiring board.*

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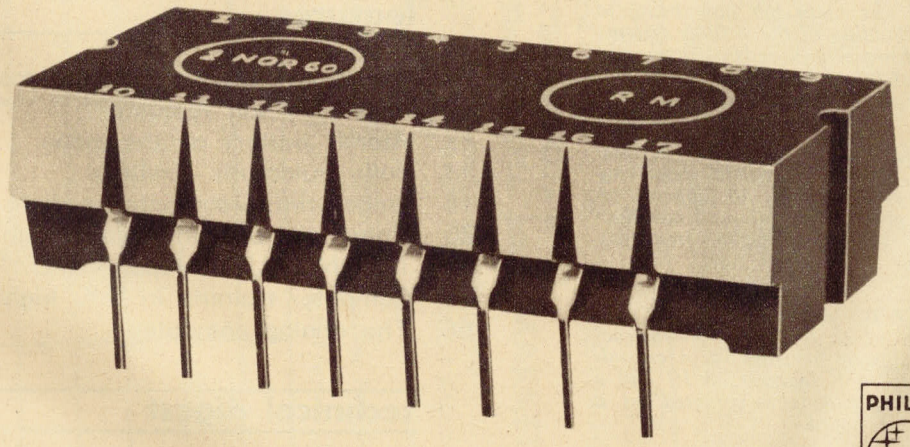
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60 SERIES NORBIT

LOW PRICED STATIC SWITCHES



PHILIPS

Single supply rail:	24 volts
25% voltage tolerance:	18 to 30 volts
Temperature range:	—10° C to +70° C ambient
Immunity to noise:	Totally unresponsive to d.c. noise of up to 1 volts on 'o' state. up to 2 volts on 'I' state. even greater immunity to noise above 100 kHz
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Where relays would have been the natural choice, NORBIT static switches cut system costs in: Alarm systems; lift systems; automatic batching; transfer line control; production machine control; electro-plating installations; power system control and all other systems (large and small) which call for a variety of sequence logic and combination logic. For further details refer to Miniwatt Digest "Special Norbit Issue" Vol. 7. No. 6. September/October, 1968. Application information and assistance in design is available from the Miniwatt Applications Laboratory.

"Miniwatt"

ELECTRONICS DIVISION OF PHILIPS ELECTRICAL PTY. LIMITED
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EDITORIAL VIEWPOINT

by Neville Williams

Electrical interference . . .

When one sets out to buy a motor car, matters of prime concern are the price, appearance, size, performance and mechanical condition, all factors which determine the suitability of the vehicle for its intended role. But if your neighbour happens to be listening on a VHF receiver when you bring the car home, he will very likely know that you are approaching. He may even be able to express an opinion about the evenness of the ignition system!

The point behind this observation is that the community evaluates motor vehicles in terms of their ability to meet a prime requirement, and without much concern that every vehicle is a potential contributor to the electrical noise ambient.

Recently, solid-state technology has given us the bi-directional thyristor, a very useful device. It is small, cheap and efficient. Without significant heat loss or power wastage, it can control the intensity of lighting, the temperature of heating elements or the speed of rotating machines. But it does have one unfortunate characteristic—a tendency to produce electrical interference which is not readily eliminated by simple means.

I mention motor vehicles and thyristors only because they are examples of what the community accepts as functional, with electrical interference a relatively minor consideration and, in any case, not subject to effective legal control. Above-ground power wiring is another example, if you need one.

It is good that the I.R.E.E. and the University of N.S.W. are arranging workshop sessions to discuss electrical interference, as announced on page 103. The sessions should have the effect of clarifying and highlighting the main problem areas and of drawing attention to appropriate—and possibly neglected—corrective measures. By the time the sessions conclude, a particular group of academics and engineers will have been suitably enlightened.

This is a good start, but it is only a start. What support will be forthcoming on a wider scale? How is the whole matter going to be translated, ultimately, from a technical environment to the marble halls of Canberra? From engineering notes to the statute books of the nation?

Let's not delude ourselves. If the ever-rising tide of electrical interference is to be contained, it will have to be by legal, not voluntary means. Laws will have to be passed which set limits on the nature and the amount of electrical "effluent" which any person or group can discharge on to public property—in this case the so-called "aether."

Is it too much to suggest that, having looked at the whole problem in a technical context, the workshop sessions should initiate a call for a Parliamentary Committee or a Royal Commission to investigate and report on the whole matter. Anything less, and we'll be wallowing in even larger waves of interference 10 years hence!

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ON SALE
THE
FIRST MONDAY
OF EACH MONTH

On the cover

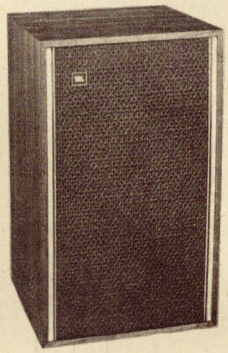
The Division of Land Research of the C.S.I.R.O., Canberra, carries out extensive investigation of plant life in its research programs designed to lead to better strains which are more crop productive, more disease resistant or better adapted to various environments encountered in Australia. In our picture, radioactive tracers are being fed into a plant as a check on relative water content. (See also story beginning page 10.)

INSTROL HI-FI

the largest HI-FI showroom in Australia.

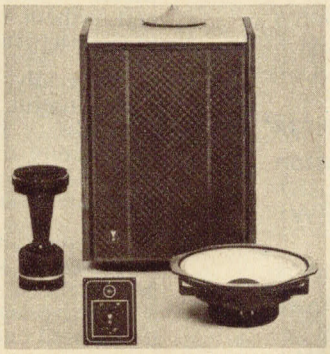
Now with the largest JBL *Hi-Fi Display In Australia*

JBL LANCER 77

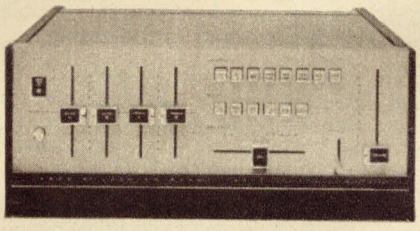


A highly sophisticated system, in which virtually all of the speaker panel is utilized as direct radiating area. It combines the LE10A low frequency driver with the PR10 passive radiator which crosses over at 2500 cps through the L X 4 - 2 dividing network to a high-frequency direct radiator. The combination gives a seamless purity of overall sound. 14" x 23½" x 11¾" deep.

JBL LANCER 101

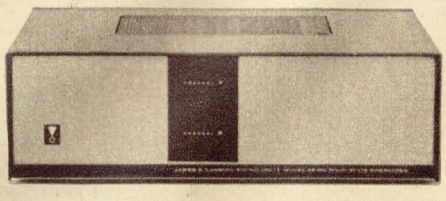


The Model LE14A 14" low frequency speaker delivering prodigious bass response is combined with the renowned LE175-DLH, a massive professional assembly consisting of compression driver, cast exponential horn and 14-element acoustic lens. These are matched electrically by the L X 8 dividing network. Enclosure has hand-carved fretwork grille, walnut side panels and a top of genuine Adriatic marble. 23" x 17½" x 12⅜" deep.



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The JBL Energizer takes the place of a conventional stereo power amplifier. Unlike a conventional amplifier, however, the Energizer's performance is precisely matched to the requirements of the loudspeaker systems with which it is used; a replaceable plug-in equalizer board sets exact damping for best transient reproduction and makes final frequency response correction for smoothest possible performance. With the board set for unequalized operation, the Energizer operates as a "flat" laboratory standard power amplifier.

Model SE400S incorporates the exclusive JBL T-Circuit (pat. pend.) and has silicon transistors throughout. IM distortion less than 0.15% at 80 watts or any lower power level, harmonic distortion less than 0.15% 20-20,000 cps at 80 watts or any lower power level. Equalizer boards to match JBL loudspeaker systems as well as systems made by other manufacturers. 4⅝" x 15¼" x 7¾".

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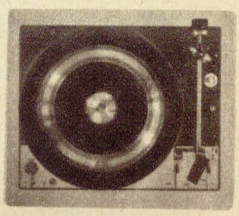


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Combined 20-20 T101 in Teak case. **$158.50**



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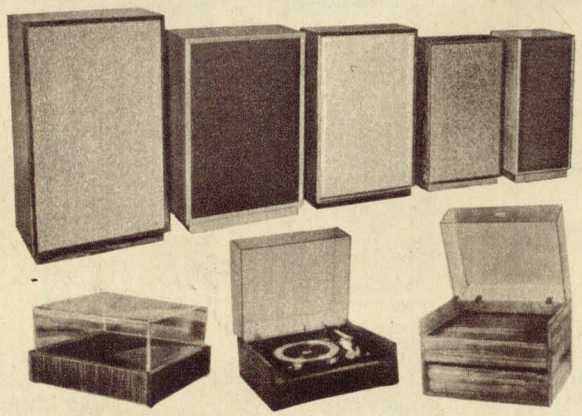
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poly-planar

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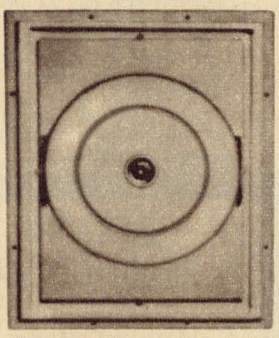
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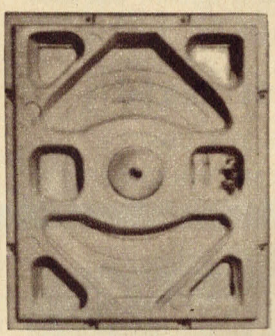
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- **Completely waterproof—more than just moisture-proof.**
- **Easily incorporated into present equipment.**
- **Priced competitively with conventional loudspeakers.**
- **Bi-directional polar pattern**
- **High-power capability.**
- **Lightweight.**
- **Ideal for consumer, industrial or military applications.**
- **Completely replaces the conventional cone speaker.**

20 WATT MODEL





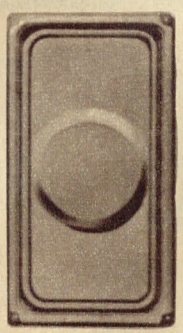


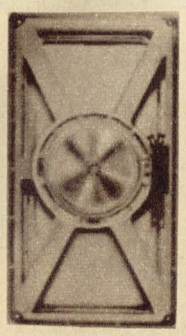
SPECIFICATIONS

Model designation:
P-20 Poly-Planar
Power capability:
20 watts peak
Frequency range:
40 cps—20 KC/S

Sensitivity: 85 DB/M
for 1 watt electrical input
Input impedance: 8 ohms
Size (WxDxL): 1-7/16"
x 11-3/4" x 14-11/16"
Weight: 19 ounces

5 WATT MODEL







SPECIFICATIONS

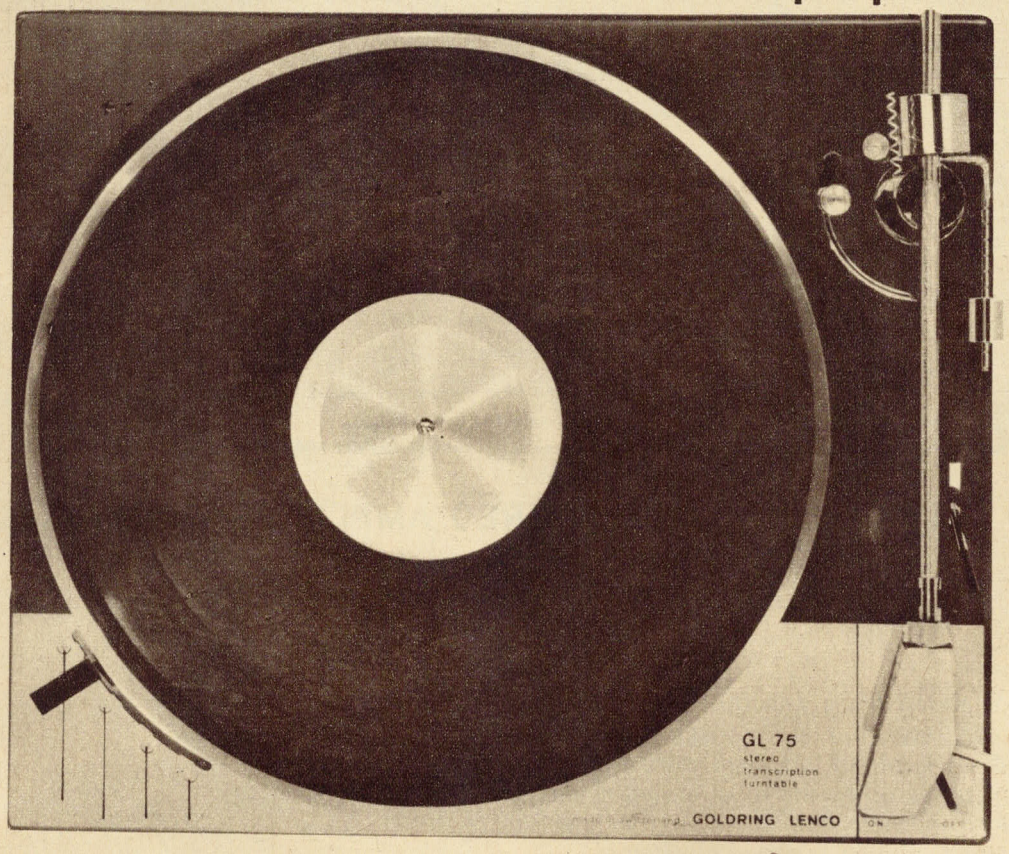
Model designation:
P-5 Poly-Planar
Power capability:
5 watts peak
Frequency range:
60 cps—20 KC/S

Sensitivity: 80 DB/M
for 1 watt electrical input
Input impedance: 8 ohms
Size (WxDxL): 13/16"
x 4-1/2" x 8-1/2"
Weight: 10 ounces

Trade enquiries: **GOLDRING ENGINEERING (A/ASIA) PTY. LTD.**
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Goldring
Trendsetters in sound equipment



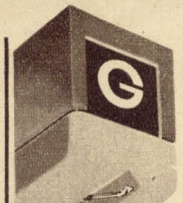
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Integrated transcription motor unit and arm, built to instrument standards of quality and appearance. The drive system is the unique Goldring-Lenco constant velocity 4-pole motor with conical shaft coupled to the underside of the turntable by a knife-edged idler (automatically disengaged by the on/off switch, which is fully click-suppressed and also operates a turntable brake).

The turntable is die-cast from non-ferrous material, weighs 9 lb and is dynamically balanced.

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Goldring '800' series free field stereo cartridge

800: In this cartridge a very lightweight tube of magnetic material lies in a "free field" generated by a fixed source coupled to a low mass diamond point. It features low mechanical impedance (tracks at 1 to 3 grams), screening from external hum fields, gold-plated contacts. Stylus is replaceable. Rivals finest in the world. Frequency response 20-20 kHz, compliance 20 x 10-6.

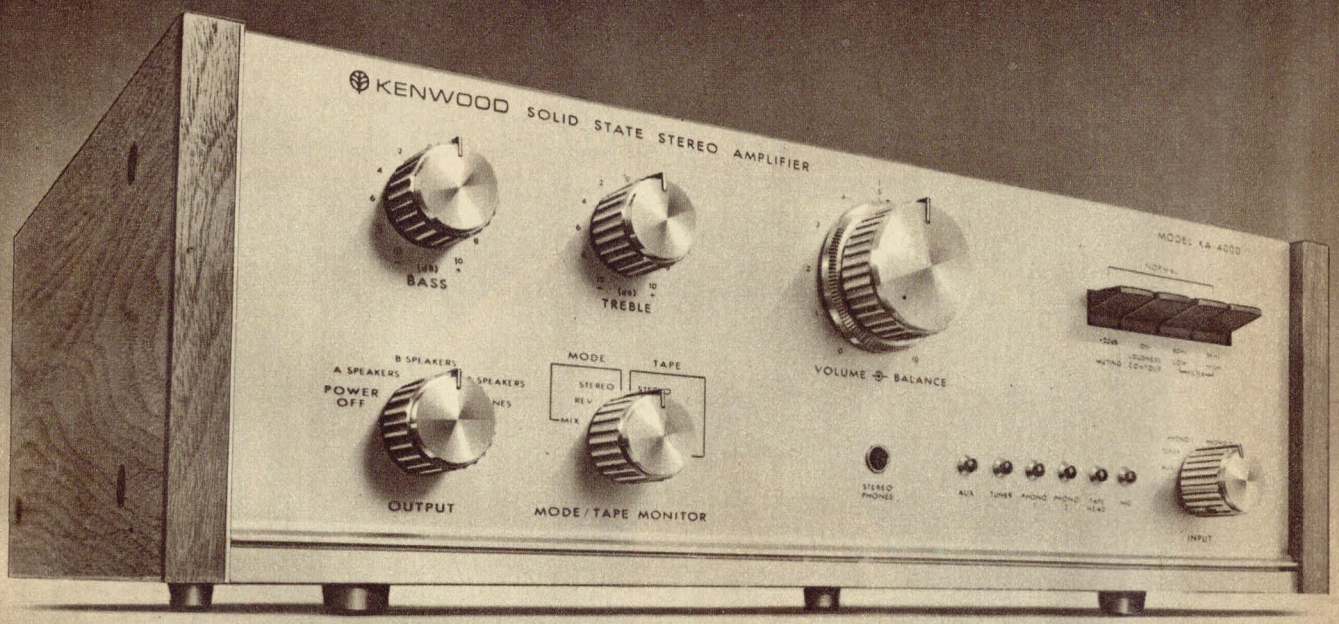
800E: Using the same cartridge body as the standard model, an eliptical diamond stylus is fitted. Compliance is substantially increased resulting in brilliant linear, resonant free, performance. Frequency response 20-20 kHz, compliance 30 x 10-6.

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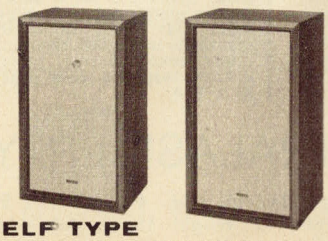
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This amazing stereo advance is further equipped with 2 dB step type tone controls
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The KA-4000 also has a blue light indicator for input selector switch.
If you desire even more total stereo power, another member of the KENWOOD family,
the KA-6000 has a booming 180 watts.
If you need less power,
KENWOOD's diversified range of instruments offers an amplifier with the output you need.



BOOKSHELF TYPE
4-WAY 5 SPEAKER SYSTEM KL-60

* Mounted speakers: 12-inch, free-edge woofer · 1 (Bass)
  6½ inch cone squawker · 1 (lower midrange)
  4 inch cone squawker · 1 (higher midrange)
  Horn-type tweeter · 2 (Treble)
* Dimensions: 15"(W), 25½"(H), 11⅝"(D).



40-WATT
SOLID STATE STEREO
AMPLIFIER TK-150U

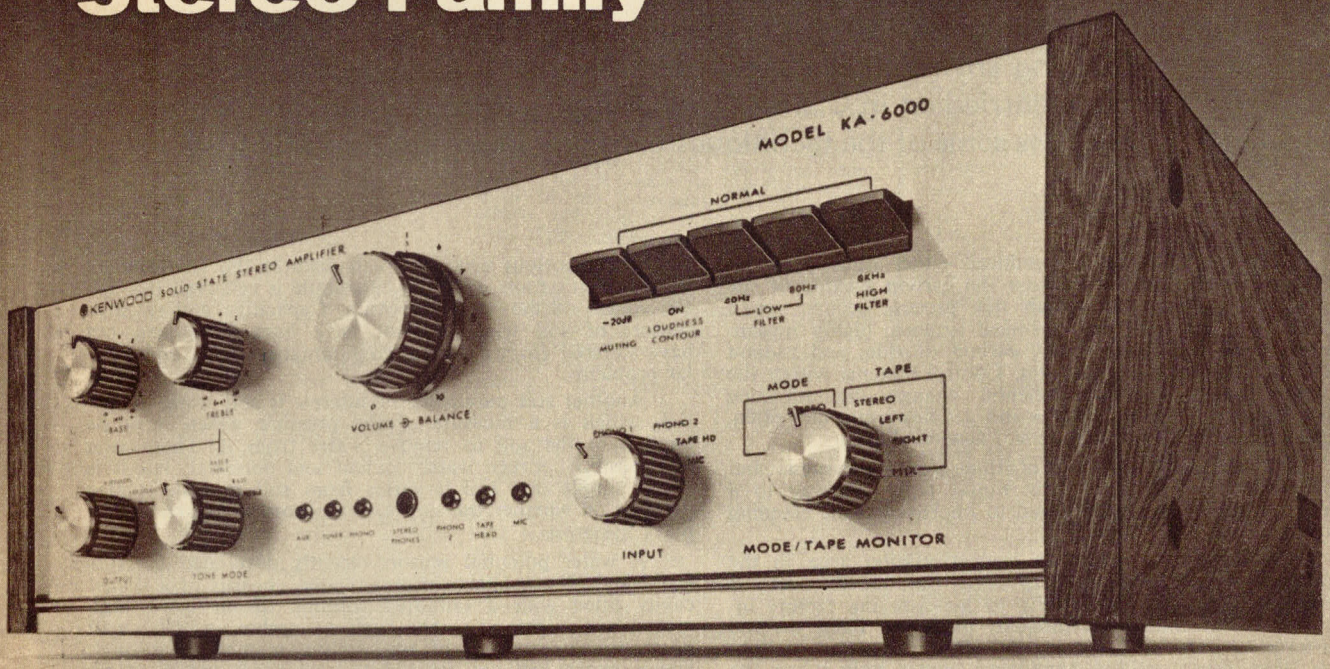
* 5 pairs of input terminals for MAG, AUX 1, AUX 2, TAPE REC and TAPE PLAY.
* Damping factor: 40 (at 16 ohms), 20 (at 8 ohms)
* Dimensions: 10¼"(W), 4⅛"(H), 9⅜"(D).



60-WATT
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TECHNIQUES OF PLANT AND

The search for improved strains of plants giving better crop yields in the widely differing environments encountered in the Australian sub-continent has been carried on in C.S.I.R.O. laboratories since its formation. This article describes some of the techniques currently being used in this work.

The world's food is produced either directly or indirectly by photosynthesis from the carbon dioxide of the atmosphere. Plants, in which this process occurs, are a complex of physical and chemical systems, highly responsive to the supply of water, carbon dioxide, and radiant energy from their environment. Control systems within the plant respond to environmental changes by adjusting temperatures, pressures, water and gas flow rates and often, the shape of plant surfaces, to suit new conditions.

A clear understanding of these control systems and their effect on photosynthesis would point the way to a much improved agriculture and to improved plant breeding and selection programs.

Challenging problems in instrumentation arise in the study of these systems and, as usual, our understanding is closely linked with our ability to measure the factors involved. Mathematical techniques, many of them derived from electrical and servo theory, can throw a lot of light on these processes, but confidence comes only when the appropriate measurements have been made on the plant and its soil-atmosphere environment.

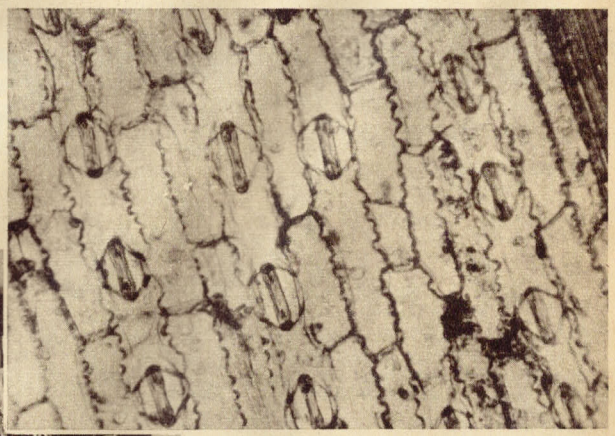
Water content of the soil is often measured by lowering the probe of a neutron moisture meter down an aluminium access tube sunk into the ground. The probe contains a source of fast neutrons such as americium-beryllium and a slow neutron detector, usually a boron-trifluoride filled Geiger tube, although scintillation detectors have been used. Fast neutrons are quickly lost in the soil except when they strike an atom of similar mass such as a hydrogen atom of a water molecule. When this happens they rapidly lose energy and are slowed down to the point at which they can be detected on the rebound by the Geiger tube.

The count rate of the tube is thus related to the water content of the surrounding soil and can be measured with a conventional ratemeter or scaler. Neutron moisture meters have not, until very recently, been reliable field instruments and the search for a cheap, reliable soil water content sensor continues. Water content of the soil can be determined gravimetrically, i.e. by auguring out a sample of the soil, weighing, drying it and weighing again, but this is a laborious process which disturbs the environment of the plant's roots each time a sample is removed through the course of the growing season. Capacitive and resistive sensors of soil water content have been developed but have suffered from chemical contamination, drift and similar problems.

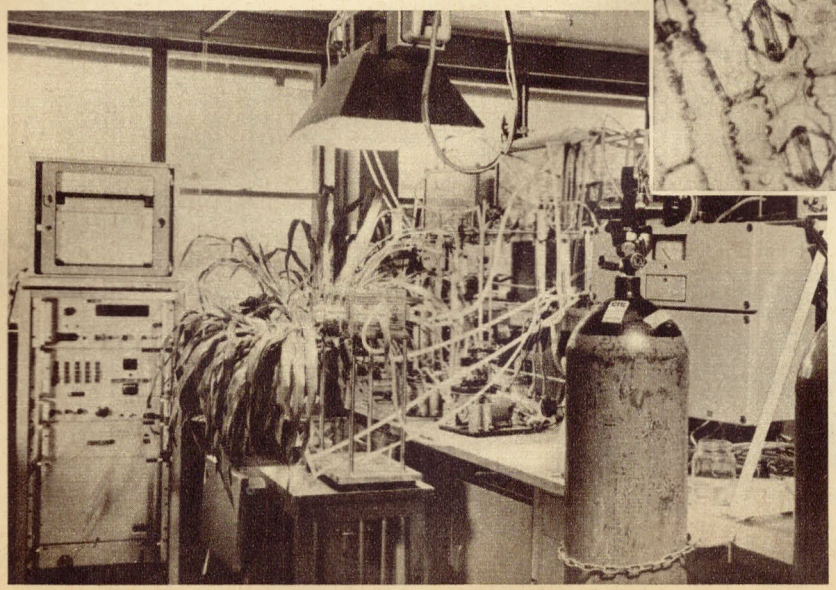
Another soil parameter of interest is soil water potential, which is a measure of the pressure which must be applied to the soil to remove water from it. There is a relationship between water content and potential, but it is not a simple one and it varies from soil to soil. It also depends on whether the soil is wetting or drying, i.e. it displays hysteresis.

A water potential sensor, recently developed in Australia and now available commercially, consists of a sealed cavity filled with a saturated solution of an inert, high molecular weight substance such as carbowax. One wall of the cavity consists of an osmotic membrane through which water but not the solute can pass, and a strain gauge pressure sensor is connected to the interior of the cavity. When this device is buried in the soil, water passes into or out of the cavity through the membrane, until the water in the cavity is in pressure equilibrium with water in the soil and so the output of the pressure sensor is a measure of the potential in the soil.

An alternative approach to measuring soil potential is to measure the water vapour pressure of air in equilibrium with the soil. A fine wire thermojunction is introduced into a hole in the soil and a reverse current passed through it. Peltier cooling causes water to condense at the



ABOVE: The surface of a bulrush millet leaf, showing stomata. The closed stomata lie across the circular areas, which are about 10 microns in diameter.



LEFT: A leaf chamber and part of the associated equipment for measuring the exchange of water vapour, carbon dioxide and heat between a section of a single leaf and the atmosphere.

SOIL RESEARCH

By G. F. BYRNE, B.Sc., F.R.S.A.
(Division of Land Research, C.S.I.R.O., Canberra)

junction, so that when the current is stopped, the junction acts as a wet bulb for a few tens of milliseconds and its temperature can be measured with a sensitive fast response recorder. The dry bulb temperature is then measured, enabling the water vapour pressure and hence the soil water suction to be calculated.

This whole procedure requires very careful design and construction of the junction and also accurate measurement of EMFs for useful results to be obtained, because of the dependence of a vapour pressure on temperature and of the small change in vapour pressure that occurs for a large change in soil water potential. Water potential in a leaf can be measured in the laboratory using the same technique. Once again precision control of techniques and measurements is required, the detached leaf section being enclosed in metal chamber controlled to, say, 0.001°C.

A good index of the water status of the plant is the relative leaf water content, which is the water content of a leaf expressed as a percentage of that when saturated with water, i.e. turgid. This is determined by weighing the leaf and then allowing it to take up water by floating it on a water surface or by bringing a cut edge into contact with free water in some similar way. The relative water content of the leaf sample can be calculated.

Another, non-destructive, way of monitoring leaf relative water content is the beta gauge technique, also used in industrial applications. A collimated beam of beta particles from an appropriate source, such as promathium 147, passes through the leaf and is monitored with a small Geiger tube. The attenuation in particle flux density is proportional to the water in the leaf, since the solid matter of the leaf remains constant and is only a small part of the total mass, say 10 per cent.

Rate of flow of water through the stem can be measured by injecting a soluble radioactive tracer or alternatively, with less disturbance to the plant, by a differential thermometer technique. If a point source of heat is placed in contact with the surface of the stem, the temperature at two points upstream and downstream from the heat source will differ by an amount related to the rate of water flow. Incidentally, sensors using a similar technique can be used to measure water movement in soil and sensitivities of the order of 10^{-5}cm per second are readily obtained. Radioactive tracer techniques are useful for answering such questions as "How much photosynthesised carbon dioxide is going into the roots?" Labelled CO_2 can provide an answer.

In the surface of the leaves of the plant there are thousands of pores, the stomata, through which the plant loses water vapour and gains carbon dioxide for photosynthesis. One of these stomata might be elliptical in shape, when fully open, with dimensions 10 x 5 micron. The stomata open and close depending upon complex and only partly understood processes related to the water content of the leaf, water potential in the leaf, ambient carbon dioxide concentration, level of incident radiation and even time of day.

Yes, there does seem to be some kind of clock mechanism involved! Under some conditions a plant will oscillate, with the stomata opening and closing in a half hourly cycle. There is reason to believe that this effect can occur in the field, when soil water suctions and light level are of the right order. In the laboratory, these oscillations have been sustained for several days and, using appropriate values for stomatal resistance, root resistance, and water capacity of the various parts of the plant, can be simulated on an analog computer.



A porometer being used for measuring the diffusive resistance of stomata.

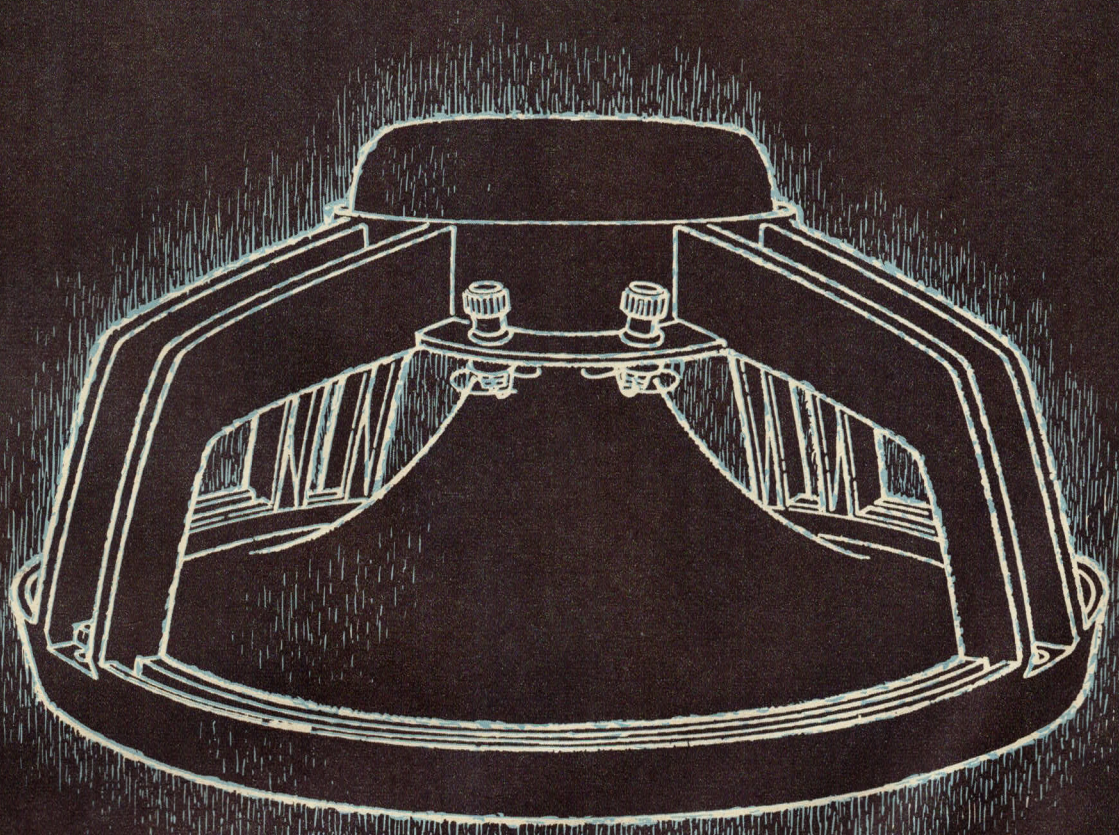
Stomatal aperture can be determined in a number of ways, one of the simplest being to spray the leaf surface with a quick drying plastic material such as artists' fixative or even hair lacquer. The impression which results can be removed from the leaf with adhesive tape and replicas of the stomata measured under the microscope. One of the drawbacks of this method is the fact that the stomata may change dimensions rapidly as a result of being sprayed with fixative.

A slightly more complicated procedure, but one that is less disturbing from the point of view of the plant, involves the use of an instrument called a porometer. A cavity containing a relative humidity sensor is brought into contact with the leaf surface and the rate of change of humidity in the initially dry cavity is measured. Knowing the leaf temperature, and hence the vapour pressure of water in the interior of the leaf, the relative humidity and also the rate of change of humidity in the cavity of the porometer, one can calculate the stomatal resistance to water vapour flow in terms of the potential drop and flux by applying an analogue of Ohm's law. Usually, it is this stomatal resistance which is of interest, but stomatal aperture can be calculated from the stomatal resistance and the number and depth of stomata.

The largely manual techniques so far described have given us a lot of insight into what happens in the soil and in a plant under various conditions. However, there are some studies, particularly those concerning interactions between parameters inside a leaf, plant or plant community, in which more elaborate measurement techniques are required, it being physically impossible to make simultaneously the required observations by hand.

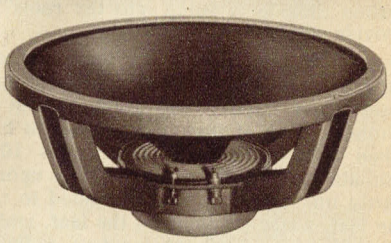
For example, in a detailed laboratory study of gas exchange of leaves, one leaf may be placed between two chambers made of transparent plastic, the gaps between the leaf surfaces and the chambers being sealed with very soft gasket material. With this arrangement, atmospheric conditions on each side of a leaf section can be controlled. A separate stream of air passes through each chamber and the temperature, water vapour and carbon dioxide concentrations at each entrance and exit port of measured. Airflow rates and the radiation level, sometimes in several

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spectral bands will also be measured allowing the photosynthesis and water evaporation to be monitored continually. In addition the airstream through one chamber may be doped with an inert gas such as nitrous oxide. By measuring gas concentration at the exit of the other chamber, one can calculate the rate of diffusion of the tracer through the leaf and hence total leaf resistance. This can only be done with leaves having stomata on both sides.

The equipment needed for a study such as this might include infra red or the newer conductivity-type gas analysers for carbon dioxide, a beta gauge, an infra red gas analyser for nitrous oxide, thermocouple differential psychrometers for water capour concentration and also micromanometers for measuring gas flow rates (in terms of the pressure drop across a constriction in a gas flow line). Themocouple thermometers, temperature control and other switchgear, radiation sensors, not to mention a high intensity light source of the appropriate spectral characteristics, will be needed.

The outputs of this equipment can be recorded with industrial type potentiometric chart recorders, although with an assemblage of gear of this order in one room, range switching, electrical noise and other equipment problems begin to absorb as much, if not more, of the experimenter's time as the plant does.

There is a tendency, therefore, to use a small digital data logger, followed by a digital-to-analog converter to drive the chart recorder. This has the advantage of providing a digital output for computer processing, while noise-free signals are available for the chart recorder. Chart records are a convenient way of monitoring plant behaviour through the course of an experiment, but an adequate analysis of the data collected with them is very time-consuming, assuming the records are sufficiently accurate for the purpose.

A single plant or one of its leaves growing in a laboratory or glasshouse may behave quite differently from a similar plant growing in the field, where it must compete with its neighbours for the available water, nutrients, radiant energy and carbon dioxide. This fact, together with the variations in the environment from minute to minute and from place to place in the crop, gives rise to a substantial data collection and processing problem.

One may want to measure air temperature, light level, water vapour pressure, carbon dioxide level, leaf relative water content and windspeed at up to eight heights at half a dozen places in a pasture, which may be many miles from a laboratory. Since the stomata of some plants can open or close within a few minutes, measurements may need to be repeated at something like this interval over many days.

Usually, the answer is a punch tape or magnetic tape data logging system and computer analysis of the data at a later time. Processing and analysing such an amount of information takes appreciable time on even a large computer; also, failures of sensors or other components may not become apparent until it is too late to do anything about them.

Where the funds are available there is now a tendency to reduce the volume of data by using a small computer on line in the logging system and partly processing the data as it is recorded. This has the further advantage that behaviour of the logging system and its sensors can be more readily monitored, either by appropriate software to calculate vapour flow rates, energy balances etc., or merely to convert voltages and currents to degrees centigrade and similar units which can be more readily monitored by eye, as they are being recorded.

An object of much of this work is to be able to stimulate and to understand the interaction that occurs between the plant and its environment, so that prediction of plant, pasture or crop performance at any given place or time and also selection of breeding plants for specific purposes can be done with increasing confidence.

Our present insight into these problems, and the instrumentation which made it possible, has largely been the work of technically-minded biologists. However, physicists, mathematicians and engineers, many of them working in Australia, are now playing a big part in recognising and developing the increasingly subtle techniques that the work requires. ■

ATOMIC BATTERY ON THE MOON

The Apollo 12 experiments left on the moon's surface by the lunar mission will be kept functioning for at last by a year with electricity developed by a nuclear electric power system.

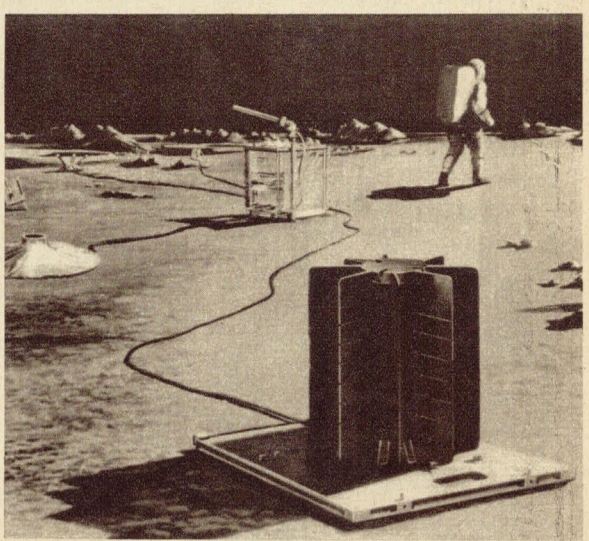
The power will be provided by a device called SNAP-27. This is one of a series of radioisotope thermoelectric generators (or atomic batteries) developed by the U.S.A.'s Atomic Energy Commission under its SNAP program. SNAP is an acronym for Systems for Nuclear Auxiliary Power. The lunar device was developed as part of a program directed at the development of generators and reactors for use in space, on land, and in the sea.

SNAP-27 is designed to provide all the electricity for continuous one-year operation of the NASA Apollo Lunar Surface Experiments Package (ALSEP). This is the array of scientific instruments and supporting sub-systems deployed by the Apollo 12 astronauts on the lunar surface.

The radioactive isotope chosen for the SNAP-27 fuel was plutonium 238. This has unique properties which make it an excellent isotope for use in space nuclear generators. It is very long lasting, and at the end of 90 years will still be delivering half of its original heat. In the decay process, it emits mainly the nuclei of helium (alpha radiation) which requires very little shielding. The fuel form of the isotope used in the generator is not harmful to human or marine life.

The rugged fuel capsule was contained within a graphite fuel cask from launch until lunar landing. This cask was designed to provide re-entry heating protection and added containment for the fuel capsule in case it became necessary to abort the mission after blast-off. It is cylindrical with hemispherical ends, and includes a primary graphite shield, a secondary beryllium thermal shield and a fuel capsule support structure made from titanium and Inconel materials.

The generator was activated on the lunar surface by one of the astronauts removing the fuel capsule from the cask and inserting it in the SNAP-27 generator, previously placed in position on the moon. The spontaneous radioactive decay of the plutonium 238 within the fuel capsule generates heat. An assembly of lead telluride thermoelectric elements converts the 1480 thermalwatts generated directly into electrical energy — about 63 watts.



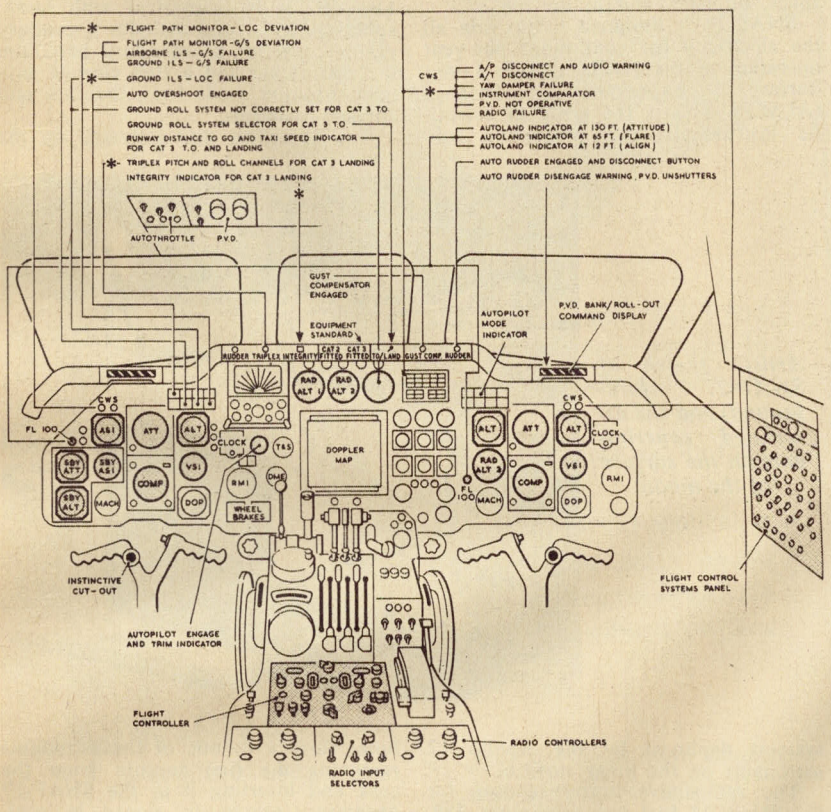
Artist's sketch of SNAP-27 (foreground) and the associated experiments on the surface of the moon.

FULLY AUTOMATIC LANDINGS

Automatic landing systems now being tested in the U.K. may mean the end of the delays and wastage imposed on commercial air traffic by conditions of poor visibility. Although the necessary equipment can amount to as much as $60,000 per aircraft, the major British airlines have thought the expense worthwhile.

by JAMES HAY STEVENS

Aeronautical consultant and writer

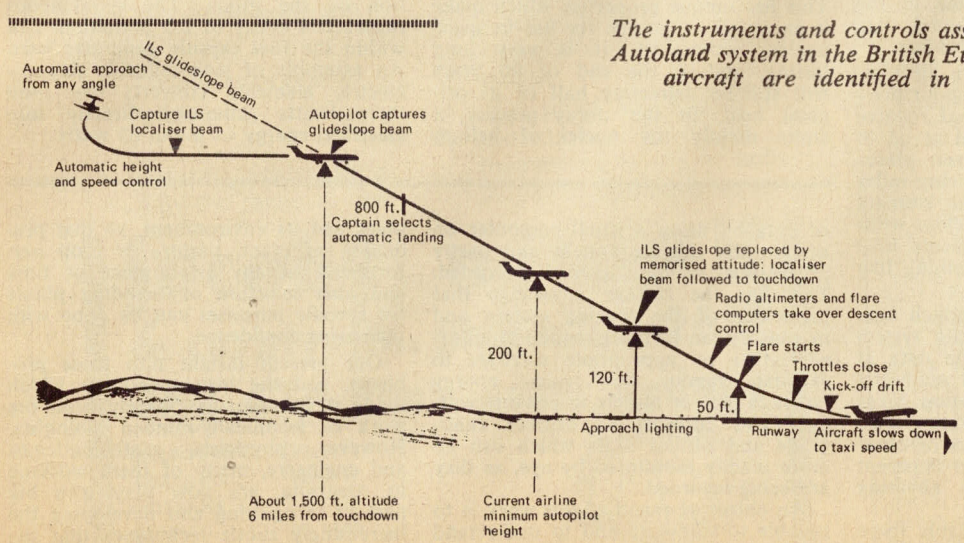


The instruments and controls associated with the Smiths Autoland system in the British European Airways Trident aircraft are identified in this line drawing.

Research into the practicability of landing aeroplanes automatically in fog goes back, rather surprisingly, for almost half a century. Perhaps the earliest experiment on record was that made by Captain R. H. McIntosh on October 20, 1921, who landed a Handley Page 0/400 airliner at Croydon Aerodrome in fog using a timed descent from the Crystal Palace. A more advanced trial was made by the Royal Aircraft Establishment in 1923, using a Vickers Vimy. In this, the aeroplane was trimmed to a steady rate of descent, with its control column held by a spring, and a weight was trailed on a wire which, when it touched the ground, signalled for the control column to be released, when the Vimy landed itself.

During World War II the R.A.F. did a great deal of work improving the radio Standard Beam Approach (SBA), which was a development of the German Lorenz system, but the last stage was always the problem. Experiments were made with a "dip stick" intended — like the wire bob weight of the twenties — to indicate ground level under very bad conditions. Although subject to distortion and interference, the "beam" has been a reasonably accurate and reliable device for more than a quarter of a century; it is the final stage of the landing when the pilot takes over and visually guides the plane in, when it breaks through the cloudbase, that the difficulties arise.

It was as long ago as 1948 that the Blind Landing Experimental Unit (BLEU) of the R.A.F. effected an automatic landing with a de Havilland Devon (R.A.F. Dove). For this a Smith's Mark 9 autopilot was coupled



LEFT: This diagram shows the principle of the automatic landing system developed by Elliot Flight Automation for British Airways Corporation's VC10s.

CONTRIBUTE TO AIR SAFETY

to the radio beam system. A version of this was ordered for the R.A.F. Avro Vulcan jet bombers. BLEU continued to refine the system and in 1957 it was also decided to develop a civil system with government backing. The BLEU experiments were mainly carried out with a Vickers Varsity, but other types were also used, including a DH Comet. The ultimate system, the Smiths Autoland, was then put into production for the Short Belfast transports of the R.A.F. A civil variant, Autoland, was developed in a Hawker Siddeley Trident jet airliner and this has been ordered by British European Airways for its whole fleet of these aeroplanes.

In parallel, the British Aircraft Corporation and Elliott Flight Automation developed a rather different system for the Super VC 10 airliners of the British Overseas Airways Corporation. This all-weather landing system has been adapted for the smaller BAC One-Eleven airliner and has been adopted by BEA for its new fleet of Super One-Eleven 500s. An extension of this system is in the prototype Concordes.

Leaving, for the moment, the means by which the end is achieved there is the question of what is required for an automatic landing.

The position of the aerodrome is shown by radio beacons and, through the navigational receivers in the aircraft and the flight director computer, its autopilot brings it into the circuit pattern and locks on to the Instrument Landing System "beam" or ILS. (A modern autopilot obeys commands, after being set to any desired mode, from the flight director computer. This sorts out signals from flight instrument readings, showing what the aeroplane is doing and radio navigational signal inputs and turns them into cockpit dial instructions as well as commands to the autopilot when this is coupled to it.) This beam consists of two pairs of overlapping directional transmissions: one is the localiser, giving heading on to the runway centreline and the other is the glide path, which gives the correct angle of descent (2.5 degrees or 3 degrees) to the touchdown point on the runway. The four transmissions form a + shaped signal, the centreline (or core) of which is the narrow beam approach path indicated by the strong signals from each pair of overlapping beams. The "fingers" of unduplicated signals give steering directions, up/down, left/right, to the centre of the beam. In addition, there are two vertical transmissions, known as the outer and inner marker beacons, which indicate distances from the runway threshold.

Before the autopilot was coupled to the ILS receivers the pilot followed a cross-pointer indicator for the beam, the marker beacon signals coming up as a flashing light on the dash. However, whether the beam was followed by the pilot or the autopilot, its use was limited to about 150ft above the ground—the height at which the pilot had to take over when breaking cloud and to complete the landing. The basic reason for this is that although the localiser (azimuth) radio signals, which are transmitted from the far end of the runway, remain satisfactory to ground level, the glide slope is unreliable below about 150ft. Because of this, in the past the pilot has had to complete the landing visually and has had to have sufficient time and space in which to pick up the runway lights and orientate himself.

The answer is to use the localiser signal right to the touchdown and — where it is sufficiently accurate—for the ground roll also, but to cut out the glide path before it becomes dubious and substitute a stabilised "glide" through the autopilot and the memory in its computer to continue the approach attitude until the flare-out height is signalled by radio altimeters.

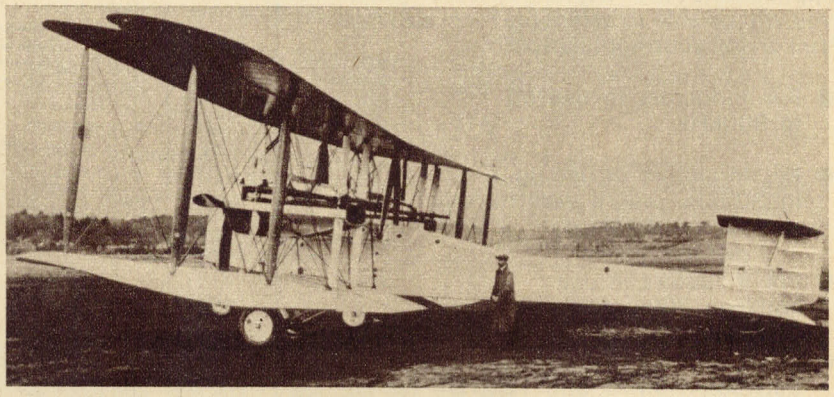
Some five years ago the International Civil Aviation Organisation (I.C.A.O.) established a series of categories covering the introduction of automatic landing. These are shown in Table I and they are colloquially known as Cat. 1, Cat. 2 and Cat. 3.

Work has been going ahead on meeting these requirements in Britain and the U.S.A., but with a fundamental difference. In Britain the approach has been to go straight for full touchdown automation, but proving it progressively by thousands of pilot-monitored landings, under fair weather, Cat. 1, then Cat. 2 and finally Cat. 3 conditions; the Americans decided to keep the pilot "in the loop" until the equipment was developed to Cat. 2 standard, so that he would make the actual flare and touchdown until the Cat. 3 stage was reached.

The safety parameter established by Britain's Air Registration Board for the critical touchdown phase—the final half minute of the landing—is a reliability factor of one in 10 million. This is based on an analysis of fatal accidents in the world's airlines which occur once in a million landings, so that the automatic system is required to be 10 times as reliable as the human pilot—using the same electronic aids when necessary.

It is in the satisfaction of this safety factor that the two British systems show their major differences. In Autoland, developed jointly by the Aviation Division of Smiths Industries Ltd. and Hawker Siddeley Aviation Ltd. for the Trident airliner, safety is achieved by triplicating the equipment, so that if one item in one system goes wrong it is outvoted by the other two independent systems and the landing continues automatically, although a flashing light on the dash indicates the reduction from triplex to duplex operation. Should a component of one of the remaining systems fail—the 10-millionth chance based on the known reliability of the equipment—the autopilots will cut out, with a signal to the pilots, and the Trident will continue on its course in a stable, trimmed state. It is then for the human pilot monitoring the landing to decide whether to continue or to overshoot.

In the Elliott/BAC system the 10^{-7} factor is achieved by a duplicate moni-



As long ago as 1923, the R.A.F. used a World War 1 Vickers Vimy similar to the one illustrated for automatic landing experiments.

I.C.A.O. Automatic Landing Limits

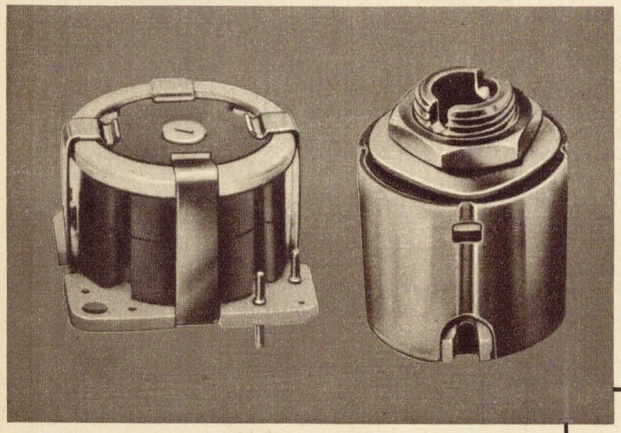
	Decision Height (DH)	Runway Visual Range (RVR)
Cat 1	200ft (60m)	2600ft (800m)
Cat 2	100ft (30m)	1300ft (400m)
Cat 3 A	Zero	700ft (210m)
B	Zero	150ft (45m)[1]
C	Zero	Zero[2]

[1]Sufficient visibility to taxi.
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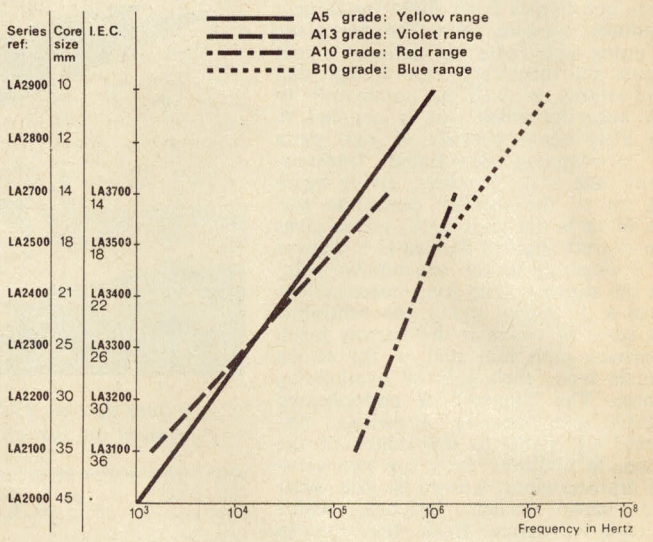
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M 233

tored approach. There are two entirely independent systems in each of which each individual item and every vital function is monitored. If a failure occurs its monitor will detect this and its system will be switched out, this fact being signalled on the dash. Should the second system develop a fault, then it switches out, the aircraft continues in the trimmed condition and the pilot makes his decision. Since only two systems are involved, this is obviously more compact, lighter and cheaper than a triplex system, the monitors being relatively small and light devices.

Both the British systems are "fail active" in the case of the first fault and "fail passive" for a second one. That is, the landing continues automatically in the first place and the aircraft is on course ready for the pilot's decision in the second.

Ignoring, for the moment, the question of duplicate or triple design philosophy, the following equipment is required for automatic landing—the receivers to capture the ILS beam transmissions; the computer to interpret these signals as instructions to the autopilot; the aircraft's air data system which indicates the behaviour of the aircraft, e.g. airspeed, height, etc.; an automatic throttle control; a radio altimeter to give precise height above ground (irrespective of barometric pressure) down to the last foot; and the autopilot to carry out the instructions from the electronic and atmospheric devices.

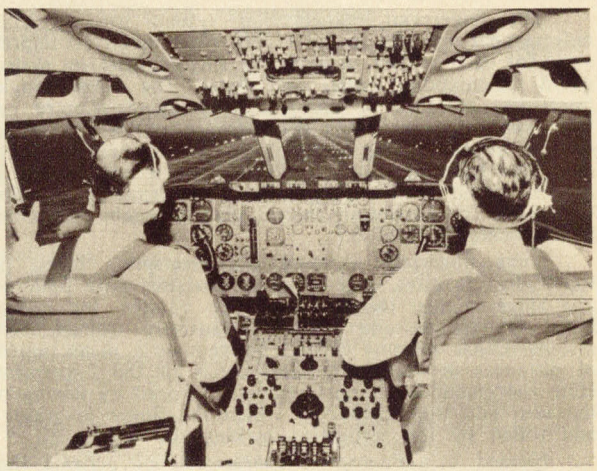
The two British systems are sufficiently alike for a single description to show what is involved in a landing if one ignores minor details in speeds and heights due to differences in aircraft characteristics.

The landing phase begins when the aeroplane approaches the aerodrome at about 1,500ft and the ILS receiver captures the localiser signals and, through the flight director computer and the autopilot, lines up toward the runway. At this stage the pilot lowers the flaps and undercarriage, sets the autopilot to maintain the correct airspeed (through the automatic throttle), checks the functioning of the radio (echo type) altimeters and the functioning of the different systems. The aircraft then flies on until the glide slope signal is intercepted and the descent is begun with the autothrottles keeping the correct speed while the autopilot flies the aircraft precisely down the centre of the beam, keeping it laterally level and correcting for drift due to any crosswind. A gust sensor in the Autoland system helps to keep the speed constant by adjusting aircraft incidence to "bumps."

The outer and inner marker beacons provide a check on the correctness of the approach and the radio altimeters give constant readings of the height above ground. Although the aircraft is being handled completely automatically, both pilots have full sets of instruments which give them a complete picture of what is happening—attitude indicators, air-speed, altitude, ILS, compass heading, etc.

The aircraft is now descending steadily and accurately at a precise speed (the throttle levers move back and forward all the time as changes in speed are sensed), trimmed and stabilised in the glide. Just below 150ft the glide slope signals are automatically switched out and the aeroplane continues in its attitude, held by the autopilot acting on instrument sensing alone—direction is maintained from ILS localiser signals.

At 50ft, signalled from the radio altimeters, the throttles close and the flare-out begins, with the autopilot trimming through the elevator to achieve gradual transition into a flight path almost parallel with the runway surface. If there is any crosswind the aeroplane will now be crabbing just above the runway, so the wheels have to be brought into line with the runway heading. Here again the two British systems differ slightly; but, basically, the runway heading is given by magnetic compass and at a height of about 15ft as signalled by the radio altimeter, the rudder is used to "kick off" drift.



This picture was taken just prior to touchdown in a B.O.A.C. VC10 equipped with an Elliott automatic landing system. Note that neither pilot is touching the controls.

In the Trident tests at Royal Aircraft Establishment (R.A.E.), Bedford, which the writer witnessed, the ground roll continued under the guidance of the localiser beam. It was remarkably convincing, on landing after landing, to see the aeroplane touch down precisely on the runway centreline, follow it, then turn two or three feet to one side, run along a couple of hundred yards and then return to the centreline. This was caused by a slight "bend" in the beam due to a depression in the runway surface.

So far we have been considering the quality and reliability of the aircraft equipment. The other side of the coin is the reliability and accuracy of the ILS transmissions. Reliability is achieved not only in the equipment, but also by duplicated, continually working transmitters, one feeding the aerials and the other working into a dissipative load, with an automatic changeover time of under half a second. Monitors continually check the accuracy of the transmissions as well as the functioning of the one in use. Not many ILS transmitters have the quality for automatic landing, but Standard Telephones and Cables STAN 37/38/39 was designed to give I.C.A.O. Cat. 3 quality and maintains the localisor beam within one foot of the runway centreline at the threshold. Even so, there are many aerodromes where local features cause distortion—the assembly of a large number of buses to take staff home can affect the delicate transmission—so that research goes on for better equipment. The BLEU at the R.A.E. has been experimenting for some years with UHF transmissions as a means of eliminating distortion and transient interference and this looks like being the next step forward.

Both British civil automatic all-weather landing systems are more advanced toward regular Cat. 3 operation—where appropriate ground installations exist—than any other. The Smiths Autoland in the B.E.A. Trident fleet is accumulating automatic touchdowns at the rate of 300 a month toward the certification goal of 5,000. Each landing is monitored by the pilots, and equipment on the aeroplane records the accuracy of every touchdown. During 1968 the Tridents were certificated for Autoland operation in Cat. 2 conditions, i.e. 100ft cloudbase and 1,300ft Runway Visual Range (RVR). These limits will be progressively lowered as experience is gained and it is expected that Cat. 3A limits will be cleared in 1970/71 and Cat. 3B the following winter. The actual usage of the system will then depend upon runway lighting for ground guidance as well as the quality of ILS installations.

The Elliott system has reached the stage of development where earlier this year it was used for the first (and second) landing of a new BOAC VC-10 on its maiden flight.

In March, both systems were demonstrated to members of the ARINC Autopilot Sub-Committee of the American Airlines Electronic Engineering Committee at the R.A.E., Bedford. The Autoland Trident demonstration consisted of six full-stop landings and an overshot from below 12ft, with a simulated engine failure. To overshoot from an automatic landing the pilot simply opens the throttle, when the autopilot system will re-trim the aircraft into climbout conditions. Also in the demonstration were the automatic roll-out, using roll-out guidance, ground speed and distance equipment that has been developed in conjunction with BLEU. Simulated asymmetric thrust reverser failures caused maximum deviations of only 10-15ft from the runway centreline. ■

FINGERPRINTS – progress with computer identification systems

In our February, 1969 issue, we published an account of work being carried out by the National Bureau of Standards in the U.S.A. on the computerisation of fingerprint identification. Continuing research has resulted in a new single-fingerprint classification system.

Devised by J. H. Wegstein, of the N.B.S. Centre for Computer Sciences, in research for the Federal Bureau of Investigation, the new method has manual steps, but is easy to use with the help of a computer and promises speedy responses. This method, whose alphanumeric descriptors can be transmitted by teletype, would greatly speed the use of medium-sized fingerprint files. Searches of the central file could be initiated at remote units, such as local police stations, and matches or verification returned within minutes.

The fingerprint classification system used by law enforcement agencies in the U.S.A. requires all 10 impressions for each subject. A workable single-fingerprint system could make coding easier and faster. The recent single-fingerprint research at the N.B.S. Computer Centre has been sponsored by the F.B.I. because of its interest in concise systems using descriptors that are amenable to computer handling. Such a system that is easily used in the field could be of use in the National Crime Information Centre—a fast-answering central file on wanted criminals that is located at the F.B.I.

Some fingerprint systems use descriptors based on topological features, such as gross patterns, core patterns, and ridge counts; these systems are vitiated by poorly inked fingerprints and require extensively trained technicians. Other systems depend on geometric measurement of distances between minutiae—details of the fingerprint. Here the classification obtained is influenced by flexing of the skin and the manner in which the finger is grasped and rolled by the technician making the impression.

Needed is a fingerprint characterisation scheme that minimises these shortcomings and that persons of limited experience can use. The notation should be one that can be readily handled by a computer because full automation will be required when a device capable of reading fingerprints automatically finally is developed.

Reticles, transparent overlays marked with geometric patterns, have been used in earlier methods of classifying single fingerprints, such as the Jorgensen, Collins, and Battley systems. Mr Wegstein's method uses a reticle engraved with radial lines that divide the area above a horizontal line into 10 numbered sectors. It fits a standard fingerprint magnifying glass for use.



A reticle with engraved positioning lines and radials as described in the article, used for the coding of descriptors for single fingerprints.

The reticle is positioned for use with a horizontal line on the first continuous ridge above the fingerprint core (its characteristic central part) and parallel to the joint crease below it. As one scans the ridges from left to right above the core, some can be seen to arch unbroken across the horizontal line from left to right. Others start abruptly above the horizontal or split apart from another ridge, while some end or merge before reaching the horizontal at the right. The reticle is used to assign numbers telling where these events occur.

The number of the sector and the number of the affected ridge (counting upward from the reference ridge) determine the code. For example, if the second ridge above the horizontal line starts in sector four, it is coded as 2s4. If the third ridge ends in sector nine, it is coded as 3e9. If the fourth ridge passes through all sectors, it is coded as 4-. Provision is made also for coding islands, or short sections of ridge.

Events occurring in ridges one to 14 are noted in this manner. The technique for coding a fingerprint is easy to learn and enables a fingerprint to be coded in less than five minutes. The police officer or technician would normally code (give descriptors for) both of the index fingers for either filing or seeking a match.

The codes describing a fingerprint can be communicated to the central computer by means of a remote tele-typewriter, or by telephone or radio link to the nearest tele-typewriter that is connected to the computer. The computer can then search its file for fingerprint codes that match the incoming one.

A computer program developed by Mr Wegstein and John F. Rafferty, also of the Centre's staff, compares a code submitted for searching against those already on file and computes a score for each comparison. The more alike two prints are, the higher the score. If a fingerprint code from the file yields a score above a "match" threshhold, the program directs the computer to transmit the identity of the corresponding individual to the remote teleprinter. Manual comparison of fingerprints can then be used for a positive identification.

FINGERPRINTING FROM ANTIQUITY TO THE PRESENT

Fingerprints have been used since antiquity to convey authenticity, as of a monarch's edict, an engraver's art, and (during the past century in the United States) to prevent forgery of commissary orders. Their uniqueness was more fully recognised early in the nineteenth century.

Sir Edward Henry first used fingerprints in solving crimes; the Henry system has now been in use for over 60 years. It assigns alphanumerical identifications to finger patterns and assembles an identification for the set of 10 prints.

Other efforts have used methods of describing single impressions; one was adopted by an International Police Conference in 1923 and others have been studied at Scotland Yard to supplement the Henry system in dealing with latent fingerprints. These are fingerprints left unintentionally—as at the scene of a crime—and hence usually show only part of the pattern, may be smudged, and are from undesignated digits. Single-fingerprint systems have been hampered by the skill and time required for coding and searches, insufficient discrimination capability, and lack of an adequate scheme for ordering the descriptive codes. ■

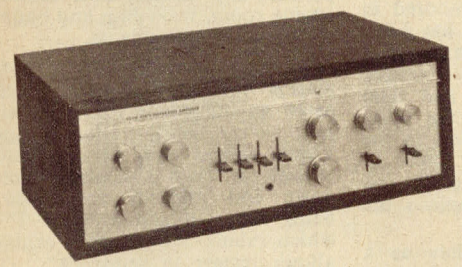
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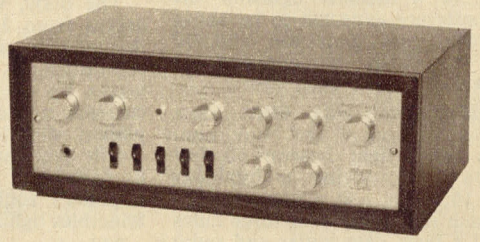
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Unmanned Beacon Replaces Lightship

Europe's first fully automatic unmanned replacement for a lightship — a 40ft diameter, 84-ton, navigational buoy — was handed over to Trinity House by Hawker Siddeley Dynamics Ltd. at a launching ceremony at London's Royal Albert Dock in December.

This prototype, known as the Hawker Siddeley Dynamics "Lanby" buoy (Large Automatic Navigational Buoy), is to be evaluated by Trinity House (the general lighthouse authority for England, Wales and the Channel Islands), to find an economical means of replacing a number of the authority's 32 lightships. The buoy's capital cost, which includes its shore-based monitoring and control equipment, is about half that of a modern lightship. Its running costs are expected to be about 90 per cent less than the $60,000 required to keep a conventional manned vessel at sea each year.

The navigational aids, fitted to a lattice mast on top of the buoy, consist of a main light beacon 40 feet above sea level, giving a luminous range of 16 miles, and a powerful fog signal which is audible over three miles away. At a later date, radar and radio beacons may be fitted, and there is provision for accommodating meteorological or oceanographic data-reporting equipment if required.

The automatic operation of these aids and their power supplies—three 5KW diesel-powered generating sets—is monitored every 30 minutes by the buoy's shore control station using a radio telemetry link. Should any failure occur, standby services operate automatically, and indication of the fault is relayed to the control station. Shore control can carry out 40 separate checks on the equipment and can control 22 different operations on the buoy.

The buoy, which can be moored in depths from 30 to 300 feet, has been designed to withstand severe weather conditions — winds up to 100mph, waves up to 40 feet high, and tidal currents up to seven knots. On completion of full operational trials in the North Sea, the buoy will be towed to its permanent site off Portland Bill (on England's south coast) to replace the Shambles lightship.

This buoy is intended solely as a navigational aid, but certain features of buoy movement are to be monitored as well as the functional parameters. Approximately five continuous and one sampling (digital) data channels could be provided for monitoring variables associated with meteorology, sea state, and vessel attitude and movement. All channels could be time shared, either on demand by the shore station or by a preset program to cover many more than six variables.

With the spare electrical power and volumetric capacity that exists in the present design, there is almost no limit to the variety of meteorological and oceanographic data which could be measured, transmitted and recorded. Each shore control station could be used as a data-collection centre serving up to a total of five buoys, depending upon line-of-sight range. The buoys are completely automatic except for the operation of the fog signal. The telemetry system monitors each of the buoy's functions to check its operation and allows remote manual intervention should any automatic facility fail to operate.

The state of the monitored equipment is updated at the time of a change, either due to a failure or a routine action, and also on receipt of an interrogate signal sent from the shore station every 30 minutes. Failure to receive this routine interrogation will cause the required transmission to be radiated by the buoy, with an alarm being given after a five-minute delay.

A "firewire" detector system is installed in the engine room with each engine having its own BCF extinguisher coupled to a detector. The electronics compartment is fitted with a smoke detector coupled to a BCF extinguisher system. A hydrogen absorber is fitted in the battery compartment, with a separate hydrogen detector and portable carbon monoxide detector in the survival compartment. A large accumulation of bilge in any of the watertight compartments is not expected and so the bilge and ballast are combined in a ring main system controlled by a mono-pump and suitable valves. A high-level bilge alarm is fitted in all compartments.

The buoy will be visited at six-monthly intervals for simple maintenance checks, refuelling and boosting the batteries. During maintenance periods, two exhaust fans ventilate the engine room, workshop and battery and electronic compartments.

Various engine-state automatic alarms are incorporated which will cause an immediate transmission to be sent to the shore station if operated. These alarms are divided into two classes—a "class 1" alarm which shuts down and prevents an engine from being restarted and a "class 2" alarm which shuts down the engine but allows restart in sequence.

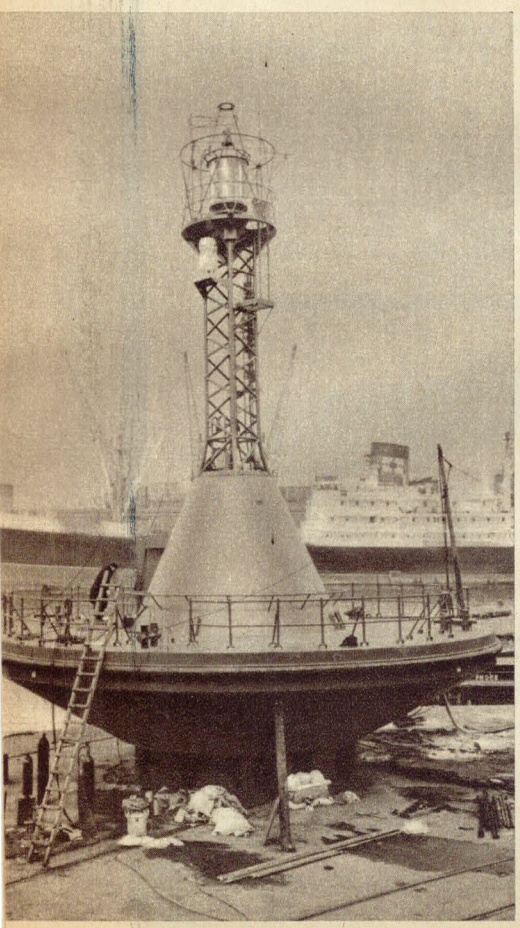
Class 1 alarms are engine overspeed, low oil pressure, high water temperature and an engine fire. Class 2 alarms are overvoltage and under speed.

Three diesel generator sets provide the power for all loads on the buoy, except for the emergency aids. Twin-cylinder 4-stroke water-cooled engines are used, each developing 12.5 BHP at 1,500 rev./min., which are designed to run for 2,000 hours between services. The lubrication system is the dry sump type using extra-large filters and high-grade oil to give lubrication for six months between servicing cycles. Each engine is close-coupled to a 5KW self-exciting alternator giving a 473V, 3-phase output. Semi-conductor rectifiers ensure a close voltage control of ± 2 per cent.

The basic concept of the system is that engine-generated power is used directly for the operation of all the electrical equipment, and for charging a bank of nickel-cadmium accumulators. The navigational aids, radio and control equipment are connected directly across the accumulators. In the event of all three engines failing, this system would provide power to maintain the equipment in a fully operational state for at least five days. At the end of this period, the emergency light and fog signal then operate from banks of dry cells for a minimum period of 20 days.

A duplicated antenna system is mounted on the buoy, working to the transmitter/receiver through a diplexer. The aerials are UHF colinear arrays with a gain of 6dB over a half-wave dipole. At the shore control station, separate aerials are used for transmitter and receiver, the antennae being 12-element Yagis. The arrays have gains of 12dB relative to a half-wave dipole.

(Continued on Page 190)



The Lanby buoy at the Royal Albert Dock, London, ready to be towed to its final position off the south coast of England.

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"SUPERLATIVE SOUND" Headed Electronics Australia's review of the Lancer 77 in November, 1969.

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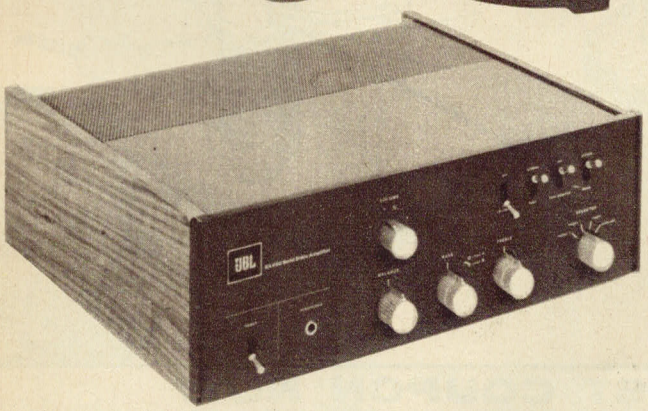
Transition between high and low frequency transducers is controlled by the JBL LX4-2 precision dividing network, designed specifically for the Lancer 77. The LX4-2 features a variable H.F. attenuater, and hand wound aluminium foil capacitors, individually checked to maintain accuracy to the plus minus 1 p.c. The Lancer 77 can be connected to the most powerful amplifier available with little danger of overload.

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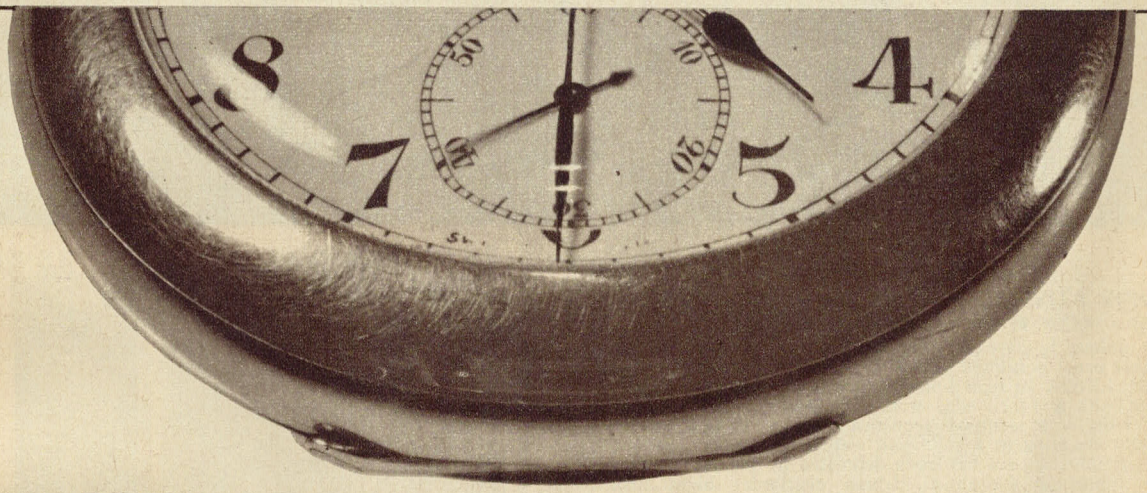
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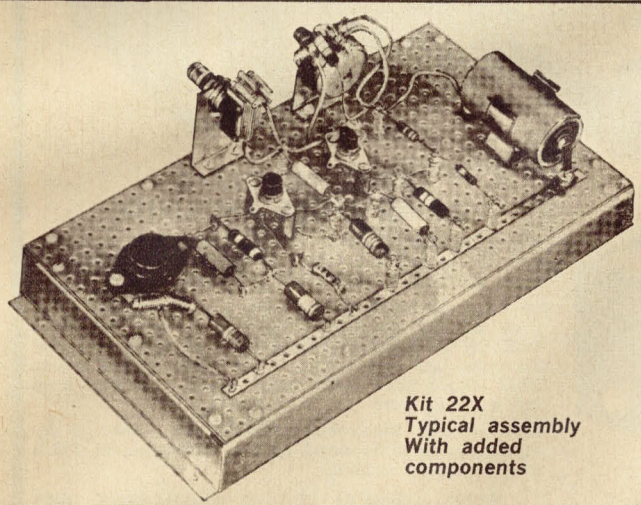
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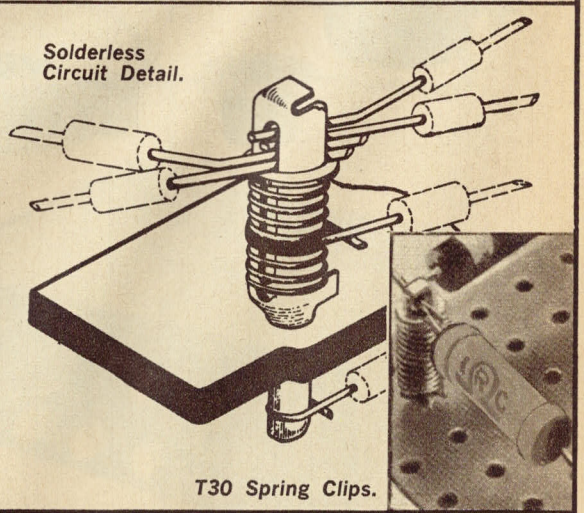
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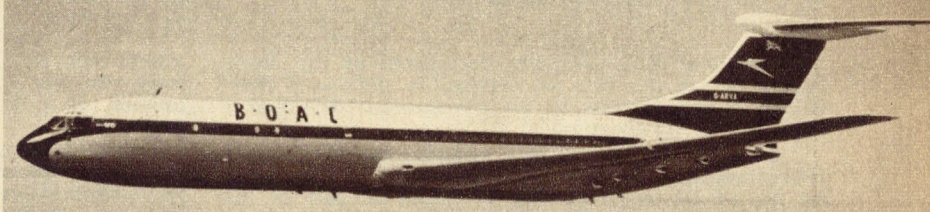
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Sat., June 27: Morning at leisure. Afternoon flight to Taipei, thence to the President Hotel.

Sun., June 28: Sightseeing Taipei.

Mon., June 29: Morning technical tour at Taipei. Afternoon to Tokyo.

Tues., June 30: Tokyo, technical and sightseeing tour.

Wed., July 1: Leisure day in Tokyo.

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Tues., July 14: Duty-free shopping. Evening flight to Sydney.

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COMPUTER TRAINING IN U.K.

Instruction in the operation of computers is becoming more and more part of the education scene in Britain. At the Royal Liberty School, in Essex, more than 600 students use computers as part of their normal education. The author is the head of the school's computer department.

The idea of a computer department at the Royal Liberty School was first put forward in 1963 as a result of the author's interest in the simultaneous development of computing and education.

Over the last decade the mathematics syllabuses in British schools have undergone considerable changes, and the use of the computer has developed as part of this change. For school students to have access to computers—normally reserved for scientists, engineers and businessmen—is an aid to their general educational development, and of national value in helping to provide more trained personnel to use the vast computing power available in Britain.

At the end of two years of campaigning, industry donated $21,429—two-thirds of the capital cost of the school equipment, an encouraging proof of industrial interest and support for the new venture. The local education authority supplied the other $10,714.5 and undertook to provide the running costs of the computer ($9,643 a year).

So the project is a joint venture between industry and education, and the close links formed with industry have been maintained—we believe, to our mutual benefit.

By September, 1965, we were ready to install our computer, an Elliott 903, and to start running our courses. The format for these had been developed as a result of experiments carried out before and during the time we were raising the money for the equipment.

At this stage it is worth looking at the educational value of teaching students how to use the computer for solving problems. To do this, the student must first know a language in which he can communicate his solution to the computer—a programming language.

The fundamental difference between writing a solution of a problem for a computer and writing a solution in an exercise book is that for a computer all possible situations which could arise must be taken into account. So the student must have a complete understanding of the problem itself. He has to study the problem, devise a logical solution to it, and express this solution as a computer program.



The author (left) explains some of the features of the school's Elliott computer to a group of students.

This, in turn, calls for the student to think logically and clearly about the problem. The computer makes a real contribution towards the student's educational development because if there are errors in the language of the computer program—and generally there are in the first effort—the computer gives a wrong answer. This clearly indicates to the student that he has made an error in his interpretation of the problem and consequently makes him examine it again in great detail.

Because of this, the student is able to concentrate his attention on the problem and the logic of its solution rather than upon the somewhat mundane arithmetic and algebraic manipulation normally involved. In addition, the computer stimulates the student's interest in his work and enables him to study more realistic problems than would otherwise have been possible. Furthermore the student will be using during his education the tool that he may ultimately use in practice. This is an important contribution not only to his educational development but to the society in which he is going to live.

The first course which we planned was an A-level General Certificate of Education course which was in fact an adaption of the London University Pure Mathematics syllabus with a bias towards solving problems on a computer and the mathematical techniques involved. This syllabus has now been in operation for more than four years.

While it has its defects, its general structure has proved successful and the original criteria in its design—that it should cover all the mathematics required for studying physics, applied mathematics and economics at Advanced level—have avoided any narrowing of the range of subjects a student can study along with this course.

The standard of the work produced is surprisingly high, which led us to experiment with teaching computing to students below the sixth form in the selective schools in the London Borough of Havering. We found that, far from the computer being a tool which can be used only by scientists and mathematicians (a thought very common in the early 1960s), a computer can be programmed usefully by students from the age of 13 upwards.

The only difficulties have been because most of our students' programming is done in a high level language requiring them to be able to formulate problems in mathematical terms.

The age level can be reduced considerably if a non-mathematical language, such as a basic assembly language, is taught.

An idea of the work being done can be gained by looking at some of the actual problems undertaken. The father of a boy at one of the local grammar schools had the job of working out the sizes of all the beams involved in making the roof trusses of prefabricated buildings — hitherto an expensive and time-consuming task of working out each one individually. In two weeks the son had produced on the computer a set of tables which people on the shop floor now simply look up to find the appropriate dimensions for all the sizes of trusses used by that company.

Another of our students, working for a local council during his holidays, found himself doing a lot of rather tedious calculations concerned with surveying, which often took two or three days to complete. Now he has written a program for this work which will solve such problems in a matter of seconds.

Another has investigated compiling school timetables on the computer. This work has not yet been completed, but it is anticipated the program will take a large burden off schools' administrative staffs.

HIGH SCHOOLS

by Will Broderick

The students also enable the computer to be used more efficiently. They write a lot of utility programs and provide some fundamental computer software, which will enable more students to use the computer. Many of these jobs are of the type normally done in industry by people earning high salaries.

The increased work load of the school's computer has made it necessary to consider expanding it, and if this expansion is to be used fully, a fairly advanced program, called an operating system, will be required.

The exact requirements of this system were designed by members of the school's staff, but the actual implementation is being carried out by a 14-year-old boy.

None of this work would be possible without the close co-operation between the school's computer department and industry, and the school has in the past, and will in the future, run courses on computing specially for industrial personnel. This will provide a worthwhile extension of contacts with industry and is expected to provide further stimulus for students.

The original computer project was aimed at selective schools. It was not anticipated that students from the secondary modern and lower streams of comprehensive schools could program a computer; but events have proved otherwise.

There is now in Essex a Certificate of Secondary Education option in the mathematics syllabus which enables students to study computing in non-selective schools and they can be examined in this subject. The examiners have been surprised and impressed by the high standard of work.

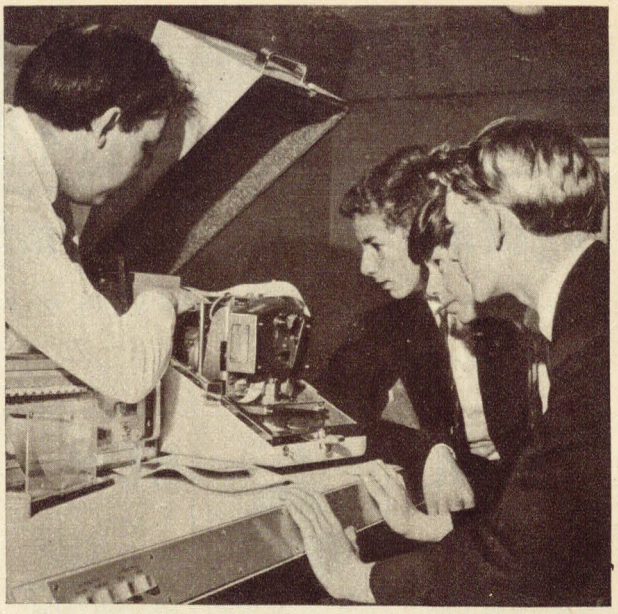
No good school locks its doors at four o'clock. The Royal Liberty School is no exception: their problem is not to persuade students to use the computer but to persuade them to go home.

Indeed, classes for secondary school students are now held until 9.30 p.m. and the students attend these out of school hours on a voluntary basis.

A major problem in developing the work of this department has been teacher training. When Royal Liberty installed its computer, there were fewer than 10 teachers in the Essex area capable of writing even a simple program for the computer. Since the inception of the project



Girls, as well as boys, are undergoing instruction on the Elliott computer. This pupil is checking a computer print-out with a calculating machine.



Boys at the Royal Liberty School, Romford, work out complicated programs virtually unaided. This group is working without supervision on programs of their own devising.

courses have been run regularly throughout the school holidays.

The success of these courses and the interest and enthusiasm they have engendered in the staff is indicated by the fact that the computer is now used by 22 schools, two teacher training colleges, one college of adult education and one technical college.

The further development of computer education is largely dependent on teacher training, so courses are made available to teachers of other authorities and a large number of contacts have been made with other areas where computer education is being developed.

The Royal Liberty School computer project is but one of many similar projects in Britain.

For instance, Dover (Kent) Grammar School is experimenting with the use of an IBM 7090 computer at Imperial College, London, on a postal system. Programs are punched on Porta-punches, a system which is providing a two-to three-day turn-round.

At Oundle (public) School, an on-line link to a commercial bureau is being used in the development of computer education.

At Hatfield School, in Hertfordshire, an on-line link has been established to the nearby technical college and a special compiler for conversational computing has been developed.

In the north of England, South Shields Grammar Technical School and Forest Grammar School both have second-hand computers, and the Schools Council has supported a remote computing experiment at Towyn School, Merionethshire, in conjunction with the University College of North Wales, in Bangor.

In Scotland, Daniel Stewarts College, Edinburgh, has run a number of programming courses and more recently has experimented with POP 2 on-line to the ICL 4100 Computer in the Department of Machine Intelligence and Perception at Edinburgh University. Glasgow Corporation's Education Department has installed an IBM 1130 computer and is developing a computer education scheme on similar lines to that at the Royal Liberty School.

These few examples give a general picture of the variety of activities which are developing and which portray the spirit and interest of the teaching profession in the development of computer education in Britain.

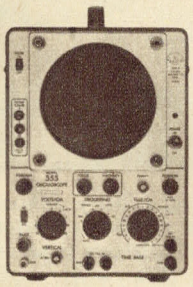
Results obtained so far indicate that there will be no universal formula for the provision of satisfactory facilities for computer education in Britain. Different educational and geographical circumstances will require different solutions. What is required is a variety of experience from which new projects can select the form of computer education curricula and facilities they are going to use, and develop this to suit local circumstances in a way to be of maximum benefit to the students. ■

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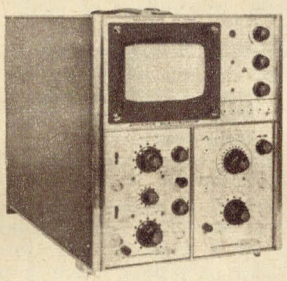
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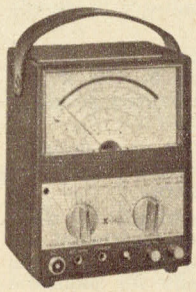
(Right) Model 555 Oscilloscope 5" CRT has 10 x 8 cm viewing. DC—7 MHz (—3dB). 20 mV sensitivity.

ADVANCE

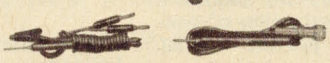


(Above) Advance OS2000 Oscilloscope. 20 MHz Bandwidth at max. sensitivity of 10 mV/Cm. 10 Cm x 6 Cm display area. Also—OS25 5 MHz Dual Trace Oscilloscope. • B4 RF Signal Generator. Alt. freq. ranges either 100 kc/s to 80 Mc/s or 30 kc/s to 30 Mc/s. • J2E AF Signal Generator. Freq. ranges 15 Hz-50 KHz. • H1E AF Signal Generator. Provides sinusoidal signal from 200 uV to 20V RMS over freq. range 15 Hz to 50 KHz. • SG67 Wide Range Oscillator. 5 freq. ranges covering 10 Hz to 1 MHz. • SG68 Low Distortion Oscillator. Freq. range 1.5 Hz to 150 KHz. • TC11, TC12 15 MHz Timer Counters. TC11 has 4 digit and TC12 5 digit display. • TC9 32 MHz Timer Counter with 6 digit display.

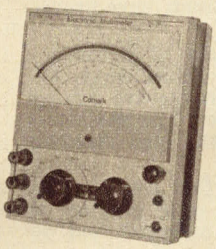
KEW



(Right) Model K-1420 VTVM. Meter sensitivity 200 uA. Also Model K-1400 VTVM. Meter sensitivity 50 uA.

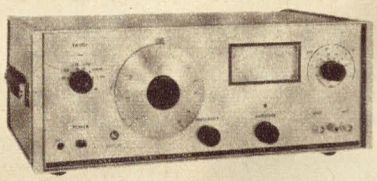


COMARK



(Right) 1200 Series Electronic Multimeter. A range to measure mV, mA, uV, uA, ohms, DC, AC. For portability, lab. or panel mounting.

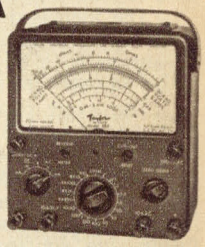
KIKUSUI



(Above) Model 433 RC Oscillator. Freq. 10 Hz—10 MHz (6 ranges). (Below) Model ORC-27A RC Oscillator. Freq. 18 Hz—200 KHz (4 ranges).

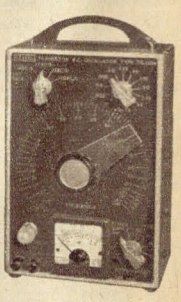


TAYLOR



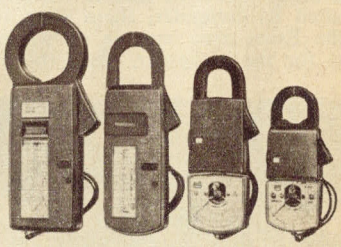
(Right) Model 88B Multimeter. Sensitivity 20,000 o.p.v. DC. 2,000 o.p.v. AC. Also— • Model 100 A Multimeter. Sensitivity 100,000 o.p.v. DC, 5,000 o.p.v. AC. • Model 101 Multimeter (slightly modified version of 100 A). • Model 127A Multimeter. Sensitivity 20,000 o.p.v. DC, 1,000 o.p.v. AC.

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(Right) TG150 RC Oscillators. 1.5 c/s to 150 kc/s. Constant amplitude, low distortion, stable frequency.

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TECHNICAL DIGEST

The Terminology of Medical Electronics

Articles concerned with medical electronics are appearing with increasing frequency in the pages of "Electronics Australia." Accordingly, the following article, from "PF Reporter," should provide useful background information for readers interested in this subject.

Because of their application to the medical field, many of the instruments to be described have high sounding names, but nearly all contain familiar circuits. The electroencephalograph, for example, consists of a low-frequency amplifier and a pen recorder; a cardiac pacemaker is essentially a blocking oscillator; and a phonocardiograph is a microphone-amplifier-oscilloscope combination for displaying heart beats. These and other instruments are described below in terms familiar to the reader with a knowledge of electronics.

Ballistocardiograph (bah lis toe kar dee o graf): Each time the heart muscle contracts, it squeezes blood through the circulatory system of the body. Like the ballistic recoil of a rifle when the bullet is ejected, the ejection of blood from the heart produces a movement of the body along the head-foot axis. A person standing on a sensitive scale can sometimes observe this effect by noting the slight deflection of the scale pointer during each heartbeat. The ballistocardiograph (BCG) is an instrument that records these body movements.

Recordings of the ballistocardiograph are accomplished with the patient reclining on a specially constructed table. The table top is mounted on springs or rollers so that it is free to move along the head-foot axis. Ballistic motion of the patient's body is therefore imparted to the table top, and a sensing device such as a phototube, strain gauge, magnetic pickup coil, or movable-core inductor responds to this motion. Output of the sensing element is amplified and fed to an oscilloscope or a pen-type recorder. The resulting waveform, known as a ballistocardiogram, can be evaluated by trained personnel to reveal information about the heart and circulatory system.

Cardiotachometer (kar" de o tack kom e ter): The cardiotachometer is a form of frequency meter used to indicate the heartbeat rate. The sensing element may be a microphone responding to heart sounds, a pressure transducer responding to the pulse, or metal electrodes picking up the voltage produced by the heart. In any case, the output of the sensing element is amplified and applied to a pulse-shaping circuit. These standardised pulses, one for each heartbeat, are then applied to a metering circuit to indicate the rate of heartbeat.

Defibrillator (de fib" ri la' tor): Fibrillation is a condition in which the muscle fibres of the heart contract in a random, un-co-ordinated sequence. The heart, therefore, loses its effectiveness as a pump, and the condition is fatal within a few minutes if normal heartbeat is not restored. By shocking the heart electrically, the defibrillator causes simultaneous contraction of all muscle fibres. This produces a condition of cardiac standstill from which the heart often recovers spontaneously, resuming a normal beat.

The output of the defibrillator is often a 50Hz sine wave obtained through a transformer from the power lines. Voltage is adjustable in the range of 50 to 200 volts. Contact with the patient is established by means of two metal electrodes placed on the chest, and the duration of the shock, .1 to .3 second, is controlled by a time-delay circuit.

High-voltage DC may also be used. Capacitance-discharge defibrillators supply a 2,000 to 2,500-volt pulse for time durations of less than 20mS. In addition, defibrillators have been synchronised with electrocardiographs for treatment of fibrillation—the device is then similar to the pacemaker.

Diathermy (di' ah ther" me): Diathermy employs RF energy to produce heat in the deep tissues of the body. Equipment consists of a high-power RF oscillator whose output is applied to a pair of metal electrodes (insulated to prevent electric shock to the patient). These electrodes, known as applicators, are positioned on the patient's body so that the tissues to be heated are between the applicators; the patient thus becomes the dielectric of a capacitor. Proper choice of size and position of the applicators permits heating of a selected region of the body. Typical frequencies of operation are in the 13-, 27- and 40-MHz bands, but some

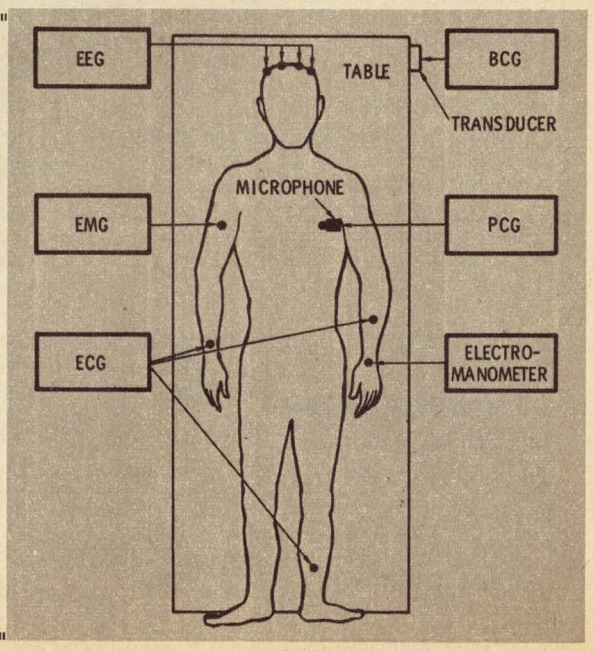
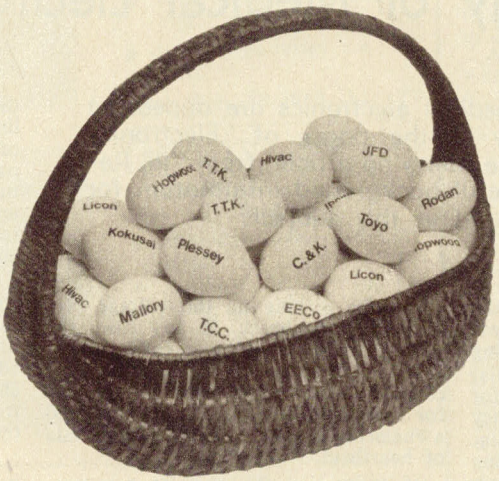


Diagram showing where some of the instruments described in the article are used. EEG records brain voltages; EMG records muscle voltages; ECG records heart voltages; BCG records movement of body when blood is ejected from the heart; PCG records waveforms of heart beats; electro manometer records blood pressure waveforms.

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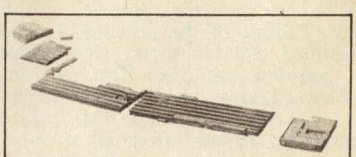
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Electrocardiograph (e lek" tro kar' de o graf): The electrocardiograph (ECG) records the voltage produced by the heart as it alternately contracts and relaxes. This voltage is picked up by means of metal electrodes strapped to the arms, legs, and chest of the patient. At the electrodes, the voltage is approximately 1 millivolt peak and must be amplified to a level sufficient to drive a recording pen which writes on a paper chart. The amplifier must have excellent low-frequency response because the input pulses from the electrodes have a basic frequency of approximately 1Hz (the heartbeat rate). For this reason, ECG amplifiers generally employ either direct coupling or capacitive coupling with relatively large values of capacitance — 2 to 10uF.

Although the low-frequency response of the ECG amplifier must extend below 1Hz, high-frequency response is not critical. Few electrocardiographs (including the pen mechanism) will respond above 100Hz, and response may be deliberately limited to less than 50Hz, to attenuate stray pickup from the power lines.

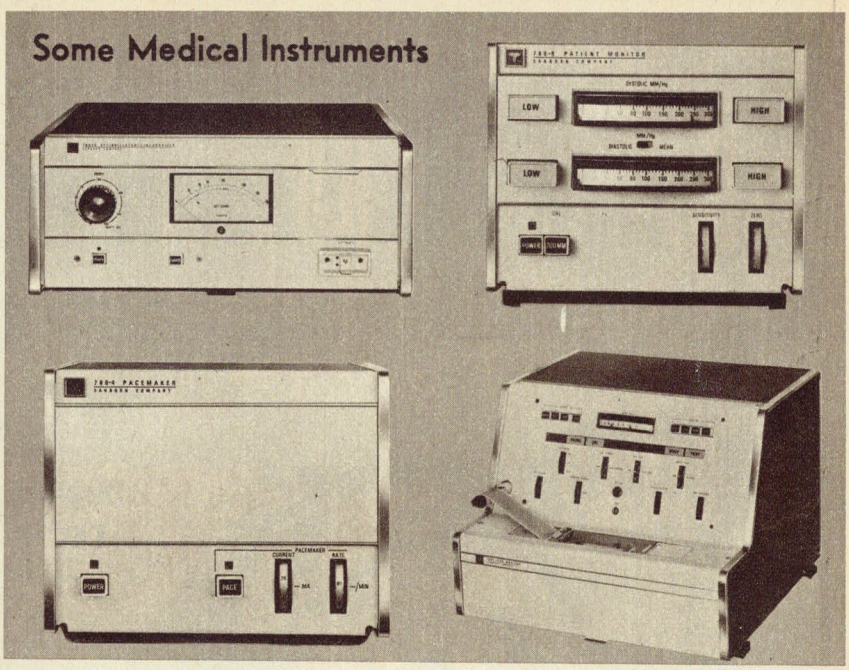
The recording mechanism is essentially a D'Arsonval movement fitted with a lightweight pen instead of the usual pointer. The pen writes on a long paper chart pulled through the machine by a constant-speed motor.

Electroencephalograph (e lek" tro en sef' ah lo graf): The electroencephalograph (EEG) records the electrical activity of the brain. Like the electrocardiograph, this instrument consists of a high-gain amplifier and a pen-type recorder. The brain-generated voltage is picked up by small metal electrodes on the surface of the scalp. The waveform is roughly sinusoidal and the amplitude at the electrodes is in the microvolt region. The dominant frequency component, known as the **alpha** rhythm, is approximately 8 to 12Hz.

Research and clinical electroencephalographs are multichannel instruments to permit simultaneous recording from different areas of the scalp. Typically, the instrument consists of eight identical amplifiers feeding eight recording pens. All pens write on the same (wide) chart so that the waveforms are recorded in correct time relationship.

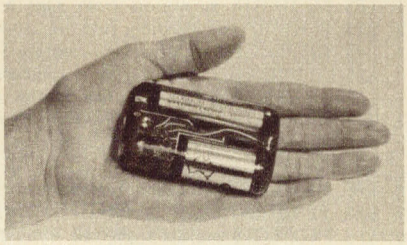
Electromanometer (e lek" tro man om' e ter): The electromanometer is a pressure-recording device. A typical instrument employs a transducer such as a strain gauge for sensing variations of pressure. The transducer is mounted in a hypodermic syringe which is inserted into the blood vessel whose pressure is to be monitored. The strain gauge varies in resistance according to pressure changes and is connected in a bridge circuit. The degree of unbalance of the bridge then varies according to pressure changes. Output of the bridge is amplified, and the resulting waveform is either displayed on an oscilloscope or applied to a pen-type recorder. Some electromanometers employ surface-type transducers such as capacitor microphones for measuring pulse pressure.

Electromyograph (e lek" tro my o graf): The electromyograph (EMG) records the electrical activity of muscle. A needle-shaped electrode is inserted into the muscle to be studied and picks up the voltage pulses produced when the muscle fibres contract; these pulses are amplified and displayed on an oscilloscope. (Pen-type recorders do not have the frequency response generally required for electromyography.) Most electromyographs include an audio amplifier and loudspeaker to make the muscle pulses audible. To the trained diagnostician, these sounds are as meaningful as waveforms on the oscilloscope.



TOP LEFT: A typical defibrillator for applying a DC pulse to the heart. BOTTOM LEFT: A cardiac pacemaker for surgery use. TOP RIGHT: Blood pressure monitor arranged with high and low level limit alarms. BOTTOM RIGHT: A monitoring array which includes electrocardiograph and pacemaker.

Oximeter (ok sim' e ter): The oximeter is a device for measuring the oxygenation of the blood. The blood sample is placed between a light source and a photocell, and the light transmitted through the sample is a measure of the oxygen content. Output of the photocell is amplified and displayed on a meter. Some oximeters employ an ear-clip so that measurement can be performed without drawing a sample of blood. The ear-clip contains a miniature light bulb and photocell to measure light transmission through the ear lobe.



A chest-mounting type of cardiac pacemaker of advanced design, developed and made in Australia. It uses a specially designed integrated circuit, and is powered by mercury cells with an estimated life of about four to six years.

Pacemaker: The pacemaker is a pulse generator used for restarting the heart after a condition of standstill (cardiac arrest) has occurred. By means of electrodes placed on the chest, or directly on the heart during surgery, pulses of current are passed through the heart at regular intervals. Each pulse causes the heart muscle to contract, restoring normal heartbeat. The pulses are 1 to 2 milliseconds in duration and are variable in repetition rate from approximately 20 to 200 pulses per minute. A few heart patients require continual electrical stimulation, and miniaturised pacemakers are implanted surgically in their bodies.

Phonocardiograph (fo" no kar' de o graf): The phonocardiograph (PCG) records the waveforms corresponding to the sounds produced by the heart. The sounds are picked up by a microphone held against the chest, and the signal is fed to a high-gain, low-noise amplifier. Amplifier output is either displayed on an oscilloscope or is applied to a pen-type recorder. A headset or loudspeaker is also included for aural monitoring of heart sounds.

The waveforms recorded by the phonocardiograph convey diagnostically useful data not obtainable by use of the ordinary stethoscope. The acoustical stethoscope (and the doctor's ears) does not respond to many important heart sounds, which are low in both frequency and intensity.

Crystal and capacitor microphones are often employed in phonocardiography. In a variation of the basic technique, a subminiature microphone can be pushed through a blood vessel until it is inside the heart. This permits monitoring of sounds within the chambers of the heart, and these sounds can be interpreted in terms of blood flow, valve action, leakage, or other desired information.

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DIGEST

U.S.A.'s TAX RECORDS ARE FULLY COMPUTERISED

For two years now, all business and individual returns from across the United States have been fed into the automatic data processing system of the International Revenue Service. According to tax experts, there will be only one way of not paying taxes in future — to have no income at all.

The heart of Internal Revenue's ADP for maintaining taxpayers accounts is the National Computer Centre in Martinsburg, West Virginia. Connected with it are seven regional data-processing service centres. These regional service centres receive the tax returns from Revenue Service district offices and then carry out preliminary processing and verification, and convert data to magnetic tape. The tapes are then transmitted to the National Computer Centre for the final, consolidated operation.

Here is the way the computer system works for return of individual taxpayers.

The taxpayer files his returns with his district director of Internal Revenue. This office checks the return for completeness, detaches, accounts for, and deposits payments. The return is then sent to the appropriate service centre. At a service centre, after mathematical verification, data from the return is transferred to punched cards, and then converted to magnetic tape. Tapes are sent to the National Computer Centre, and there data is recorded in the individual taxpayer's account, and matched against information in the central record. This latter would include informational return data covering payments to the taxpayer, such as wages, dividends and interest which are reported by the paying organisations to the Revenue Service.

As the current data on tapes is fed into the computers, the new tapes are produced for use in preparing refunds, bills, or other statements to the taxpayer. The machines can also be programmed to identify returns with characteristics that may warrant a closer look by Revenue Service auditors.

Business tax returns are handled in much the same way. One of the essentials of such a system is a positive method of identification of each of some 80 million taxpayer accounts. Names alone are not enough, because of the millions of similar names, and thousands of identical names, that exist throughout the country.

It was determined that a combination of name and a permanently assigned account number was the answer. Since most taxpaying individuals already had a Social Security number, and procedures for issuing such numbers already existed, it was decided to use this system for tax account numbering also.

With ADP, the Internal Revenue Service can be sure that all required returns are filed. This applies particularly to detecting filing delinquencies. Robert L. Jack, Assistant Commissioner of the Internal Revenue Service, gives an example for such a proceeding. In one year, the master file system identified 1.2 million potentially delinquent business returns. Of these, one-half million proved actually delinquent —a tax potential of over $100 million.

In the individual income tax area, he said, experience has been inconclusive, due to the magnitude and movement of population. But the tax authorities have learned one thing: thousands of taxpayers, by not filing tax returns, have deprived themselves of refunds to which they are entitled. Now that all taxpayers are covered, computers and taxpayer account numbers will guarantee an effective check on non-filing of tax returns.

Now, after installation of complete ADP, the Internal Revenue Service is looking ahead to the computer system of the 70s. They have confidence that the versatility of ADP can meet the changing needs of the American tax system.

The reason for this confidence is that computers have such an unlimited capacity to accommodate expansion of workload and a vast potential to absorb innovations in processing. A still greater efficiency of the computer system will continue to have a great impact on the tax world.

Mr Jack saw progress in these important areas as:

High-speed retrieval of information from the master file;

Expanded use of photographic equipment as a means of relieving paper retention needs;

Simplified tax reporting, with the Service providing assistance to the taxpayer in preparing his return from information furnished by the taxpayer and from his sources of income; and

The desposit of taxes through the nation's banking system, with prompt transfer of records of such transactions into the computer network of the Internal Revenue Service. ("Electronics Weekly," 15/10/69.) ■

MAGNETIC "BUBBLES" FOR COMPACT DATA PROCESSING

Minute magnetic "bubbles" may provide compact and inexpensive data-storage and processing for computer and telephone switching systems.

The "bubbles" — locally magnetised areas that can move about in thin plates of magnetic material — are the basis of a new technology being explored at Bell Telephone Laboratories.

Bell scientists have long sought a new technology to make possible low-cost low-power all-digital data-processing and switching. In present computer and communications technology, connections between electronic components are a major factor in costs. In the new technology, the bubbles can be created, erased and moved any where in thin sheets of magnetic materials without interconnection. They may interact with one another in a controlled fashion and their presence or absence can be detected. Therefore devices employing the new technology could be made to perform a variety of functions — logic, memory, switching, counting — all within one solid magnetic material.

The energy needed to manipulate the bubbles can be applied either by current-carrying conductors or picked up from a surrounding magnetic field by microscopic ferromagnetic antennae in printed patterns distributed over the surface of the material. The bubbles may be controlled either by programming electric currents in an overlayed pattern of conductors, or — with no connecting wires — by controlling the surrounding magnetic field.

Stepping-stones to the new technology are the orthoferrites, magnetic materials composed of rare earth iron oxides; they were grown as crystals first at Bell. When a magnetic field of a critical value is applied to an orthoferrite, bubbles — almost perfectly cylindrical magnetic domains — are formed. These bubbles can be moved at high speed in the plane of the sheet of the orthoferrite material. As the bubbles are moved into precisely defined positions, their presence or absence at different positions can represent binary numbers.

Bubbles of a size corresponding to only a few wave-lengths of light can be manipulated. These lead to memory densities of about 10^6 bits/in^2. The energy required to move (or switch) such a bubble is minute — a fraction of that needed to switch a transistor. One experimental device using the bubble technology is a shift register, a component widely used in data-transmission equipment and computers for temporary storage of binary digits. Data rates of 3Mbit/s have been demonstrated.

Only a few processing steps are required to realise its simple structure, and devices of very low cost are anticipated. ("Design Electronics," November, 1969.) ■

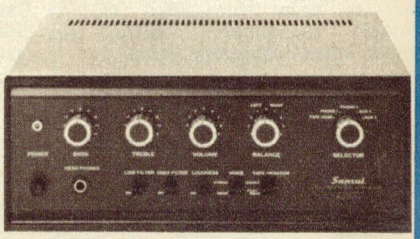
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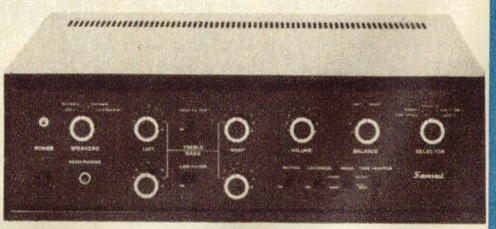
SANSUI MODEL
AU 222
– 46 WATTS

Using low noise silicon transistors throughout, the Model AU-222 features a frequency response of 20-30,000 Hz. ± 1dB. and a power output of 46 watts (music power). Input sensitivity suits magnetic cartridges at 2 mV. Performance of this compact stereo amplifier is quite outstanding and every desirable control is incorporated. List price is $180 Inc. sales tax.



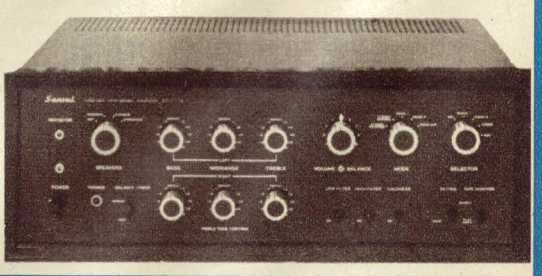
SANSUI MODEL
AU 555
– 60 WATTS

Total music power is 60 watts and frequency response is 20-80,000 Hz ± 1 dB. Input sensitivity suits magnetic cartridges at 2 mV. Advanced circuitry is employed — low noise silicon transistors are used throughout. Controls are extremely flexible — audio quality is superb. List price is $217 inc. sales tax.



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SCIENTIFIC AND INDUSTRIAL NEWS

Compressing radar signals

Elliott-Automation Radar Systems Ltd., of the U.K., has developed an electronic equipment, called Electra, which compresses radar signals into sequences of simple pulses which can be transmitted over ordinary telephone lines. Using this system, the Royal Netherlands Air Force is sending radar pictures of clouds and rain approaching the northern Dutch coast along 55 miles of telephone line. The whole operation is controlled from a weather centre, and the radar itself is unmanned. The radar operates in any of six modes selected remotely by push-buttons at the weather centre.

A height-finding radar has been modified to observe cloud and rain up to 160 miles out at sea, to scan it horizontally and vertically at various rates, and to plot contours of constant rain intensity (iso-echo contours). The Electra terminal gathers sequences of related returns into a store, averages them, and feeds the groups at reduced speed (and therefore reduced band-width) into the line. As soon as transmission begins, further stores gather the next groups of radar signals. The process not only compresses the radar information, but also eliminates some of the radar receiver noise and thus improves the quality of the signal. The iso-echo contour processing is applied after compression, so this function is also improved. At the weather centre, the Electra terminal reconstitutes the radar picture on a conventional display tube. (Elliott-Automation Radar Systems Ltd., Airport Works, Rochester, Kent, England.)

Satellite navigation

The U.S. Navy has made its Navy Navigational Satellite System (N.N.S.S.) available for commercial use. It currently maintains four satellites in polar orbits, and operates tracking stations and a computer centre. A satellite's position is determined by data transmitted anywhere in the world when the satellite is in view. The vessel then determines its own latitude and longitude using the Doppler principle to establish the relationship between itself and the satellite. The N.N.S.S. can fix a ship's position to an accuracy of 600ft almost instantaneously. By comparison, celestial navigation using a sextant is accurate to within two miles on dead reckoning with an expected error rate of 1 per cent of the distance travelled.

An electronic teleprinter, made by N.C.R.'s Military Division, provides the shipboard operator with a visual check on the data which his receiver is supplying directly to the ship's computer. In some cases, the device can be used to print numerical data which is later fed to the computer. The printer uses N.C.R.-developed thermal-printing techniques. Controlled heat is generated in a thin-film conductor which is in contact with thermochromic paper in tape form. Specially developed chemical compounds in the paper change colour when a certain temperature is achieved, thereby producing a print. Thermal-printing systems require only a single moving part—the paper advance mechanism. All basic machine functions are controlled by solid-state circuitry. The printing is non-impact, noiseless and free of RF interference. (National Cash Register Co. Pty. Ltd., 14-16 York Street, Sydney, 2000.)

Film processing

At the motion picture processing laboratories of the Rank Organisation in the U.K., a punched-tape controlled additive colour printer uses dichroic filter separation in scene-to-scene colour correction on film prints. The pre-punched control tape offers up to 50 automatic light changes in each colour channel. Film makers in 42 countries send more than four million feet of film to the laboratories each week for processing. At another laboratory of the company, colour news film is processed and ready for transmission within 35 minutes of being received from the cameraman. (The Rank Organisation, Denham, Mddx., England.)

A technician checks the control tape feed to the additive colour printer.

Monochromaticphotoheliocinematograph

A device, used for the daily monitoring of the sun as part of the National Aeronautics and Space Administration's Solar Particle Alert Network, has been given the name "monochromaticphotoheliocinematograph" by the Lockheed Electronics Co. It includes an optical telescope and a television monitor, and is used at Houston, Texas to watch the sun while astronauts are on a mission. With other scientists around the world, the Lockheed staff are watching for solar flare activity that might produce hazardous radiation. Technicians operate both the optical telescope and the radio telescope on the site of NASA's Manned Spacecraft Centre. Data from these instruments are fed into a teletype connected to Mission Control Centre. Every 10 seconds while the sun is shining, the solar image is recorded on 35mm film. Each day's record can be shown as a motion picture.

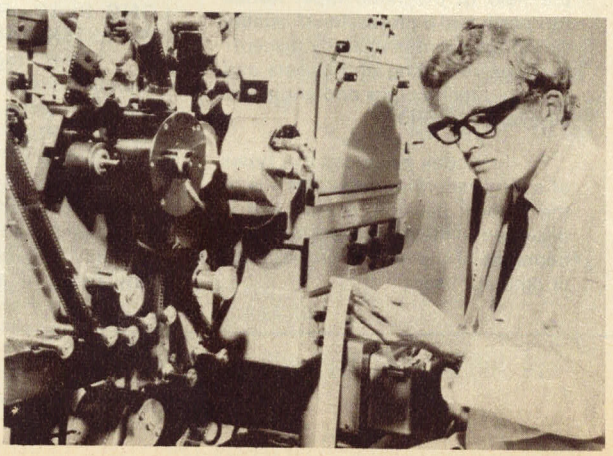
Spanish colour TV

It has been announced that Spain is to have colour television in 1971, using the PAL system. This system is considered to be more suitable for Spain's rugged terrain than other colour TV systems. As a trial, Spain transmitted the recent Eurovision Song Festival in PAL. The quality was said to be excellent. Initially, colour programs will be transmitted on the country's second network, while the first network continues in black and white. Consideration will be given to extending colour to the first network when the second network has reached a transmission average of 30 or 40 hours. Portuguese television has also declared officially its intention to use the PAL system when it commences colour transmissions.

765KV autotransformer

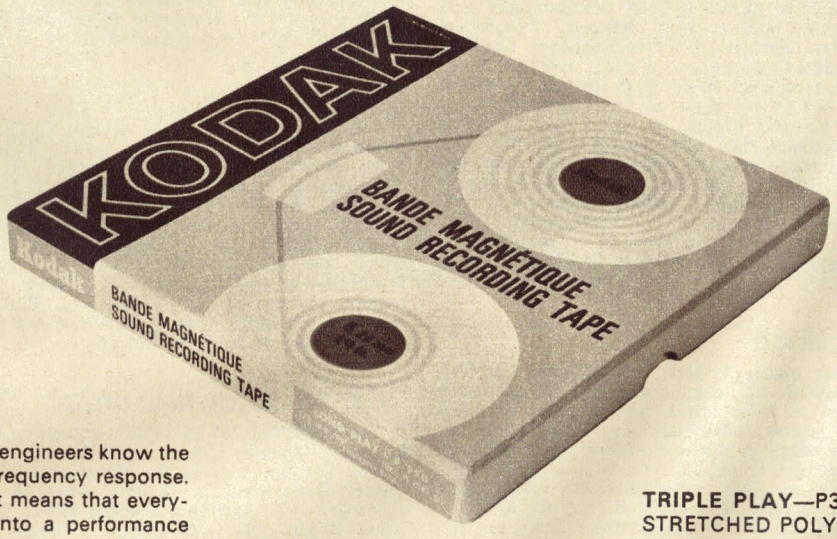
A 500MVA, 765 to 345KV autotransformer is now installed in West Virginia, U.S.A., after having successfully passed intensive in-plant tests at the Westinghouse Large Power Transformer Department in Indiana, where it was built. The unit, ordered by the American Electric Power System, is now undergoing 12 months' field testing. Design verification, prior to manufacture, was accomplished through the use of an electromagnetic model and electrostatic field plots.

An electromagnetic model used in the design of any large transformer consists of a ½ or 1/5 scale reproduction of the unit to be investigated. The individual coil inductances are proportionally the same as those in the full-scale transformer. Proportionate coil-to-coil, coil-to-ground, and other capacitances are calculated and properly located within the structure so that the electromagnetic performance of the model duplicates that of the full-size unit. Voltage oscillations which may occur in the windings of the full-size transformer, under varying conditions, are monitored by use of voltage test connections in the electromagnetic model.



a nice flat response

Kodak Sound Recording Tape



Sound engineers know the value of a flat frequency response. In plain terms, it means that everything you put into a performance comes out on the tape. Kodak has gone flat out for it in producing Kodak Sound Recording Tape, and set new standards in recording tape manufacture. That's what you'd expect. Kodak has a unique knowledge of coating techniques, gained through over sixty years experience in making photographic film.

Turning this knowledge to the field of magnetic tape, Kodak has produced a professional-quality sound tape that is used by discerning tape-recording enthusiasts and informed technicians and engineers all over the world.

Kodak produces five types of sound recording tape. Each is of the highest possible quality and is designed to meet the most stringent demands of the critical professional or amateur user.

Whichever tape recorder you use, whatever your speed or editing requirements, you will be certain to find a Kodak tape that will give you outstanding, and consistent, results.

STANDARD PLAY—P100 POLYESTER BASE

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Has the same acoustic characteristics as P100 with a useful 50% extra playing time.

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The world's first quadruple play tape. Designed for use on small battery-driven recorders.

For further information, contact Motion Picture & Education Markets Division,

Kodak

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K2150

Cassette video player

Sony Corporation, of Tokyo, Japan, has introduced a video tape play-back device, the "Color Videoplayer," which uses magnetic video tape techniques with a tape cassette called "Videocassette."

The device is essentially a replay machine intended for use with prerecorded tapes. It is not a recorder in its basic form. The player can be connected to any standard (N.T.S.C.) colour television receiver, without modification to the set, to reproduce colour pictures with sound. It may also be used with a black-and-white TV receiver. The system could provide educational or entertainment colour video programs in remote areas, on ships at sea, and even in countries where television broadcasting is not available.

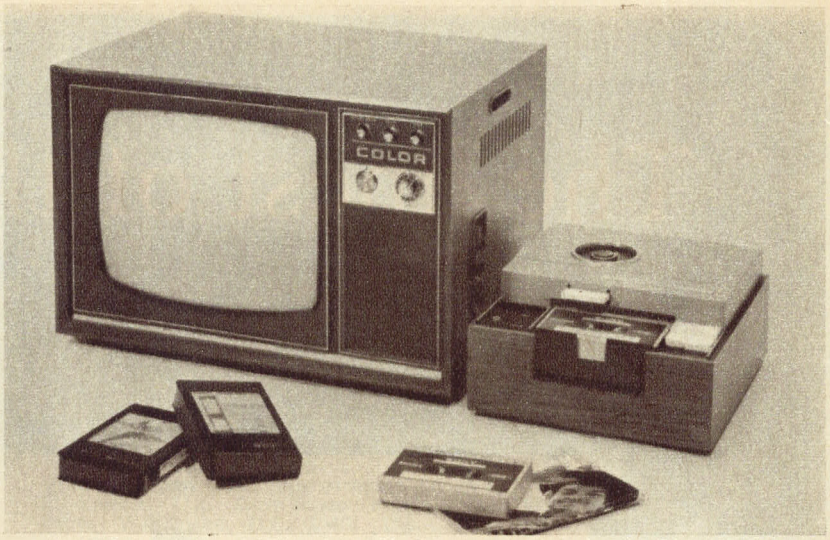
A Videocassette measures 8in x 5in x 1¼in thick, weighs 1lb, and provides a 90-minute program. Videocassettes can be loaded and unloaded very easily in a manner similar to an audio cassette. A program can be stopped at any point, the cassette removed without rewinding, and replaced by another cassette. Upon reinserting the removed cassette, its program can be continued from the point of interruption.

The Videocassette has two sound tracks. These may be used to provide stereophonic sound or, in the case of a foreign language program, narration in two different languages.

After a customer has finished with a program the Videocassette can be returned to the program supplier and exchanged for a new program. Most of the customer's expense for Videocassettes will be for the programs. The program fee can be charged according to the number of times the program is played, since each Videocassette has a built-in counter to indicate the number of playing times.

By attaching a simple adapter, it will be possible to record television programs from the air, in colour or black-and-white, on a Videocassette at home.

To create a Videocassette library for a wide variety of programs, Sony intends to make its facilities available to the motion picture industry, TV networks, music recording companies, publishers, educational institutions and sports promoters, to transfer their programs to Videocassettes. Sony believes this will create a new way for these industries to sell programs to the public. The largest movie producer in Japan, Toho Co. Ltd., has already indicated its intention to make films available to Videocassette libraries.



A Sony Color Videoplayer next to a 19in colour TV receiver with a Videocassette in front.

The Sony Company expects the ultimate price of the Color Videoplayer to be as low as $350 in the United States, and the ultimate price of the recording adapter to be $100.

Sony Corporation is represented in Australia by Jacoby, Mitchell and Co. Pty. Ltd., 469-475 Kent Street, Sydney, 2000.

Electronics courses

Beginning in March, 1970, the Division of Postgraduate Extension Studies of the University of New South Wales is to present two electronics courses.

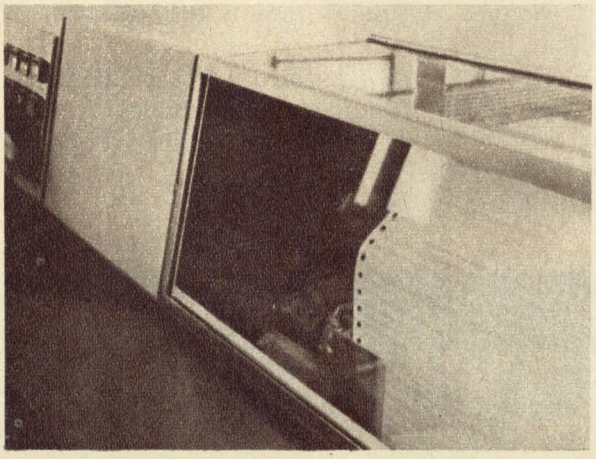
One course, entitled "Industrial Electronics," will consider the application of electronic power control and digital techniques associated with speed control systems and drives. The course is expected to be of particular interest to plant engineers and project personnel. It will consist of eight radio lectures, to be broadcast over Radio University VL2UV, and two seminars using Television University VITU. Tape recordings of the lectures are available where a class or group wishes to enrol, or for people beyond the range of the broadcasts.

The other course, "Introduction to Electronic Data Processing and Information Systems," will consist of 10 lectures over Television University VITU. The general aim is to provide students with a useful appreciation of electronic computers and their applications in the field of commerce. There will be considerable attention given to the basics of the subject. A short resume of the historical development of computers will lay the groundwork for a study of computer hardware. An elementary computer will be described in basic non-technical terms. By writing simple programs, students will be able to control this computer and perform simple calculations.

Further information on these and other radio, television and tape courses can be obtained from the Division of Postgraduate Extension Studies, P.O. Box 1, Kensington, N.S.W. 2033.

Chemical computer programs

A series of four special computer programs, called "Crossbow," has been developed by Imperial Chemical Industries Ltd., Millbank, London, S.W.1, England. It is said to be the first system which enables a computer to print out structural chemical formulae. Known substances are coded and fed into a vast data store. From this chemists can retrieve all chemicals on the file that have certain factors in common, then have them translated into chemical structures at the rate of 100 per minute. The computer process is varied according to the question being asked. The programs can be used in any computer with adequate capacity and a slightly modified line-printer. ICI plans to offer the set of programs to manufacturers, universities, research and other organisations throughout the world for about $13,000.



Lunar roving vehicles

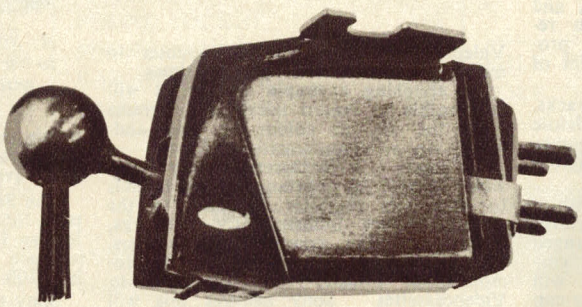
The Boeing Co. has been awarded a contract by the National Aeronautics and Space Administration to design, develop, test and deliver four flight-qualified lunar roving vehicles and related test and training equipment. The four-wheeled vehicles will be carried to the moon aboard the descent stages of the Apollo spacecraft lunar module on flights planned in the 1971-72 period. Each lunar rover will provide transportation on the moon for two astronauts and equipment for the collection of lunar samples and performance of other experiments.

Seaway navigation

Ships on the St. Lawrence Seaway in Canada are now under the control of a computerised marine navigation system, designed and supplied by the Canadian branch of the Decca Radar Co. It provides marine traffic controllers at Quebec with a 33ft long map of the Seaway on which coloured markers, representing ships, move in accordance with the ships' progress. The system helps to speed traffic in the St. Lawrence as controllers no longer have to hold up ships while they find out if it is safe for them to proceed.

Ships identify themselves and report position, course and speed by radio. This information is fed into the computer which calculates the positions of the ships and automatically moves the markers. Each time a ship reports a new position, course and speed, this information is fed to the computer which corrects its estimates.

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Hungarian conference

The 3rd Conference on Magnetic Recording to be held in Budapest, Hungary, will be held from 8 to 12 September, 1970 instead of from 12 to 15 August as originally announced. (See "Electronics Australia," November, 1969 page 41.) This change has been made by the Hungarian Optical, Acoustical and Filmtechnical Society to enable participants to attend another meeting — the International Conference on Magnetism, to be held in Grenoble, France from 14 to 19 September, 1970 — the topics of which are related to the Hungarian Conference. (Hungarian Optical, Acoustical and Filmtechnical Society, Budapest V, Szabadsag ter 17, Hungary).

Telecommunications film

A graphic colour film of the Australian telecommunications industry is being shown throughout the country during the early months of 1970. It will also be shown in New Zealand and the Pacific Islands. The film, sponsored by the Australian Telecommunications Development Association, has three objectives: to give the general public a better appreciation of the industry; to convince the Government of the expertise of the Australian telecommunications industry and its ability to manufacture equipment comparable to the world's best; to show the diversity of products manufactured in Australia and exported to the world markets.

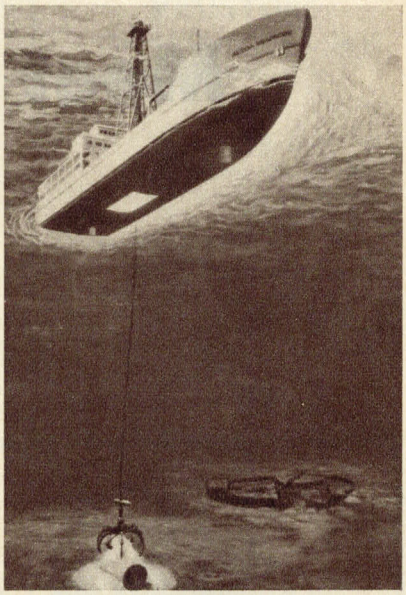
The film crew travelled to the Hamersley and Mount Newman mining projects in Western Australia to film the large privately-owned telecommunications systems which connect the mining sites with the coastal townships and control the mile-long ore-hauling trains. Sequences of the film show electronic devices used in satellite-relayed communications, and the tracking of space vehicles from earth stations at Moree and Honeysuckle Creek. The film shows the manufacture of microelectronic devices and of crossbar switching equipment for telephone exchanges. Other items include an improved instrument landing system at Mascot Airport, the automatic Telex network, the Datel service (data transmission to and from computers), and mobile communications using transmitter-receivers.

Music-controlled lights

The heart of the Christmas decorations in Melbourne was a Chromasonic Control System. This is an electronic device somewhat similar to, but very much larger than, the "Musicolour" described in "Electronics Australia" for October, 1969. It controls coloured lights in such a way that they respond to various musical notes. In this installation there were five channels each controlling a different colour. The control signals can be derived from almost any sound source: in this particular display, the lights were made to conform to a regular pattern lasting several minutes by sounds on an endless tape loop.

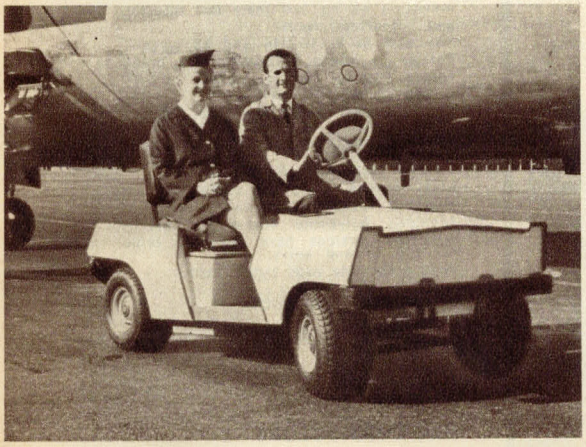
The decorations, organised by Stan Ostoja-Kotkowski, took the form of a "Star of David." The display had a total of 2,400 lamps and extended from the 10th to the 20th floors of the building. Total power consumed when all the lamps were on was 90KW, equal to the power consumed by three floors of the building during normal office hours. The system was built by Storr Electronic Enterprises, 36 Elizabeth Street, Torrensville, S.A. 5031.

Search vessel



The "Alcoa Seaprobe" is an all-aluminium 244-foot vessel being built for Ocean Search Inc. (a joint venture of Aluminium Company of America and Ocean Science and Engineering Inc.) When completed in 1971, the ship will be able to hold its position in rough seas; to search, core and sample mineral deposits on the sea floor; to locate and retrieve heavy objects more than a mile beneath the surface; and to carry out other research and oceanographic explorations.

Electric-powered vehicles

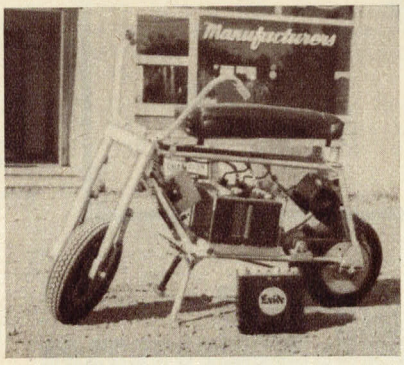


LEFT: An electric runabout in use at Sydney Airport.

BELOW: An electric motorcycle outside the manufacturer's premises.

A battery-powered electric car, used for mail collection at Mascot Airport, Sydney, is the first of a range of Westinghouse (U.S.A.) vehicles to be marketed in Australia. Initially they will be imported, but Australian manufacture is planned. The two-passenger vehicle, on loan to Ansett Airlines, covers about 15 miles daily in intermittent stop-start service between 6 a.m. and 11 p.m., with overnight battery charging. (Email Ltd., Joynton Avenue, Waterloo, N.S.W. 2017.)

A small electric motorcycle, manufactured in Australia, has been designed for such duties as in-plant transport for maintenance personnel, supervisors, and night watchmen. Range is 35 miles at 6mph or 15 miles at the top speed of 18mph. Power is from two 12V 40AH lead-acid batteries. The manufacturers have developed their own high-speed electric motors and 2-speed, no resistor, low loss control system — which are available to other companies for similar applications. The overall operating cost is said to be well below other forms of powered personnel transport. (Doring Electrical Industries Pty. Ltd., Pacific Highway, Taree, N.S.W. 2430.)



Radiocommunications

The International Telecommunication Union (I.T.U.) is to organise the Second Symposium on Space and Radiocommunications to be held in mid-1971. The exact date of the Symposium will be announced later, but it is expected to be held during the 29th International Air and Space Show to be held in Paris, France, from May 7 to June 6. This is then followed by the Second World Conference of Space Radiocommunications which will meet for six or seven weeks beginning on June 7. All who are interested in attending the Symposium are requested to write to: Monsieur le Secretaire General, Union Internationale des Telecommunications, Place des Nations, 1211 Geneve 20, Switzerland.

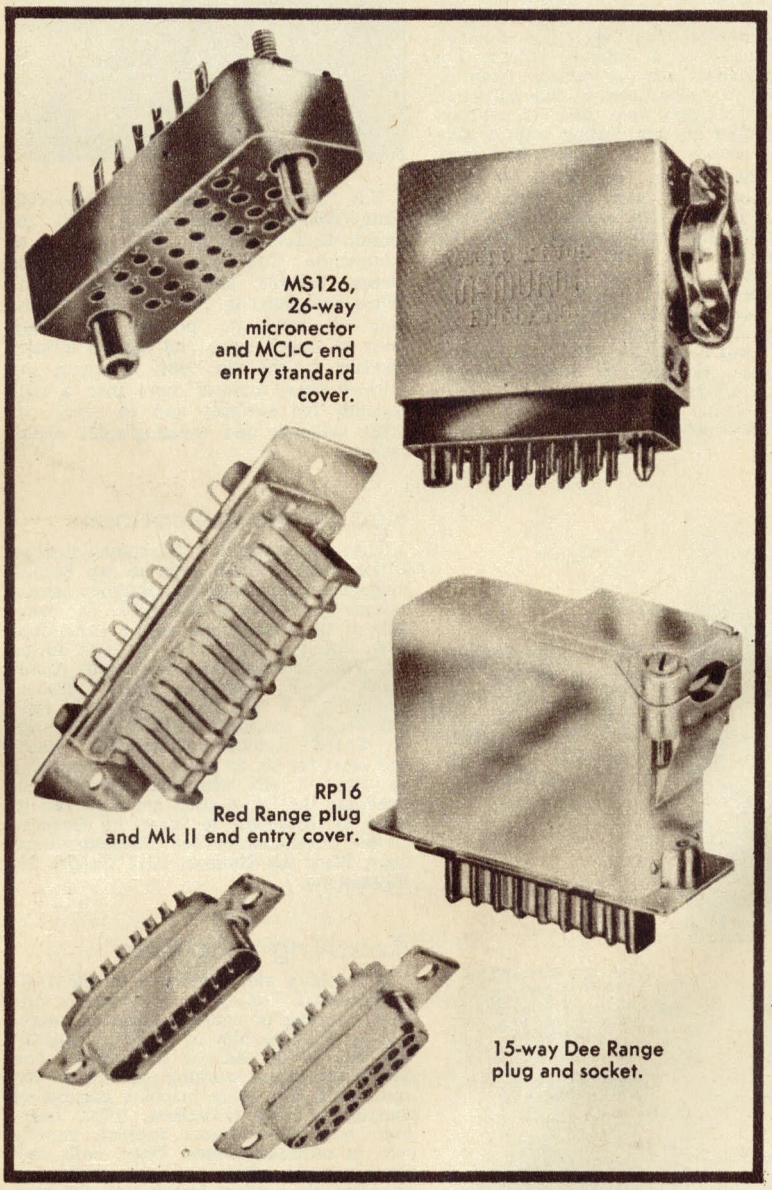
Teaching machines

A teaching aid, developed in the U.K. by Feedback Ltd., gives a student a full understanding of rotating electrical machines by allowing him to construct quickly any one of 30 AC or DC motors and alternators with a working machine as the end result. The tutor machine consists of component parts (baseplate, rotor, bearings, etc.) which piece together rapidly even in unskilled hands. Poles, coils and brushgear are added until the machine is complete, the student learning all the time the role of each component and its effect on machine performance.

Power requirements are 12-20V DC, 135V single-phase AC, and 240V three-phase AC. Shaft speeds vary from very low values up to 3,000rpm according to application. More advanced work involving generators and selsyn systems requires an extra kit or an external driving motor. (Australian agents: Ronald J. T. Payne Pty. Ltd., 385-387 Bridge Road, Richmond, 3121).

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Plug contacts—gold over silver on hard brass.
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Maximum contact resistance—0.0025 ohms.
Current rating per contact—7.5 amps.
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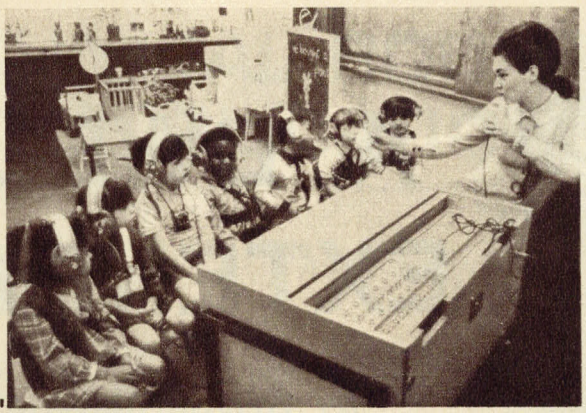
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School for deaf children

Opened recently in London is a day school specially designed for severely deaf children at a cost of $300,000. Each child's own hearing aid can be plugged into a master console in each teacher's desk. The classrooms, hall and playground are equipped to allow the children to hear the teachers speaking through a microphone. Mrs Maryla Lawler, from Melbourne, conducts a "speech" lesson with junior children.



Cryoelectronics research

The National Burea of Standards, U.S.A., has established a Cryoelectronics Section, under the direction of Dr. Robert A. Kemper. The new organisation will consider applications of superconductivity and other low-temperature phenomena to the development of improved techniques and instruments for measuring electrical quantities, including fundamental constants.

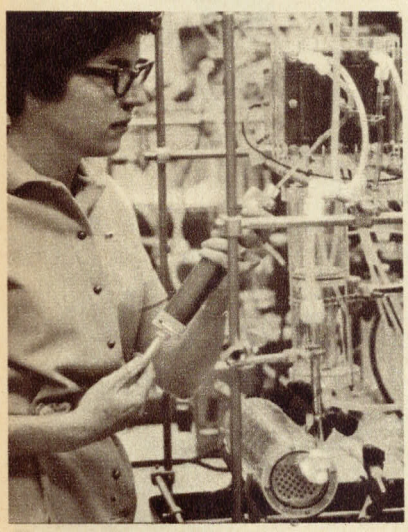
One particularly interesting phenomenon which will be examined is the Josephson effect, which occurs where a weak link is formed between two superconductors. This link can be made quite simply by touching together two pieces of superconducting metal that have been exposed to normal atmospheric corrosion to form a thin insulating layer on the metal. Pairs of superconducting electrons are then able to "tunnel" across the insulating barrier, giving rise to a current with no attendant voltage drop. A unique property is that radiation is emitted at a discrete frequency when a given voltage is imposed on the junction. (National Bureau of Standards, Boulder, Colo. 80302, U.S.A.)

Rocket ignition

Lockheed Propulsion Co., Redlands, Calif., U.S.A., has developed an ignition system which consists of thin strands of wire embedded in the propellant grain of a tactical solid rocket motor. Known as the Exothermic Bimetallic Ignition System (E.B.I.S.), the igniter is simply a predetermined pattern of bimetal strands that may be coupled to a rocket's normal ignition voltage source. During the ignition phase, the E.B.I.S. generates a high localised heat to ignite the adjacent propellant. A number of such igniters located strategically throughout a rocket motor propellant system will establish a large variety of burning patterns to match most performance requirements in present tactical rockets.

Life support systems research

An electrolysis cell that breaks down water into its chemical components of hydrogen and oxygen is still operating after 11 months of continuous 24-hours-a-day testing at Lockheed Missiles and Space Co. of the U.S.A. The experiment is part of the work under a contract the company has with the National Aeronautics and Space Administration (NASA) to design reliable life support components. Besides the oxygen-generating cell, researchers are investigating a technique for generating nitrogen in the same process. Cells generating both gases have operated continuously for over four months without a malfunction. A two-gas spacecraft atmosphere decreases the amount of oxygen needed for a specific cabin pressure and reduces the fire hazard.

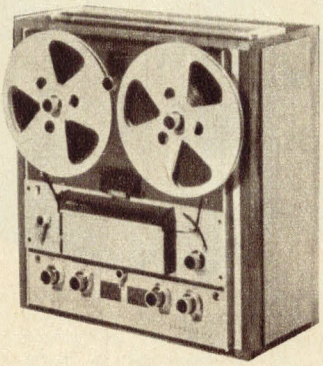


Lockheed life support project leader, Mrs Barbara M. Greenough, takes a gas sample from the electrolysis cell which has been in operation continuously for 11 months.

Another life support contract awarded by NASA to Lockheed is to build a device to process body wastes and produce materials useful for the life support of astronauts on long space journeys. An effective waste management system would eliminate possible contaminants and the hazards of polluting the spacecraft atmosphere; reclaim useful materials; and reduce spacecraft weight.

The Lockheed four-man system is based on a process called wet oxidation. This means that wastes are burned under high pressures in the presence of water, oxygen and steam. Chemicals that might otherwise be harmful are transformed so as to be easily handled by the spacecraft crew and the life support system. Chemical reaction in the system produces largely carbon dioxide, nitrogen and water which can be used by the life support system to provide water and a breathable atmosphere for the crew. Chemicals such as sulphur and phosphorous emerge from the system as salt compounds in the water and are easily removed as the water progresses through the life support system. In other waste incineration methods, the sulphur and phosphorous emerge in oxide forms which can contaminate the spacecraft. ■

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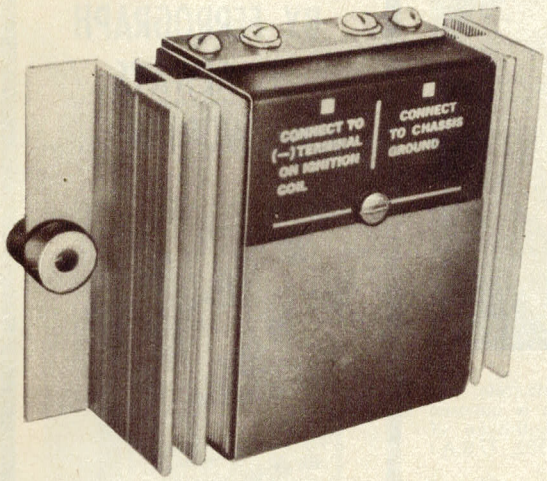
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A simple electronic assist for auto ignition systems:



A DWELL EXTENDER

*By George Meyerle**

Many schemes have been proposed in the last ten years for improving electronically the efficiency of the ignition system of the internal combustion (automobile, boat, etc.) engine. Such proposals, whose basic purpose is to improve overall performance and reduce fuel consumption, are all based on the principle of increasing the spark energy at high engine speeds (see panel, opposite page).

Many of these spark improvement systems have value—whether they are simple switching transistors or elaborate, relatively complex capacitive-discharge circuits. Unfortunately, they also have varying disadvantages of some type. Most involve a fair outlay; some draw much heavier current from the electrical system. Some present a major roadside problem in reverting to the original system if the electronic assist should fail.

The "Dwell Extender" described here increases spark energy at high engine speeds by lengthening the dwell time electronically and requires only two connections to the existing system. The patented circuit, shown in figure 1, can be used in any car or boat with a negative ground. It can be installed or removed in a matter of minutes and is applicable to any number of cylinders, provide a coil-and-breaker-point system is used. It cannot be used on engines having a magneto ignition or a positive-ground.

What can be expected of this unusual system? Truthfully, not very much if you have a new car that is properly tuned up and if you don't drive at high speeds. However, if your car has a lot of mileage on it and you want additional "zoom" for passing or accelerating on a hill, the Dwell Extender can provide an improvement in your car's performance.

The use of this system in your car will also save you some petrol due to more efficient burning; and you will find that problems resulting from worn points are reduced, since they no longer

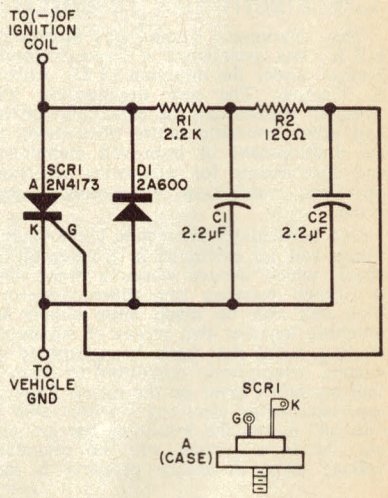


Figure 1: The circuit diagram. Be sure to use the components specified or similar so that the finished device can withstand both engine-space heat and any switching transients.

*The article is reproduced by arrangement from "Popular Electronics."

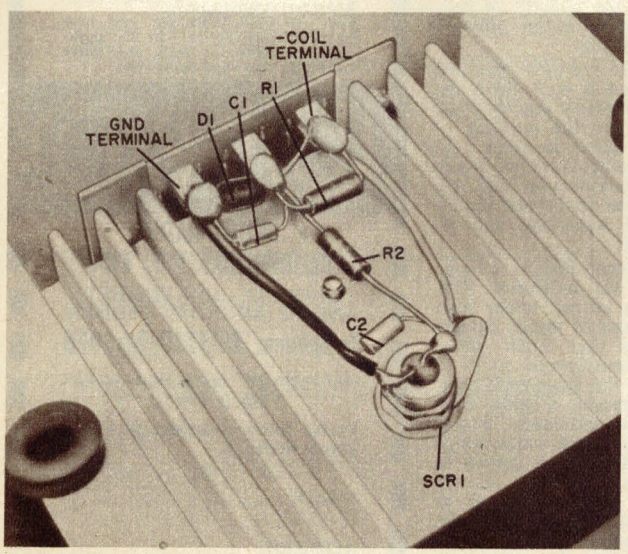


Figure 2a: Install the SCR so that it is completely insulated from the metal heat sink. Mount a large solder lug between the case and insulator to make the anode contact. All wiring is point to point.

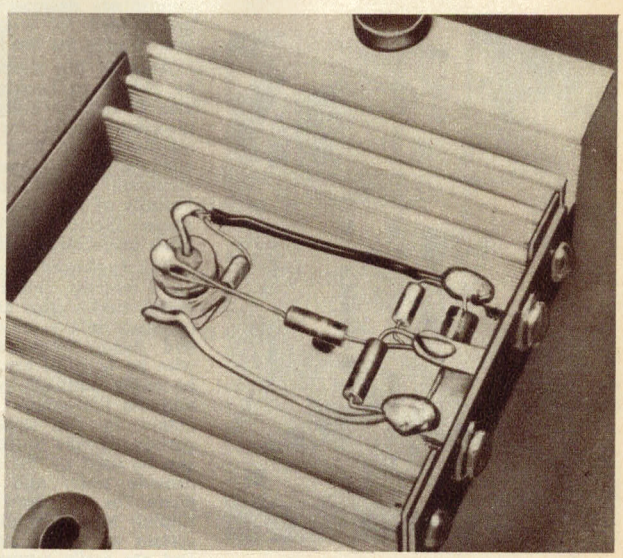


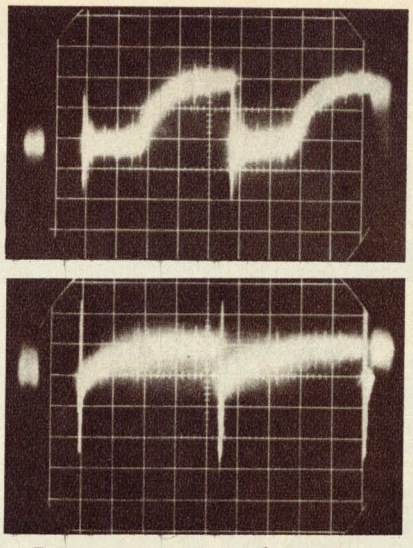
Figure 2b: The three-screw terminal is mounted on a U-shaped cover that snaps over the heat sink. Remove centre screw and cover the outside hole with tape. Use the lug for wiring support only.

play such an important part in the ignition system. Spark plugs will last longer due to reduced fouling and burning.

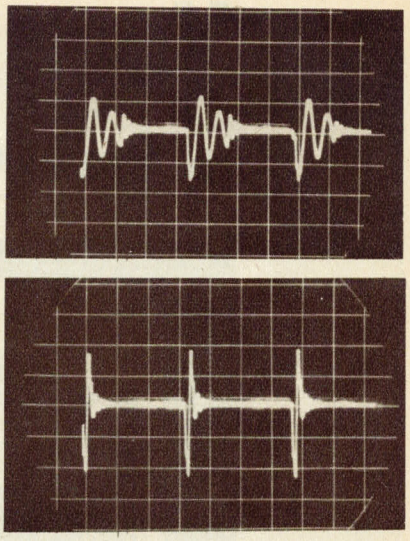
Operation: When the points are closed, the Dwell Extender circuitry is shorted out, so that the SCR is non-conducting. During this time, current through the closed points and through the coil builds up the magnetic field. When the points open, the back EMF from the collapsing field around the secondary induces a voltage high enough to fire the particular plug. To this juncture, the cycle of events is identical to that described for the basic Kettering system.

However, with the Dwell Extender in circuit, the instant the points open, the positive voltage from the battery is applied directly to the anode of the SCR and, through an RC network, to its gate. About 1000 microseconds after the points open, the positive pulse reaches the gate, firing the SCR. This closes the primary circuit electronically. Shortly afterward, the points close mechanically.

The end result is that the coil is being charged for almost the entire duty cycle, except for the 100-microsecond break that allows the field to collapse and the plug to fire. The result is that the strength of the magnetic field is increased at the higher engine

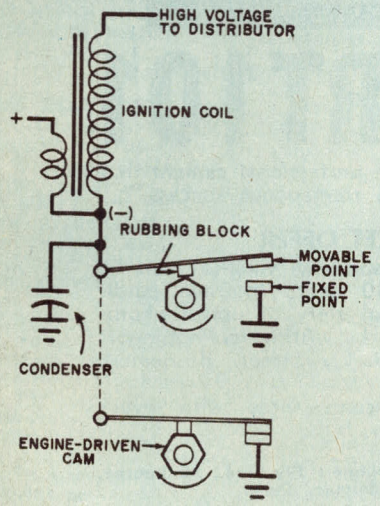


Primary current in the ignition coil without (top) and with (bottom) the Dwell Extender. Calibration is 5mS per division horizontal, and 2.5 amperes per division vertical. Note the longer time that ignition coil current flows using Dwell Extender.



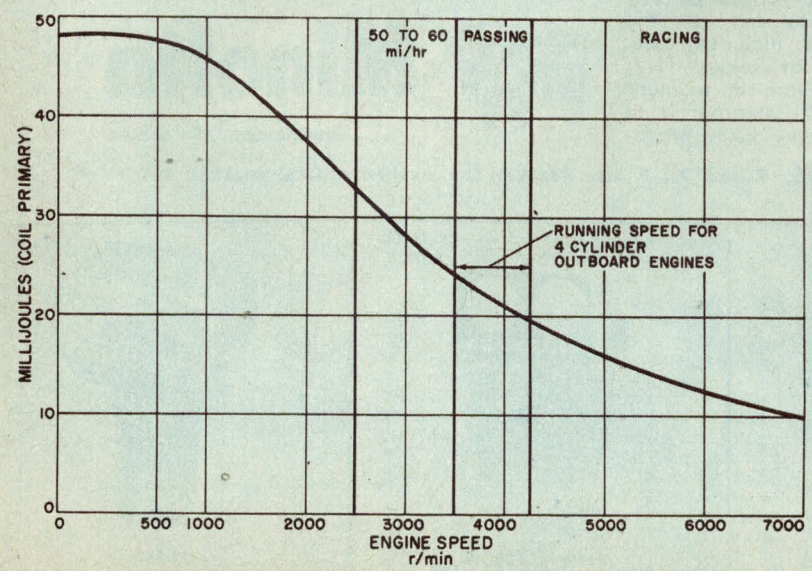
Secondary voltage of the ignition coil without (top) and with (bottom) the Dwell Extender. Calibration is 1mS per division horizontal and 10KV per division vertical. Note the reduced ringing and the higher voltage using the Dwell Extender.

ABOUT SPARK ENERGY



The efficiency of an internal combustion engine depends, in the final analysis, on the mixture of gasoline and air that is introduced into the cylinder and the successful ignition of that mixture by an electrically induced spark. If we assume that the carburettor is doing its job of providing the proper fuel mixture, then obtaining the right spark energy to fire it is the best way to improve efficiency.

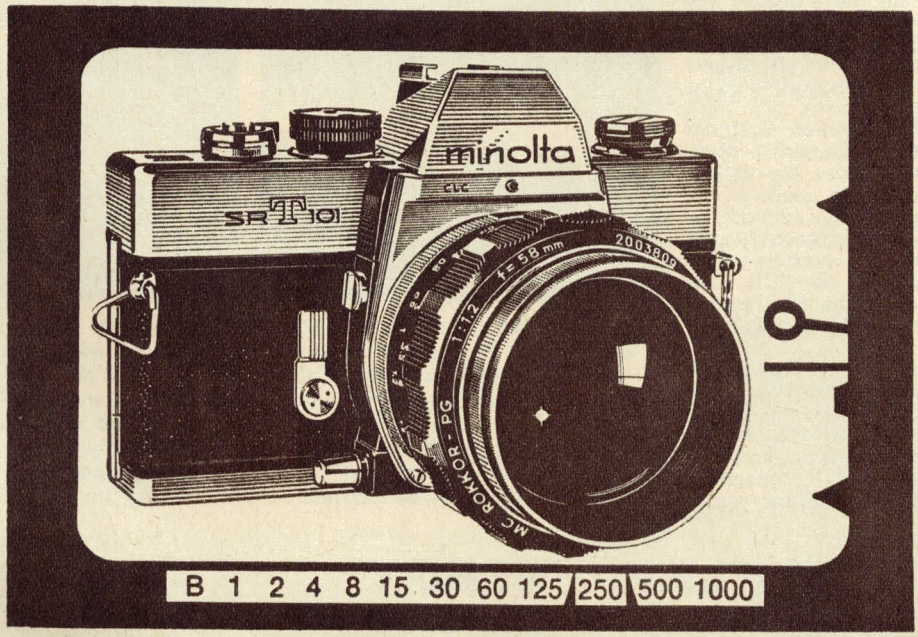
To provide a spark, the majority (about 98 per cent) of conventional engines use the Kettering system, which was developed about 50 years ago. In this system, battery current is allowed to pass through the primary of an autotransformer (ignition coil) when the breaker points are closed. The opening and closing of the points are timed by an engine-driven cam that is designed to open the points whenever a spark is required by a cylinder. When the points are closed, the current flowing through the coil builds up a magnetic field which saturates the coil. When the points open, the current flow stops and the magnetic field collapses. As the field collapses, the magnetic lines of force cut the turns on the other portion of the autotransformer, inducing a very high back EMF. This voltage is applied through the distributor to the appropriate cylinder to ignite the gas-air mixture. The time that the points remain closed is called the dwell time and is specified in degrees of dwell for the particular engine.



An ignition system of this type always works (unless something is drastically wrong) but it does have its disadvantages, which result primarily in the loss of performance at high engine speeds. This is because, as the engine speeds up, the amount of time that the points remain closed is proportionally reduced. When the engine speed reaches 2,000rpm or more, the points are closed for such a short time that the magnetic field within the ignition coil does not build up to maximum. This results in a much lower "thinner" spark voltage for ignition. As a result the energy in the coil primary drops dramatically. Because the higher engine speeds are used in accelerating and passing, "sluggishness" is noted in many engines when this situation occurs. Since the fuel doesn't burn properly, the condition also wastes gasoline and the spark plugs get fouled up, causing an even further drop in performance.

The purpose of most ignition-improvement systems is to overcome the "droop" in spark energy at high engine speeds.

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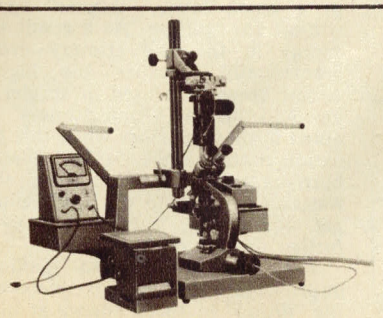
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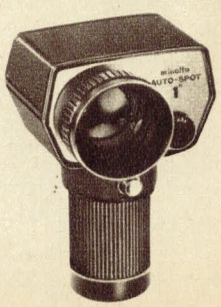
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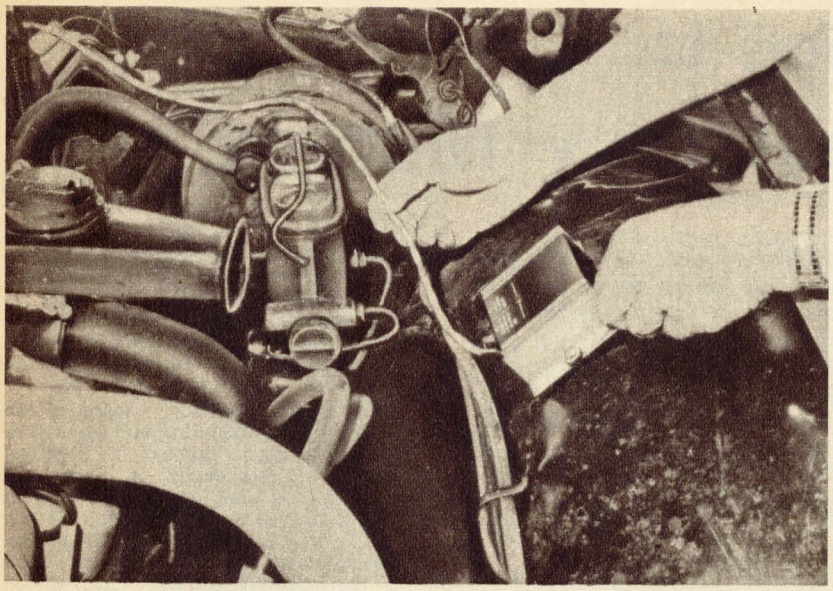
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VIEWMETER 9



AUTOSPOT



Mount the Dwell Extender in relatively cool place (in this case on sheet-metal wheel housing) using suitable mounting hardware and shock-absorbing rubber grommets at two heat-sink mounting holes. The two-wire connecting cable can use same mounting hardware as the conventional engine wiring system.

PARTS LIST

C1, C2—2.2uF, solid tantalum capacitor (Sprague 164D or similar).

D1—2-ampere, 600-volt PIV rectifier diode (Solitron Devices 2A600 or similar).

R1—2200-ohm, ½-watt resistor.

R2—120-ohm, ½-watt resistor.

SCR1—Silicon controlled rectifier (Motorola 2N4173 or similar).

Misc.—SCR mounting hardware (Motorola MH475 or similar); heat sink (Wakefield 400 or similar); three-lug screw-type terminal strip; metal for U-brackets; length of 14 twin-conductor cable; two crimp-on lugs; rubber grommets (2); mounting hardware, etc.

speeds where diminishing dwell time would otherwise become significant. A much more potent spark is therefore available from the distributor. In fact, tests have shown that the effective spark energy is almost doubled at high engine speeds.

The diode D1 shunts the negative spike that occurs when the points open.

Construction. It is important that you use the silicon controlled rectifier (SCR1) called for in the parts list, or one with equivalent characteristics. It is capable of withstanding the temperature extremes existing near the engine and it can take the reverse voltages that occur when the points open. Similarly, the capacitors must be of the solid tantalum type which can withstand the temperature extremes.

The components are actually mounted on the heat sink (or similar) prescribed in the parts list. Drill a hole in the centre of the heat sink for SCR1. Mount the SCR with an insulating (mica) washer around the stud on each side of the heat sink and a soldering lug making contact with the case of the SCR on the wiring side of the heat sink.

You may also have to use some type of insulating tubing around the stud where it passes through the heat sink, to avoid any contact between the two. When you have the SCR mounted, use an ohmmeter to check that there is no contact between the case (anode) of the SCR and the heat sink.

Prepare a U-shaped metal cover to fit over the top of the heat sink and project down over the two sides. Cut out one end of the cover so that a three-lug terminal strip can be mounted on it as shown in figure 2b. The two outer lugs serve as wiring connections for the internal components and for connection of the external leads. The centre lug is used as a standoff insulator for internal wiring which is point-to-point.

Once the circuit is complete, spray the interior with a non-corrosive lacquer to provide protection against moisture. Make another U-shaped cover to fit over the bottom of the heat sink and cover the electronic components.

Drill holes in the ends of the heat sink for mounting and insert rubber grommets in the holes to provide protection against shock and vibration.

Clearly identify the two external connections. Mark them "chassis ground" and "(—) terminal of ignition coil."

Installation. Select a suitable mounting spot for the Dwell Extender—away from the heat of the engine and radiator. The location can be on the sheet-metal wheel covering, the firewall, or even inside the car (or boat). Make sure that rain or snow (or spray, if used in a boat) cannot reach the device. A maximum of 6ft of wire can be used to connect the system to the ignition coil.

Identify the connections on the ignition coil. There are usually three wires: one (large diameter coming from the insulated top of the coil) carries the high voltage to the distributor; one goes to the ignition switch and may be marked (+) or "batt"; and the third goes to the distributor (where the points are) and is marked (—) or "dist." This last connection is the one you want.

Loosen the nut that secures this lead to the coil and insert the lead from the proper terminal on the Spark Injector. Do not remove any existing wires. Tighten the nut, making sure that all of the leads are making good contact with the coil terminals. Locate a convenient ground screw or nut. Loosen it and insert the ground lead from the Spark Injector. Retighten the screw or nut.

Use 14 gauge insulated wire to make these electrical connections. A spade lug can be soldered to each wire to make it easier to connect to the proper points.

When new points are installed or you want to check dwell time, disconnect the Dwell Extender by removing the one wire to the ignition coil. Once the dwell has been checked or reset, reconnect the Dwell Extender lead.

Editor's note: As indicated, the foregoing article has been reproduced by arrangement with "Popular Electronics" by reason of its potential interest to Australian readers. No work has been done on the device in our laboratory and we are not in a position to add to the information presented in the original article.

The American parts numbers have been retained in the parts list for any value they may have but the unit is simple enough to permit use to be made of available local components. An alternative SCR, which we have used in a number of our projects, would be the General Electric type C20D, while a suitable diode, from the same source, would be the A15M.

The author of the article, George Meyerle, is President of Metrotec Industries, of 1405 Old Northern Boulevarde, Roslyn, N.Y. 11576, U.S.A. The company can supply a complete packaged kit for a Dwell Extender, with instructions, for $7.50. The heat sink, covers, wire and mounting hardware are available for $3.15, SCR's with mounting hardware $3.60 each, 2A600 diodes for 24c each, 2.2uF tantalum capacitors for 40c each. All prices quoted are U.S. currency, F.O.B. New York. ◘

FUNDAMENTALS OF SOLID STATE: Our Technical Editor Mr Jamieson Rowe has been heavily committed in recent weeks to the development of a series of digital measuring instruments. An introductory article on the subject of digital frequency meters appears overleaf. The time and effort involved has made it impossible for him to prepare the regular insalment of his series, "Fundamentals Of Solid-State." This should appear next month, however, and will introduce the subject of bipolar transistors.

An Introduction to Digital Frequency Meters

The first of three articles describing a new low-cost digital frequency meter design which has been developed for use by radio amateurs and development labs, and for production testing. This article introduces the reader to digital techniques and their application to frequency measurement; the subsequent articles will give full constructional information for both low-frequency and high-frequency versions of the instrument.

by Jamieson Rowe

A digital frequency meter or "counter" of the type to be described offers many advantages compared with conventional analog instruments. In common with other digital instruments it offers an order of stability, reliability, resolution and reading convenience which is very difficult to achieve using analog techniques. And the accuracy of measurement can be extremely high, being determined primarily by the frequency reference or "timebase" employed.

These features make a digital frequency meter or "DFM" the ideal choice wherever frequency measurements must be made, both within electronics itself and in the many disciplines which have adapted electronic measurement techniques for their own purposes. An awareness of the advantages of such an instrument has in fact provided much of the motivation for our development of this project; the remaining motivation emerged from a realisation that recent developments in pricing and availability of semiconductor components have at last made it possible to produce a high-performance DFM at a really attractive price.

It is hoped that the DFM to be described will have wide appeal in all frequency measurement applications, and that it will be of special interest to those working in such fields as radio communications, where measurements must frequently be made at both audio and radio frequencies. Although either version of the instrument may be constructed at a fraction of the cost of currently available commercial digital counters, they offer a standard of performance which should make them of value to both the professional communications engineer and the amateur radio operator.

The instruments may also be of interest to universities and technical colleges, both as possible constructional projects for engineering and science students, and also as low-cost measuring instruments for teaching and research purposes.

As noted there are two versions of the DFM, both sharing a common basic logic design. The two are very similar in appearance, as may be seen from the accompanying photographs; in fact the metalwork is identical except for individual lettered front panels.

Full specifications for the two versions of the instrument will be given in the constructional articles, and will not be given here. However, a brief description of the capabilities of the design may be worthwhile background for the introductory material which follows.

Both versions of the design are fully solid state, apart from the gas discharge tubes used for readout display. The instruments have "three decades plus single digit over-range" display, and employ low cost integrated microcircuits (ICs) of the RTL, DTL and ECL varieties. Most of the wiring of both versions is in the form of printed wiring boards, which results in a considerable reduction in assembly time and effort.

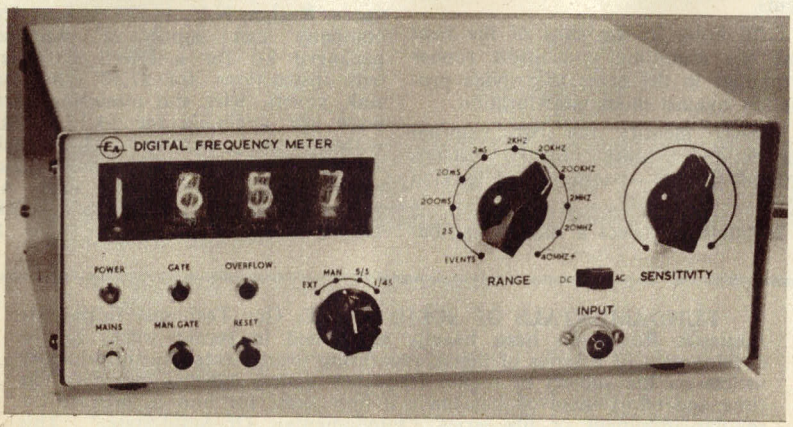
The "high frequency" version of the design features counting and input processing circuitry capable of handling signals at frequencies in excess of 40MHz, and has a full-scale quartz crystal reference oscillator and divider chain to enable direct frequency measurements to the frequency limit of the counting section. This version is also capable of performing time period measurements of up to 2 seconds' duration, and events counting. The internal timebase may also be used as a source of reference frequency signals for calibration of radio receivers and other equipment.

The "low frequency" version of the design uses the same counting and input processing circuity as the high frequency version and, if an external timebase system is used, it is thus also capable of making direct frequency measurements to above 40MHz. However, for economy reasons, the timebase frequencies of this version are derived by a simple process from the AC power mains, limiting the maximum frequency range of the instrument itself to 200KHz. It is envisaged that this version of the design will be of use mainly in audio and ultrasonic applications.

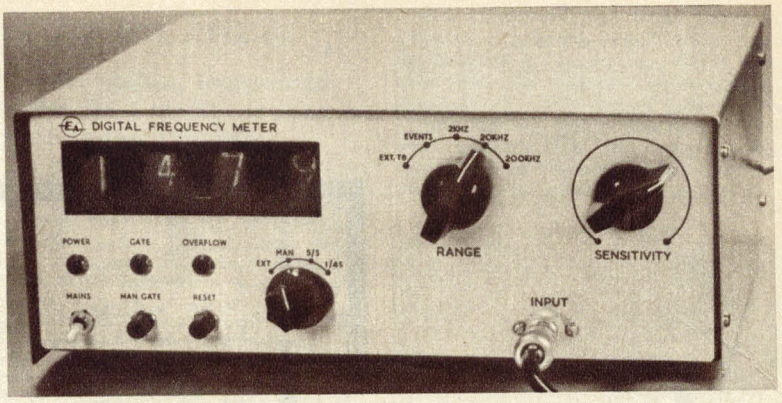
For the benefit of readers who are as yet rather unfamiliar with digital circuit techniques and their application to such tasks as frequency measurement, the remainder of this article will attempt to provide a basic introduction to the subject. However, this will of necessity be brief, and readers who find it unsatisfying are referred to such books as the author's "An Introduction to Digital Electronics." (Available from Electronics Australia offices at a cost of $2.20 including postage.)

Although in the discussion which follows the reader may at times find it difficult to see the connection between the ideas presented and practical frequency measurement, please bear with the author and continue reading. The discussion only introduces those concepts which the author has found essential for a clear understanding of the operation of digital frequency meters and counters, so that it is hoped that your patience will not be unrewarded.

Digital circuits are generally characterised by the "two-state" nature of their behaviour. In contrast with conventional analog circuits, where voltages and currents may generally vary smoothly over a significant range, the currents and voltages in digital circuits tend to be found in one of only two levels. Changes in the state of the circuits thus occur as rapid "jumps" or transitions between these two levels.



The "high frequency" version of the new frequency meter, which is capable of direct frequency measurements to above 40MHz. It also provides for period measurements and events counting.



The "low frequency" version of the instrument, which although also capable of measurements to above 40MHz, contains a low cost time-base limiting the "self-contained" range to 200KHz

The actual values of the two voltage or current levels involved varies considerably, depending upon the type of circuitry and such factors as the speed of operation for which it is designed. In typical digital circuitry employing silicon transistors, the two current levels involved may simply correspond to the "cutoff" and "saturated" values for the transistors concerned; similarly the voltage levels may correspond approximately to the supply rails, e.g., 0V and +6V, or −5V and 0V.

In other transistor circuits, designed to operate at very high speeds, the transistors are prevented from entering the saturation region of operation in order to reduce charge-storage effects. Here the current and voltage levels for the two digital states are naturally less separated than the "all or nothing" values corresponding to cutoff and saturation. However, they still represent two distinct conditions at which the circuit may operate alternatively in a stable manner, or between which it may switch as required.

Because of the two-state nature of digital circuit behaviour, such circuits have proved very suitable for performing arithmetic and other mathematical operations with high reliability. This arises because the two circuit states can easily be made to correspond to the "0" and "1" of the binary system of number representation.

Similarly digital circuitry has proved highly suitable for performing logical operations and information processing, as the two circuit states can be made to correspond to the "true" and "false" values of logic (also represented as "1" and "0," respectively).

The application of digital circuitry to these tasks has resulted in a very worthwhile "feedback" in terms of concepts, because it has been found that many of the concepts of symbolic logic and Boolean Algebra are both applicable and worthwhile, not only in the design of computers and specifically "logical" circuits, but also in the design of most other varieties of digital circuitry. Hence the reason why digital circuit design often seems to involve a considerable amount of "logic design" and other apparently non-electronic activity, and why the term **logic circuit** is often regarded as a synonym for "digital circuit."

A major benefit gained from the "marriage" of logical concepts and digital circuitry is that it has shown that almost any digital circuit may be built up using appropriate numbers and combinations of a relatively small number of distinct and basic sub-circuit "building blocks" or elements. These elements may be constructed using discrete components such as transistors, diodes, resistors and capacitors, but in recent years it has been found possible to manufacture them in "integrated" form, with all of the circuit components fabricated on a single chip of semiconductor material such as silicon. Hence the extensive use in digital circuitry of the increasingly encountered digital microcircuit or "IC."

Probably the most common varieties of digital circuit element are the **gates.** These are relatively simple elements which are designed to perform the basic operations of symbolic logic. There are five such operations, which are usually identified by the terms AND, OR, NOT, NAND and NOR.

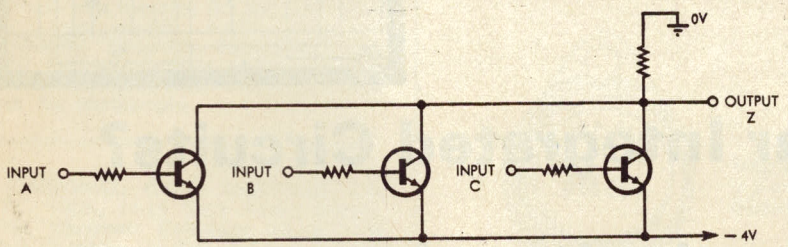


Figure 1

The AND operation is defined logically in the following manner. If a statement such as "Rain causes the road to be wet" is represented by "A," and another statement such as "It is raining now" is represented by "B," then fairly obviously a third statement "The road is wet," which we can represent by "Z" will be true if, and only if, A **and** B are both true at the same time. Hence it can be said that statement Z is equivalent to (A.B), where the full point indicates AND.

A digital gate element is said to be performing the AND operation if it produces an output voltage or current whose level corresponds to logical "true" (1) **when, and only when,** all (i.e., two or more) input voltages or currents applied to the gate are also at levels corresponding to logical 1.

The OR operation is similar to the AND operation, but in this case it is defined as an operation in which a statement "Z" is true if **any, or all,** of a number of input statements "A," "B," "C," etc., are true. Hence in the case of two inputs the OR operation be said to apply if Z is equivalent to (A + B), where the plus sign indicates OR. Hence a digital gate element is said to be performing the OR operation if it produces a logical 1 output if any, or all, of the signals applied to it are also at logical 1.

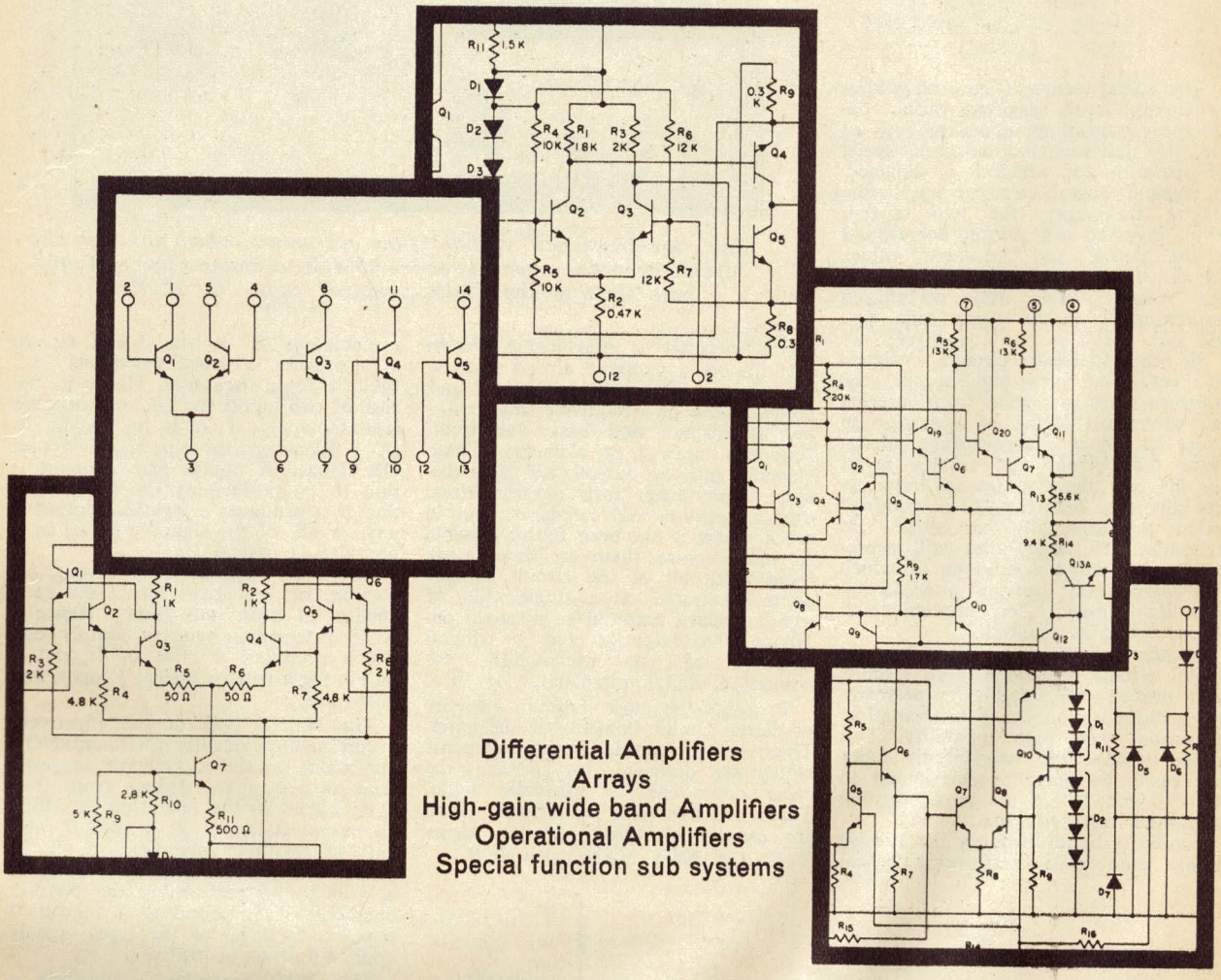
The NOT operation is simply inversion, or in logical terms the conversion of truth into falsity. Hence a NOT gate or inverter is simply one which produces a false or logical 0 output for a true or logical 1 input, and vice-versa.

The NAND operation is effectively a combination of the AND and NOT operations, as the name itself suggests. And as one might deduce from this, it is defined as the operation in which an output statement Z is false if, and only if, all input statements A, B, C, etc., are true. A digital gate element is said to be performing the NAND operation if it produces a logical 0 ouput only if all of the input signals applied to it are at logical 1.

The NOR operation is similarly a combination of the OR and NOT operations, being defined as the operation in which an output statement Z is true if, and only if, all input statements A, B, C, etc., are false. A digital gate element is said to be performing the NOR operation if it produces a logical 1 output only if all of the input signals applied to it are at logical 0.

At this point the reader may well be wondering which of the two voltage or current levels in a particular digital circuit are taken to represent the logical truth (1) and falsity (0) values. The answer to this is that there is no fixed correspondence; the relationship between logic values and electrical states is quite flexible, and may be varied at will.

Hence in a digital circuit operating between 0V and +6V, for example, either of these may be chosen as that corresponding to logical 1, the other naturally becoming logical 0. And whichever "logic convention" is adopted in one section of the circuit need not necessarily be maintained throughout sections. In fact, by varying the logic convention at strategic points, the circuit designer can often "save" circuit elements and simplify his system considerably.



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An important implication of the foregoing is that the logical function performed by a digital circuit element is largely a matter of the "eye of the beholder" — in other words, it depends upon the logic convention one chooses to adopt. An example may help to make this clear.

Consider for a moment the simple logic gate circuit shown in figure 1. This is a simple three-input "RTL" or resistor-transistor-logic gate using resistors and NPN transistors, and in this case operating between 0V and −4V.

The electrical operation of this gate is quite straightforward. If any of the three input terminals A, B or C is taken to 0V, the appropriate transistor will conduct and output terminal Z will be taken down to approximately −4V. However, if all three input terminals are either left floating or (preferably) taken to −4V, the three transistors will be cut off and Z will be at 0V.

While the electrical operation of the gate is fixed, its operation from a logical viewpoint depends very much upon the logic convention(s) which we may care to adopt. For instance if we decide to adopt the convention that logical 1 = 0V and logical 0 = −4V, a few moments' thought should show that the gate will perform the NOR operation. The output Z will only be true (1 = 0V) when all inputs are false (0 = −4V).

On the other hand if we care to adopt the opposite convention, with 1 = −4V and 0 = 0V, the gate will be found to perform the NAND operation. The output Z will be false (0 = 0V) only when all three inputs are true (1 = − 4V).

Not surprisingly we can arrange for the same gate to perform the AND and OR operations merely by altering the logic conventions again — to be precise, by using differing logic conventions at the input and output. If we adopt the (1 = 0V, 0 = −4V) convention at the input and the opposite convention at the ouput, the element will become an OR gate; while if we adopt the opposite arrangement it will become an AND gate.

We can even arrange for the gate to perform the NOT operation, simply by tying two of the input terminals to the −4V line and using the third as a single input. The gate will then function as a logical inverter or NOT element, providing we adopt the same logic convention at both input and output.

From the foregoing example it should be fairly clear that the actual logic function performed by a digital gate element depends very much upon the logic conventions adopted in the system in which it is connected. Other digital circuit elements behave in a similar fashion.

Logic elements such as gates are commonly—and rather whimsically—regarded in digital electronics as "black boxes," or more correctly as elements performing a particular logical operation. Hence it is usual to represent them not by drawing their internal circuitry, but merely by a so-called "logic symbol" indicating their logical function. Typical logic symbols for gates are shown in figure 2: from the foregoing discussion of logic conventions it may be realised that any of these symbols may in fact be applied to a single gate such as that of figure 1, depending upon the function performed in a particular circuit.

In passing it should perhaps be noted that although the gate shown in figure 1 employs the so-called "RTL" or resistor-transistor-logic, many other circuit configurations are also used—not only for gates, but also for the many other digital circuit elements. Each of these configurations or "logic forms" offers a particular combination of such characteristics as cost, power supply drain, operating speed and immunity to disturbance by electrical noise.

Other logic forms which are currently in fairly wide use are "DTL" or diode-transistor-logic, which as the name suggests employs appropriate combinations of diodes and transistors, and "ECL" or emitter-coupled-logic, which consists of transistor circuits in which the transistors are used as non-saturating emitter followers and common-base amplifiers. As noted earlier, the digital frequency meters to be described use devices from each of the RTL, DTL and ECL "families."

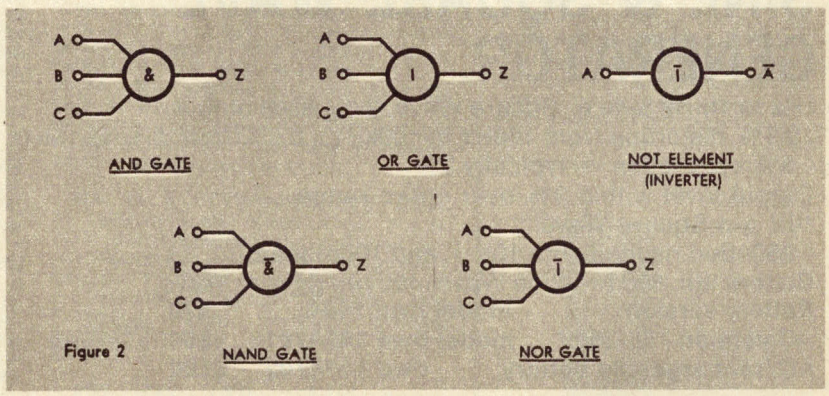
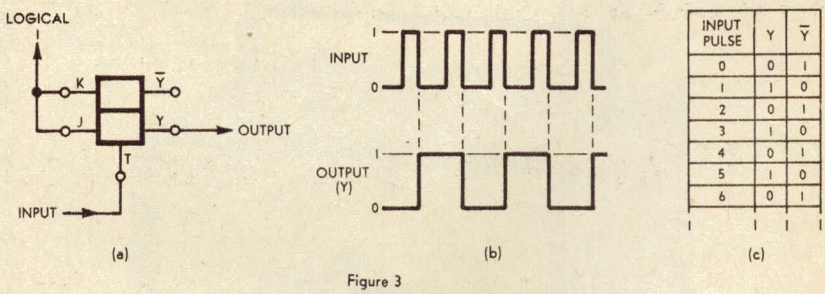


Figure 2



INPUT PULSE	Y	$\bar{Y}$
0	0	1
1	1	0
2	0	1
3	1	0
4	0	1
5	1	0
6	0	1

Figure 3

Another very important type of digital circuit element is the **flip-flop.** There are a number of varieties of flip-flop, but all have in common the property of being capable of remaining in one of two stable states in the absence of input signals. Because of this property, flip-flops are often used for storage of information in digital form.

One of the most important types of flip-flop is the so-called "J-K" flip-flop, whose behaviour is in contrast with most other varieties in that it may be predicted for all input signal combinations. The full details of J-K flip-flop operation are given in most texts on digital electronics, and need not concern us here. It should be sufficient to note that the element is capable of a mode of operation called "toggling," in which it may be used both for counting and frequency division.

A common logic symbol for the J-K flip-flop is shown in figure 3 (a), together with the connections for toggling mode operation. It may be seen that two "gating" terminals J and K are tied together and taken to logical 1, while the input signals are applied to the "clock" input labelled T. The state of the element is then indicated by the voltage level at either of the two remaining terminals Y and Y-bar, which are always at the opposite or "complementary" logic levels. Thus if Y is at logical 0, Y-bar will be at logical 1; this is called the "reset" state of the flipflop. The alternative state, in which Y is at 1 and Y-bar at 0, is called the "set" state.

The characteristics of a J-K flip-flop are such that if the J and K terminals of the element are both held at logical 1, a logic level transition of one specified direction at the T terminal will cause the element to simply switch or "flip" from whichever of the two states it occupied to the opposite state. If it was in the reset state it will switch to the set state, and vice-versa.

Which type of logic level transition at the T input terminal produces this "toggling" behaviour depends upon the exact internal circuitry of the flip-flop, as one might expect. In some cases it is a 0-1 transition, and in other cases a 1-0 transition.

The way in which a J-K flip-flop connected in toggling mode may be used for frequency division is illustrated in figure 3(b), which shows the input and output waveforms of the element when a regular series of pulses are applied to the T input. In this example the flip-flop is assumed to be one which toggles on the 1-0 transitions of the input signal. It may be noted that the output signal available at the Y output terminal is a square wave of exactly half the repetition frequency of the input pulses—i.e., the flip-flop is capable of acting as a 2:1 frequency divider.

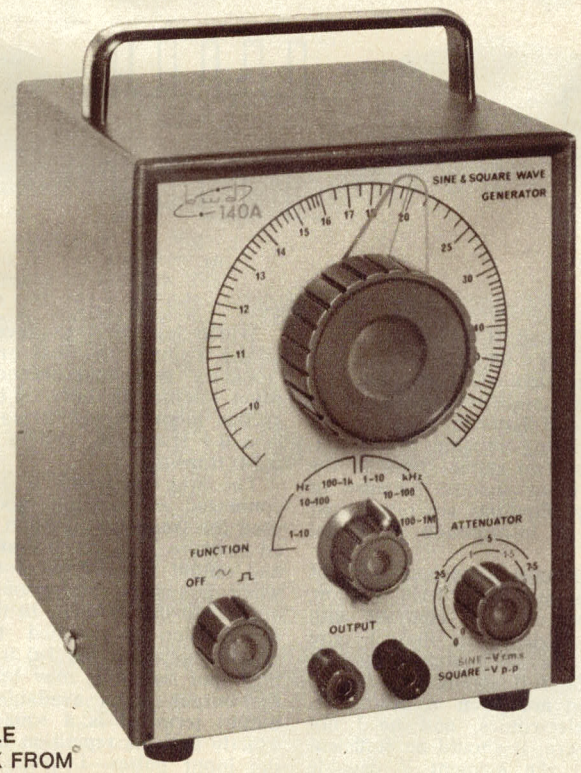
In passing it should perhaps be noted that an output waveform is also avail-

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able at the Y-bar output terminal of the element, again at a frequency of half the input frequency. The only difference is that this signal is the logical opposite or complement of the signal at the Y terminal.

The ability of such a flip-flop to count pulses may not be immediately obvious from figure 3(b); however the table in figure 3(c) may help in visualising this. If the element is arranged to be in the reset (Y=0) state prior to the arrival of the first pulse transition, it may be seen that after the arrival of the first pulse it will be in the set state, and after the second pulse it will have returned to the reset state. In fact after every **odd** pulse it will be found in the set state, and after every **even** pulse in the reset state.

This property gives the element the ability to act as one stage in a binary counting system — a counting system operating basically in powers of two in contrast with the decimal system based on powers of ten. By cascading a number of J-K flip-flops connected as in figure 4(a), one thus produces a simple **binary counter.**

As may be seen from the waveforms in figure 4(b), each flip-flop in such a counter switches each time its predecessor returns to the reset state. If all elements are initially in the reset state the sequence of events upon the arrival of input pulses may thus be shown by a table as in figure 4(c).

Inspection of the table will show that the elements of the counter effectively count in successive powers of two. FF1 counts the "1s," FF2 the "2s," FF3 the "4s," FF4 the "8s," and so on. Hence, if only two elements are used in such a counter it will be capable of counting from 0 to 3 before repeating itself. If three elements are used, the counter will be capable of counting from 0 to 7; if four are used, from 0 to 15. Lamp circuits may be attached to either the Y or Y-bar outputs of the elements in order to "read out" the count at any time.

Perhaps it should be noted that the table of figure 4(c) has been arranged with the binary number weightings increasing from left to right, to correspond with the diagram of figure 4(a). Hence if it is desired to visualise the counting of this configuration in terms of normal binary numbers, whose weightings like the familiar decimal numbers increase from right to left, the column order in the table should be reversed.

Although simple binary counters of this type are quite practical, they have the disadvantage that the count is registered in binary notation and is accordingly rather unwieldy where large counts are involved. Binary notation also tends to be inconvenient for the human operator, who is generally more familiar with the decimal system.

Luckily this disadvantage can be obviated by arranging the flip-flops to count in a modified binary notation known as a binary-coded-decimal or "BCD" code. There are actually many such codes, all possessing the ability to be electrically decoded and displayed in familiar decimal notation.

Counters using a BCD code are made up of groups of flip-flops, usually four per group, with each group counting successive decimal decades. Thus the first group counts the "1s," the next group the "10s," the next the "100s," and so on.

Figure 5 shows a typical logic configuration for a single decade, in this case one which counts in the so-called "8421 BCD" code. This code is often used because, as may be seen from figure 5(b) and (c), the four flip-flops count from 0 to 9 while still retaining their original binary weightings of 1, 2, 4 and 8 (reading left to right on the logic diagram).

As may be seen this particular BCD counting decade differs little from the pure binary configuration of figure 4. The main difference is the addition of an AND gate which controls the logic level applied to the K input of FF4, and used to ensure that this element cannot switch to the set stage until both FF2 and FF3 are both set. There is also a modified carry-over, whereby the T inputs of FF2 and FF4 are fed in parallel from FF1, and a feedback path from the Y-bar output of FF4 to the K input of FF2. These changes merely cause the group to reset together on the arrival of every 10th pulse, so that they count from 0 to 9 instead of from 0 to 15.

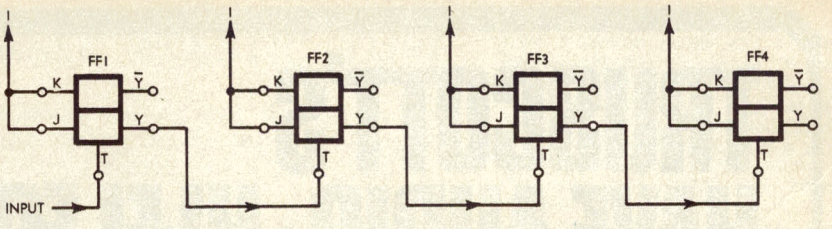
For convenience the count registered by such decades is usually "decoded" into a form where it may be used to drive a display tube indicating in the familiar decimal numerals. The details of decoding need not concern us here; basically, however, the decoding is performed by a network of AND gates which are each arranged to detect the occurrence of a particular combination of states for the four flip-flops.

Generally the decoder for each decade has 10 outputs, each corresponding to a particular decimal numeral. The outputs are thus suitable for the operation of one of the various types of decimal display unit, either directly or via a set of power amplifiers or "drivers." A popular type of display device is the numerical discharge tube, which is basically a neon lamp having 10 separate cathodes formed into the shapes of the various numerals.

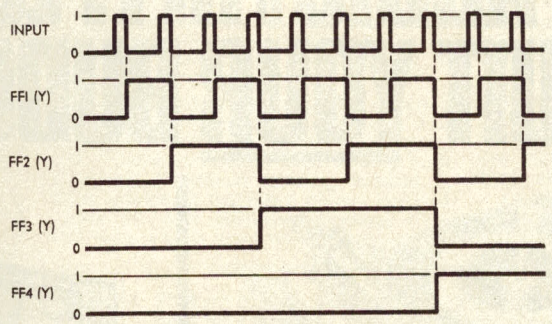
In basic terms, then, a practical digital counter consists of a number of BCD counting decades in cascade, with a decoder and possibly a driver for each decade to operate a readout display device. Typically there will also be a means whereby the admission of input signals to the first decade may be controlled; this may consist in the simplest case of an AND gate, as illustrated in figure 6.

How is such a counter used to measure the frequency of a particular signal? Simply by arranging for it to count the number of complete cycles of the signal occurring in a known period of time. For convenience this period of time is usually arranged to be either one second or a suitable decade fraction of a second, in which case the counter reading may be read off directly in terms of frequency.

Hence if 26,743 cycles of a signal are registered by the counter after counting for a period of exactly one second, that signal must have a frequency of 26.743KHz. Similarly if 17,850 cycles of another signal are counted during a period of exactly one millisecond, that signal must have a frequency of 17.850MHz. Note that for the measurement of high frequencies the measurement time or "gating time" is normally reduced so that inordinate



(a)

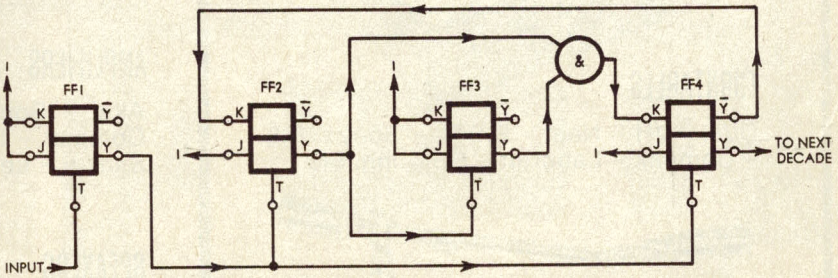


(b)

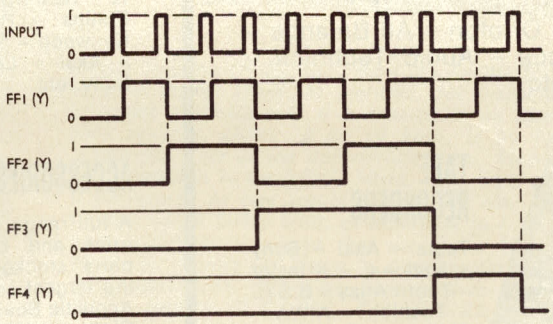
INPUT PULSE	Y1	Y2	Y3	Y4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1

(c)

Figure 4



(a)



(b)

INPUT PULSE	Y1	Y2	Y3	Y4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
0	0	0	0	0

(c)

Figure 5

capacity is not expected from the counter.

Basically, then, a typical digital frequency meter or "DFM" consists of a digital counter which is provided with a means whereby the input signal gate may be opened for precisely controlled periods of one second, 100 milliseconds (mS), 10mS, and so on. The higher the frequencies to be measured, the shorter the measurement times which are generally provided.

There are a variety of methods whereby the input gate of the counter of a DFM is opened for the appropriate measuring periods, and the details of these need not concern us here. It will probably suffice to note that, with most methods, the gate is actually under the control of a "gate control flip-flop" whose toggle input (T) is fed from one of a number of selectable **timebase** frequencies — the periods of which correspond to the required gating times. Additional logic circuitry is provided to ensure that the gate control flip-flop can only toggle once on each occasion, so that the gate of the counter is only opened once — for the prescribed period — during each measurement.

The timebase frequencies used to derive the counter gating times naturally play a dominant role in determining the absolute accuracy of the measurements concerned. For this reason most DFMs generate the timebase signals using a high-stability quartz crystal oscillator, followed by high reliability digital frequency dividers.

In some cases, where ultra high accuracy is required, use is made of primary frequency standards such as the caesium-beam resonator to provide the timebase source. Conversely, where

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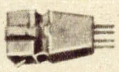


TURNTABLES

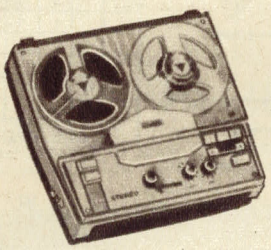
Dual – JH – Neat – B.S.R. – Sony – P.E. – Compax – Labcraft – Goldring, etc.



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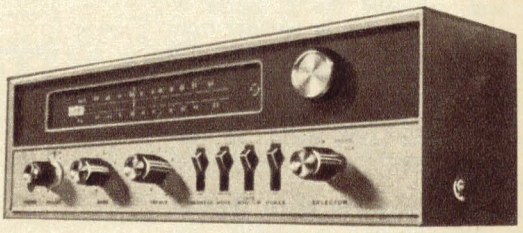


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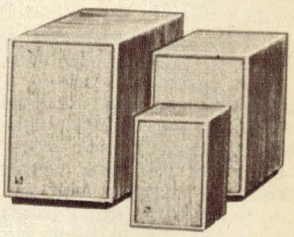


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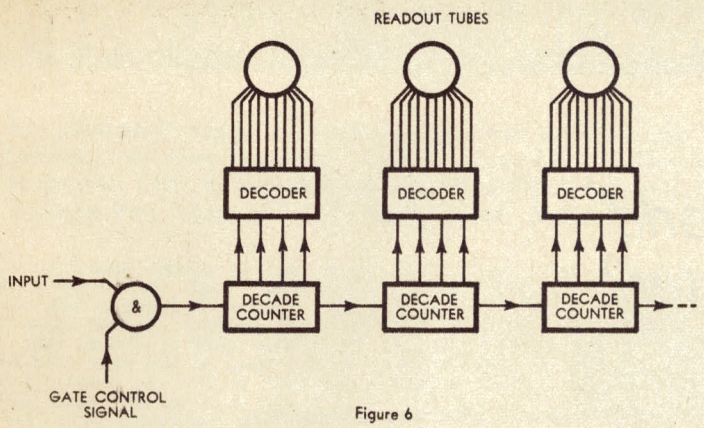


Figure 6

high accuracy is not necessary and economy is most important, use may be made of the modest frequency stability of the AC power mains to derive suitable timebase frequencies.

The basic configuration of a DFM is shown in figure 7. Here the switch S is that which selects the timebase frequency corresponding to the desired gating time. Each time a measurement command or "sampling" pulse is presented to the logic circuitry, the latter controls the J and K inputs of the gate control flip-flop to allow it to switch into the set state for a single period of the selected timebase frequency.

The sampling pulses fed to the logic circuitry are derived from either a manual pushbutton, a small free-running "sampling oscillator," from the timebase itself, or from a source external to the instrument itself, such as a computer. In each case the purpose of the sampling pulses is to command the instrument to perform successive measurements, either to allow the operator to keep track of frequency variations, or to ensure that the readings obtained by the instrument are consistent. Single readings are naturally subject to error due to spurious signals such as noise, hum and signal harmonics.

Note that the input signal whose frequency is to be measured is passed through a "shaping" element before being applied to the counter input gate. The purpose of the shaping element is to "square up" the input signal, transforming it from a sinewave or other random signal waveform into a rectangular waveform compatible with the digital circuitry.

It may also be seen that figure 7 shows two single flip-flops, FF1 and FF2 cascaded after the main counting decades. These illustrate optional circuitory which may be fitted either singly or in combination to both general-purpose digital counters and DFMs, in order to provide so-called "over-range" and "overflow" facilities.

The "over-range" facility is a means whereby the counting capacity of an instrument may be effectively doubled —a useful increase—at a cost considerably less than that which would be involved in the addition of a further complete counting decade/decoding/readout system. As may be seen, it basically involves the addition of only a single flip-flop (FF1), together with a display driver transistor and either a neon lamp or incandescent lamp.

The idea is that these few additional components simply count and display the "1" which would be read by an additional decade, when the main counting decades have reached full capacity and returned to the "all reset" condition. This allows the main decades to continue counting, until the filled condition is again reached.

An example may clarify the point. if there are three main counting decades, as shown, these will together give the instrument concerned a counting capacity of from 000 to 999. However, the addition of the over-range flip-flop and lamp effectively doubles this capacity, and the maximum count will be extended to 1,999.

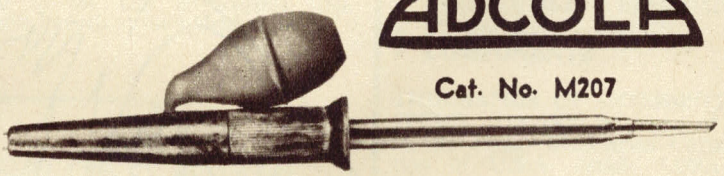
The "overflow" circuitry, which is also illustrated in figure 7 is distinct from that associated with over-range and although it is often used in instruments fitted with over-range, it may also be found on instruments lacking this facility. As the name suggests, it is simply a means of detecting and indicating when the counting section of the instrument has "gone around the clock," or filled to maximum capacity and returned to the fully reset state.

It may not be immediately apparent to the reader why such an indication is desirable, as it may be thought that the operator would find it easy to follow the counting operation by visually monitoring the readout display. However, the fact is that for high frequency measurements the counting process may be taking place in a gating time of 10uS (microseconds), or even less—a period very much less than the classical "blinking of an eye." It may be appreciated from this that the counter could well fill to capacity many times over without the operator being in the least aware of the situation.

Naturally the measurements made in such circumstances would be very much in error, because the reading finally displayed after a measurement would simply represent the pulses which entered the counter after it had counted to full capacity and overflowed an unknown number of times. Hence it can be a decided advantage if the instrument is provided with a means of indicating immediately if overflows occurs.

As may be seen the overflow circuitry is similar to that associated with over-range, consisting of a single flip-flop, a driver transistor and a lamp. The only difference is that in this

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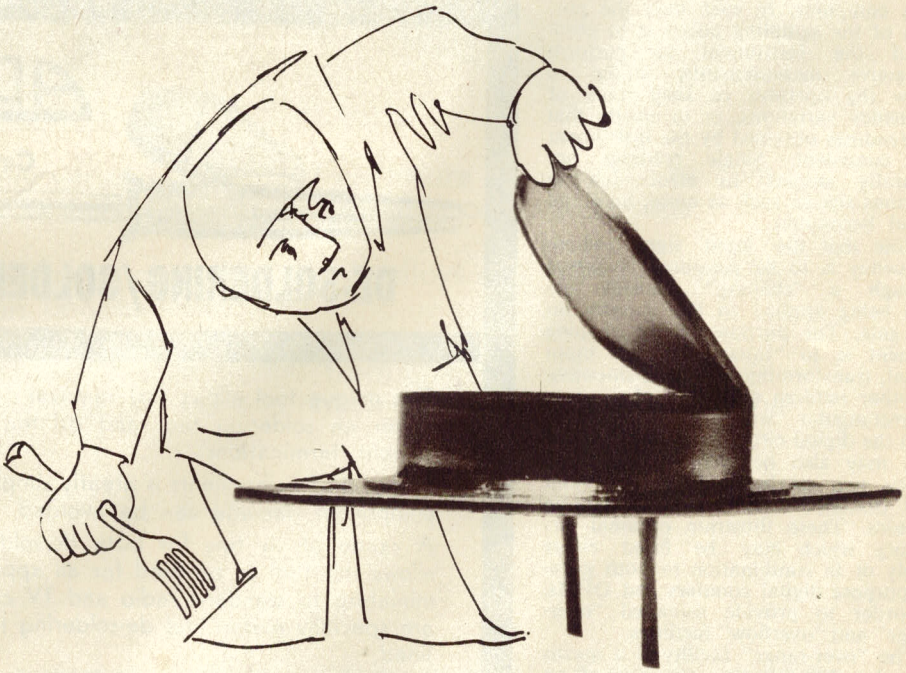
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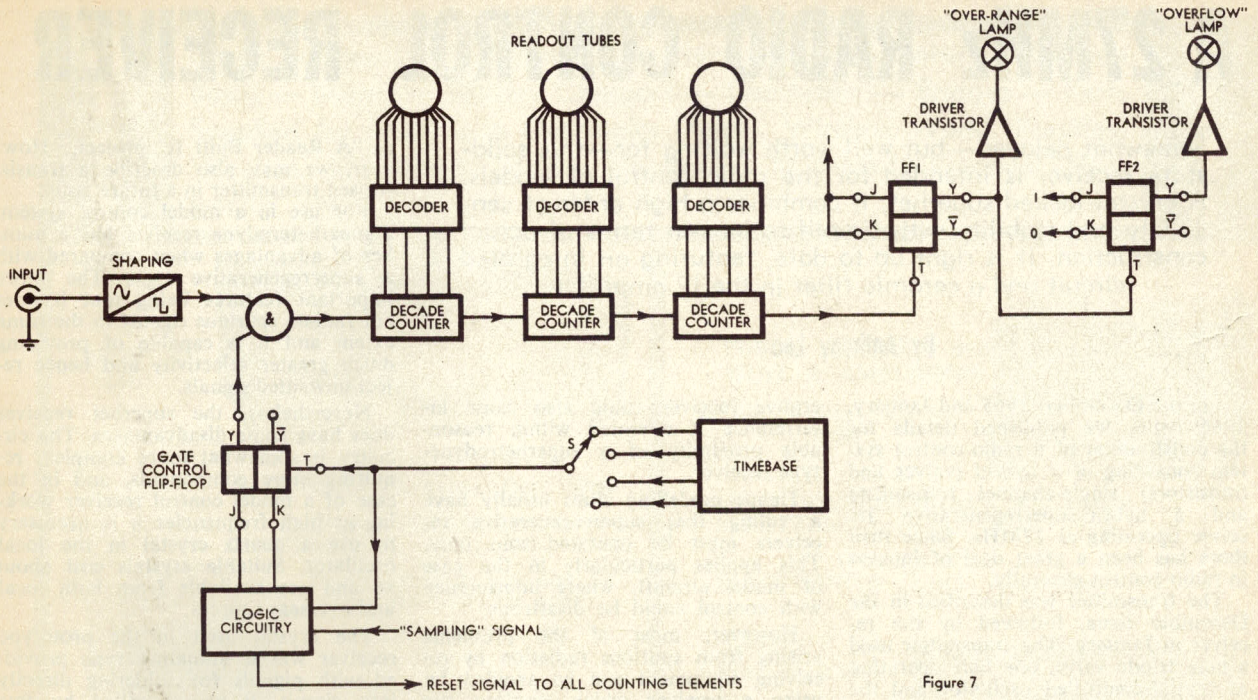


Figure 7

case only the J input of the flip-flop is taken to logical 1, the K input being taken instead to logical 0. The effect of this is that the flip-flop is only capable of being switched to the set state by a transition arriving at the T input—further transitions have no effect, as the logical 0 applied to the K input prevents the element from returning to the reset state.

Thus once overflow occurs, as signified by the arrival of a transition at the input of FF2, this element switches to the set state and remains there as a steady indication for the remainder of the measuring cycle concerned.

As with all the other counting elements, the over-range and overflow flip-flops are reset prior to each measurement by means of a reset pulse, which is generally derived from the sampling pulses by the logic circuitry associated with the gate control flip-flop.

The configuration shown in figure 7 is well suited for the accurate measurement of low, medium and high frequencies, but for very low frequencies it has the disadvantage that inconveniently long gating times must be used if readings are required to have high resolution—i.e., have a large number of significant digits. Thus for very low frequency measurement a modified configuration is often used, to perform **period measurement.**

The period measurement configuration is almost identical with that of figure 7, except that the connections for the timebase and input signals are exchanged. The timebase signal selected for the measurement is applied to the counter input gate, while the squared input signal from the shaper is applied to the gate control flip-flop and its associated logic circuitry.

By this means the counter input gate is arranged to be opened for a period exactly equal to one cycle of the input frequency, admitting timebase pulses for this period. Hence at the end of the measurement period the counter will indicate the number of complete timebase cycles corresponding to a single period of the input signal. Since the timebase frequencies are normally arranged to be decade multiples of 1Hz, this allows direct readout of the period of the signal in seconds, milliseconds or microseconds, as the case may be.

For example if the timebase frequency in use is 1KHz, its pulses will have a period of 1mS, so that a signal for which 3,000 timebase pulses are admitted to the counter during one cycle must have a period of 3,000mS. Inverting the period gives the signal frequency (i.e., F equals 1/T), so that in this case the frequency would be (1,000/3,000) or 0.333Hz.

It may be noted from this example that to find the frequency of the input signal from a period measurement, one must perform an inversion operation.

(Continued on Page 190)



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By Anthony Leo

In the December, 1965 and January, 1966 issues we published details for the construction of a radio-control system consisting of a hybrid (valves and transistors) single-channel transmitter and a hybrid-superregenerative receiver operating at 27MHz. Since then there has been a great deal of interest in radio control generally.

The transmitter was described in the December issue, followed by the receiver in January. The transmitter used a twin triode valve, one half operating as crystal-controlled oscillator and the other as a class-C amplifier and output stage. A two-transistor multivibrator provided single-tone modulation with a frequency between 400 and 500Hz.

The receiver used a miniature low-voltage valve as the superregenerative detector followed by three transistors for audio amplification, the third transistor being used to actuate a relay. A miniature transformer was used to provide audio coupling from the collector of the second transistor into the base of the third actuating transistor.

While a superregenerative receiver is very simple in terms of circuitry, it is not without disadvantages. It has rather poor selectivity, and also radiates radio frequency energy from the regenerative detector; it is the spurious radiation which presents the greatest problem.

Because of the spurious radiation it is not possible to operate two regenerative receivers within reasonable proximity without one interfering with the operation of the other. A superregenerative receiver could also cause interference if operated within reasonable proximity of a superheterodyne-type receiver.

Hence modelling clubs usually have a ruling that superregenerative receivers must be operated solo only. This applies particularly in the case of model aircraft, where interference with control could be disastrous.

However, most of the problems arising from spurious radiation by receiving equipment can be avoided by using a receiver which employs the superheterodyne principle similar to that used in an ordinary broadcast receiver or transistor radio. A miniature transistorised superhetrodyne receiver is the subject of this article.

The superheterodyne receiver to be described can be used with the single channel transmitter described in the December, 1965, issue and in fact we used this transmitter in field testing the receiver. Also, it can be used with a transistorised transmitter which was described in the December, 1968, issue as "A Reader Built It" project. However, we may also describe a transistorised transmitter in a future issue.

For use in a model control system, a superheterodyne receiver has a number of advantages when compared with a superregenerative type. The more important features being that it does not radiate spurious signals to the same extent and it is capable of providing much greater selectivity and hence reject unwanted signals.

Nevertheless, the superhet receiver does have some disadvantages. The circuitry is somewhat more complex, requiring more components, and in the case of a model control receiver working at high frequencies it is necessary to use a quartz crystal in the local oscillator. Suitable crystals cost about $6 and are available from both local and overseas sources.

The crystal used in the prototype receiver was a miniature type provided with pigtails for soldering directly into circuit. It was supplied by Pye crystal division and we understand that crystals will be made available direct to constructors. The type is Q15A/3.

When ordering a crystal specify the frequency, the type number, and the kind of circuit in which it is to work. In this case it will probably be sufficent to quote the "Electronics Australia" circuit but, if the manufacturer is not familiar with the project, a copy of the circuit should be enclosed with the order.

In order to explain how we use the superheterodyne system for this application we have shown a block diagram of the receiver in figure 1. While using the fundamental superheterodyne principle, the method of applying it is slightly different from that in an ordinary broadcast receiver.

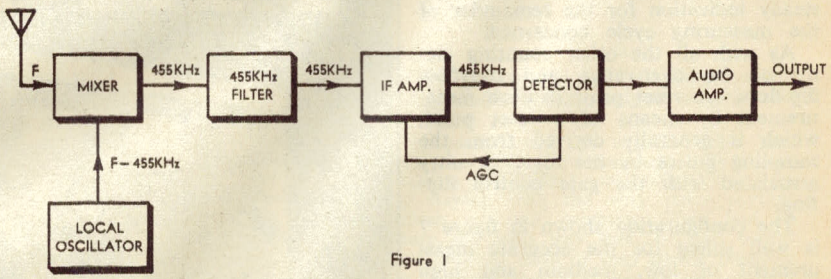
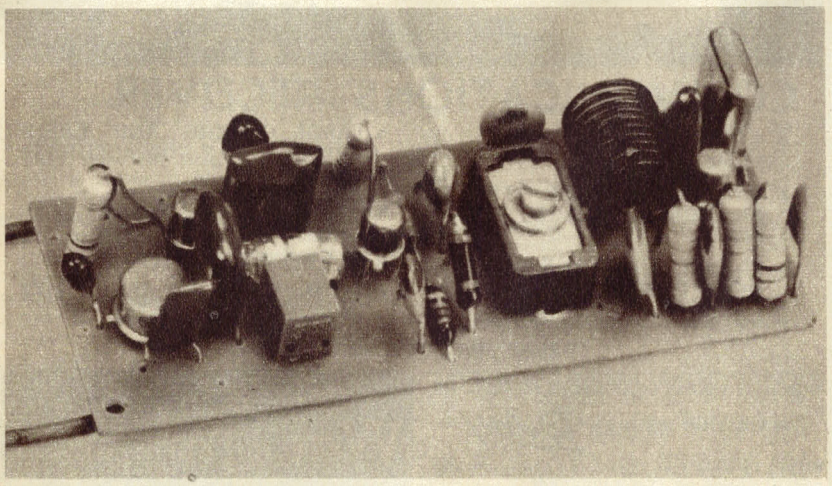


Figure 1

It will be apparent from the block diagram above that the sequence of stages in the tiny receiver is the same as in any conventional superhet. The diagram is related by the text to the full circuit opposite.

The differences are mainly a result of the high frequency (27MHz) at which the receiver operates, and the main one is the use of a quartz crystal to ensure local oscillator frequency stability. The effect of local oscillator stability on receiver performance will become obvious in the following paragraphs.

A transmitted signal of frequency F



The complete radio-controlled superhet receiver, with the mixer-oscillator at the right and the IF-detector-audio system to the left. The receiver measures 3-1/8 x 1-3/16 inches, so that the picture is actually larger than life.

At right is the complete circuit diagram involving three discrete transistors and an integrated circuit. The only inductor is that used for signal pre-selection ahead of the frequency changer. The oscillator frequency is determined by a quartz crystal while a ceramic filter provides the necessary 455KHz bandpass characteristic.

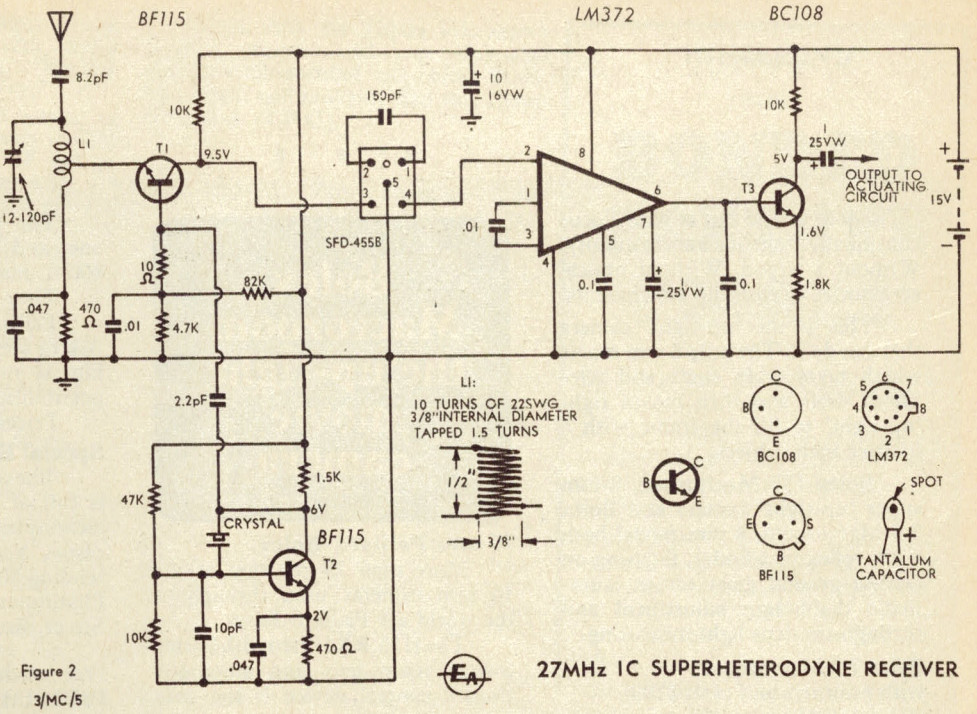


Figure 2

3/MC/5

27MHz IC SUPERHETERODYNE RECEIVER

arriving at the aerial is introduced to a frequency mixer. A second signal of frequency (F—455KHz) is generated by the local oscillator and also fed to the mixer. By the process of heterodyning, which relies upon the mixer having non-linear amplification, a number of new frequency products appear at the output including one at 455KHz.

In this case we are interested only in the frequency of 455KHz, which passes through a filter and is then amplified by an intermediate frequency (IF) amplifier. It is in the IF amplifier section of the receiver that the signal undergoes greatest amplificaion.

Conversion to a lower frequency makes amplification simpler because, in general, amplifiers are simpler and more easily controlled at low frequencies. Also, by virtue of frequency conversion, a superheterodyne receiver is inherently more selective than other types of receivers.

The selectivity of this receiver is determined mainly by the 455KHz filter and, for this reason, it is important that the local oscillator have the frequency stability provided by a crystal. Otherwise, a small percentage change in the local oscillator frequency could move the intermediate frequency product away from the 455KHz pass frequency of the filter, resulting in a serious loss of sensitivity.

Following the IF amplifier a detector recovers the audio tone from the modulated IF signal. Further amplification is provided before the tone signal is delivered to an actuating circuit.

As can be seen in the circuit diagram (figure 2), the receiver employs three transistors and an integrated circuit. Several functions shown in the block diagram of figure 1 are contained within the integrated circuit.

The frequency conversion section of the circuit comprises transistors T1 as mixer and T2 as a crystal controlled local oscillator. The latter operates at a frequency of 26.800MHz. The transmitted carrier frequency of 27.255-MHz appears at the aerial and is coupled into the base of T1 via an 8.2pF capacitor and a tuned circuit.

This is not the only transmitting frequency which can be used. The model-control band extends from 26.957MHz to 27.282MHz and, in theory, one could use any frequency between these limits. In practice, a number of specific frequencies have been nominated by model-control enthusiasts, and these are the most popular ones. Any one can be used provided the associated receiver is fitted with an appropriate crystal; that is, one which is 455KHz lower than the transmitter frequency. The table below lists the preferred frequency pairs.

Transmitter crystal frequency	Receiver crystal frequency
26.995	26.540
27.045	26.590
27.095	26.640
27.145	26.690
27.195	26.740
27.255	26.800

A tuned circuit is used at the input to provide initial selectivity by rejecting, to some extent, unwanted carrier frequencies. To achieve maximum rejection it is necessary to have T1's emitter tapped into the coil at a low impedance level. This reduces the damping effect on the tuned circuit.

It is particularly important to tap at a low impedance point because, so far as the incoming signal is concerned, T1 is connected as a common base amplifier. In general, this configuration has superior high-frequency performance, but the input impedance at the emitter is lower than the base input impedance of a common emitter configuration.

Local oscillator signal is coupled into the emitter of T1 by a 2.2pF capacitor and appears across a 10-ohm resistor. There is, in addition, some leakage of local oscillator into the mixer circuitry due to stray capacitance. The heterodyned-frequency product (455KHz) is fed from the collector of T1 into the IF filter.

We have used a ceramic transfilter to provide the IF selectivity because it is extremely small and lightweight. A transfilter is a piezo-electric device with some characteristics similar to a quartz crystal. By virtue of its physical construction, the transfilter can be used in place of a conventional-tuned IF transformer.

IF amplification is provided by an integrated circuit. Then follows the trans-

PARTS LIST

1 Printed wiring board, 70/R1.
1 Quartz crystal, see text.
1 Murata transfilter, type SFD-455B.
1 Aerial coil, 22SWG, enamel wire for same.
1 Ducon adjustable mica capacitor, 12-120pF.
1 National Semiconductor integrated circuit, type LM372.
2 BF115 or equivalent.
1 BC108 or equivalent.

RESISTORS (5 p.c. ¼ or ½-watt).

1 82K, 1 x 47K, 3 x 10K, 1 x 4.7K, 1 x 1.8K, 1 x 1.5K, 2 x 470 ohms, 1 x 10 ohms.

CAPACITORS:

1 10uF 16VW tantalum.
2 1uF 25VW tantalum.
2 0.1uF metalised polyester.
2 .047uF ceramic.
2 .01uF ceramic.
1 150pF polystyrene.
1 10pF ceramic.
1 8.2pF ceramic.
1 2.2pF ceramic.

Note: National Semiconductor products are available from Rutherford Electronics Pty. Ltd., of 833 Doncaster Road, Doncaster, Victoria, 3108.

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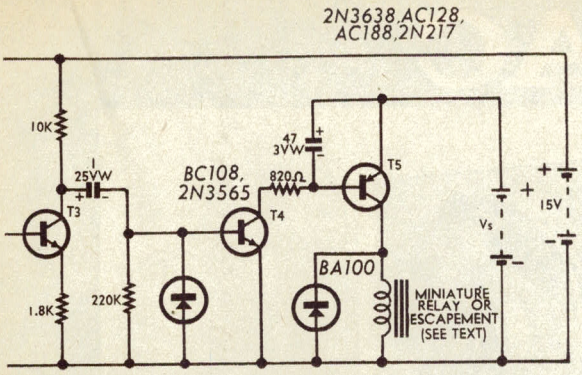


Figure 3

This very simple actuating circuit relies on R/C coupling to the receiver, the diode rectifying the audio tone to produce a DC potential. This is utilised by T4, T5 to operate the relay.

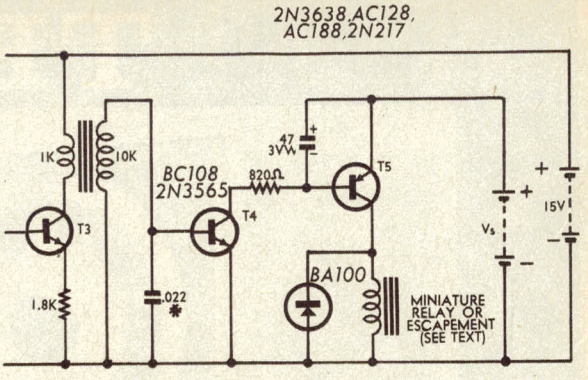


Figure 4

By using a suitable transformer in the output circuit of the receiver, greater sensitivity can be obtained. Then, by tuning the transformer to the control tone, the response to noise is reduced.

filter, which provides most of the receiver's gain. Using an integrated circuit greatly simplifies the receiver both in terms of design and construction, particularly as the IC has an internal automatic gain control system (AGC).

Automatic gain control is desirable as it enables the receiver to give a constant output in conditions of varying signal level. When the signal level is high the IF amplifier reduces its gain, thereby preventing overload of subsequent stages. However, when the signal level is relatively weak the IF amplifier has maximum gain and the receiver as a whole then has greatest sensitivity.

The integrated circuit also incorporates an "active" detector which recovers the audio modulation. The detector is termed "active" because, in addition to recovering the audio modulation, it provides some audio amplification.

Further audio amplification is provided by T3, a silicon PNP transistor which is directly coupled to the IC's output. This final stage has a voltage gain of approximately five times.

From the specifications for the LM372 integrated circuit, the audio output voltage is approximately 0.8 volts peak-to-peak within the range of AGC. Hence the output voltage from the receiver at the collector of T3 will be approximately 4 volts peak-to-peak.

Thus, up to this point, we have a sensitive superheterodyne receiver which can deliver quite a high level of audio tone voltage in response to a signal radiated by a control transmitter. But this is by no means all that is required for an operational control system in a model.

To perform useful control functions, the receiver's output must be fed to decoding and actuating circuitry. For a single channel system providing only one control function, decoding circuitry is usually not necessary. However, any system must have actuating circuitry in the form of a relay or escapement to translate the receiver tone output into electrical or mechanical control.

However, in a multi channel system providing a number of control functions decoding circuitry is necessary to enable the various channels to be selected independently. The simplest system uses modulating tones of various frequencies in the transmitter and a reed-bank relay in the receiver. The relay has a number of small reed type armatures which resonate at the various audio frequencies generated at the transmitter.

Thus, when an audio tone is fed to the relay winding only the reed which is resonant at the particular tone frequency will vibrate and close an electrical circuit. The reeds are thus used to operate secondary power relays and escapements in the various control channels.

Electrically operated devices, such as motors in a model boat, are usually controlled by a relay while a mechanically operated device, such as the rudder on a boat or the elevator of an aeroplane, is usually controlled by an escapement. An escapement is similar to a relay in that it has a coil and a moving armature, but instead of opening or closing electrical contacts it controls a mechanical crank, often powered by an elastic band.

Elaborate systems often use servomotors to provide the mechanical force to drive the various control elements. As their name suggests, these motors can be controlled both in terms of direction of rotation of the armature and of the speed and/or distance travelled by the mechanical linkages.

There is a multitude of decoding systems and circuitry for multi-channel operation together with numerous electro-mechanical actuating devices which can be used in models, but these

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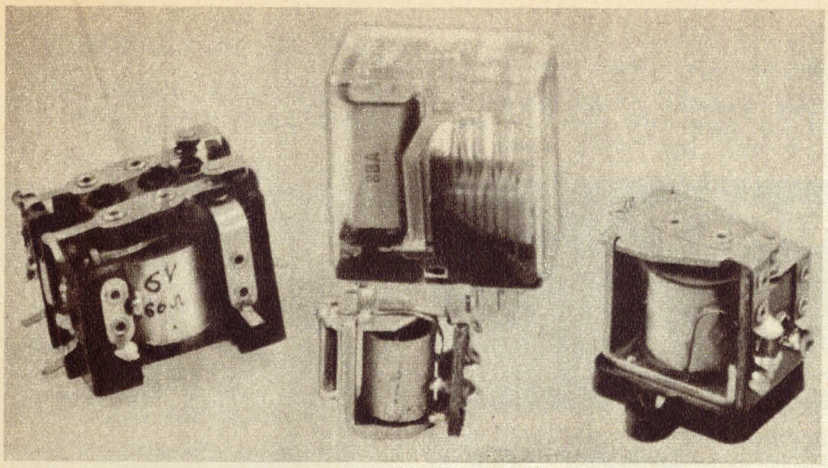
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Model control enthusiasts must be prepared to scout around to find components which are small enough and suitable for their requirements. The miniature relays at left and right came from H and N Products, 6 Middleton Road, Dee Why, N.S.W. The relay at the rear is an English-made Varley unit obtained from Associated Controls Pty. Ltd., 14 Enterprise Avenue, Padstow, N.S,W,

are a whole topic in themselves, requiring many pages for an adequate description. For this reason we must limit discussion to that of a receiver plus two single channel actuating circuits and a multi-channel reed relay actuating circuit. These are shown in figures 3 to 5.

The simplest actuating circuit is shown in figure 3 and consists of two transistors used to drive a miniature relay or claw-escapement. The relay circuit is connected to the collector of the audio output transistor in the receiver proper (T3), via a 1uF tantalum electrolytic capacitor. Tantalum capacitors are specified because of their small physical size and weight.

The alternating audio tone from the receiver is rectified by the action of T4 together with the OA91 germanium diode and then filtered by the 47uF (tantalum) capacitor. The DC voltage across the capacitor is applied to the base of T5 causing it to conduct and activate the relay. A second diode (BA100) is connected across the relay winding. This is a precaution against transistor damage which might occur with some combinations of relay and transistor types, due to inductive voltage spikes.

When working with the prototype circuits we tried a number of different relays and a small "OS" brand claw escapement. The various relays and the escapement all had different voltage and current requirements and to accommodate this we simply altered the supply voltage to the actuating circuit (T4 and T5) to suit.

Due to the voltage across T5 when it is conducting and saturated it is necessary to have a supply voltage (Vs) slightly greater than that normally required for the particular relay in use. With a 12V relay a 15V supply should be used, but the coil resistance of the relay should be sufficient to limit the current through T5 to around 300mA. However, this current should be more than adequate to operate even a moderately sized relay.

The current limit results from the maximum allowable power dissipation in T5. There is also a maximum allowable collector to emitter voltage rating for T5. Because of this, the relay supply Vs should not exceed 15V.

If a 6V relay is used, Vs should be made 9V for reliable relay action. And with most claw-escapements requiring 3V Vs should be, say, 4.5V. Again, the current through T5 should not exceed 300mA.

While it is necessary to have a separate battery supply for Vs where the voltage is other than 15V, this does offer an additional benefit in receiver reliability. With a separate relay sup-

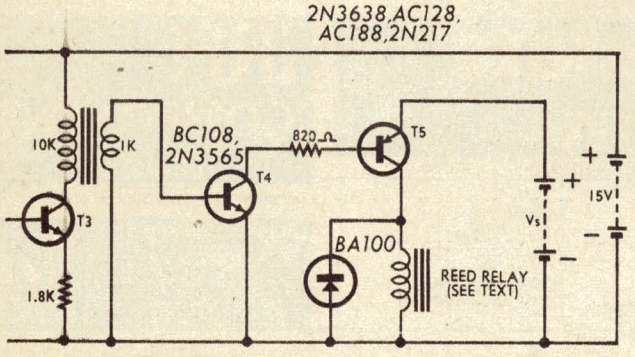


Figure 5

Modified from figure 4, on page 57, this circuit lends itself to multi-channel operation. Operating without bias, the transistors feed rectangular-shaped pulses to a resonant reed relay system.

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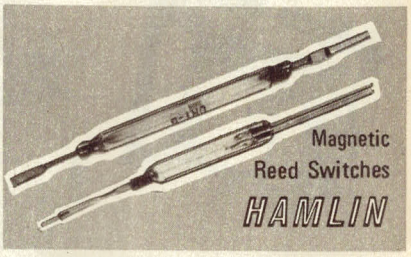


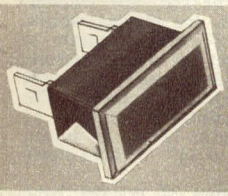
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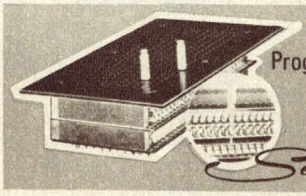
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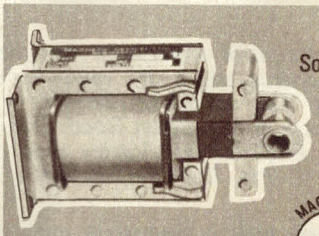
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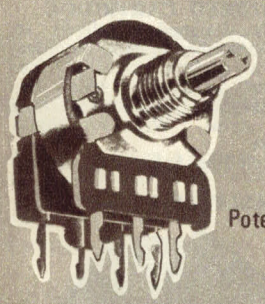
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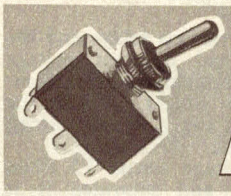

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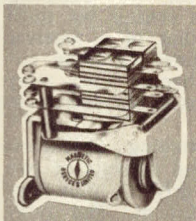

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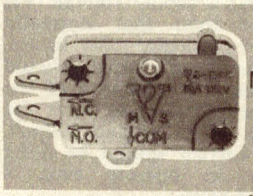

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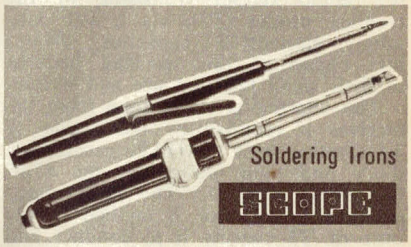

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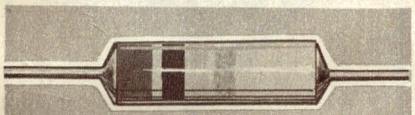

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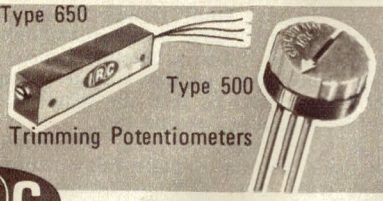

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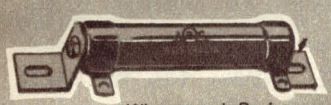

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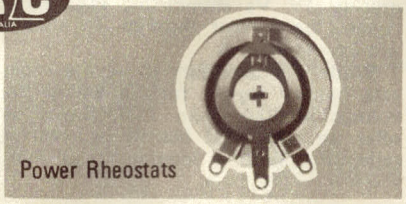

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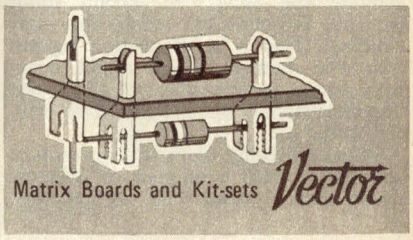

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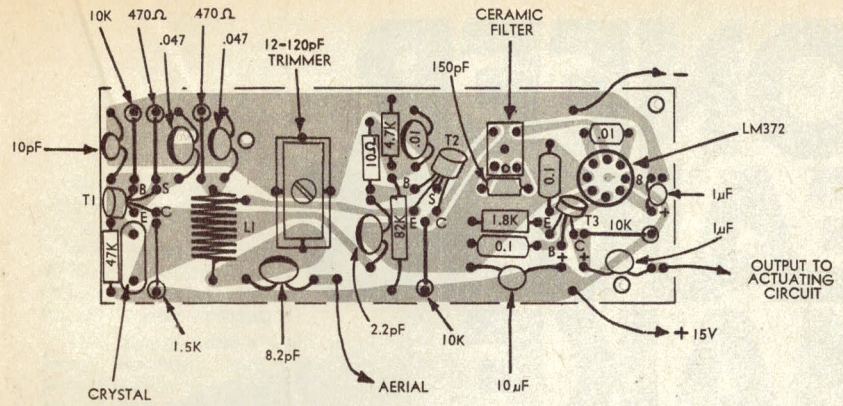
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Once the printed wiring board and the appropriate components are to hand, the job of actually assembling the receiver could hardly be more simple.

ply the chance of erratic operation due to relay switching transients is minimised.

An improvement on the actuating circuitry is shown in figure 4. Essentially, this requires a modification in the output stage of the receiver. By replacing the resistive collector load in T3 with an audio transformer the overall sensitivity is improved markedly. In addition, by tuning the transformer secondary winding to the audio tone frequency, the actuating circuit can be made insensitive to the effects of man-made noise.

The transformer which we used was a minature Japanese audio type (REX, LT-43A) with an impedance ratio of 10K to 1K. However, the ratio is not overly critical and a ratio of 10K to 2K would probably be suitable with a slight loss of sensitivity. A tone frequency of 450Hz was used for the prototype work and the transformer was tuned to this frequency with a .022uF capacitor. However, for other transformers it may be necessary to modify this value for a tone of 450Hz. For other tone frequencies modification of the capacitor value will be essential.

To summarise, the actuating circuits in figures 3 and 4 are both for single channel operation of a relay or escapement. The circuit in figure 4 offers improved sensitivity with some noise rejection, but it requires an audio coupling transformer.

An actuating circuit for multi-channel operation is shown in figure 5. Decoding of the various tones for different channels is provided by a resonant-reed relay, driven by a transistor amplifier consisting of T4 and T5. The combination of transistors is essentially the same as for the other circuits except that the 47uF electrolytic capacitor is omitted.

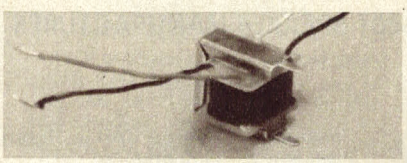
With this arrangement, signal from the receiver output is coupled into the base of T4 via the audio transformer. Both T4 and T5 operate without any forward bias. This makes for a very efficient amplifier, even though the signal delivered to the reed relay coil is closer to a square wave than a sine wave. This presents no problem, since the relay will operate just as reliably from a square wave as from a sine wave. Most such relays will require a supply voltage of six.

While a transformer is used to couple this circuit to the receiver output it could be replaced by the 10K resistive load and 1uF coupling as shown in figure 3. However, some loss of senstitivity would result. The OA91 diode would have to be included as in the other capacitively coupled circuit. Note that the transformer secondary should not be tuned as a number of different tone frequencies will need to be handled for a multi-channel reed-relay system.

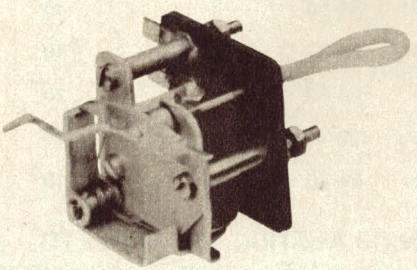
While we have made a number of suggestions for actuating circuits to be used with the basic receiver, they are by no means the only ones which are suitable. Constructors can combine the receiver with any other actuating system which they may favour.

Circuits for multi-channel systems without using reed relays and circuits for digital and servo control are available in regular modelling magazines which specialise in radio control systems. We suggest that readers who are interested in radio control should acquaint themselves with such magazines in order to learn more about these systems.

The purpose of this article is to present the radio link together with



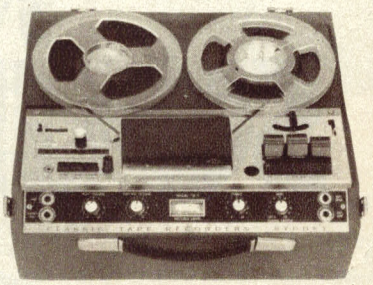
The miniature transformer referred to in the text. It is pictured about normal size.



Also pictured about normal size is a miniature escapement relay. Power for the mechanical function controlled by the escapement may be supplied by a twisted rubber band.

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PAX-A25	10	fo-20,000	23-37	8	40	101	2 WAY
PAX-25B	10	fo-20,000	40-50	8	20	102	2 WAY
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the three simple actuating circuits. There should be no problem in taking the receiver output, by way of either capacitive or transformer coupling, and applying it to other actuating systems and circuits.

All of the receiver circuitry shown in figure 2 is accommodated on a printed wiring board. Because of the variety of actuating circuits, however, it is not possible to arrange a wiring board for this section.

For transformer output coupling the 10K collector load resistor for T3 and the 1uF capacitor should be omitted from the wiring board and the transformer leads inserted in the mounting holes for the resistor. However, there is no place on the board for the transformer and this should be mounted with the rest of the actuating circuitry on a second assembly.

In order to keep the receiver's weight to a minimum, constructors may use miniature ¼-watt resistors mounted flat on the wiring board. However, the more usual ¼-watt resistors may be used, as in the phototype, in which case they should be mounted upright on one end.

When constructing the receiver, mount all the resistors and capacitors first, including the 12-120pF tuning capacitor. Then mount the transistors and integrated circuit, being careful to correctly orientate the IC, and attach the various leads and aerial wire. Fairly fine wire which will fit in the small wiring board holes should be used.

The aerial consists simply of a 24in length of hookup wire connected to the aerial terminal on the wiring board. Note that it is important to use only 24in of aerial wire with this particular input circuit, otherwise the receiver's performance could be upset.

Constructors should be very careful when soldering the wiring board because of the very fine copper pattern. Do not use excess heat, otherwise some of the copper pattern could lift off the board. Use a small soldering iron.

Details of the coil are shown in figure 5. It is wound from 22SWG enamelled wire and should have an internal diameter of 3/8in. The coil can be wound on the shank of a drill, preferably with a diameter slightly less than 3/8in to allow for coil expansion due to the natural springiness of the wire. It would be best to wind on a few more turns than the required 10, then cut it to 10 turns plus a little excess to mount into the wiring board.

Coil-mounting legs are made on the terminating ends by bending the small excess at right angles to the coil itself. Before mounting the coil stretch it to an overall length of ½in and make the "tap." The tap is at 1½ turns from one end and is made by removing a small amount of insulating enamel and soldering a short length of copper wire to the tap point. The wire then passes through the coil and is wired into the board.

At this point, the receiver should be complete and ready for operation but, before connecting the battery supply, recheck the placement of all components. For optimum sensitivity it is necessary to adjust the aerial circuit tuning capacitor and to do this a transmitter of appropriate frequency is required.

There are several ways of measuring the receiver output while peaking the tuned circuit; perhaps the easiest method is to use a crystal earphone, from a transistor radio, and listen to the audio tone output. To make the adjustment, switch on the transmitter with the aerial almost fully retracted and key it for tone modulation. When the tone is heard, tighten the capacitor adjusting screw from fully slack until the tone is loudest.

The transmitter should now be moved away from the receiver until the tone becomes weak and receiver noise can be heard. Now re-adjust the tuning capacitor again for the loudest tone. It is necessary to have a weak signal when tuning the receiver so that the automatic volume control will not flatten the signal peak as the tuning is adjusted.

While the receiver can be tuned well enough using an earphone, more precise tuning can be obtained by monitoring the tone output on an oscilloscope or meter. If an oscilloscope is not available, the output can be metered using the lowest AC voltage range on a multimeter. However, when peaking the receiver with a meter, provide only sufficient signal level to give a useable meter indication. Most meters with an AC voltage range should be suitable.

As a third alternative, the receiver could be peaked for maximum collector current in T5 in any of the actuating circuits. Again use a fairly weak signal to avoid misleading results in tuning due to AGC action.

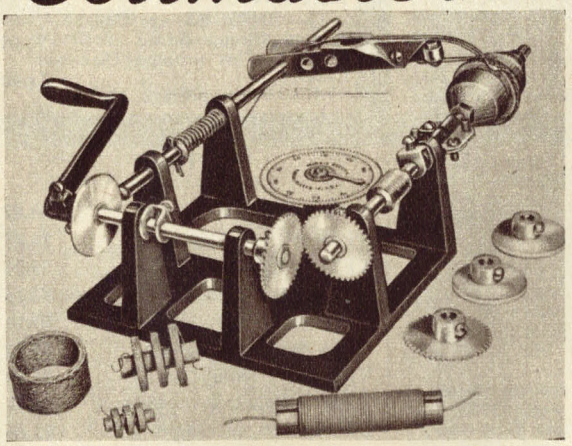
A number of voltages have been given on the circuit. These are measured without any signal from the transmitter. It should be noted however, that the voltages at the emitter

(Continued on page 190)



Here is an exact size copy of the printed wiring pattern given, as much as anything, for identification. Actual boards should be available through parts suppliers while those intending to make their own would be better off to work from a photographic reproduction available through our Information Service for 50c.

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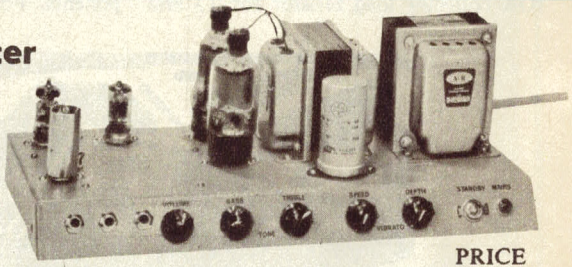
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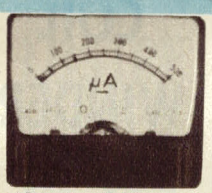
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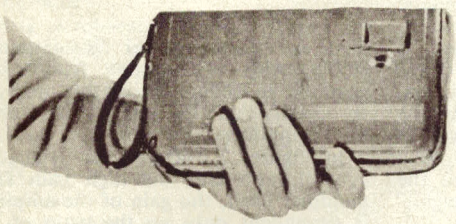
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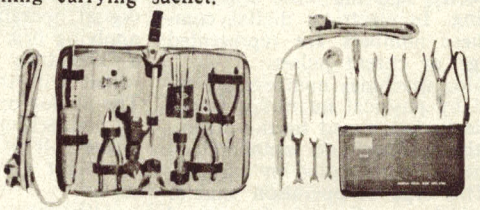
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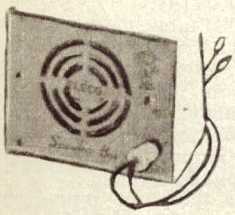


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The Analog Computer

A powerful tool for the scientist and engineer, at times of greater use than its digital counterpart. This article explains the basic principles of operation.

by L. C. Debnam, Instructor in Mathematics and Physics, Darling Downs Institute of Technology.

When the subject of modern computers arises the thoughts of most people turn to high speed digital calculators and data processing machines, and often no thought is given to that other important engineering workhorse—the analog computer.

In digital computers, as used for high speed numerical calculation and data processing, numbers are operated upon directly, and the basic operation is counting. In electrical digital computers these numbers are represented by voltage or curent pulses.

In analog machines numbers are represented by physical quantities whose magnitude is determined by the magnitude of the number, and mathematical operations are represented by physical events. This type of operation enables mathematical operations to be carried out continuously without recourse to repetitive discrete operations of addition, subtraction, multiplication or division.

The basic difference between digital and analog computation may be compared by considering two fundamental types of computer used in primary schools. These are the abacus (digital) and the Cuisenaire rods (analog).

The basic operation of addition, for example 3 + 5, may be carried out on the abacus by placing all beads on the right hand side of the wire, then sliding three beads to the left hand side, followed by a further five beads. The result of these operations is eight beads at the left, thus 3 + 5 = 8.

When using the Cuisenaire rods, if the basic rod (white) is taken to represent "one" the number "three" is represented by the green rod (three times the length of the white rod) and the number "five" is represented by the yellow rod. When the green and yellow rods are placed end-to-end their total length is seen to be the same as the brown rod which represents "eight," thus again 3 + 5 = 8.

These operations may also be effected by simple electrical circuits. The digital operation may be simulated by applying first three, then five pulses to a "Dekatron" or similar counting tube which will then register eight pulses. The analog operation may be simulated by connecting a three volt battery and a five volt battery in series, the resultant eight volts being read on a voltmeter.

Although analog computation can be effectively carried out by mechanical means, such as the slide rule, complex computers are usually of electronic design, where numbers are represented by voltages.

These voltages are generally obtained, in the first instance, via calibrated potentiometers (usually of the ten-turn variety) from a stabilised supply. The number of such voltages is thus limited only by the number of potentiometers available on the machine.

The real heart of the analog computer, however, is the **operational amplifier.** This consists of a high gain (usually greater than 1,000,000 : 1) DC amplifier with sufficient negative feedback applied so that the gain is reduced to the range between about 1 : 1 and 10 : 1 . In such conditions the working gain of the amplifier is extremely stable. Also as negative feedback is required to reduce gain, the amplifier is usually an inverting (180° phase shift) amplifier.

In figure 2, where the triangular symbol represents the high gain D.C. amplifier itself, the gain of the amplifier is dependent only on the ratio of the feedback and series resistors. When both resistors are of the same value e.g., 100K, the output voltage is the same magnitude as the input voltage but the polarity is reversed thus the mathematical operation of inversion or negation is performed.

Multiplication by a constant may also be performed by the same basic circuit. For example if the feedback

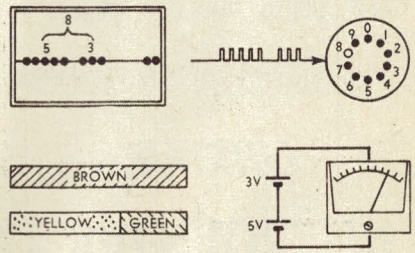


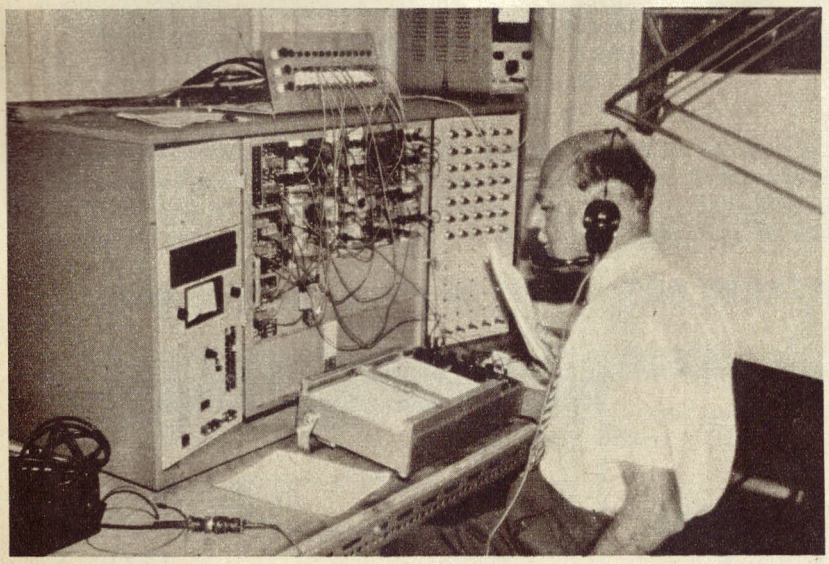
Figure 1: Simple mechanical and electrical devices which perform digital and analog "computation".

resistor is 1M and the series (input) resistor is 100K, the gain is −10, (i.e., multiplication by 10 occurs) and if the feedback resistor is 100K with a 1M input the gain is −0.1. (Note here that the negative sign simply represents inversion.)

Addition may be performed by using extra input resistors as shown in figure 3, where the "common" connection has been omitted for clarity.

In practice the three input voltages are usually from the same source, the input resistors being calibrated variable resistors. A variation of this method uses input resistors of fixed value, the input voltages being supplied from calibrated potentiometers connected as voltage dividers.

Subtraction is the same process as addition, the only difference being that a reverse voltage is used for the number which has to be subtracted. For example to perform the operation "8-5," the feedback resistor and two input resistors are set up with the same value. One input is supplied with +8 volts with respect to ground and the other input is supplied with −5 volts with respect to ground. The output of the circuit will then assume −3 volts with respect to ground, the negative sign in the output being due to inversion. To obtain an output of the correct polarity a further amplifier



A modern analog computer, the EAI "Pace" TR48 which, while compact, is capable of solving quite complex engineering problems. The unit pictured is at the Australian National University.

may be used with a gain of −1, the output then being +3 volts.

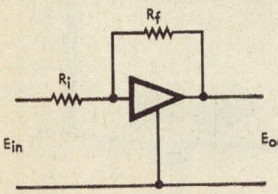
To perform the operation A(B + C), the feedback resistor is chosen to be "A" times the value of the input resistors (equal in value), with "B" volts applied to one input resistor and "C" volts to the other.

This particular operation is particularly useful if the result desired is too great to be handled normally. For example, if the output voltage cannot be greater than 10V due to supply voltage limitations the operation of adding "8 + 8" cannot be carried out by the method "8v + 8v = 16V" so the system is set to perform the operation

$$0.1(8 + 8)$$

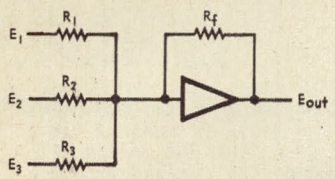
and the result is multiplied by the appropriate corrective "scale factor," in this case ten.

More complicated operations such as differentiation and integration may also be performed with the operational amplifier. These operations are illus-



$$E_{out} = -\frac{R_f}{R_i} E_{in}$$

Figure 2: The basic operational amplifier.



$$E_{out} = -\left(\frac{R_f}{R_1}E_1 + \frac{R_f}{R_2}E_2 + \frac{R_f}{R_3}E_3\right)$$

Figure 3: The operation of summation.

trated in figure 4, where, for integration, the applied voltage is removed after time "t."

While theoretically feasible, the differentiating circuit shown in figure 4(b) is rarely used in practice, as low-level noise is amplified with the required signal and the result is rather inaccurate. In practice differential equations are usually solved by integration methods.

The foregoing remarks have only considered static inputs, i.e., inputs which represent **numbers.** When pure numbers are being considered the analog computer is not as useful as the digital computer, as the digital computer is capable of far greater accuracy. The analog computer, however, is extremely useful for solving equations involving functions, i.e., expressions for which graphs may be drawn, such as sin(x), cos(x), log(x), and so on.

When functions are to be added, for example

$$\sin(x) + \cos(x) = ?$$

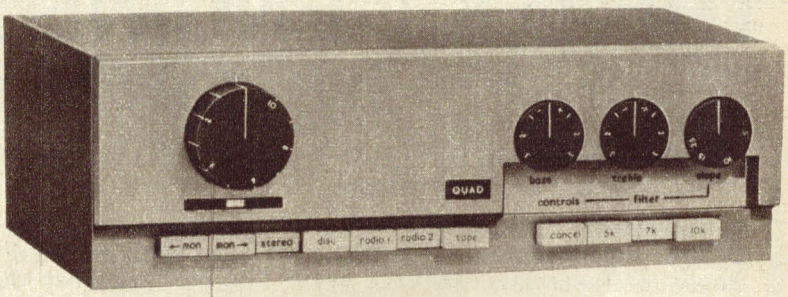
time-varying voltages may be applied to the inputs of figure 3, and the output may be applied to a recorder or oscilloscope to be drawn as a graph, from which the value at any specific

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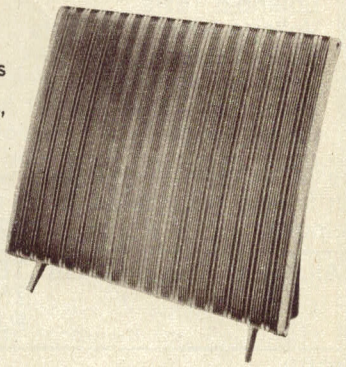
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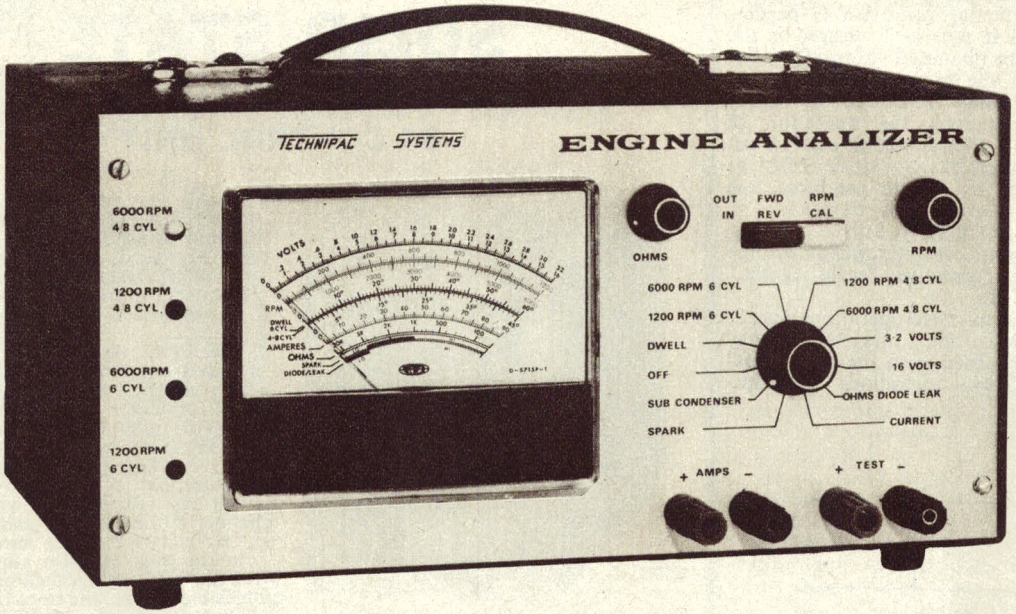
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point may be determined.

For this purpose the analog computer contains circuits which are capable of generating voltages which vary according to standard functions. Functions such as the sine function may be readily generated with normal electronic oscillators, and as the voltage varies with time the correct notation is sin(t), where t is the variable.

Although a great variety of functions may be generated directly, many cannot, and devices known as "Variable Function Generators" are used to provide these. Some variable function generators are preset to common functions such as x^2 and some are

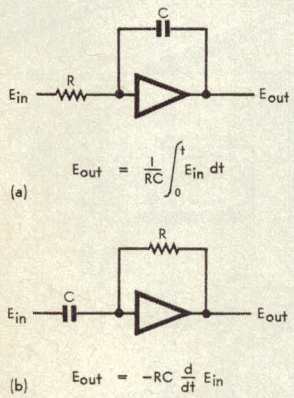


Figure 4: Integration (a) and Differentiation (b).

usually available for the operator to set as he wishes.

To understand the operation of the variable function generator the graph of a function "f" shown in figure 5, should be considered. If the value of the function, i.e., the point on the graph, is known for x equals a, b and c in this diagram, these may be placed in position on the graph. The approximate shape of the graph may be obtained by connecting these points by straight lines. Obviously the more points that are known the shorter are the straight lines, and the approximation is nearer to the correct shape.

The vertical axis of the graph of figure 5 may be a voltage which steadily increases from zero to the first breakpoint as the input voltage increases, then increases at a different rate until it reaches the second breakpoint. Such a process can continue as long as is desired and by setting the points to which the voltage must increase (or decrease) any function may be generated.

The simplest type of function generator is the **potentiometer function generator** shown in figure 6. Usually such a potentiometer has 15 to 20 tapping points equally spaced along its length. The "input" i.e., the value of "x" on the graph is determined by the mechanical position of the potentiometer wiper and control shaft, and the ouput [f(x)] is the voltage obtained at the wiper.

The disadvantage of the potentiometer function generator is that the input is in mechanical form (position of the control shaft) and the output is in voltage form. A more useful type of function generator is the **diode function generator** illustrated in figure 7.

In the diode function generator the breakpoint control is used to set the

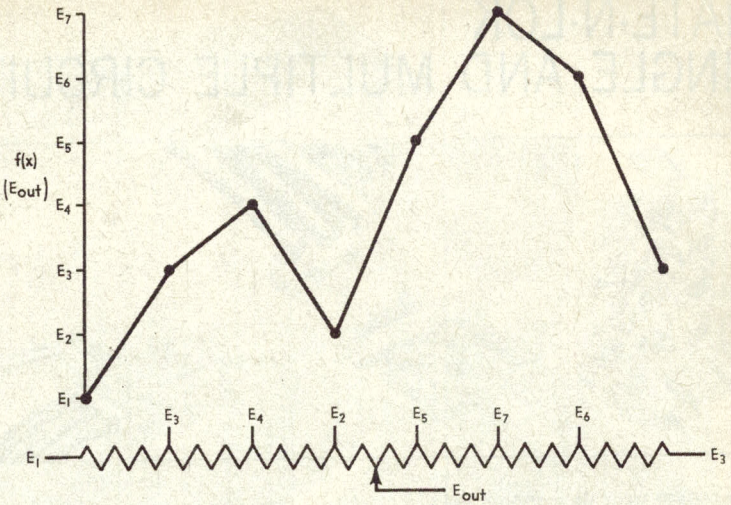


Figure 6: The potentiometer function generator.

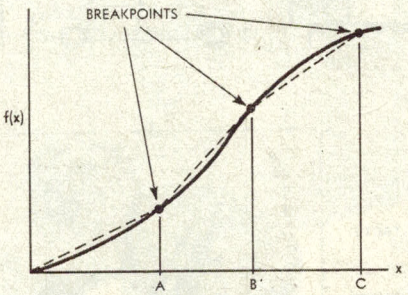


Figure 5: Approximation of a function using straight line segments.

bias on the diode so that conduction does not occur until the breakpoint value of the input voltage (x) is reached. When the diode conducts the gain of the amplifier is changed to an extent determined by the value of the section of the "slope" control concerned. This in turn determines the steepness or slope of the graph, so that the graph of the function is composed of a number of breakpoints with pre-determined slopes between them.

In figure 7 only two diodes are shown but in practice the number used is dependent on the number of breakpoints required.

An advantage of the diode function generator is that the breakpoints are not clearly defined, due to non-linearity of the diodes, and rounded corners are obtained on the graph. This generally results in an approximation even closer to the original function than that obtained with pure straight-line segments.

As illustrated in figure 2, multiplication by a fixed number is relatively simple. But if two numbers are obtained as the results of problems and these two numbers are required to be multiplied, some difficulties arise with this method. The major problem is that the gain of the amplifier, i.e., ratio of feedback to input resistor, must be manually set to equal one of the numbers, which is time consuming and introduces a possible source of error.

To avoid this, a device known as a **quarter squares multiplier** is often used.

The quarter squares multiplier relies for its operation upon the well known mathematical identity

$$xy = \frac{(x + y)^2 - (x - y)^2}{4}$$

Basically it consists of five amplifiers and two squaring circuits, in the configuration shown in figure 8. However, where the squaring modules used are only capable of dealing with voltages of one polarity a more complex arrangement is used.

An analog computer may be designed and built to solve one specific problem, but is generally more useful if built in a general-purpose form. The general purpose form usually entails the mounting of input resistors, amplifiers, potentiometers and function generators as discrete modules which may be interconnected as required by the use of plug-leads.

This enables the operator to set up any arrangement that he wishes, in the same way that programming a digital computer involves writing instructions to "tell" the computer what to do at each step.

A typical arrangement of com-

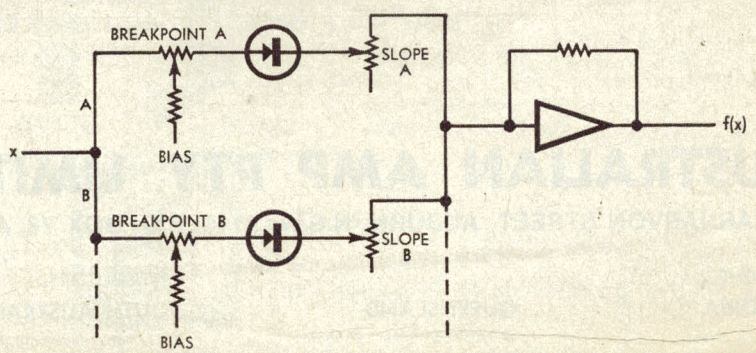
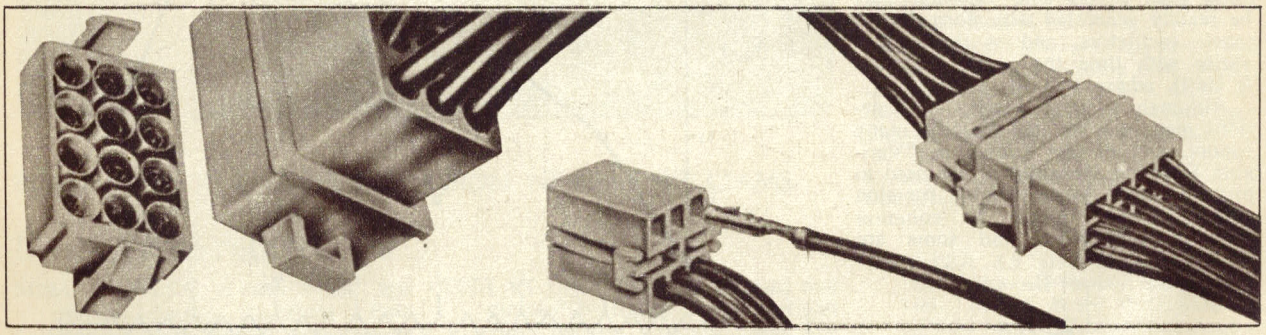
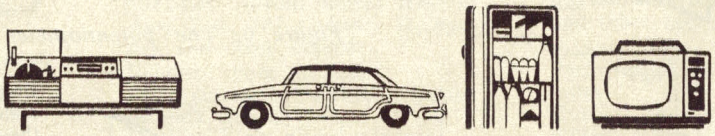


Figure 7: The diode function generator. Only two diodes are shown.

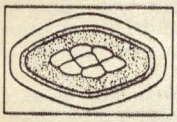
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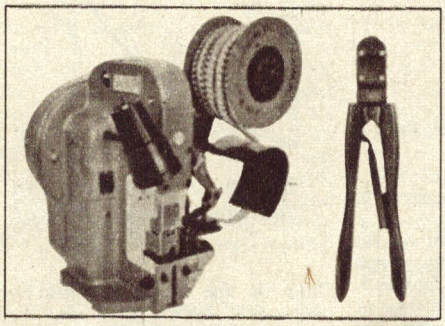


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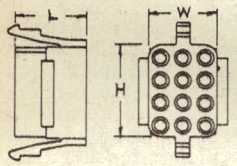


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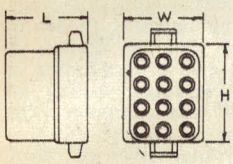
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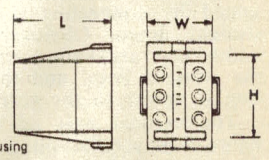


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No. of Circuits	Housing Part No.	Dimensions H	W	L	Type
1	Pin 1-480350-0**		.300	1.200	Panel Mount or Free Hanging
	Socket 1-480340-0**		.255	.870	
2	Pin 151679**	.600	.320	1.055	
	Socket 151680*	.598	.320	.975	
3	Pin 1-163037-0**	.890	.320	1.055	
	Socket 1-163038-0*	.880	.320	.975	
6	Pin 1-163035-0**	.660	.970	1.055	
	Socket 1-163036-0*	.600	.880	.975	
12	Pin 1-163031-0**	1.215	.965	1.055	
	Socket 1-163032-0*	1.165	.880	.975	
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	Socket 925008-0**	.840	.695	.975	

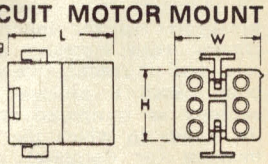
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For Details of Panel Mounting holes Consult Australian AMP



Socket Housing

6 CIRCUIT MOTOR MOUNT



Pin Housing

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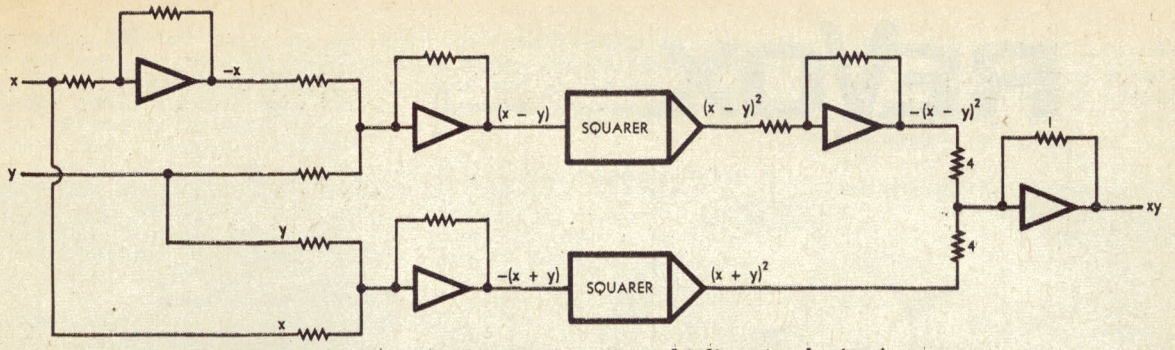


Figure 8: The "quarter squares" multiplier, in basic form.

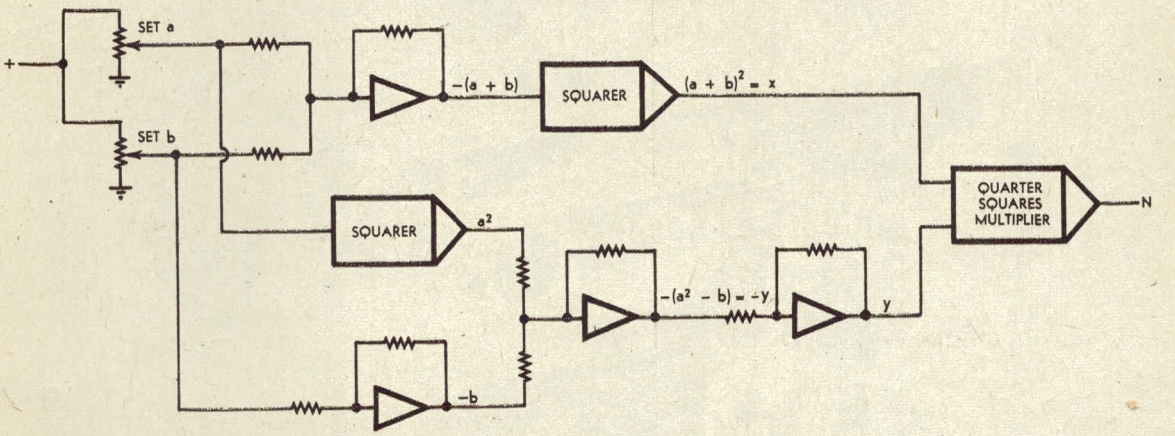


Figure 9: An analog computer setup capable of solving the equation given below in the text.

ponents and modules in an analog computer is shown in figure 9, where the computer is set up to solve the equation

$$(a + b)^2 \times (a^2 - b) = N.$$

To solve this a and b are set by voltage divider networks from a standard voltage source, added and fed to a square function generator. This gives the value for +x which is then fed to a quarter-squares multiplier.

At the same time "a" is fed to a square function generator and "b" to an inverter to obtain "−b." These are fed to an adder to obtain −Y which is also fed via an inverter to the quarter-squares multiplier, which therefore has an output equal to "N."

Voltages "a", "b" and "N" may be simultaneously monitored by voltmeters, and by setting a and b to the required numbers N may be determined directly.

The advantage of an analog computer in situations like this is that the inputs may be varied continuously as required and the result, N, is immediately available. If a digital computer were used the whole problem would generally have to be recalculated each time using the new numbers.

A further advantage of the analog computer is that once set up to solve a particular problem, it can be used to determine easily the answers to other questions about the problem situation, different from the original question. Hence the circuit of figure 9 may also be used to answer such further questions as "For what values of a and b does N=3?", or "If a=2 and N=6, what values can b have?"

A facility which is often built into modern analog computers is a repetition system which permits circuit parameters to be varied automatically over a set range, so that the results for various parameter values may be plotted for repeated calculations. This enables the operation of such things as feedback control systems to be simulated, and possible trouble centres localised.

There are many situations in engineering design where the ability to vary parameters is useful to determine allowable tolerances in construction. Such variations may be determined by digital computers, but digital computer time is relatively expensive and for many establishments is not readily available. In situations such as this the analog computer is a useful tool.

For design work the initial design may be carried out by an engineer or team of engineers. If the plant is to be expensive or dangerous the design may then be checked by an analog computer, after reduction to equivalent mathematical terms, and preliminary tolerances determined. If the design is feasible the pilot plant is next constructed and any operational variations from the original design noted. These variations are then set up in the analog computer circuit where the new tolerances and optimum plant operating conditions may be determined.

The analog computer is not a replacement for the digital computer although, like the spade and the shovel, they can often be used for the same job. The analog computer has limited accuracy because components such as resistors are rarely more accurate than ±0.1 per cent, but very often this is not a significant disadvantage as, for example, variables such as the tensile strength of steel often cannot be determined to better than ±10 per cent. ■

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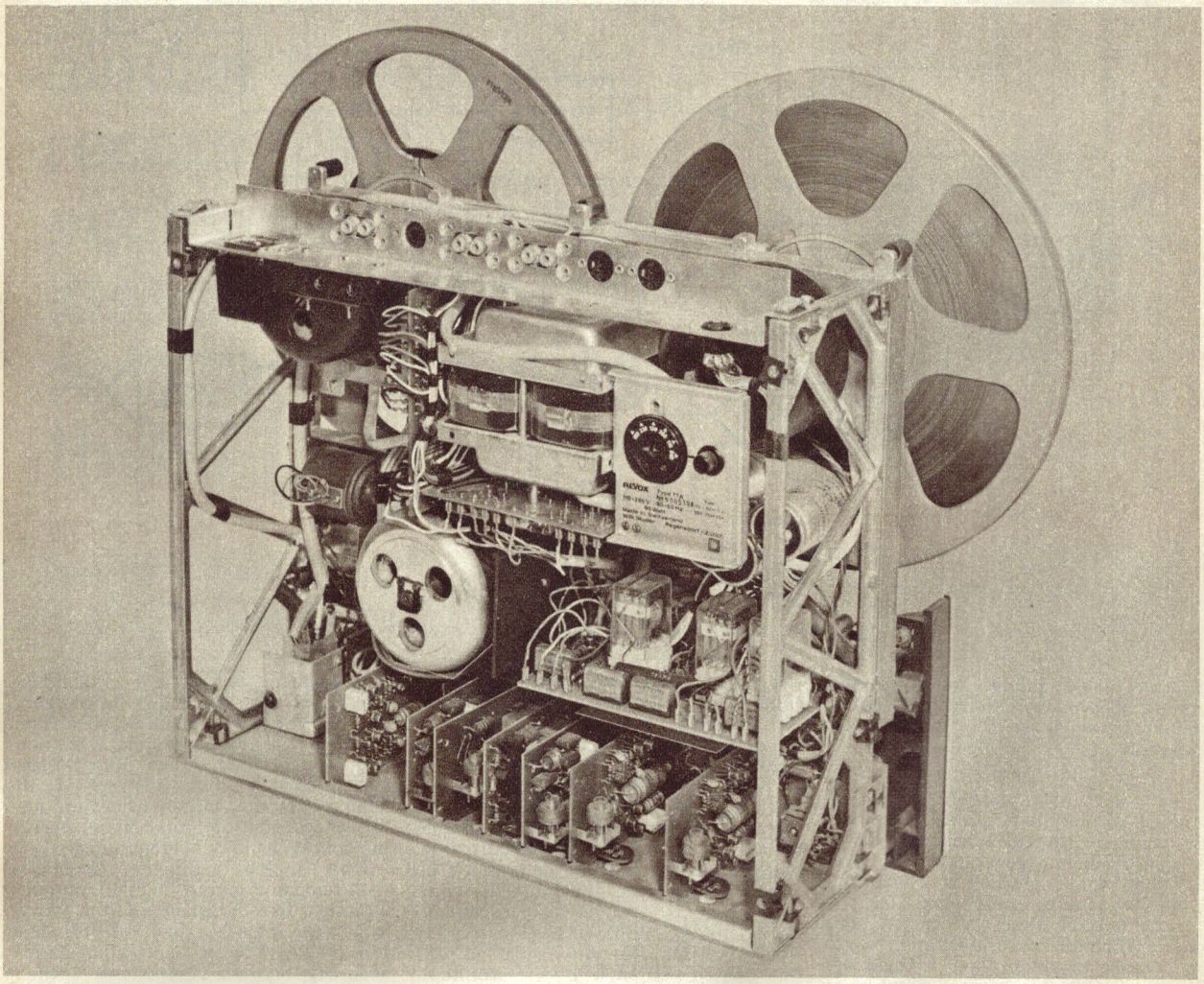
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THE SERVICEMAN

Misery is an amplifier without its watts!

"It never rains but it pours" might be the appropriate introduction to this month's "Serviceman." To be faced up with a public address amplifier is a fairly unusual event in the everyday round. To strike two similar amplifier problems in quick succession is indeed noteworthy.

For me, the story began with a phone call from the proprietor of a small reception centre on the fringe of my district—one of those places which which Mr and Mrs Suburbia hire for an afternoon or an evening when a daughter turns 21, or decides to get married.

This particular one was a fairly humble set-up, adapted from what had once been a community hall, and run on a shoestring by a husband and wife team. My only reason for mentioning this is to add that the amplifier system was also a "shoestring" job, of indeterminate make and age, which the owner confessed to having bought cheaply from a "bloke who no longer had any use for it."

While the amplifier had apparently changed hands fairly cheaply it wasn't, in fact, a bad sort of a unit. It had two microphone and two pickup channels, with mixing facilities and provision for a variety of loudspeaker loads. It was protected on top by a perforated steel cover and underneath by a steel baseplate. Removing the latter revealed tidy wiring and an array of venerable but quite respectable components.

Peering through the perforated top cover, I could make out two or three small octal valves and a couple of 807 output tetrodes.

The presence of the 807s indicated that the amplifier should have been able to fill the area with sound to spare, but a listening test confirmed that all, indeed, was not well with the old warrior.

Turning up the volume with a record playing produced a signal that was anything but clean. But, then again, there was none of that gross, raspy distortion that one so often hears when failure of a valve or component causes severe non-linearity and early overload. The trouble seemed to be most apparent on the bass notes; in fact, when there was no heavy bass present, it was almost possible to convince oneself that the system was okay. In fact, my first impulse was to blame the pickup which, as far as I could see, was a crystal or one of the early ceramics.

But suspicion of the pickup was dismissed by the sound when the owner spoke over the microphone. Again, the distortion was not gross and it didn't seem to occur at a particular sound level. It was just as if the speaker had a slightly sore throat. There was also another quality about it which I couldn't understand: almost as if the sound had a built-in echo!

I know it sounds crazy but that's the best way I can describe the effect.

When the owner mentioned that the place would be closed for a few days for painting and redecoration, I suggested that the best thing I could do would be to take the amplifier back with me and give it a good going-over on the bench. He agreed and, while I was disconnecting it from the wiring, he disappeared, with the remark that he thought he had some spare valves somewhere.

The spare valves turned out to be a motley collection of octal types and a whole batch of 807s, which had been part of the original deal.

Back at the workshop, later, I located a heavy-duty tapped resistor that I keep around for the odd amplifier job. The full 15-ohm section was wired to the 15-ohm output on the amplifier, to act as an output load. Across this I connected the VTVM



"I'm getting just a little suspicious of these late emergency calls!" ("PF Reporter")

set to the 30-volt AC range, and the workshop oscilloscope. (Having been caught before, I made sure that the earthy side of the instruments were together on the earthy side of the amplifier output circuit).

With a 1000Hz signal to one of the pickup inputs, I was set to check the waveform and measure power output although, with no circuit and no specifications, I had no clue what the output was supposed to be. I could only guess that I should find something between 20 and 30 watts.

But alas, as I wound the gain up, the output waveform began to flatten noticeably on one side with only about 8 volts RMS across the 15-ohm load. I didn't need a slide rule to know that 8 x 8/15 represented only about 4 watts. No wonder the amplifier sounded sick!

Next step was to run over the voltages and, again, while I had no circuit to go by, a figure of around 370 on the 807 plates and 290 on the screen seemed likely enough. The bias was in the 20-25 volt region (I am relying on memory) but it was, again, a likely enough figure. And the same remark was true of all the other voltages around the rest of the stages. It looked as though I wasn't going to find just a dud resistor or coupling capacitor to account for the problem.

I wondered what would happen to the voltages when I advanced the output from zero to the very modest overload level? With the multimeter lead on the 807 screens, I did just this — to find that the screen voltage increased slightly with signal. So did the plate voltage, but the bias voltage decreased. This was crazy, for the voltages should have behaved in just the reverse manner.

Very obviously I would have to have a good look at the components around the output stage, particularly as the overload pattern had showed that one side was flattening well before the other.

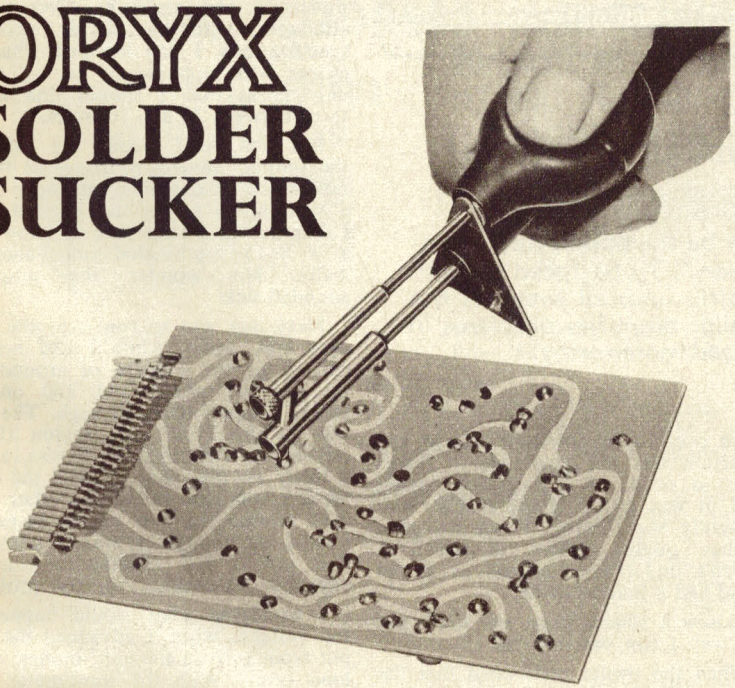
And here I "struck oil." From one grid to ground measured about 0.5 megohm; from the other grid to ground, there was an open circuit. No wonder the voltages, and presumably the currents — had been playing tricks, with one of the output grids floating around in a quite haphazard fashion. No wonder the amplifier had sounded peculiar on high amplitude bass signals, and almost normal on signals of lesser amplitude.

Even the "echo" effect could probably be accounted for by the grid being influenced by charges from high amplitude pulses which it could not get rid of through the open-grid return circuit.

Quite convinced that the trouble had been found, I replaced the resistor and again checked power output. It had improved, all right; I now had a whole 6 watts! At least the voltages and currents were behaving themselves but the big question remained unsolved: Why only 6 watts?

There was nothing for it but to go through the almost forgotten audio routine. First, I disconnected the negative feedback so that I could follow the signal through the amplifier stage by stage and see where the overload was occurring. This cannot be

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done at all readily with feedback operating because distortion anywhere inside the feedback loop will be fed back to the point of feedback injection and appear in all stages in the loop.

With the feedback disconnected, I turned the gain of the amplifier to the 6-watt overload point and, with the oscilloscope lead had a look at the signal stage by stage. Rocking the gain control up to and beyond the overload zone, there was no sign of any distortion on the signal anywhere along the amplifier chain or on either of the 807 output stage grids. The overload was clearly confined to the output stage.

Either one or both of the 807s were faulty, or the output transformer had a partially shorted winding. And I sincerely hoped that it would not be the latter.

Swapping over the two 807s caused the flattening on the CRO pattern to change from bottom to top. That seemed to clear the output transformer and point to the output valves. So I grabbed one of the spares which had been supplied and plugged it in in place of one of the existing valves.

This produced slightly less flattening and a whole 7 watts clean.

Knowing how confused one can get swapping push-pull valves around, and observing that the amplifier has a standby switch on the HT supply, I decided on a bit of rough justice. I simply removed one output valve altogether and checked the power output with one 807 only in position. I reckoned that such a test would be more conclusive than messing around with a valve tester.

The result was most enlightening. Both the original 807s and most of the other spares managed to produce about 5 watts each, but two of the batch gave 10 watts or more. Plugged in together, the two good ones produced just on 20 watts of steady-tone audio. Since this seemed to be a reasonable figure, and since I had no new 807s in my own stock, I decided to call it a day.

In fact, the owner was quite delighted with the amplifier when it was reinstalled and claimed that it sounded far better than it had done for a long time—a statement which I found no difficulty in accepting. The only sour note was my advice to throw into the garbage can all the 807s that he had been safeguarding as spares. Whatever their history, they were certainly no good now. They would only confuse any future situation.

That was the first job.

The second was in my lap, almost before I had time to draw breath.

Well satisfied with the P.A. system, the owner beckoned me over to a small electronic organ which was apparently a permanent part of the equipment. He switched it on and invited me to listen.

The sound was pleasant enough until he played a bass note on the foot pedals; then the treble notes seemed to get all mixed up with the bass. The owner had worked out that the trouble seemed to be worse with some stops than with others and it therefore had to have something to do with the stops.

However, having heard troubles like this before, I said that it would almost certainly be an amplifier problem.

Playing the treble notes alone, the amplifier could handle the signal reasonably well. But, when a big bass signal was added, bad intermodulation distortion occurred, so that the bass notes seemed to chop the treble notes into little pieces.

I suggested that I ought to take the organ amplifier back to the shop and put it through the same tests that I had done on the P.A. system. And this was what I was commissioned to do.

The organ amplifier turned out to be a good deal more modern than the other one but the circuit itself was much the same, with 6CA7s in the output sockets.

And believe it or not, it also gave 6 watts of output before overload, with severe flattening on one side.

Yes, I checked the grid resistors, checked all the voltages, disconnected the feedback and had a look at the waveform. Again, there was signal drive to spare up to each of the output valve grids. And, again, the lack of power either had to be due to the output valves or the output transformer.

So I swapped the valves around and observed that the unequal flattening of the waveform changed on the CRO screen from bottom to top. As we used to say in the days of continuous screenings: "This was where I came in!"

Not having any 6CA7s in my stock, I rang the owner and indicated how curiously the two cases corresponded. We decided to buy two new output valves on the assumption that, with one weak, the other would probably be on the way down, anyway.

Two new 6CA7s gave me an output of 16 watts at overload, which I knew to be about par for the course for this particular instrument.

Out of curiousity, however, I plugged in one of the old valves — easily recognisable because it was rather discoloured with age. Surprise! The power output was still 16 watts.

Obviously the other valve was the dud.

But, when I plugged that one in, I still got 16 watts.

In fact, with the two old valves in place, up came 16 watts again.

At that stage, I had the horrible suspicion that I had been caught. Could it have been that there was a poor socket connection which had been righted by my repeated action of changing over the valves?

Or was there an intermittent underneath?

With this thought in mind, I turned the chassis over to do some probing, only to notice the old familiar, distorted waveform on the CRO screen. When I turned the chassis right up again, the output waveform came good.

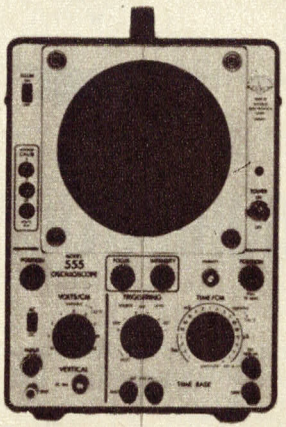
Probing underneath the chassis gave no hint of any intermittent connections but a bit of patient fiddling and tapping brought to light what I needed to know: One of the 6CA7s was itself intermittent internally. With the amplifier delivering 16 watts, a gentle tap on the glass would drop the power and produce the distorted waveform. It was a mechanical failure inside the valve, as distinct from a weary cathode.

But what a nasty one!

Still, the story had a happy ending, with a satisfied customer and an organ that "sounded like it's old self." ■

Two big-in-features

5" CRT oscilloscopes

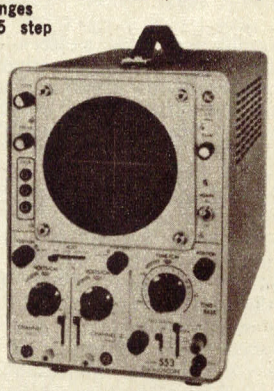


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Internal, external, mains freq.
Trigger Range
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Calibrator
Output Waveform 1 KHz square wave
Voltage 5, 0.5, 0.05 V p-p
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Sensitivity 0.02 V/cm-10V/cm
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1-2-5 step



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Sweep Time: 1 uS/cm-1 sec/cm
Sweep Magnifier: X5, accuracy ± 5%
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Sensitivity: Approx. 1V p-p/cm (0.2 V p-p/cm in case sweep magnifier is actuated)
Bandwidth: 2 Hz-200 KHz within —3dB
CRT
130 ARB1 or 130ARB31

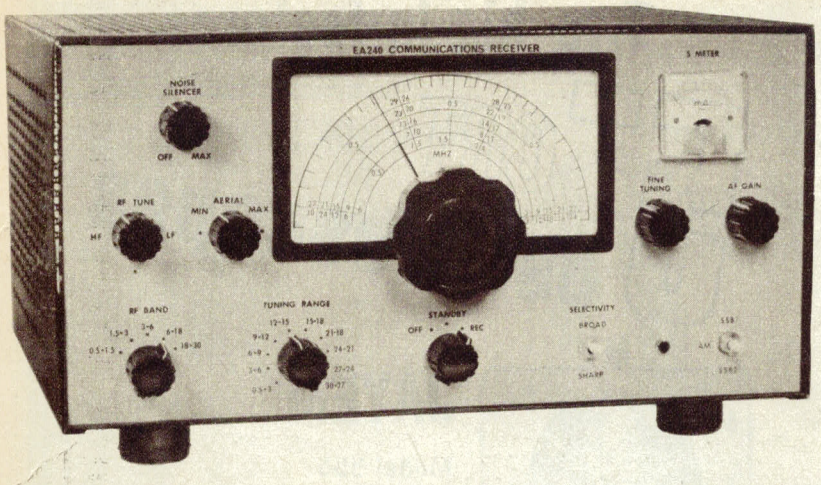
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JM/35-69



PART TWO

Our New Communications Receiver

Last month we described the broad principles of our new communications receiver and the thinking which led to the development of this particular design. This month we take up the story with a discussion of the noise silencer. We anticipate that we will require at least one more article to complete the story.

By Ian Pogson

Before discussing the noise silencer, we would draw readers' attention to a minor error in the circuit diagram published last month. Full details are given in the "Errata and Notes" for this month.

The noise silencer follows the second mixer amplifier. This silencer is our most recent development, being an outcome of both the valve unit described in August, 1969 and the solid state unit in December, 1969. It embodies the best characteristics of both.

When we developed our first solid state silencer, with a symmetrical transistor as the gate, we immediately began to consider how it could perhaps, be simplified and reduced in size. In the process, we reverted to the concept of using transformers and a balanced gate with two diodes. Otherwise the circuitry remains substantially the same.

We used the impedance transforming emitter-follower as before and the amplifier following the gate is also the same. Instead of the symmetrical transistor gate, we used the balanced diode gate as in the valve version. The transformers are miniature types and can be readily wound.

The noise amplifier has been modified slightly, mainly in regard to bypassing for the 470 ohm emitter resistor. Less by-pass capacitance has been used and is now confined to the 470 ohm resistor rather than the whole emitter circuit. Degeneration across the 2.5K variable resistor, which increases as the bias is increased, provides improved control of this stage. Also, the emitter circuit is broken with a switch on the 2.5K potentiometer, so that the silencer can be completely disabled. An important change is the replacement of the transistor phase-splitter, with another miniature transformer, rather similar to those in the gating circuit. This transformer feeds a full wave noise rectifier.

In the following pulse amplifier stage we were able to reduce the number of components considerably and, we believe, with no deterioration of performance. In point of fact, we have DC coupled the output of the noise rectifier right to the gate itself. Comparing the two silencers, we feel that there is little to choose between them for performance. However, the one installed in this receiver is smaller and simpler, and obviously more economical.

Briefly, the operation is as follows: For the purpose of impedance transformation, an emitter follower precedes the gating circuit. The gate is a pair of diodes in a balanced arrangement. To convert the normally unbalanced signal circuit to one of balance, and to revert to an unbalanced condition again, an input and an output transformer are used, as shown in the circuit.

COIL AND TRANSFORMER DATA

L1 Secondary, 110 turns, 29 B&S enamel on Q2 toroidal former. About 90 turns occupy full former length. Overwind remainder back. Primary, 10 turns, interwound at earth end of secondary.

L2 Secondary, 50 turns, 25 B&S enamel on Q2 toroidal former, wound to occupy about 90 per cent of former. Primary, 5 turns, interwound at earth end of secondary.

L3 Secondary, 8 turns, 18 B&S enamel on Q2 toroidal former, wound to occupy about 50 per cent of former. Primary, 2 turns 25 B&S enamel, interwound at earth end of secondary.

L4 Secondary, 4 turns, 18 B&S enamel on Q2 toroidal former, wound to occupy about 33 per cent of former. Primary, 1 turn 25 B&S enamel, interwound at earth end of secondary.

L5 Secondary, 18 turns, 27 B&S enamel close wound on 7.6mm (0.300in) x 1¼in Neosid former. Primary, 4 turns over earthy end of secondary. Grade 900 slug.

L6 Secondary, 50 turns, 27 B&S enamel close wound on 7.6mm (0.300in) x 2½in Neosid former. Primary, 10 turns over earthy end of secondary. Grade 900 slug.

L7 Same as L6 but without primary winding. Grade 900 slug.

L8 One winding, 40 turns, 27 B&S enamel close wound on 7.6mm (0.300in) x 2½in Neosid former. Grade 900 slug.

T1 25 turns, 30 B&S enamel, trifilar wound, on Neosid type 1050/1/F14, or Ducon type F684, Q2, balun core.

T2, T3, T4 Same as T1.

T5 Same as above, but with 30 turns 30 B&S enamel.

T6 Same as T5.

T7 Same as above, but with 45 turns 34 B&S enamel.

The two diodes are normally forward biased and this allows signals to pass unimpeded to the following stages. After the gate we have an amplifier, with a nominal amount of gain, to make up for the insertion loss of the gating circuit.

A split of the signal (and noise) is taken from the input of the emitter-follower and fed into a "noise amplifier." The gain of this amplifier is manually controlled and can be so biased that the transistor slices off the signal being received but passes, and amplifies, noise pulses which exceed the signal in amplitude. These pulses are rectified by the full-wave rectifier which follows.

Positive-going pulses emerging from the rectifier are further amplified in the pulse amplifier. By virtue of the voltage phase reversal which takes place in common-emitter amplifiers, negative-going pulses from the pulse amplifier are fed into the gating circuit.

The output of the noise rectifier is DC coupled to the pulse amplifier, which is just sufficiently forward biased to allow a small current to flow under no-signal conditions. In turn, the output of the pulse amplifier is DC coupled to the gate biasing circuit. The effect is to overcome the reverse bias applied to the output end of the gate, and make the diodes conducting. Pulses from the rectifier normally bottom the pulse amplifier and the collector voltage drops, allowing the reverse bias on the diodes to take over, thus cutting off the diodes for the duration of the pulse.

It may be asked why two diodes are used in a balanced gate, rather than a simpler single diode in an unbalanced arrangement. The main reason is that the sudden change in current through the gating diode, under unbalanced conditions, can cause as much noise as would occur without a gating system at all! When two diodes are used in a balanced circuit, sudden current through the diodes occur in phase opposition, such that the effects are cancelled in the transformers. The gate is therefore able to cut off without introducing any noise of its own.

The next stage is the main filter block assembly. It is here that the major selectivity characteristics of the receiver are determined. Two bandwidths, 5KHz and 2.5KHz, at 6dB down, are provided by five Murata type SFD-455B ceramic resonators. This assembly is the same as described in detail in September, 1969, pp. 59-65 and readers are referred to this article for full details. The respective bandwidths are selected by a toggle switch on the front panel, actuating germanium diodes in the signal paths.

Two junction FET IF amplifiers are controlled by the AGC line and are coupled with a ceramic resonator, of the same type as used in the main filter block. The last IF amplifier is a bipolar transistor. This operates without AGC, but with a small amount of emitter degeneration. This complete amplifier was described in November, 1969.

Since then, however, an S meter has been added. This is a 0-1mA meter in a bridge circuit, which gives a forward reading characteristic. The meter is referred to the source resistor voltage of the second FET amplifier. This voltage varies with the AGC voltage

PERFECT MATES



SHURE

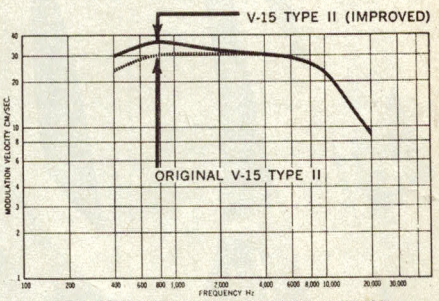
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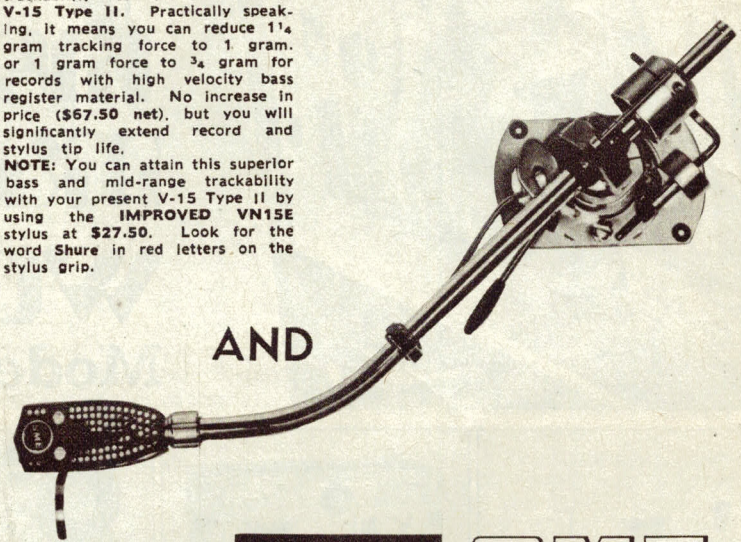
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Model X-330



Model X-330

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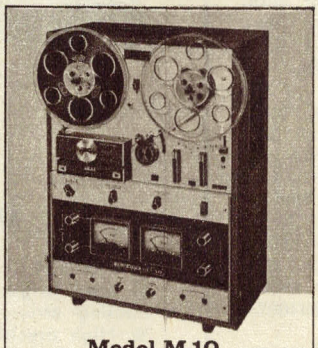
*Program minder (Automatic continuous reverse) *Sensing tape continuous reverse *Manual reverse *CROSS-FIELD HEAD *3 speed motor for capstan drive *Magnetic brake *Enabling to use 10½" reel *4-track stereo/monaural recording and playback *3 speeds, 4 heads *40W all silicon transistorized amplifier *24 hours continuous Hi-Fi stereo playback capacity at 1⅞ ips (7,200 feet tape) *12 hours continuous Hi-Fi stereo recording capacity (total 24 hours) at 1⅞ ips (7,200 feet tape)
*Matching speaker: SW-150 (3 way, 40 watt input)



Model X-360

PROFESSIONAL STEREO TAPE RECORDER—X-360

*4 heads, 3 motors *4 track stereo/monaural recording and playback *4 tape speeds (1⅞, 3¾, 7½ and 15 ips) *3 speeds main motor *CROSS-FIELD HEAD *50 watt solid state amplifier *Automatic volume control (Comput-O-matic) *Automatic continuous reverse (Reverse-O-matic) *Automatic dust minder *Magnetic brake for motors
*Matching speaker: SW-160 (4 way, 60 watt input).



Model M-10

THREE MOTORS AUTO. REVERSE TAPE RECORDER—M-10

*CROSS-FIELD HEAD *3 motors *Sensing tape continuous reverse (Auto. reverse) *Manual reverse *3 speeds, 3 heads *3 speed capstan drive motor *Automatic stop/shut off *Automatic pinch wheel release *Automatic lever release *4 track stereo/monaural recording and playback *40W music power solid state amplifier with two integrated circuits *Fine vinyl leather or wooden cabinet
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fed to this stage and the meter reads accordingly.

The AM product detector, using only two diodes and a few other components, was also described with the IF strip. Suffice to say that it is about as simple as a composite detector could be.

Closely associated with the detector, is the BFO. This uses, as its frequency determining element, a ceramic resonator of the same type as used for the coupling units and the main filter. The oscillator is a two stage arrangement, with a phase splitter, to provide a balanced drive for the detector. The frequency of the resonator is adjusted with a network of a 1mH inductor and two capacitors, switched from the front panel. This oscillator was described in full, in October, 1969.

IF signal for AGC generation is taken from the collector of the last IF amplifier. This drives an AGC amplifier, with low output impedance, feeding the AGC detector and gating system. Following the detector is a dual time-constant circuit, selectable from the front panel, together with the AM/SSB switch. This circuit was also described in full, with the IF amplifier, in October, 1969.

The audio amplifier consists of a preamplifier, driver, and a complementary-symmetry output pair, designed to drive a speaker between 8 and 15 ohms. This amplifier was described as a separate unit, in October, 1969.

A point worth mentioning here is that we used a 2N3638 PNP transistor for the driver. In keeping with the other types already in use, we could use a BC178 transistor, which is the Philips or Mullard type suited for this position. The 470pF capacitor between the base and collector may not be needed with this transistor.

The power supply, with its three output voltages, is so designed that the regulated voltage fed to the oscillators is held constant, even under the severe current changes demanded by the class B audio amplifier. This power supply was described as a separate unit in August, 1969.

Some comments relating to components used in the receiver are offered for the guidance of builders. The metalwork for the prototype was supplied by Messrs Heating Systems. Possibly other suppliers may offer suitable metalwork. We are advised by Heating Systems that there has been a minor change in the cabinet since we obtained ours. Instead of the elongated perforations used in the panels of our cabinet, smaller, circular, perforations will be used.

The knobs we used are imported and are an excellent product. The spindle is clamped by a collet, rather than the more usual grub screw. These knobs are imported by Associated Controls and supplies should be available through all good stock houses.

Selection of the most suitable type of capacitors can present a problem to readers. Here are a few pointers. Most by-passes of 0.1uF or so can conveniently be ceramic low voltage types, the Ducon "redcap" being a suitable example. However, these must not be used for AGC line by-passes, which should be a type having a high insulation resistance, such as polystyrene or polyester.

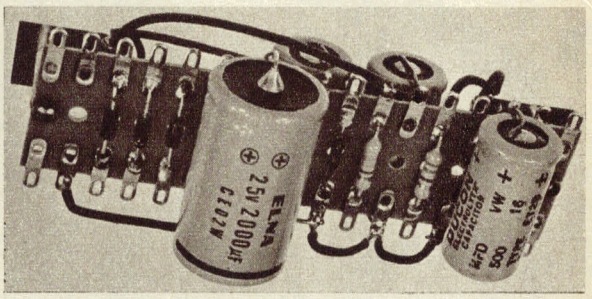
By-passes associated with tuned circuits can be either polystyrene or polyester for larger values, with either mica or ceramic NPO for lower values. In the tuned circuit of the VFO, only stable types should be used. These may be silvered mica, polystyrene, or ceramic NPO, due regard being given to types available in the capacitance required. In many cases, the actual type used in the prototype receiver can be seen in the photographs.

So much for the design and theoretical aspects. In the practical description which follows we hope to supply sufficient details to ensure that readers will have no difficulty in duplicating the prototype. Each section will be dealt with separately as a minor project.

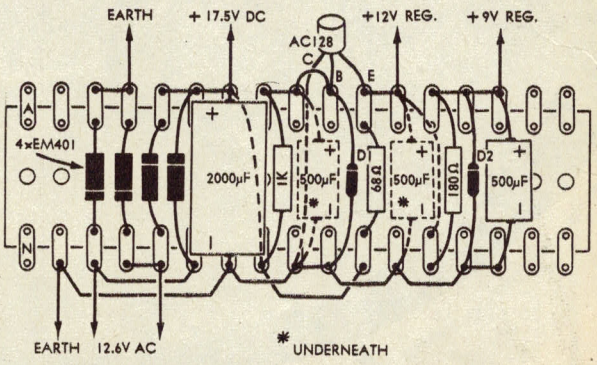
A good place to start is the power supply. By starting here and working backwards, we can finish off each section and test it immediately. The power supply, less transformer, is built on a piece of miniature tag board, with 17 pairs of tags. It is a very simple item to wire, particularly when reference is made to the wiring diagram.

In the version as published in August, 1969, we included a fuse in the DC return circuit. This has been omitted, but may be retained by readers who wish to do so. The finished assembly is fitted with a pair of stand-off pillars. Under each pillar will be seen a heat sink, one for the AC128 transistor and the other for a now obsolescent type of zener diode. The new zeners, such as the BZY88 series will not need this heat sink. The assembly is mounted by means of these pillars, with the heat sinks hard against the chassis.

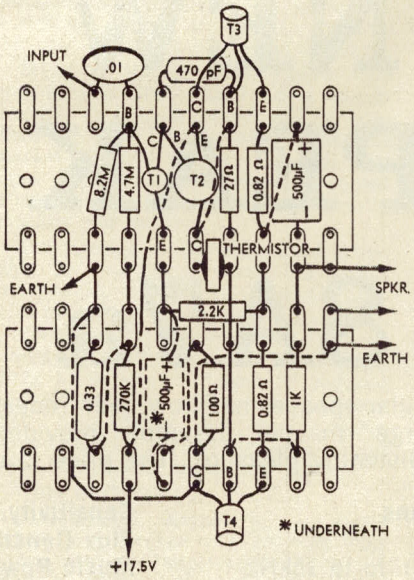
There are several types of suitable transformers available. The prime need is for a secondary voltage of 12.6 at between 500mA and 1A. This can be obtained from a single winding of 12.6 volts, or two in parallel. Another choice is to use two secondary windings of 6.3 volts each and connect them in series. The choice is up to the reader.



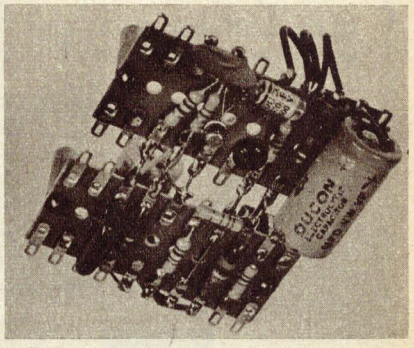
On the power supply board note the heat sink, partially obscured top left, for the AC128 transistor. The zener heat sink, top right, may not be needed.



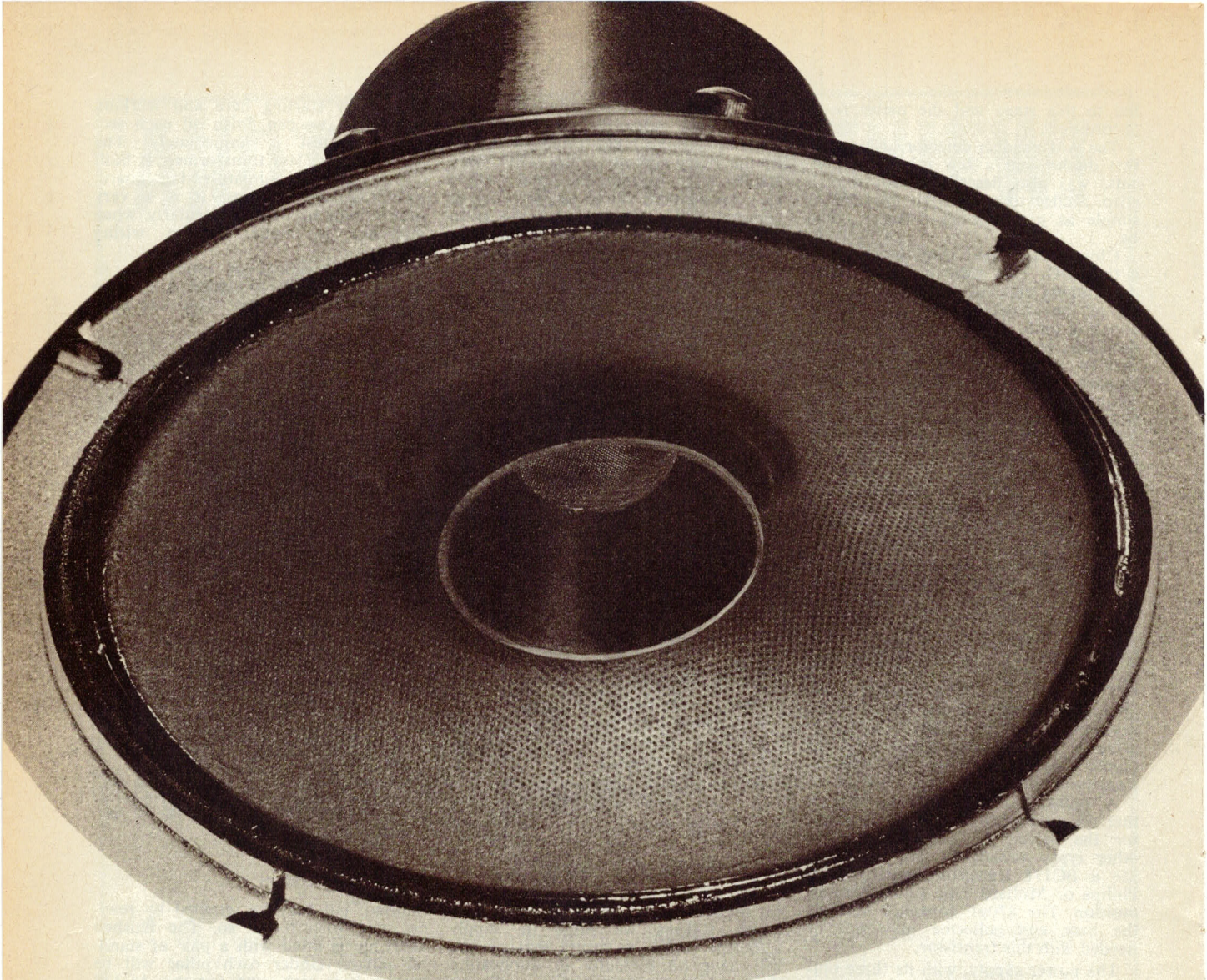
The power supply wiring diagram. It shows clearly the position of all components. Compare it with the photograph above. Lugs at left are for mains input.



The audio amplifier wiring diagram. Compare it with photograph at right. The spare lugs at left were provided for a preamplfier, which turned out to be unnecessary.



In this audio amplifier picture, note particularly the positions of the partly obscured heat sinks for the output transistors.



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The audio amplifier is constructed in a similar manner to the power supply, except that it consists of two tag boards, each of 10 pairs of tags, side by side. Once again the wiring diagram should make assembly and wiring an easy matter. Note that this assembly is provided with four mounting pillars, two of which are used for anchoring the heat sinks for the output transistors.

The next assembly is the largest of the whole project. It includes the three IF amplifiers and the detectors in one section, with the AGC generator and BFO in the other section. Each section is based on a piece of tag board, with 22 pairs of tags.

The two assemblies are mounted back-to-back, secured by two screws to an aluminium panel between them, which serves as both a shield and a mounting bracket for the final assembly.

The aluminium panel is 5¼in long, 1 7/8in high and with a 5/16in foot. Two mounting holes are provided near the ends of the foot. The holding screws are at the fourth hole in from each end, with the boards about ¾in apart. Instead of spacers, we used long screws and nuts against all faces. We fitted a solder lug against the outside face of the AGC-BFO board and soldered it to the nearest earth lug. This brings the earth leads on the boards to the chassis of the complete receiver.

There are five holes in the aluminium panel to allow leads to pass from one unit to the other. These are for the earth, positive 12 volts supply, AGC voltage, AGC take-off from the third IF amplifier for the AGC amplifier, and the BFO leads to the detector.

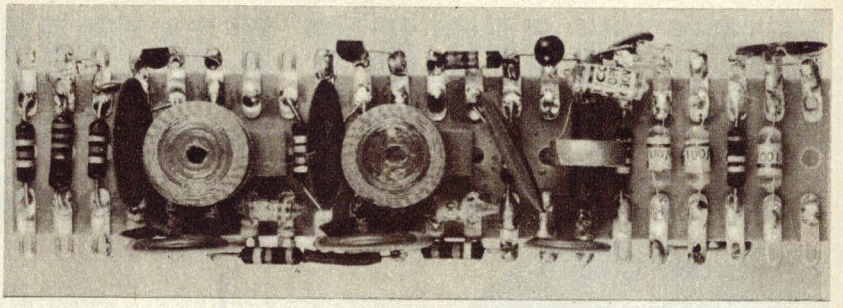
Although there appears to be a lot of work here, assembling and wiring the two strips is not difficult and the builder is rewarded with two neat assemblies in a short time. As always, care must be taken to make good soldered joints, but individual components must not be overheated in the process.

The ceramic resonators are mounted directly on the tag boards and between the relevant tags on the boards. A little care must be used in mounting, as it is necessary to drill five holes fairly accurately. Only holes large enough to pass the leads should be drilled. The resonator leads are passed through the holes and the other leads and components are then soldered to the opposite side. This is sufficient to hold the resonators in place.

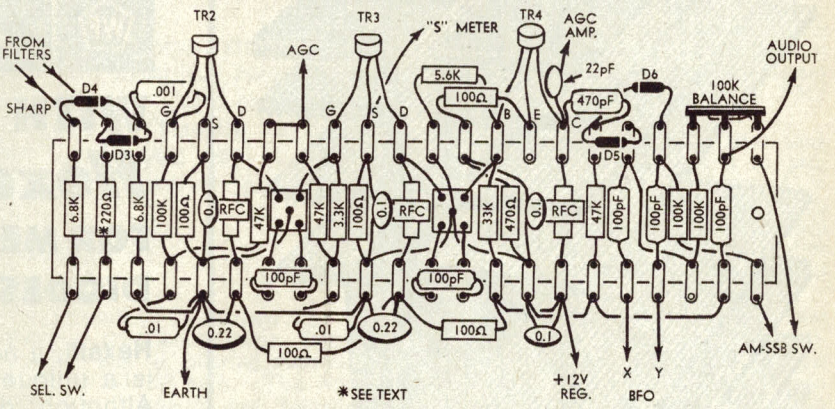
The main filter block assembly is constructed on a small printed board. Apart from the individual resonator units, there are only the five top coupling capacitors and one 3.3K resistor. Make sure that the "dots" on the resonators are orientated correctly.

A small tag board with 5 pairs of tags carries the components associated with the S meter. These are the 1K tab potentiometer, and the 2.7K and 56 ohm resistors. A 220 ohm resistor and a 500uF electrolytic are added when "muting" is desired, to avoid "slamming" the meter movement under switching conditions. The complete assembly is fixed to the back of the meter, on the meter terminals.

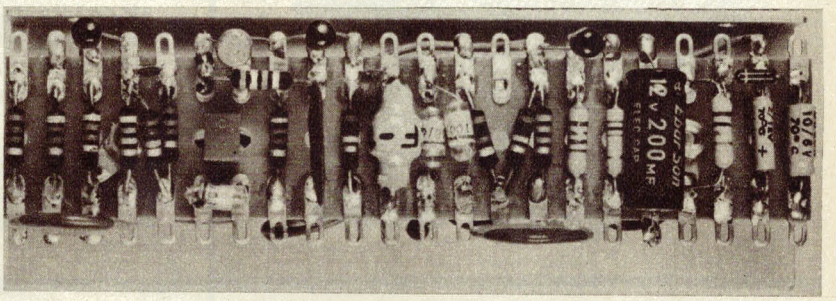
The remaining assemblies, the noise silencer, tunable IF, first mixer and RF amplifier, all require coils and transformers. These should be wound next.



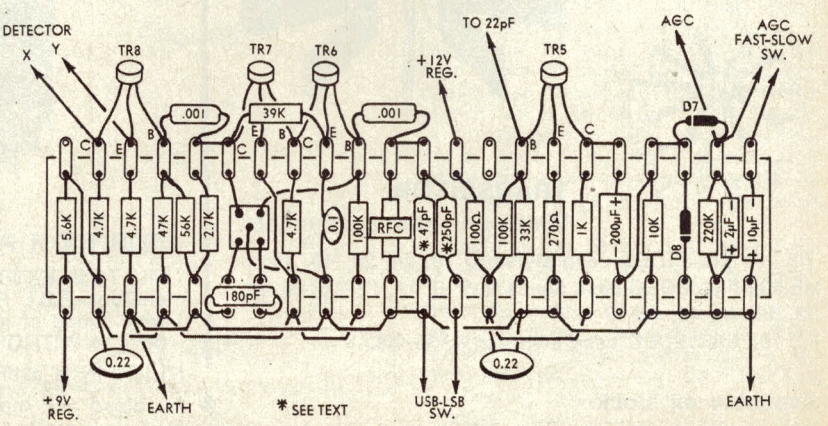
This picture of the IF amplifier strip, following the filter assembly, shows the input circuits at the left, with the switching diodes. At the right is the AM-SSB detector, with its balancing potentiometer. A mixture of RF choke types was used as IF amplifier loads but the more conventional single pie type is satisfactory.



This wiring diagram of the same IF amplifier strip, shown in the same position, gives all the detail necessary to duplicate the original.



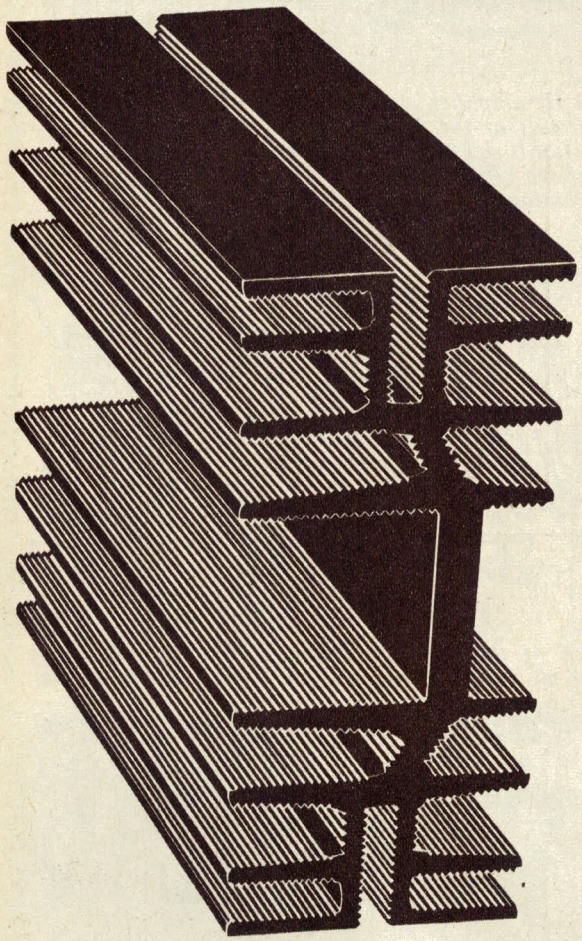
This is a picture of the other side of the complete assembly, and includes the AGC amplifier and rectifier circuits to the right, together with the BFO components occupying the left half. The fixed capacitors, which are switched to change the BFO frequency, could be replaced by a combination of fixed capacitors of smaller value, shunted by trimmers to provide precise adjustments of carrier reinsertion.



This is the wiring diagram for the AGC and BFO circuit components, corresponding with the picture immediately above. Where indicated by an asterisk, or at the builder's discretion, components may be wired on the back of the board.

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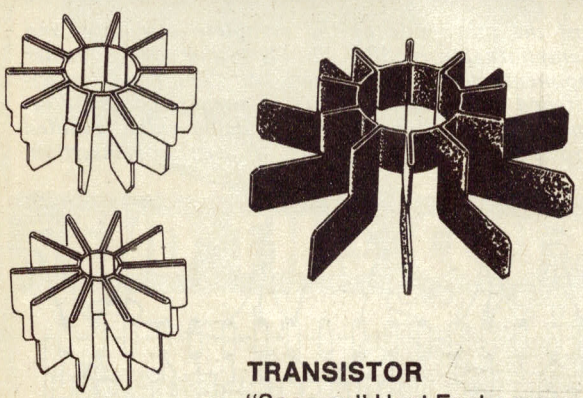
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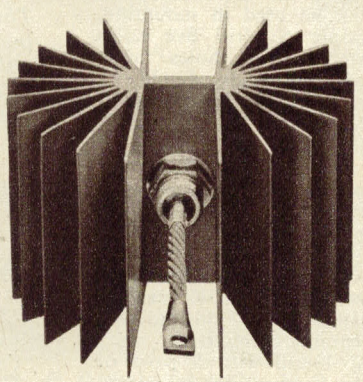


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The RF amplifier coils L1-L4, are wound on Ducon toroids, which are about ½in outside diameter, and of Q2 material. These coils have a high Q, can be wound readily, and they have the extra advantage of being compact. The coil winding details are given in the table. The number of turns on each winding and the disposition of the windings should be closely adhered to. However, the gauge of wire specified is simply a guide. If you do not have the exact gauge, then something close to it should suffice. At the same time, particularly for the higher frequency coils, the gauge of wire should be as heavy as practicable. This will reduce the resistance of the coil and so give a higher Q.

L5 is wound on a Neosid former with a diameter of 0.300in. The secondary is wound first, with the primary wound over the earthy end of the secondary. The means of anchoring each end of the windings is largely up to the reader. We have used a couple of different methods of anchorage. In one, a loop of linen thread is placed lengthwise on the former, with the loop near the start of the winding. The end of the wire is passed through the loop, a few turns made, and then the linen ends are drawn tight, causing the loop to anchor the wire at the start. A similar method is used at the finish. The loose ends are cut off and the anchorages augmented with a small application of cellulose glue.

An alternative, but perhaps not quite such a good method, is to use a small strip of plastic adhesive tape, in a manner similar to that for the linen thread. In any case, when the secondary is wound, it is a good idea to place a piece of plastic adhesive tape over the secondary, where the primary will be wound. This will prevent any possibility of a short-circuit between windings.

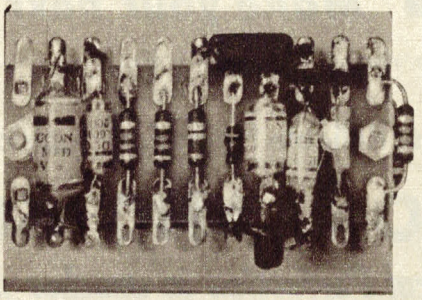
Coils L6, L7, and L8 should be wound on the longer formers, of the same type as used for L5, and in a similar manner to L5. Although care should be taken to make all windings in a firm and workmanlike manner, this applies particularly to L8, which is the oscillator coil. This must be wound tightly and precautions taken so that there will be no movement of the turns. If this is not done, then the stability of the whole receiver could be spoiled.

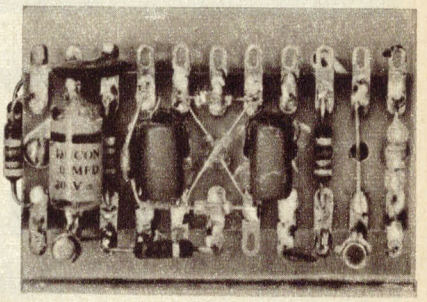
When coils L5 to L8 are wound and terminated, each winding is then placed in a can, ready for use in the final assemblies.

Next come the transformers, T1 to T7. As this type of transformer may be new to some readers, we will describe the construction in some detail. They are wound on a ferrite moulding about ½in long and having two 1/8in diameter holes running along its length. A common use for these cores is for TV aerial circuit "baluns." ("Balun" is an adaptation of BALanced to UNbalanced.) More precisely, a balanced to unbalanced transformer. This is exactly what we want them for; to transform an unbalanced circuit to a balanced one, or vice versa.

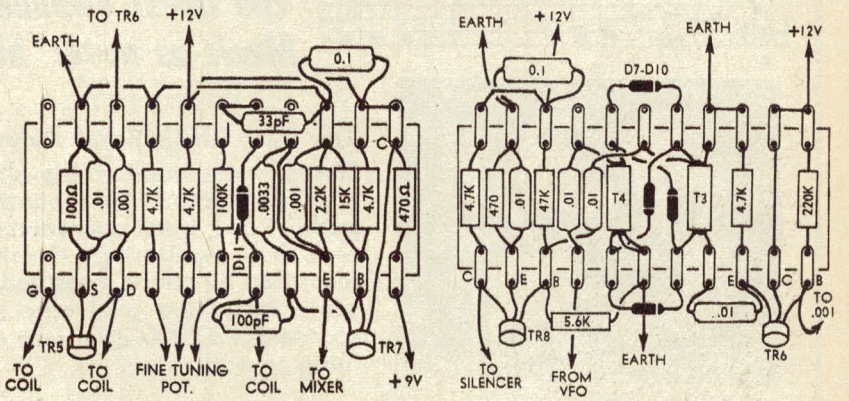
Another term requiring explanation is "trifilar winding." As the name suggests is means a triple winding, or three windings executed at the same time. Instead of a single length of wire we use three lengths, treating them exactly as we would a single length. This technique results in a transformer which is well balanced with respect to its windings, a highly desirable characteristic for this application.

Before starting to wind, it is a good idea, although not essential, to get some P.V.C. or cambric tubing (spaghetti) of a diameter such that it

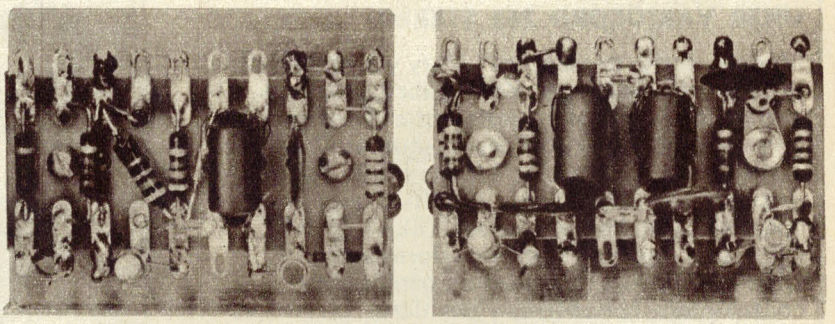




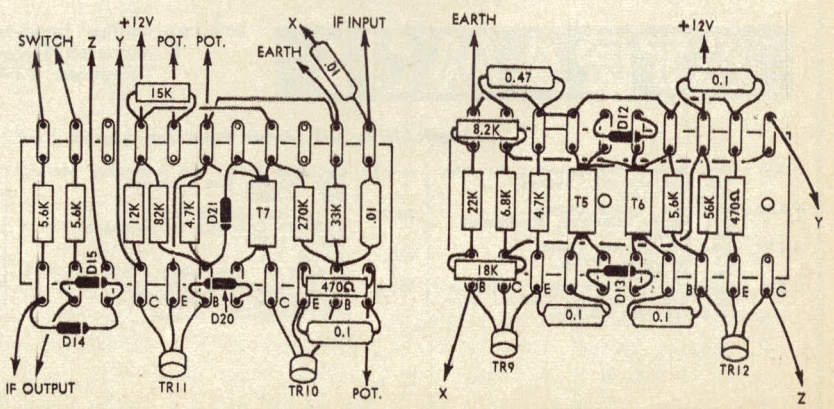
The picture at left, includes the tunable IF amplifier and VFO. The picture at right shows the opposite side of the assembly which includes the mixer circuits.



These two wiring diagrams correspond to the two pictures above. Direct comparisons can be made to obtain complete details of the full assembly.



These two pictures show both sides of the noise silencer assembly. The board with one transformer contains the noise rectifier and associated circuits.



These two wiring diagrams again correspond to the pictures immediately above them. It is important that all germanium diodes should face in the direction shown.

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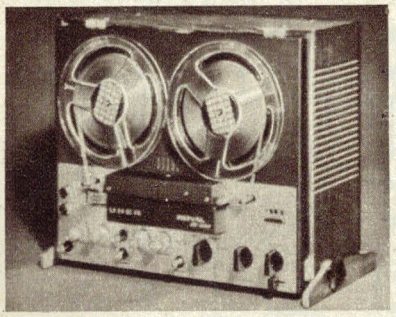
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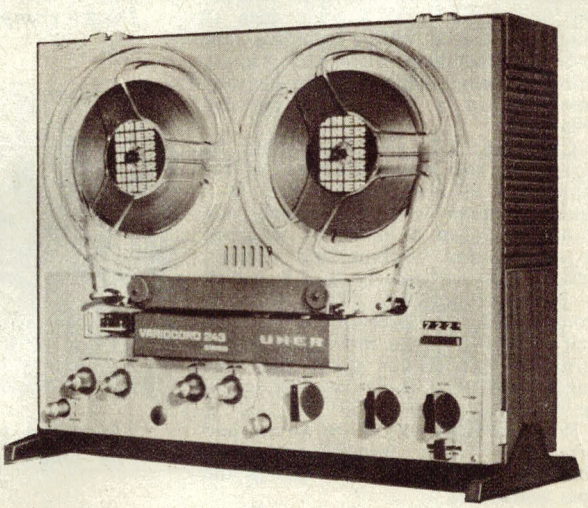
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will just fit into the holes in the core. This helps to prevent any loss of enamel from the wire during the winding process.

T1, T2, T3 and T4 are all the same and should be wound first. Estimate the required length of wire and cut off three strands and bring them together. To make winding easier, approach the lady of the house for a sewing needle with an eye which is just large enough to take the three strands of wire. Thread the needle, with about two or three inches of wire passed through the eye.

Winding consists of threading the wire through the two holes alternately, round and round, drawn through with the needle. One turn consists of the wire having passed through both holes once. Take care that the wire does not become tangled or knotted.

T5 and T6 are similar, to the first four but have five extra turns. T7 is best left until last. The lessons gained in winding the others can be applied to the one which requires the most turns with a finer gauge of wire.

It must be freely admitted that the winding process just described is a little tedious. Nevertheless, the final result is well worth the effort. By virtue of the nature of the ferrite material and the actual shape of the core, it is possible to wind a transformer which is highly efficient and with very little insertion loss.

Also, as mentioned earlier, such transformers are well balanced, and this makes them particularly well suited to the "double balanced" or "ring" mixers. Electrically, these mixers are inherently balanced, which is their main virtue. However, if the components used in this mixer — including the transformers— are not also balanced or symmetrical, then some of the advantages of the mixer may be lost. By trifilar winding the transformers, we can achieve a satisfactory balance for many applications, without going to any further measures to achieve balance.

The noise silencer is constructed in a manner similar to the IF amplifier and other sections, i.e., on two pieces of terminal board, one on each side of a metal panel. The boards each have 10 pairs of tags.

One board accommodates the emitter-follower, balanced gate and the silencer amplifier. The other board includes the noise amplifier, rectifier, pulse amplifier and the silencer amplifier output switching circuits. These are all shown clearly on the wiring diagrams and pictures.

The aluminium panel between the boards, is 2¼in long, 1-7/8in high and with a 5/16in foot. The mounting holes are the second from each end, the fixing techniques being the same as for the IF amplifier assembly. In addition to the two holes just mentioned in the panel there is one near to each end of the foot and four more to allow leads to pass from one board to the other. These are for the earth, positive 12 volts supply, .01uF input capacitor lead, and the lead from the collector of the pulse amplifier to the gate input transformer centre tap.

Assembly and wiring of the two boards is straightforward, except for the three minature ferrite transformers. As can be seen from the pictures, they are mounted on edge and actually glued into position on the boards. Although there are many adhesives which could be used, we fixed ours with Selleys "Aquadhere." During the gluing process, the transformers must be held lightly in place, while the glue dries overnight. This method is satisfactory for receivers which are permanently installed and where they are not subject to vibration. If the receiver should be used for mobile purposes, then we suggest the gluing process be augmented with some linen or other thread to tie the transformer to the board as well.

To identify the windings, bare all six ends and check on the ohms range of a multimeter. With one of the "start" leads, check for the "finish" and these become S1 and F1, as shown in the diagram. Identify S2 F2 and S3 F3 in the same way. F2 and S3 become the centre tap of the secondary, as shown in the diagram. The leads are now cut to length and bared again, tinned and soldered to their respective lugs.

The tunable IF assembly is made the same way. The two boards each consist of 11 pairs of tags. One board contains the 2N5459 IF amplifier and the VFO, while the other board includes the emitter-follower, the second detector and the second detector amplifier.

The aluminium panel is 2¼in long, 1-7/8in high and with a 5/16in foot. The holes at each end of the boards are used for mounting. Holes are required in the foot for mounting purposes, and two are needed in the panel to pass the lead from the .001uF capacitor to the emitter-follower base, and from the VFO emitter to the injection winding of the second mixer.

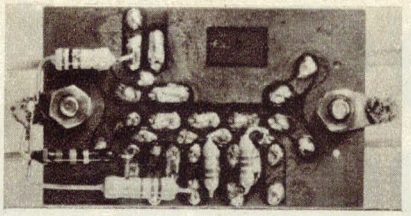
There are several points worth noting on this assembly. The components which do not appear on the boards, are mounted externally, on or adjacent to the tuned circuits. The mixer transformers are treated in the same way as those for the noise silencer and the same comments apply. Terminations must again be made the same as shown in the diagram.

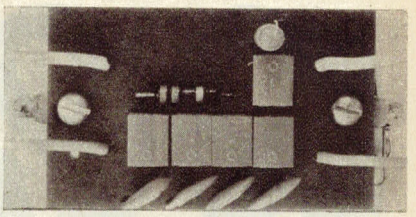
A point of vital importance is the quality of the components used in the VFO. All should be new and of good quality, but the capacitors are most important. Both polystyrene and silver mica types are satisfactory. In fact, we used a mixture of both. The 33pF and the 82pF are silver mica, with the rest polystyrene.

Finally, for best mixer operation, the four diodes should be wired in circuit just as they are shown in the circuit. It is possible to reverse them all and they will still function, but we have found that the connections shown give the best results. Needless to say, if there is a mixup in the diode connections, the mixer will not function properly.

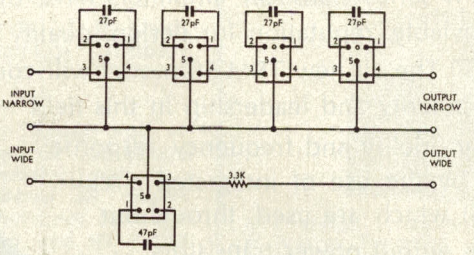
So much for the modules for the 3-6 MHz part of the receiver. The "front end," with its RF amplifier, mixer and crystal oscillator circuits are all that are left. Of these, only the RF amplifier is a sizable assembly, with a small one for the first mixer. The other circuits are not really assemblies in their own right and they will be dealt with under the final assembly notes.

(To be continued)

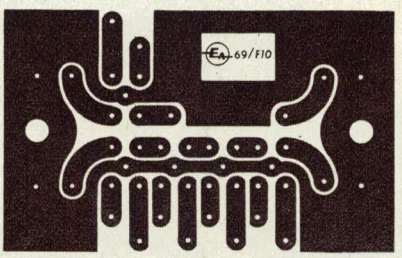




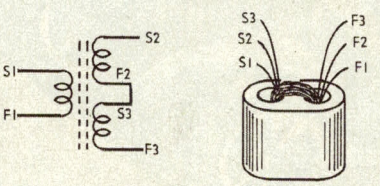
At left is the underside of the IF filter printed board, showing how resistors are added to effect a correct pass-band shape. At right is the top view of the same board.



Details of the filter circuitry, not shown in the main diagram. One or more of the 27pF capacitors may be slightly increased to widen the bandwidth, if desired.



Actual size photograph of the copper side of the printed board.



This drawing shows clearly how the trifilar windings are terminated on all the transformers.

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ADDING AN S-METER TO YOUR RECEIVER

Reprinted from an earlier issue, this article answers the often repeated questions: How does an S-meter work? How can one be added to an existing receiver? How may it be calibrated? While it refers to valve receivers in particular, the basic ideas are applicable also to transistor receivers.

At the outset it must be emphasised that, for the most part, S-meters, (i.e. signal strength meters) give comparative rather than absolute readings.

Among the reasons for this are:

1. The sensitivity of most receivers varies over their range, so that meter readings may vary from one input frequency to another for signals of the same nominal strength.

2. The signal fed to the receiver depends on the pickup of the aerial and this varies widely with frequency and directivity.

3. Even assuming that the "zero signal" and "maximum signal" limits of the meter scale are reasonably defined, the law of the readings in between may vary randomly from one combination to the next.

4. S-meter readings are frequently affected by the setting of manual RF and IF gain controls and may be misleading unless these controls are operated normally at full-on.

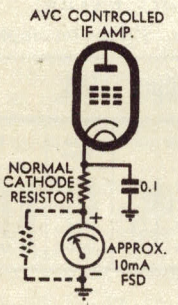


Fig. 1

Despite these problems, S-meters can usefully indicate a difference in strength for signal to signal or from day to day, and recorder S-meter readings have a definite advantage over a mere, aural impression and memory. However, only if an S-meter has been specifically designed into a receiver and then calibrated with the aid of a signal-generator will its reading mean much in terms of input signal microvolts.

The simplest type of S-meter or tuning indicator is a 5mA or 10mA meter wired in series with the cathode resistor of an AVC controlled IF amplifier. (See figure 1.) With no input signal, or with the aerial terminal shorted to chassis, the meter reads near maximum current.

When a signal is tuned by the receiver, a negative voltage is developed on the AVC line and applied to the IF amplifier control grid.

The IF amplifier draws less current, with the result that the meter in the cathode circuit shows a reduced reading. Hence the meter reading varies with the AVC voltage applied to the IF amplifier and this, in turn, is directly related to the signal strength of the station to which the receiver is tuned.

To achieve the maximum sensitivity with this S-meter circuit, it is desirable that the IF amplifier associated with the circuit be arranged to operate with high natural gain for weak signals. This will give the greatest swing of cathode current for an applied AVC voltage variation.

If two IF amplifier stages are in use, it should be possible to determine experimentally whether the meter can be operated most effectively in the cathode return circuit of either one or both together.

If the cathode current should exceed the meter rating, a shunt across the meter can be used to give full-scale reading under no-signal conditions.

With this circuit, the meter reads deflected to the right with no signal input, but returning towards zero as the strength of an incoming signal increases. With a very strong input signal, the cathode current may fall to about 10 per cent of full scale.

Technically, there is no special disadvantage in a reverse-reading scale, the only requirement being that it be suitably calibrated, either with figures hand-lettered on to the meter face or pasted on to the front of the meter glass.

For those who may wish to achieve a simple "forward reading" scale, the meter may be mounted upside-down with the needle pointing to the bottom of the front panel.

In the design of commercial equipment, it has been an accepted standard that an S-point calibration should equal an increase in signal strength of 6dB.

By way of example, in calibrating the S-meter on a typical communications receiver some time ago, we set S1 as being equivalent to a one microvolt signal at the aerial terminal. As each succeeding S point was equal to a 6dB increase in signal strength, S9 resulted from a 256-micro-volt signal. While it thus takes quite a signal to give an S9 reading, at least the readings are realistic and do convey some meaning when the input signal per S point is quoted.

With the particular receiver, there was no special problem about this calibration, because the internal circuitry of the front-end unit was arranged to maintain a substantially constant order of gain over the entire range of frequency coverage. In receivers where the gain varies from band to band, it may be necessary to strike some kind of an "average," or calibrate for the band of greatest interest or add to the bandswitching some provision to modify bias or screen voltage to even things out.

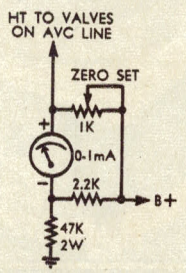


Fig. 2

For those who do not have access to standard signal generators, it is not practical to calibrate an S-meter on this basis and an arbitrary calibration must be made.

A logical approach to the problem is to set S9 on the meter as being a very strong signal, with no background noise, received from a station other than a nearby neighbour. From this point the meter reading could be evenly divided to provide calibrations of 1 to 9 S points. However, if you receive a request for an accurate S meter report, it is only fair to explain the arbitrary way in which the S-meter calibrations of your receiver have been determined.

As distinct from the simple cathode current measurement of figure 1, various circuits have been devised to produce an inherently forward reading type of S-meter, in which the pointer is deflected "up-scale" to the right as the strength of the incoming signal increases. In such circuits, it is also usual to arrange matters so that the meters read from near zero for no input signal to near full scale for maxi-

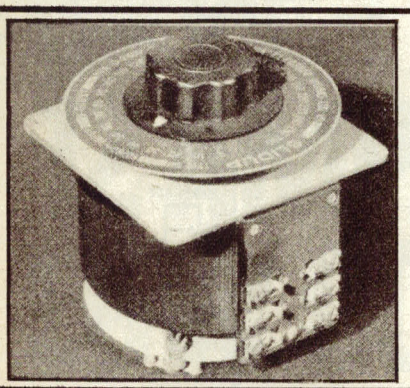
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mum signal, so that the full length of the meter scale is used.

A line of approach is to use a fairly sensitive meter, typically a 1-milliamp movement, in what is virtually a bridge circuit and so arranged that a decrease in the plate current of one or more AVC-controlled amplifiers produces an increase in the current flowing through the meter.

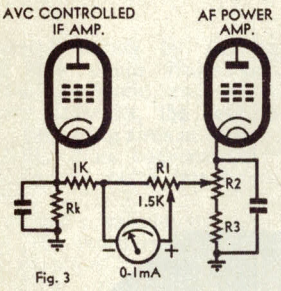


Fig. 3

A simple form for this bridge circuit, frequently used in communication receivers, is shown in figure 2.

With about 250V HT, about 5mA would flow through the 2.2 and 47K resistors, putting the junction between the two about 11 volts below the HT line. In the other arm of the bridge, set to the full 1,000 ohms, the same voltage drop would be evident with about 11mA flowing to the metered valve; under these conditions, the meter would read zero.

Application of an AVC voltage to the metered valve would reduce its current, reduce the voltage drop across the 1K potentiometer and allow the positive side of the meter to approach more closely the HT line, causing the meter to read forward.

Adjustment of the 1K potentiometer allows the meter to be set to zero, under no signal conditions, for a total

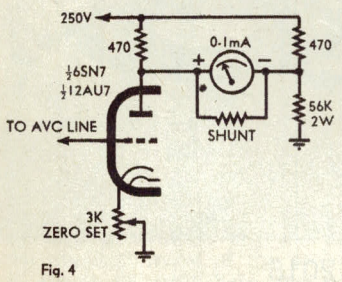


Fig. 4

metered current higher than about 11mA. For currents less than this figure, it may be necessary to revise the value of the 2.2K resistor.

The amount of forward deflection depends on the meter sensitivity but can also be varied by shunting the meter or by modifying the value of the 2.2K resistor and the setting of the 1K pot.

Adjustments as outlined in the two preceding paragraphs are commonly necessary with forward reading type S-meters. They are aimed at (1) securing zero meter deflection with no input signal and (2) controlling the sensitivity of the circuit so that the meter will read S9 (256uV) at less than full scale, with a margin for those signals (S9 plus) which are even stronger than this.

A somewhat different circuit arrangement is shown in figure 3. Resistor Rk is the normal cathode resistor of an AVC controlled IF amplifier. Resistors R2 and R3 should add up to the normal resistance for the cathode circuit of the audio power amplifier. These resistors should be selected in value so that the moving arm of R2 can be set to a voltage equal to that at the cathode of the IF amplifier under no-signal conditions.

In some cases it might be necessary to reverse the positions of R2 and R3. It also may be possible to use a single potentiometer instead of R2 and R3 but this will decrease the vernier effect of the series resistor. To adjust the S-meter set R2 with the aerial shorted for zero reading; set the sensitivity control, the 1500-ohm potentiometer (R1) for full-scale reading with the IF valve removed from its socket.

The idea of obtaining a balancing voltage from another valve has the advantage that voltages are applied to both sides of the meter at about the same time, as the two valves begin to draw current. With figure 2, on the other hand, voltage is applied via the 2.2 and 47K resistors immediately voltage appears on the the HT line. The meter therefore is subject to a reverse voltage before the controlled

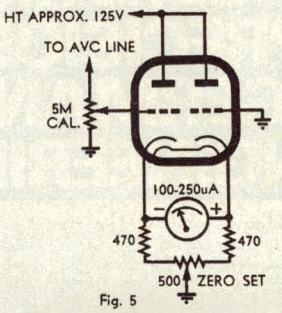


Fig. 5

valves begin to draw current. This is not likely to damage the meter but it does not look the best.

The remaining circuits illustrate forward reading S-meters using additional valves. These tend to give an approximate linear dB scale without undue crowding.

In figure 4 a milliameter is incorporated in a bridge in the plate circuit of the additional valve. To adjust this system either remove the additional valve from its socket or open the cathode circuit so that the valve does not draw plate current. While the circuit is in this condition adjust the shunting resistor across the meter until full-scale reading is obtained. The value of the shunt will depend on the internal resistance of the meter used. With the valves mentioned on the diagram the approximate current flowing in the meter will be 2.5mA.

With the valve, or circuit, restored to normal the aerial of the receiver should be shorted to chassis and the zero set potentiometer set to give zero reading on the meter. Increase of signal strength will be registered to the stage where the AVC voltage is high enough to cut-off the additional valve's plate current. This will normally occur with approximately 15 volts on the AVC line, which represents a very strong signal.

The final circuit is one which can be fitted easily to most receivers, either internally or externally. It incorporates a twin triode valve in what is essentially a valve voltmeter circuit. Again two pre-set controls are used to set the parameters of the meter readings. The zero set may be used to adjust the meter to minimum reading with no signal other than receiver noise. The calibrate control can be arbitarily set to give an S8 or S9 reading at between mid to threequarter scale.

While there are many other S-meter circuit configurations, the ones given here will probably allow the selection of a suitable type for most receivers. If mounting an S-meter on an existing receiver, where space is at a premium, consideration could be given to the use of edge type meters now available in Australia, some of which are available with S-meter calibrations. ■

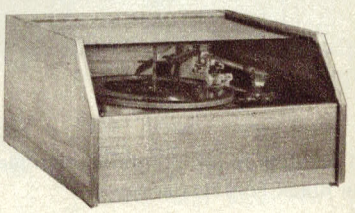
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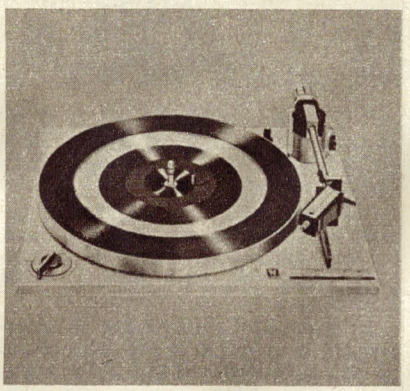
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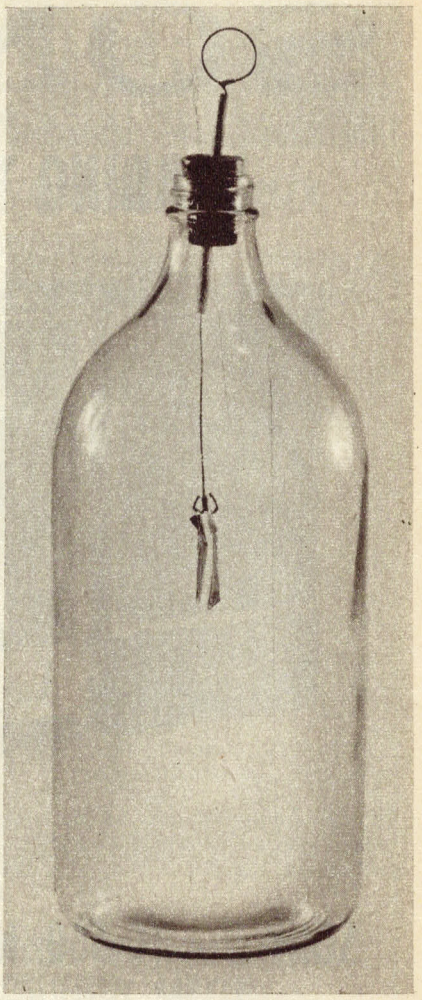
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SIMPLE ELECTROSCOPE

This simple device, which can be built virtually at no cost, provides scope for a number of interesting experiments with static electricity. Quite high voltages can be generated and stored with complete safety.

By Harry Tyrer



Benjamin Franklin's famous kite-flying experiment during a severe thunderstorm is quoted in many elementary science texts as an introduction to the subject of static electricity. If Franklin had really understood the dangers he was courting, he might have been content with less spectacular experiments. Those of our readers who are interested in the subject will not need to do things the hard way, as Franklin did. They can build the simple electroscope described below. But first a word about the nature of static electricity.

Many readers will have experienced a slight, or possibly even unpleasant, electric shock when leaving a car. Many will have experienced the phenomenon of visible sparking when taking off a silk or nylon garment in a dark room, usually hearing at the same time a distinct crackle. Similar results are often obtained when dry hair, free from greasy preparation, is combed with a plastic comb. These are but three examples of static electricity. There are many others which individual readers will have experienced, without necessarily knowing the cause of the phenomenon.

Static electricity of this type is brought about by friction. When you slide across the plastic-covered car seat, static electricity is generated. The nylon shirt rubs against the cotton or woollen garments, and static electricity is generated. In hundreds of cases when two dissimilar materials rub together, static electricity is generated.

This static electric charge is in fact a shortage, or an excess, of electrons in the materials concerned. Some materials lose electrons readily to other materials, and thereby become positively charged when moved in frictional contact with such materials. Others acquire electrons readily from other materials, and become negatively charged.

By a suitable choice of materials, the maximum transfer of electrons can be induced. Plastic materials generally are greedy "swallowers" of electrons when suitably excited; other materials, such as wool, cotton and silk, are not so able to retain their quota of electrons from the electron grabbers.

The voltages which can be generated by such means are surprisingly large, and even rubbing a plastic ballpoint pen on your sleeve can generate a charge of hundreds of volts. However, the amount of actual energy stored is fortunately very small, so you are in no danger of being severely shocked by your charged-up ballpoint.

Glass is a material which gives up electrons fairly readily, and rubbing a glass rod with a piece of silk or nylon can induce in the rod a respectable positive charge.

Before the introduction of AC voltages, and the development of transformer theory, electrostatic generators were the only means available to science for the generation of high voltages for experiments, including those which led to the generation of X-rays. Reference to some of the devices used will be found in the article "An Experimenter's High Voltage Generator" in the January, 1968 issue. This article also refers to the Van de Graaff generator, an electrostatic generator of more recent origin, which can develop the enormous voltages required for electron acceleration in atomic research.

The presence of electrostatic voltages can easily be demonstrated by the so-called electroscope. A simple electroscope may be easily constructed from odds and ends, and indicates the magnitude of static electricity of either positive or negative polarity by the movement of small pieces of metallic foil.

The foil pieces mutually repel each other when they acquire the same static charge. This action is a practical demonstration of the rule that like charges repel each other. The simple electroscope cannot, however, demonstrate the rule that opposite charges attract each other, as it is so arranged that the two pieces of metal foil will always have the same charge, of either positive or negative polarity.

A glance at the diagram will show how this is achieved. The foil pieces are attached to the same wire so any charge acquired through this wire will affect both pieces of foil identically.

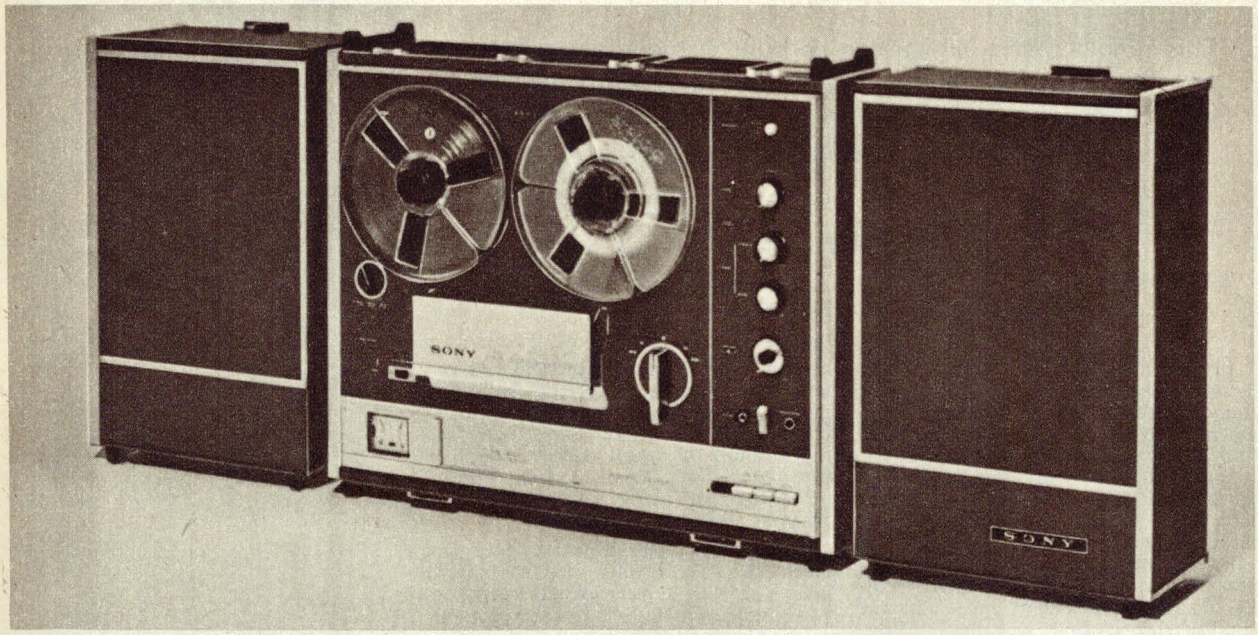
To construct the electroscope, the first thing to acquire is a clear glass bottle with a capacity of about 10 to 20 fluid ounces, preferably with a rubber stopper; otherwise an ordinary cork stopper can be used. The type of bottle used by chemists for storage of liquid pharmaceuticals is very suitable. The only other requirements are a short piece of fairly substantial insulation sleeve, such as the inner sleeve of a coaxial conductor; about 6in of about 22-gauge non-insulated copper wire; and two pieces of very thin foil. With regard to the last named, it should be noted, to avoid disappointment, that ordinary domestic foil or foil used in chocolate and cigarette wrappers, is too heavy, and will not operate satisfactorily. Gold leaf is perhaps the best to use, but failing this, foil salvaged from an old paper-type capacitor will do very well.

The first thing to tackle is the copper wire which will support the foil pieces in the bottle. First, cut off about ¼in and shape it into a hook, as shown in the diagram. The end of the longer piece is then similarly shaped, and the two pieces can be soldered together, taking care not to put any solder on the hook section where the foil will be placed. Next, fit the insulating sleeve over the wire. The better the insulating qualities of this sleeve, the longer the electroscope will remain charged, as the purpose of the sleeve is to prevent the charge leaking away through the stopper. The sleeve should be a tight fit over the wire, to hold it firmly in position.

(It may seem curious to have to insulate something from a glass bottle. In fact, many types of industrial glass

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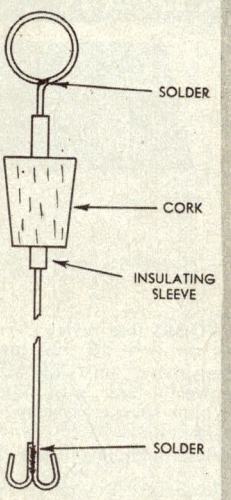
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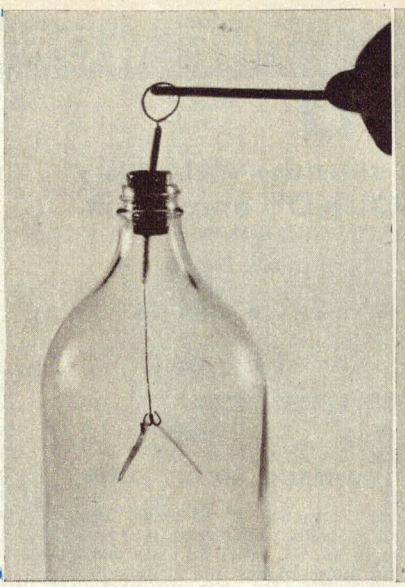
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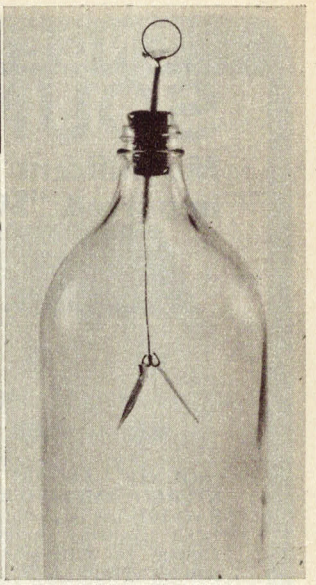
RIGHT: Diagram of the wire and foil assembly. The insulating sleeve and wire rod should both fit snugly, so that they do not slip down.

CENTRE: The metal foils should fly apart when the loop is touched with a charged object.

FAR RIGHT: When the source of charge is removed from the loop, the foils will remain apart until the charge leaks away.







are very slightly conductive. Again, chemicals which may have been stored in the bottle could have left a microscopically thin conductive layer on the inner surface. Either way, a charge intended for the metal rod can distribute over the whole surface of the bottle, defeating the whole experiment. The real purpose of the bottle is to prevent the foil from being disturbed by air currents.)

Now a hole must be drilled or bored through the cork, in which the wire and insulator assembly must make a firm fit. When the wire assembly is fitted through the hole in the cork, the top of the wire may be shaped into a circle of about ¾in diameter, and soldered.

The foil pieces can be prepared next and fitted on to the hooks. The size of the foils is not critical but about 1in long and ¼ to ½in wide should give satisfactory results. Carefully make a small hole with a pin as close to one end of the foils as possible, and slip them on to the hooks. This completes the assembly, and the cork can now be carefully inserted into the bottle mouth. You are now ready for your experiment.

This will typically involve generating a static charge by rubbing a plastic pen or a plastic ruler on a dry shirt sleeve or coat sleeve, whichever happens to produce the best result.

When a plastic pen or ruler is rubbed on a piece of cloth, heat is produced by friction, where the two surfaces are in contact. The heat imparts extra energy to some of the electrons associated with the atoms in the two surfaces, allowing them to move a little more freely from atom to atom, or even leave the parent material altogether.

In fact, with certain materials such as a plastic pen and a garment containing cotton or wool, quite a lot of electrons may transfer from the cloth to the plastic surface. Areas of the plastic pencil which have been rubbed against the cloth may therefore end up with a large surplus of electrons and therefore a substantial negative charge. The charge will tend to remain on the surface for a significant period because the high insulating qualities of the plastic inhibit the charge from leaking away.

If the charge could leak away, it certainly would do so, as surplus electrons tend to exhibit a great deal of mutual repulsion. Not surprisingly, therefore, if the charged area is brought into contact with the wire protruding from the bottle, many of the electrons which can make their way to the wire will do so and these electrons will distribute themselves over the surface of the wire and of the two pieces of foil in contact with it. The pieces of foil will therefore acquire surplus electrons—or a negative charge — and will tend to repel one another.

In contrast with plastic, glass tends to lose electrons to cloth on which it is rubbed and areas on the surface of suitable low-conductivity glass tend to end up with a marked deficiency of electrons and therefore a positive charge.

If such an area is brought into contact with the wire in an electroscope it will attract electrons from the wire and foil, so that the two foils end up with a similar positive charge. Once again, they will tend to repel one another as a result.

Let us use this phenomenon for our first simple experiment. We take a plastic rod (an ordinary ball point pen can be used if nothing more substantial is available) and rub it briskly on a piece of cloth for a few seconds. If we now touch the loop of the electroscope with the rod or pen, the foil pieces will move apart to form an inverted "V." If we repeat the process, the foils will move further apart, and will eventually form an angle rather more than 45 degrees. At some stage, a point will be reached when we cannot make the leaves move further apart for any length of time, although a slight kick will be observed each time we touched the charged rod to the loop. The reason for this is that the foils and support wire are capable of holding only a limited static charge at the charging voltage which can be produced. This is their "capacity," the same term used in connection with capacitors.

In fact, the degree of deviation from the vertical taken up by the charged foils is an indication of the voltage impressed upon them. In our own experiments, we were able to apply a voltage known to be of around 15KV, which moved the foils to about a 60 degree angle. A capacitor charged to 300V did not even move the foils when applied to the loop, whereas with a plastic handled screwdriver we were able to obtain an angle of more than 45 degrees, thereby proving that we were developing a pretty high voltage, well over 300 but short of 15,000.

If the insulating material you have used for the sleeve is good enough, the charged foils will remain in their "V" position for a long time in conditions of low humidity. On humid days, it is virtually impossible to keep the charge on the foil for more than a minute. When the charge is holding well, you can demonstrate the eagerness of the electrostatically charged foils to give up their electrons, as the slightest touch of the finger on the loop will cause the foils to collapse.

We can now repeat the process with a glass rod instead of a plastic pen. The results obtained should be identical. Although the glass rod is acquiring a positive charge, whereas the plastic rod acquired a negative charge, the two foils will still repel each other, since they are both charged with the same polarity. If, however, we make two electroscopes, and charge one positively, the other negatively, and we touch the loop of one to the loop of the other, the foils in both instruments will collapse. This is because the positive charge in one will cancel the negative charge in the other, and vice versa.

If you want to make a more elaborate electroscope to demonstrate the principle that opposite charges attract, this should be fairly easy to do by fixing two separate insulated wire assemblies into one bottle, each with a single foil. If one foil is charged negatively, the other positively, they will attract instead of repel.

At this point, we must leave our experimenters to devise further experiments for their electroscopes. Try different combinations of materials, try waving rods close to the top loop without touching it, and so on. Have fun. ■

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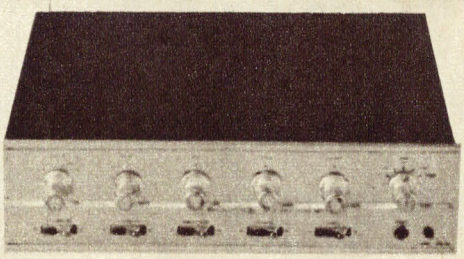
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An IC Volume Compressor for Recorders, PA and Transmitters

A new solid-state unit which will limit the dynamic range of signals for recording or public address, or permit heavy modulation of transmitters without risk of overmodulation and "splatter." The circuit is straightforward and uses only two transistors and one integrated circuit.

By LEO SIMPSON

Readers who have experience of "live" tape recording will know that, in general, it is best to record at the highest level possible before the onset of distortion, for in this way the best signal-to-noise ratio is obtained. However, it is a tedious task to continuously monitor the recording level meter or indicator in order to avoid sustained or momentary peaks which can overload the amplifier and/or saturate the tape. Often momentary peaks have occurred before one can react to change the recording level, and in any case most meters are incapable of giving a true indication of the magnitude of brief transients.

Similarly, in public address or "PA" work it is usually a problem to set the amplifier system gain at a level which will provide adequate sound reinforcement without producing acoustic feedback. Here the main problem is usually the person at the microphone, whose head movements often produce both variations in the signal level, and changes in the acoustic path between speakers and microphone. Consequently, the "optimum" gain control setting tends to vary significantly from moment to moment.

What is really needed, then, is a device which will continuously monitor the level of the incoming signal and automatically reduce the gain by a suitable amount for high level peaks. Such a device is known as a **volume compressor.** With a volume compressor in circuit the maximum desired signal level can be set, and all incoming signals below the predetermined level will receive the normal system gain while those above this level will receive less gain depending on their magnitude. The result is that the peak output level tends to vary by only small amounts from an average just below the set level, despite variations in the input signal level.

Apart from tape recording and PA applications, another application where a compressor is particularly useful is in modulators used in conjunction with RF transmitters, such as are used by broadcast stations and amateur radio operators. The commercial radio stations are reputed to make extensive use of compression, to obtain the maximum possible linear modulation. This ensures the loudest possible audio signal output for a given RF input signal to the aerial of the receiving sets.

The case for compression with amateur radio transmitters is even stronger, since the RF power output is strictly limited to a modest level. The use of a simple compressor such as the one featured in this article can greatly increase the "talk power" of any amateur transmitter, without the risk of objectionable "splatter" due to over-modulation.

A further application where compression is not so common, but is very useful, is in conjunction with guitar amplifiers. By their very nature, guitar amplifiers are often used at close to the maximum possible output, with no margin to spare. Under such conditions higher-than-average signal peaks will drive the amplifier into clipping, and the resulting distortion at high power levels is objectionable even to those with the most tolerant ears. Because of the high peak-to-peak voltages generated by the guitar pick-ups, a moderate degree of signal compression can greatly increase maximum possible loudness obtainable from any amplifier/loudspeaker combination without the heavy expense involved in uprating amplifier and loudspeakers.

The volume compressor described in this article is expressly intended for use with tape recorders and amateur

SPECIFICATIONS

A low distortion AF volume compressor suitable for use with transmitters, public address amplifiers, tape recorders and, with modifications, guitar amplifiers. The compression threshold or "turnover" is adjustable. Nominal output level is 250mV.

ATTACK TIME: Approx. 8mS.

DECAY TIME: Approx. 200mS.

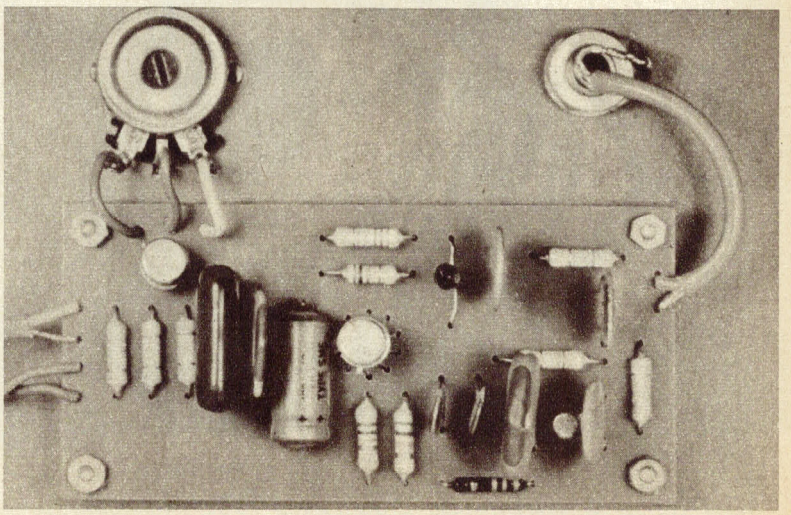
FREQUENCY RESPONSE: 80Hz-24KHz within plus or minus 1½dB.

DISTORTION: At 300mV output, zero compression, less than 1 per cent.
At 300mV with 20dB compression, less than 1 per cent.
At 1V output, zero compression, less than 2.5 per cent.

PRECOMPRESSION GAIN: Approx. 47dB with an input impedance of 47K.

SIGNAL-TO-NOISE RATIO: Approx. 40dB below 250mV.

POWER SUPPLY: The circuit requires 18V or 12VDC at approx. 10mA, which may be supplied by batteries or a zener-derived supply from associated equipment.



A view of the prototype compressor, which was mounted on a metal panel to represent a typical "built-in" application. As may be seen most of the components are mounted on a printed wiring board.

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radio transmitters. However, by deleting the transistor input preamp. stage it can also be used with guitars.

One of the most important characteristics of a volume compressor is its "attack" time—the time it takes to reduce the gain upon receiving a high level signal. Unless elaborate and costly signal delay equipment is used, the initial portions of signal peaks are not compressed in proportion to their amplitude. They literally "sneak through" before the "gate is closed." If the attack time is more than about 50mS the resulting distortion can be most objectionable. In a practical compressor it is desirable to maintain the attack time at less than 10 milliseconds.

Another important characteristic of a compressor is the "decay" or "release" time — the time the compressor takes to revert to normal system gain after the passage of signal peaks. If this is too fast, the amplitude distortion of the signal will become gross. Intelligibility of speech and music tends to become very poor, as the syllables in words and the notes in music are given grossly different degrees of amplification. An ideal compressor would have adjustable decay time to suit the program material. In general, the decay time should at least be of the order of several hundred milliseconds.

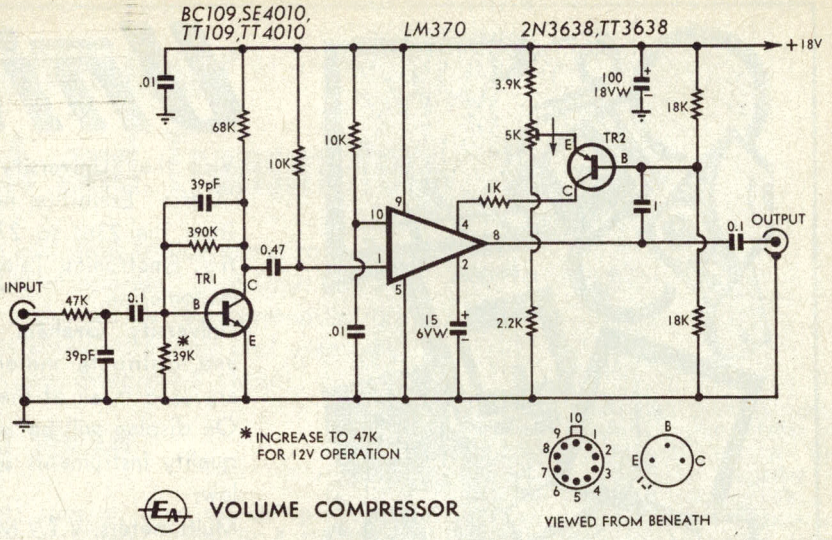
The volume compressor featured in this article is fully solid state and employs as the variable gain element an operational amplifier whose voltage gain is controlled over a wide range by an external DC voltage. The operational amplifier is contained in a microcircuit, the LM370, recently released by the National Semiconductor Corporation of California and distributed in Australia by Rutherford Electronics Pty. Ltd.

The LM370 is a very complex integrated circuit in a 10-lead, TO-5 metal package. It contains 36 transistors in all. In addition to applications in volume compressors the LM370 can be used in communications AGC and squelch configurations, as a constant amplitude audio oscillator, linear low frequency modulator, single-sideband automatic load control and as a variable DC gain element in analogue computation. It can be used with supply voltages ranging from 4.5 to 24 volts and is protected against damage from overdriving the inputs or short circuiting the output.

Price of the LM370 is $4.50 plus tax in quantities from 1 to 24 and we understand that it will be available from normal component sales outlets.

The gain of the LM370 can be varied over a range of approximately 70dB by control voltages ranging from 1.8 to 2.6 volts at a maximum total harmonic distortion of 4 per cent. What is needed for volume compression is means of generating these voltages for signals which rise above a set level, in proportion to their amplitude.

In the circuit we have used, a silicon PNP transistor is arranged as a negative peak detector. Its base bias



EA VOLUME COMPRESSOR

The circuit of the compressor. Note that as a result of the complex functions performed by the IC, the remaining "external" circuitry is relatively simple.

PARTS LIST

1 LM370 microcircuit.
1 BC109, SE4010 or similar low noise silicon NPN transistor.
1 2N3638, BC157 or similar PNP silicon transistor.
1 aluminium utility box, 2¼ x 2 3/8 x 5 inches. (optional).
1 printed board, 70/p1.
Input sockets, batteries, screws, nuts, connecting wire, etc.

CAPACITORS

(Higher voltage ratings may be used)
1 100uF/18VW electrolytic (12VW may be used for 12V supply).
1 15uF/6VW electrolytic.
1 1uF metallised polyester.
1 0.47uF/25VW ceramic or metallised polyester.
2 0.1uF/25VW ceramic or polyester.
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2 39pF ceramic or polystyrene.

RESISTORS

(All half watt rating)
390K, 68K, 47K, 39K, 2 x 18K, 2 x 10K, 3.9K, 2.2K.
1 x 5K tab-mounted, preset potentiometer.

NOTE: National Semiconductor devices, including the LM370 microcircuit are available in Australia from Rutherford Electronics Pty. Ltd., of P.O. Box 30, North Balwyn, Victoria, 3104.



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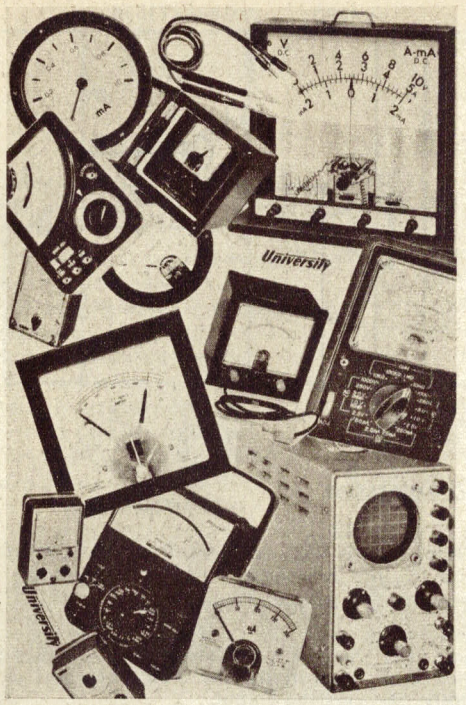
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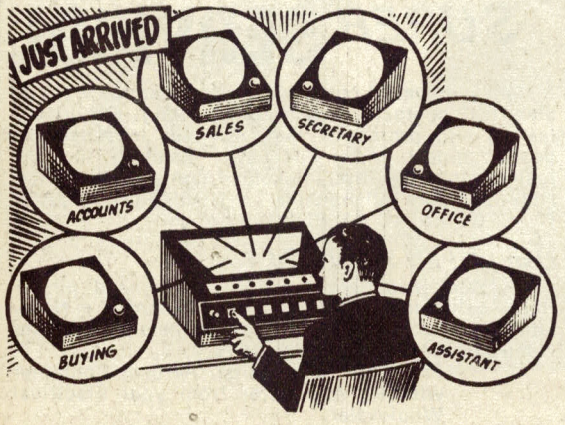


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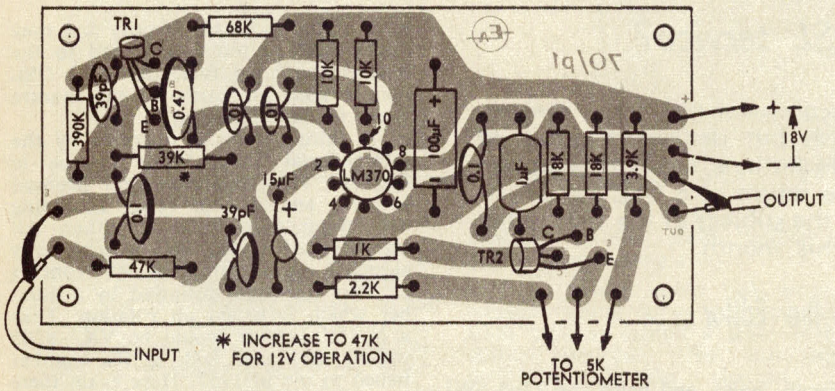
voltage is held at approximately half the supply voltage by the voltage divider consisting of two 18K resistors, while the emitter voltage is variable For low-level signals the transistor is non-conducting and so zero control voltage is applied to pin 4 of the IC. Under these conditions no gain reduction occurs.

Negative peaks of high amplitude signals are coupled from the output via a 1uF capacitor and cause momentary conduction of the PNP transistor; this applies voltage to pin 4. This in turn causes the 15uF capacitor connected to pin 2 to be charged up and maintain control voltage on another of the AGC

50mV the potentiometer becomes very critical of adjustment and the IC goes into virtual cut-off.

The frequency response is flat within 1½dB from 24KHz down to 80KHz, which should be more than adequate for most tape recording and amateur radio transmitters. The low frequency response can be extended to below 30Hz if so desired by replacing the 0.47uF capacitor with a 10uF electrolytic capacitor.

The power requirement of the compressor is approximately 8mA at 12V DC or 12mA at 18V DC. The use of a 12V supply will enable the unit to be used conveniently with equipment



Above, the wiring diagram for the compressor board.

control points within the IC. The size of the 15uF capacitor determines attack and decay characteristics of the compressor. Increasing the capacitor increases both attack and decay times and vice versa.

The level at which the PNP transistor begins to conduct is determined by the "threshold" potentiometer in the emitter circuit. Thus we have a mechanism by which incoming signals above a certain adjustable level will undergo reduced gain in proportion to their amplitude.

The integrated circuit by itself does not have enough gain to drive it into compression with the signal from most dynamic microphones of 50K impedance. Accordingly, we have added a preamplifier stage using a low-noise silicon transistor. This gives the compressor an overall gain of about 47dB with no compression applied, i.e., 1mV input will give approximately 210mV output. The preamplifier has substantial negative feedback applied from collector to base which rolls off the high frequency response rapidly from 24KHz. This is essential as the compressor may often be used in close proximity to high amplitude RF signals.

The "threshold" control in the compressor takes the form of a preset potentiometer which is adjusted by a screwdriver. The preset maximum level may be from about 50mV RMS up to the maximum undistorted output of the compressor, i.e., more than 1V RMS, depending on the supply voltage. The potentiometer may be set with the aid of an AC millivoltmeter, the recording level indicator on a tape recorder, etc. If an attempt is made to set the compressor for maximum output less than in cars. Alternatively, the supply may be derived from 2 small 9V batteries if the unit is to be built into its own

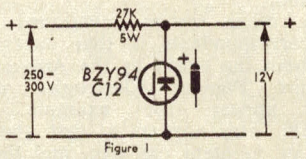


Figure 1

case. With valve equipment the most convenient approach would be to use a zener diode voltage divider connected to the HT line, as shown in figure 1 or to derive the supply from the 6.3V heater line via a "voltage doubler" rectifier.

If a 12V supply is used, incidentally, the 39K resistor from the base of the BC109 transistor to the negative supply rail should be increased to 47K.

Modifications to enable the compressor to be used with guitar amplifiers are simple. The preamplifier stage is deleted and the input is taken directly to pin 1 of the IC via a 47K resistor and 0.1uF capacitor. Where the guitar has a very high output it may be necessary to reduce the input signal with the aid of a voltage divider, while still maintaining the input impedance at 47K.

All of the compressor circuitry apart from the preset potentiometer is accommodated on a printed board measuring 4¼ x 2 1-8 inches. We elected to use a tab-mounting pot. instead of the smaller printed board variety because of problems of availability.

The compressor may be built as a self-contained unit in a compact, aluminium utility box measuring 2¼ x 2 3-8 x 5 inches which are available from most component sales outlets. This would have sufficient room for batteries, an on-off switch and input and output connectors. Alternatively it can be built into existing amplifiers, mixers, modulators and so on, the only proviso being that it should be fully shielded to prevent pickup of hum, noise and excessive RF. ■

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FORUM

Do we need another QSL service?

For more years than most of us can — or care to — remember, there has been a smallish but dedicated group of people who listen to distant radio stations, send off reception reports, and hopefully await the return of a QSL (or verification) card. These cards form the subject of the first letter to "Forum" this month.

Conducted by the Editor

As many will doubtless have noted, the subject was raised a couple of months back in a letter which appeared in our "Answers To Correspondence" section. Our reply was fairly brief, as much as anything because none of our editorial staff members can boast any detailed knowledge of the QSL situation.

However, the letter which follows comes from a reader who is a keen listener, a collector of QSL cards and actively engaged in their distribution. He writes as follows:

"Dear Sir,

"As an SWL of many years' standing operating solely on the Amateur bands, I was interested in a paragraph on page 189 of the December issue signed by J.E.C. and D.T. of Guildford in reference to the possible allocation of another call-sign system for SWLs in this country.

"For the records, I have been an active SWL since 1950; I hold the WIA DXCC for SWLs, have heard over 300 countries, and am the current 'DX News' sub-editor for the W.I.A. magazine 'Amateur Radio.'

"Over the years there has been an outcry for a new type of call allocation for listeners in this country but, in my opinion, it is not warranted.

"There are several basic types of identification available for listeners throughout the world at the present time. Each country has its own system, and that operated by the Wireless Institute of Australia is quite adequate for our use here. It consists of the letters WIA-L followed by a letter group with the first number being that of the particular call area in which the listener concerned resides. Thus I hold the identification WIA-L2022, which to any member of the Australian or overseas Amateur fraternity, particularly QSL managers, identifies me as an SWL member of the Wireless Institute of Australia, resident in New South Wales, and being the 22nd SWL registered.

"The other system mentioned by your correspondents is that operated throughout the world by the American Magazine 'Popular Electronics' and would appear for example as G3PE1N. This appears at first glance to be an Amateur call-sign, and there is an opinion throughout the world that this is done for its possible snob value. The breakup of the aforementioned call is G3 being the operator's call area, PE for the magazine initials, and the remainder of the call 1N is their registration.

"The system has the disadvantage that return QSL cards often finish up at the Popular Electronics QSL bureau and are then sent to the local area bureau for distribution — unless the listener concerned keeps a stamped and addressed envelope in the U.S.A. for the return of cards.

"The position is complicated by the fact that, if the operators of the Australian QSL bureau received a card for, say, VK2PE2R, they would not have a clue as to his identity and they might have to return the card to the sender. In actual fact, the VK2 QSL bureau send all cards of this nature to me for identification.

"A third system is operated by the International Short Wave League in England. This body caters for licensed amateur and listener alike, according no difference in status to either. All members are issued with a universally accepted identification which consists of their call area, followed by a number which is issued on rotation. Thus a N.S.W. listener would be VK2/8205 which, in actual fact, is the number issued to me in 1957. Here again there can be difficulties with cards using these identifications arriving at the W.I.A. and being virtually unidentifiable. However, these ISWL calls are universally recognised, and normally are returned for dispatch to the ISWL bureau which mails them on to members free of charge.

"Then we have the system used by the Radio Society of Great Britain. This consists of the letters BRS or BERS (British Receiving Station for home members, and British Empire Receiving Station for overseas members) followed by an identification number. Again, this system is foolproof, as cards automatically go back to the R.S.G.B. and are forwarded on to members. In fact this is one of the oldest if not the oldest system in use.

"Your correspondents ask for readers' opinions, and I can only state the aforementioned facts. To summarise, taking into account that the SWL population in this country is so small that it is well catered for, I can only say that the Wireless Institute of Australia provides an adequate identifica-

Phonograph patents

I read with interest the item on page 105 of the December issue about a method of simulating reverberation from 78rpm liscs. It was mentioned that the writer had applied for a patent.

It might be significant that a patent was applied for in 1898, with reference to cylinder recordings, which employed two reproducers in tandem, the second stylus tracking the same groove at the first. The inventor was interested in the idea that the reproduction would be twice as loud as that from an ordinary phonograph. The modified instrument was called the Polyphone.

While on this general subject, the Graphophone Company, about the same year, produced a phonograph employing three separate horns and reproducers with three separate recordings on the one side. This was called the "Multiplex Graphophone Grand."

To study the detailed history of recording is to realise that there is not much that had not been thought about at some time in the past. And a lot of discoveries that could have had great possibilities, had they been developed, were ignored or forgotten. The constant surface speed disc machine is one example, invented by Bell and Sainter.

G.T., Carlingford, N.S.W.

tion (got it that time) for its SWLs, and gives excellent QSL Bureau service. If a member must patronise an overseas club, then either of the English clubs provide excellent service, possibly with a slight advantage going to the ISWL for their excellent QSL bureau.

"One final note concerning the Australian short-wave listening population. We could not support another callsign system in this country; the numbers would not warrant it. There are maybe 20 senior experienced listeners in Australia, and they are known throughout the world by their existing identifications from the clubs of their choice. It would be extremely unlikely that they would subscribe to any system which would have them change calls, thus lose their identity. Finally, some years ago there was an outcry for SWL awards to be issued by the W.I.A. Eventually this was done, and after several years on issue we would be extremely lucky if a dozen have been issued, which is indicative of the SWL situation here.

"Should any reader want more details of either R.S.G.B. or ISWL operations they could drop me a line and I would put them in the picture."
Don Grantley (Box 222, Penrith 2750).

Well, there it is.

Don Grantley feels that there is no need in Australia for any new organisations to handle QSL cards. Did the original correspondents know about the W.I.A.-sponsored bureau, which we mentioned or were they simply unaware of its existence?

Changing the subject, we have reproduced in the panel a letter from a reader who maintains that the idea of using tandem pickup heads on a record is very old indeed even though, at the time, those who suggested it were concerned with obtaining results other than synthetic echo or reverberation.

On his second point, I remember having had a triple-track disc in my collection, many years ago, although one of much more recent vintage than G.T.'s reference. I don't think it had anything to do with the "Multiplex Graphophone Grand," but was simply released as a puzzle record.

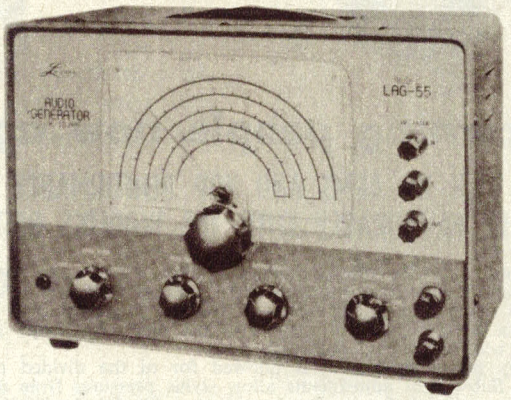
Superficially, it looked just like any other 10-inch 78rpm disc. Instead of a single groove, however, three grooves started from different places around the edge and spiralled inwards side by side. Each groove carried a different sound and, in lowering the needle, it was a matter of chance which groove you picked up and which program you heard.

At a party, it could be quite a conversation piece, particularly if those who knew were careful not to reveal the very simple explanation for the "mystery."

I cannot share G.T.'s enthusiasm for the constant surface speed disc system. Whatever advantages it might have had in terms of constant lineal groove speed, it involved horrendous problems in attaining and holding the desired speed accurately; this without the complications of different groove pitches or variable pitch. I remember, some twenty years ago, a lot of constant-speed devices being unloaded on the clearance market. In fact, I wrecked a couple trying to adapt them as lathes for home recording!

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LAG 55

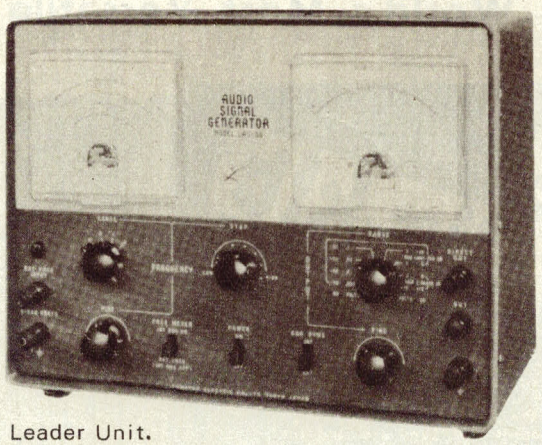
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Complex Wave Output	Above 5,000Hz combined with line frequency Amplitude ratio 4:1 (low to high); Output 10Vp-p

● ● ●

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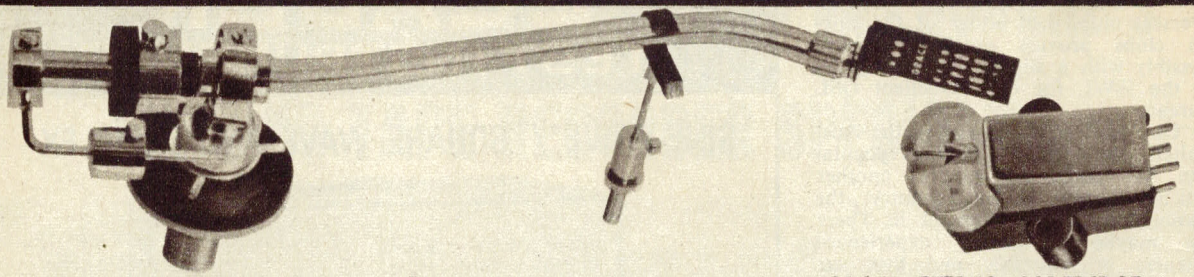
Generator —		Frequency Meter —	
Frequency Range:	11 to 110,000Hz in 4 bands	Range:	10 to 110,000Hz in 4 ranges
Output Voltage	600 ohms: 0—1V in 6 ranges 10k ohms: 0—10V in 2 ranges	Input Impedance:	200,000 ohms approx.
		Accuracy:	1.5%, full scale: 10 to 11,000Hz
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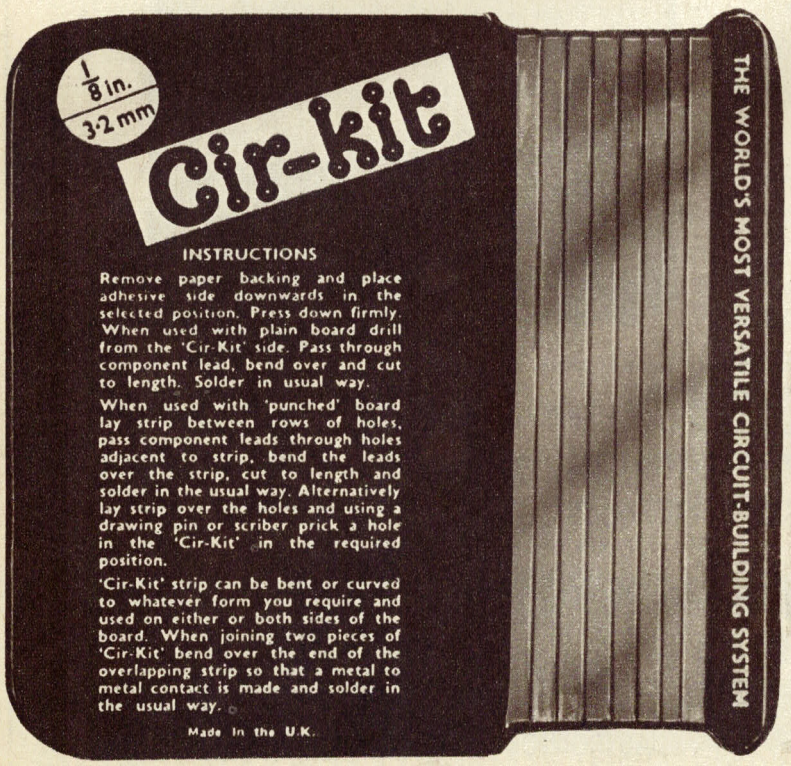
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RADIO INTERFERENCE WORKSHOP

A workshop session in radio interference will be held at The School of Electrical Engineering, The University of New South Wales, on Tuesday, February 17, 1970.

Sponsored jointly by The University of New South Wales and The Institution of Radio and Electronics Engineers Australia, the sessions will have the following aims in view:

1. To bring those concerned with the problems of radio interference together.
2. To permit organisations with problems of interference to explain their situation.
3. To allow organisations and individuals to propose solutions which may be adopted to overcome the general problem of interference.
4. To provide an opportunity for specialists in some fields to hear papers on other facets of the general problem and to take part in discussion of papers related to their specialty.
5. Informing non-specialists and those who have an interest, but lack detailed knowledge of the subject, about the present state-of-the-art, and possible lines of development.

The program will include eight talks by invited authors, covering: —

Situations where electromagnetic interference is produced:

Situations where the performance of equipment is affected by the presence of electromagnetic interference.

The program and a book of summaries is available for those persons interested. Abstracts of the papers will be issued to those who attend the Workshop.

Information on matters related to the program may be obtained from Dr J. Hiller, School of Electrical Engineering, The University of N.S.W., P.O. Box 1, Kensington, NSW 2033, telephone 663-0351, ext. 2803, 2796. On matters related to organisation, etc.— K. G. Knight, General Secretary, The Institution of Radio and Electronics Engineers Australia, Box 3120, Sydney, N.S.W., 2001 (telephone 27-1039).

On this page is announced a workshop, which is being arranged in Sydney specifically to have a look at the problem of electrical interference in relation to communications and other electronic equipment.

We certainly applaud the initiative of those who have taken it upon themselves to organise these sessions. We would like to think that some of the things we have had to say about interference have helped to produce a climate of protest—a climate which will contribute to the success of the workshop in terms of practical, down-to-earth recommendations.

Our main fear is that the workshop could drift off into the realms of high theory, with too much attention given to the obscure processes of noise generation and penetration, and too little to the practical issues of the problem as it affects us right here and now.

I have in mind matters which we have come up against repeatedly during the past year:

CONTROL TONES ON THE MAINS: Correspondence on this subject has indicated that it is a nuisance encountered in widely separated areas of the nation. There was indication that the trouble had arisen because supply authorities had progressively been pushing up the level of the control tones, rather than maintaining critical adjustment of the controlled units.

When customers began to complain — mostly through "Electronics Australia"—the process was halted or reversed and we had reports from a number of complainants that the trouble seemed to have eased following the publicity. But I gather that it's on again, in some areas.

The workshop might well ask; not only about the limits which might reasonably be recognised, but who is going to impose and police those limits.

INTERFERENCE WITH TELEVISION: During the past 12 months or more, a member of our technical staff has been fighting a running battle involving his local council, local member, the P.M.G. Radio Branch and the electrical supply authority for his area. The problem: Gross hash, with a 50-cycle modulation component, which rips his television picture to pieces during a large proportion of his evening viewing time. When the insulators are very clean or very wet, there is no problem; when they are coated with dust and dew, the problem is at its worst.

Here, indeed, is a fine subject for debate and the workshop might turn up some interesting facts about the nature of insulators, the effects of different kinds of surface fouling, the efficacy of certain coatings, etc.

But what about the situation in which viewers find themselves right now, when complaints merely land them on a merry-go-round, with each authority busily explaining the limits of their responsibility, their lack of jurisdiction over other areas, and so on?

Discussion of the problem is fine but it can be abortive if there is no coercion to force supply authorities to take measures which are important from the interference viewpoint, but redundant to their prime task of conveying power from point A to point B.

"RADIO" TYPE INTERFERENCE: Here is a ludicrous situation indeed.

If a lad in suburbia mocks up a 0.1 watt transmitter and broadcasts unofficially to his friends in the neighbourhood, he can be prosecuted with all the weight of the law. If a radiotelephone operator or an amateur radiates energy outside his assigned piece of spectrum, he'll hear about it!

Quite rightly, I might add, because the Radio Branch of the P.M.G. Department is there to police the regulations.

But here's the rub:

If someone installs RF equipment for welding plastic or heating meat pies, and it leaks kilowatts of energy into the ether and into the mains, he can ignore the radio inspector if he wants to. He's not operating a thing called a radio transmitter! It's as simple as that. I gather that the P.M.G. itself have had to suffer in silence from interference to its links.

And much the same applies to any non-transmitter that generates radio interference. It might be anti-social but it isn't anti-law.

I would have been much happier if the announcement of the workshop had carried some mention of the legal aspects of interference.

To be sure, it's a hard and thorny question, which tends to scare off academics and engineers. But, if we are going to make any real progress against the rising tide of interference, it will have to be on the heels of a hard-hitting bill, brought down in Canberra, and aimed alike at the little man and the big public utility.

If academics and engineers aren't willing to agitate for such a bill, who will?

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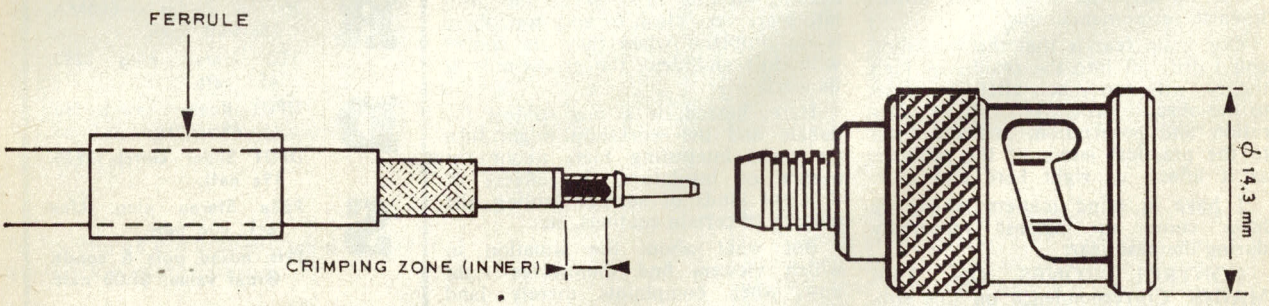
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A READER BUILT IT

Draws The Curtains At Sundown

This novel light-operated device is designed to automatically close curtains or venetian blinds when daylight falls below a predetermined level. It can also switch on internal lights.

The light sensitive element is an LDR (Light Dependent Resistor), and this operates in conjunction with a two stage direct coupled amplifier and a relay. The characteristic of the LDR is that it has a very high resistance (typically several megohms) under conditions of no light and very low resistance (a few hundred ohms) under bright light conditions.

As shown in the circuit it forms one arm of a voltage divider, in conjunction with the 10K potentiometer, supplying base bias to the OC71. Under bright light conditions the resistance of the LDR is relatively low and little forward bias is applied to the base. Under these conditions very little collector current flows through the OC71.

As the light level on the LDR decreases its resistance increases, thereby increasing the forward bias on the base and increasing the collector current. This collector current, in turn, provides forward bias for the OC81, thereby increasing its collector current also. When this collector current reaches a large enough value the relay is pulled in.

The relay may be any sensitive 12V type with two sets of make contacts and two sets of break contacts. During daylight conditions the relay is open but, as night approaches, and at a level determined by the setting of the 10K potentiometer, the relay will close and operate the motor. The motor may be any toy motor, such as one from a slot car. It should be capable of being reversed by reversal of the applied voltage.

(Editorial comment: The size of the motor will really depend on the size of the curtains. It would appear that these were quite small and light in the original set-up.)

When the motor operates it pulls the cord to close the curtains. As the curtains meet in the centre a magnet, fastened to the moving curtain, opens a magnetic reed switch (RS1), causing the motor to stop. When the return of daylight causes the relay to drop out, reverse voltage is applied to the motor which then runs in the opposite direction and opens the curtains. When the curtains reach the full open position the magnet in the curtain operates a second reed switch (RS2) and stops the motor.

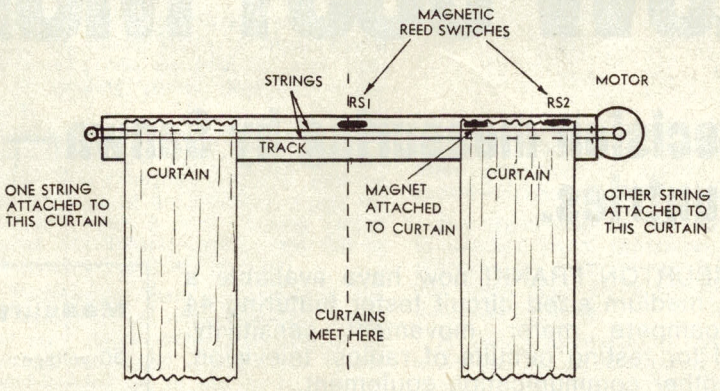
(Editorial note: Most reed switches are "normally open" devices which will close in the presence of a magnet. To make them "normally closed" it will be necessary to bias these with a fixed magnet mounted at a suitable distance from the reed, and with its north and south poles suitably oriented. Presence of the moving magnet will now cancel the effect of the bias magnet and allow the reed to open. An alternative arrangement is to use a "changeover" type reed, which may be wired for either function.)

More than one set of curtains could be operated by this unit by repeating the motor circuit shown in the dotted box. If desired, additional reed switches may be added to switch on (and/or off) inside lights when the curtains are closed or opened.

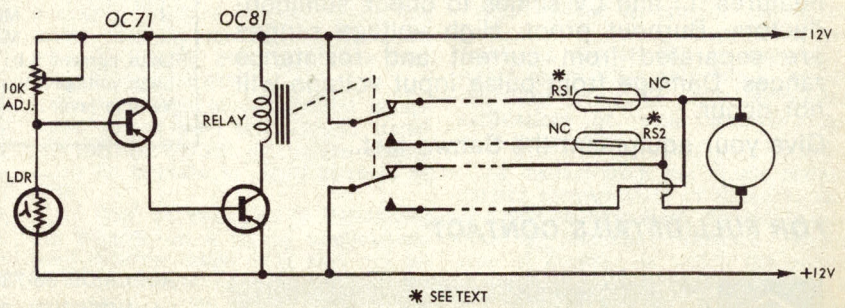
The LDR is located outside the building, preferably in the open shade rather than direct sunlight, and where it will not be affected by street or window lights at night.

The original unit was built and tested with complete success. It was fitted in a microbus converted to a caravan and operated from the car battery. If it is to be operated from the mains, a suitable power supply will have to be provided. The exact size of the power supply will depend on the size of motor used to draw the curtains, which will depend, in turn, on the size of the curtains. It may be possible to use a mains-operated motor, but the requirement that it be reversible must be kept in mind. Brush-type motors, AC or DC, can normally be reversed by reversing the connections to the brushes.

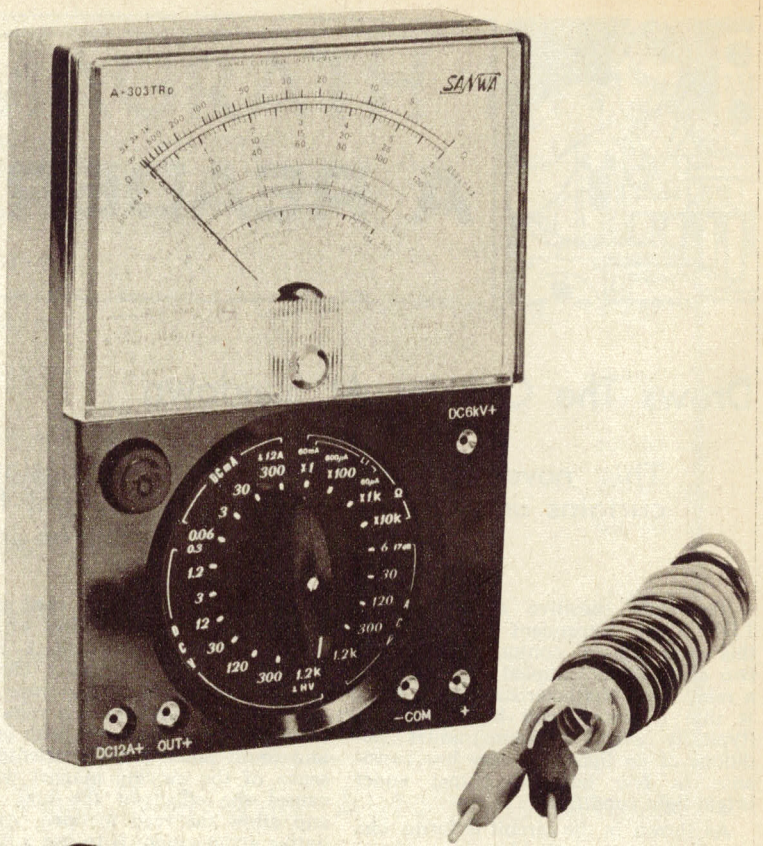
(Submitted by: Mr G. Hayward, Post Office, Young, N.S.W. 2594.)



The layout of the complete curtain system, showing location of the motor, reed switches, and magnet.



Circuit diagram for the curtain control system. Note the wiring of the changeover relay contacts in conjunction with the reed switches. The latter must function as "normally closed" types.



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Measurement Ranges Available.

DC voltage:	0.3V	1.2V	3V	12V	30V	120V 300V
	1.2kV	6kV	25kV (with probe)			
AC voltage:	6V	30V	120V	300V	1.2kV	
DC current:	60μA	3mA	30mA	300mA	12A (300mV)	
Resistance:	Range	·	×1	×100	×1K	×10K
	Midscale	·	25Ω	2.5kΩ	25kΩ	250kΩ
	Maximum	·	5kΩ	500kΩ	5MΩ	50MΩ
Load current (LI):			60mA	600μA	60μA	
Load voltage (LV):			1.5V	1.5V	1.5V	
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A READER BUILT IT . . . continued

A "Unipivot" Tone Arm

Those readers interested in the mechanics of tone arms should find some interesting ideas in this description of a "unipivot" design.

This arm embodies what I feel are some novel principles, which permit the simplicity of the unipivot while allowing full dynamic balancing.

The arm is suspended on a steel spike in the usual way. The bearing is a glass one taken from a car compass. A cross-arm is fitted to the main tube, the centre line of the cross-arm passing through the pivot point. A hole is drilled at each end of the cross-arm, on the centre line. A length of terylene thread is secured in each hole, and the two threads pass through the mounting base, and meet at a point directly below the pivot, where they are fastened to a tensioning spring. This arrangement allows the necessary freedom of movement without the pendulum effect of the normal unipivot.

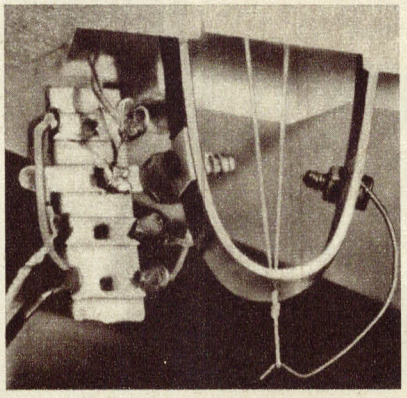
The arm is made from aluminium tube. A socket for a Decca Deram cartridge is glued to one end. The counterbalance is cast from lead and dynamically balanced to minimise tension on the lateral support threads. Dynamic balancing was achieved by hanging the counterbalance eccentrically and drilling it appropriately. Even without the support threads the original arm would remain in any position and was very free.

Leads out of the arm are twin wires twisted together. The leads from the two channels spiral in opposite directions. No trouble has been experienced with hum.

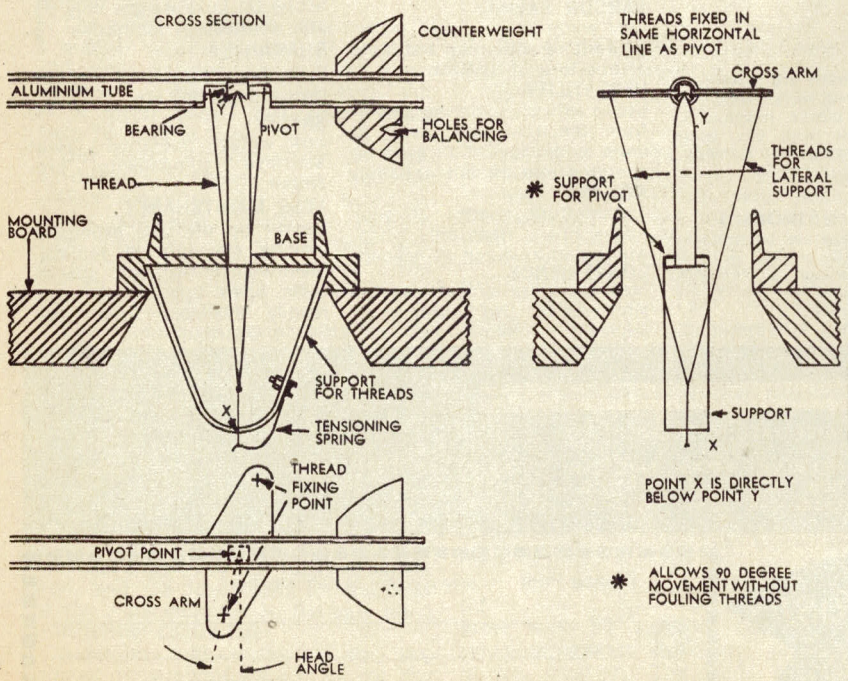
The tracking angle and overhang were calculated from the Radiotron Designers Handbook.

(Submitted by: Mr H. M. H. Given, 3-156 Pacific Highway, Hornsby, N.S.W. 2077.)

(Editor's Footnote: "Reader Built It" projects are published for the general interest of experimenters and as a source of ideas. Based on readers' contributions, they have not been tested in our laboratory and we cannot accept responsibility for them.)



Underside view of the unipivot mechanism, showing the stabilising cords and tension spring. Terminals on right accommodate the pickup connections.



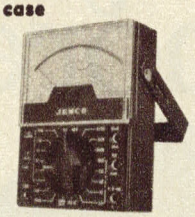
The unipivot assembly in greater detail. At top left is a side elevation, at right a rear view showing the stabilising cords in detail, and at lower left a plan view of the cross arm.

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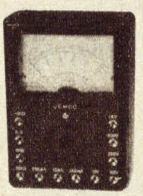
DC volt: 0.25/1/2.5/10/50/250/1000.
AC volt: 2.5/10/50/250/1000.
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AC current: 10A.
5 7/8 x 4 1/8 x 1 7/8 inches.

Robust workshop model MT-216 $11.40 2000 o/v, leather case $2.60.



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Quality pocket meter MT-114 $7.20 4000 o/v, leather case $2.



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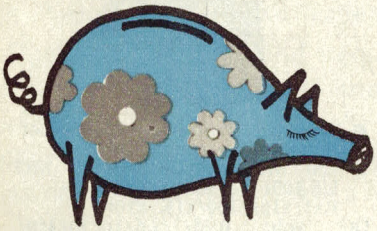
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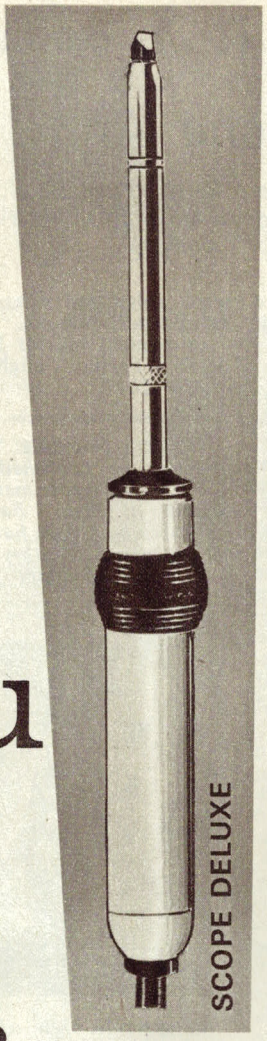
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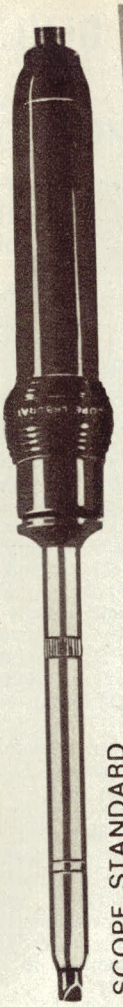
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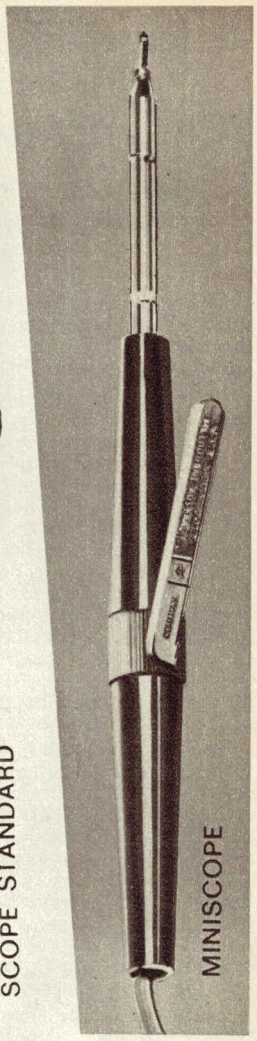
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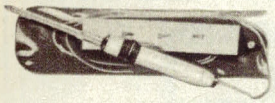


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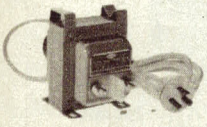








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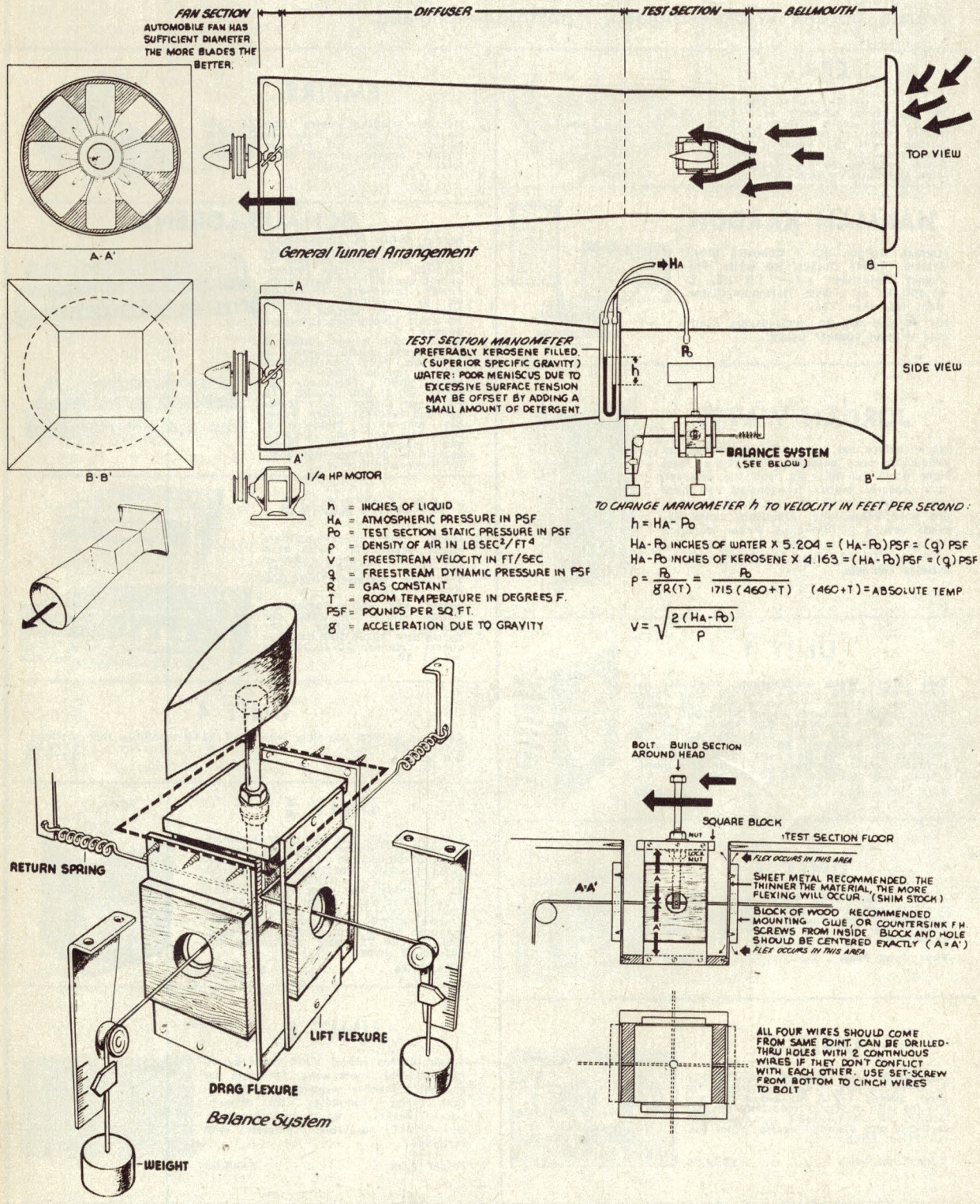
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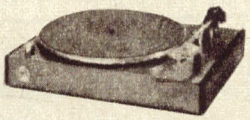


The project illustrated above does not qualify as either "Reader Built It" or electronic. Nevertheless, we feel sure that the section of our readers who enjoy these pages, will find it interesting. It is reproduced from "Boeing Magazine" by arrangement with the publishers and describes a model wind tunnel suitable for testing small aerofoil designs. While it may be a large undertaking for an individual, it would be ideally suitable for a club project. No dimensions are shown but the full length of the tunnel is approximately 52in, and the drawings are to scale. Note particularly that we have no information additional to that shown, nor does the Boeing Company. Please do NOT write to either ourselves or Boeing requesting further details.

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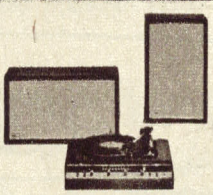
Empire—Loudspeakers, Turntables, Cartridges — Most Perfect Record-playing Equipment, Made in U.S.A., Harman Kardon—U.S.A., Schaub-Lorenz—Germany, Era — France, Jordan Watts—England, Armstrong—England.

ERA



Era Mark III Turntable: The ERA arm can track perfectly at 1/10th of a gram—while listening to a record you can hit the turntable vertically with your knuckles and the arm does not jump one groove. Power requirement 1.6 watts, total wow and flutter 0.04%. Belt driven.

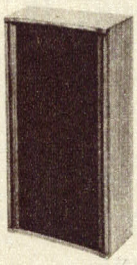
HARMAN KARDON



Harman Kardon SC 7 Compact Music System: Power Output: 60 watts, Frequency Response: +/— 1.5 dB, 8-45,000 Hz at 1 watt, Harmonic Distortion: less than 1%.

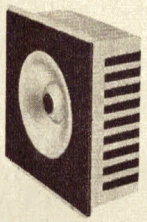
HK 40 and HK 20 loudspeakers available without speaker boxes.

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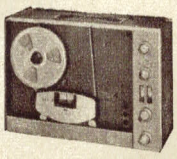
UNIT 1



Two Jordan Watts loudspeakers, frequency response 30-17,000 cycles +/—3 dB. Unit Power Handling Capacity: 12 watts rms, 24 watts music power. Frequency range 30-17,000 cycles +/—6 dB. Armstrong 521 stereo amplifier, power output 25 watts each channel into 8 ohms. Power bandwidth 20-25,000 Hz, frequency response 20-20,000 Hz +/—1 dB. Era Mark IV turntable, which can track at 1/10th of a gram. Empire 808 cartridge, 10-20,000 Hz.

Total Price $464.00

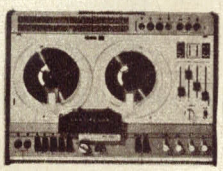
UNIT 2



Ampex Model 2163 stereo tape recorder, complete with two Harman Kardon HK 40 loudspeakers, response from 30-20,000 Hz, handles over 50 watts music power, 4 ohm impedance. Total Retail Price: $925.

Your Total Price $800.00

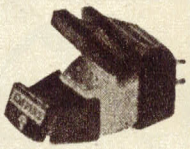
UNIT 3



NordMende tape recorder Model 8000/T, three motors, Quarter track: 7in reels: speeds 1-7/8 in, 3-3/4 ins and 7½ ins with multiplay (complete mixing) facility. PE 34 turntable complete with cartridge and diamond needle. Total Retail Price: $695.

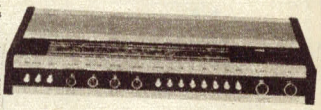
Your Total Price $595.00

EMPIRE



Recently released Empire 1000 ZE Cartridge, frequency response: 4-40,000Hz, Output voltage: 4.0 mv per channel, Channel separation: 35 dB, Tracking force: ¼ to 1¼ grams.

SCHAUB-LORENZ



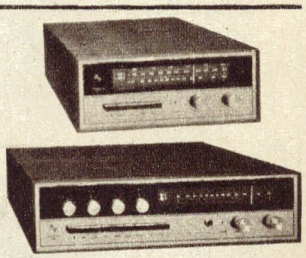
Model 5000: A tuner/amplifier that brings you the spectacular depth and breadth of perfectly reproduced stereophonic sound. Four wavebands. Power bandwidth 15-40,000 Hz at maximum distortion factor of 1%. Output of 2 x 20 watts (continuous sine-wave power).

Model 4000: Power output: 2 x 16 watts, music power 2 x 25 watts, fully transistorised. Built-in rumble filter.



Model 3000: Frequency response 20-30,000 cycles, 15 watts per channel, fully transistorised tuner/amplifier. Tuner has long-wave, middle-wave, short-wave and FM. Ceramic and magnetic input. Most beautifully designed high-quality tuner/amplifier.

ARMSTRONG



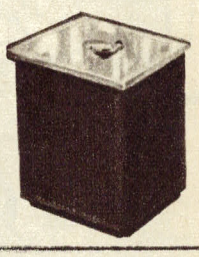
Model 526 tuner/amplifier: Power output: 25 watts each channel into 8 ohms. Power bandwidth: 20-25,000 Hz. Frequency response: 20-20,000 Hz +/—1 dB.

Model 521 stereo amplifier: Power output: 25 watts per channel into 8 ohms, power bandwidth: 20-25,000 Hz, Frequency response 20-20,000 Hz +/—1 dB.

UNIT 4

Kenwood AU250 complete with Dual 1210 turntable and cartridge.
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Our price $210.00

UNIT 5



Armstrong 526 AM-FM tuner/amplifier, 25 rms per channel, frequency response from 20-20,000 Hz +/—1 dB, less than .1% distortion measured at 15 rms. Era Mark IV turntable, Empire 1000 ZE cartridge, frequency response from 4-40,000 cycles, 4.0mv per channel, tracking force ¼ to 1¼ grams. Two Empire 2,000 loudspeakers, frequency response 35-18,000 cycles, power handling capacity 75 watts, undistorted. Impedance 8 ohms.

Total Price $1,070.00

UNIT 6



Schaub-Lorenz Model 3000 tuner/amplifier, AM-FM, short wave, 15 watts per channel, frequency response from 20-40,000 cycles, complete with Schaub-Lorenz speakers in boxes, fully imported. Dual 1210 turntable, complete with cartridge.

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AUDIO TOPICS

IS FOUR-CHANNEL STEREO ON THE WAY?

So you've learned to live with two-channel stereo. The loudspeakers and the chairs in your listening room have been suitably arranged. The family likes — and expects — sound with a sense of dimension. But don't settle too comfortably into the pattern. What would you say to four-channel sound — or, if you prefer — "four-channel stereo."

By Neville Williams

In asking the question, we're not talking about simply pushing a couple of extra loudspeakers in between your present stereo pair; of filling the so-called "hole in the middle." We're thinking of a system which puts a loudspeaker in each corner of the listening room, so that you're literally surrounded by sound, related in content, phase and amplitude to the sound scene from which the performance originally came.

Some time back, odd references to this all-round four-channel stereo began to be heard in circles where hi-fi buffs congregate. The references didn't create any great surprise or any great sense of intrigue. Technically, there was no special reason why anyone, who wanted to, couldn't set up a four-channel system of recording and playback.

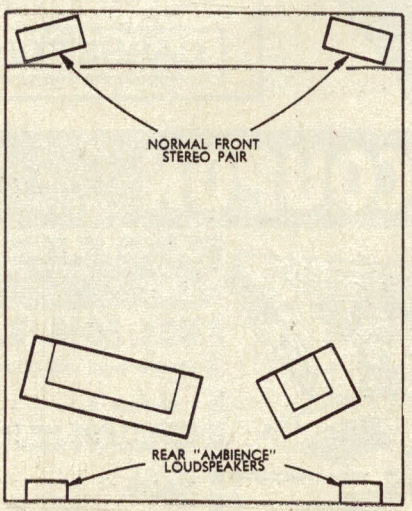
Two stereo quarter-track pairs on ¼-inch tape is an industry standard and the more complex decks already carry an array of heads, for separate record and playback, bi-directional play and so on. Given a couple of external amplifiers, it would be no great problem to rearrange matters so that all four channels on the tape could be active simultaneously. The recording might be offset longitudinally on the tape but that would not matter if the tapes were replayed on the same or an identical machine.

Why then should anybody be surprised if a few professional hi-fi buffs carried out some experiments along these lines for their own entertainment and satisfaction? If they became enthusiastic enough, even, to hold a few joint discussions and demonstrations. It didn't commit the industry or indicate a trend—any more than did the efforts of the back-room boys in Detroit to produce steam or electric automobiles!

But, since these early, isolated exercises, all-round four-channel stereo has kept on popping up in the U.S. hi-fi scene, to the point where it has begun to form a rather solid pattern. New words have been coined, like "Quadrisonic." Vanguard has established a proprietary name: "Surround Stereo," and is offering four-channel tapes for $14.95 each. The Acoustic Research Company has become involved in broadcast demonstrations via FM/Stereo; Columbia has been looking at the record situation; Nortronics and Michigan can supply four-in-line heads, and 3M/Wollensak can offer a complete deck—all at this stage, very specialised and very pricey.

And there are others.

Faced with all this, engineers, writers and executives, who had earlier ignored or dismissed four-channel stereo as a lab. plaything, began to wonder whether there was not, after all, a proverbial small cloud on the commercial horizon; whether the day might indeed come when they would be designing, evaluating and selling domestic four-channel systems.



The four-channel system extends the concept of conventional stereo by providing two channels of extra information behind the listener.

But why four-channel? What could it offer, so dramatic, as to unsettle the well-established two-channel system?

In fact, the two-channel system has proved to be economical, convenient and effective, for domestic use, whether per medium of disc, tapes or FM/multiplex.

Engineers and producers have long since learned how to use it to produce a complete wall of sound in front of the listener, or sound which appears to emanate from a central point, either side or all three; any or all of these separately or together, as desired.

So effective can the system be that there has been little incentive to supplement the line-up with extra physical channels. Why then the sudden upsurge of interest in something much more complex?

As we have already indicated, what the hi-fi buffs have been playing with are not four channels arrayed in front of the listening position, but two in front and two behind. There is a wall of sound in front and a wall of sound behind. More than that, the two loudspeakers which happen to be on the left can re-create, between them, the left environment: similarly for the two on the right.

Some hi-fi authorities, who have heard this kind of sound, claim that the total effect is nothing short of dramatic. The listener finds himself involved to a far greater extent than ever before, in a re-constituted sound environment. Echoes, reverberation, audience noise are all around him and there is a tremendous sense of being present at the original performance.

Behind this statement lies a good deal of basic audio psychology. Forty years ago, producers of radio plays learned that, if they could provide the right kind of vocal identity and the right kind of sound effects, listeners' imagination would do the rest. The players could be on the lonely moors, in a busy street or in a plane, hurtling to its doom. The more realistic the sound, the more convincing would be the mental image created in the mind of the listener.

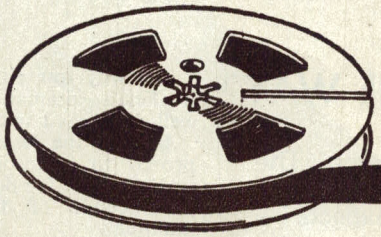
There is no doubt that good two-channel stereo has a lot more "presence" than mono; it can create a more convincing image. And, according to those who have heard it, four-channel "all-round" stereo has a lot more presence again that the two-channel "out in front" variety.

While multi-channel stereo is new on the domestic scene, it is certainly not new in the film and theatre world. Perhaps the best known of the early efforts was the Disney/Stokowski film "Fantasia," which provided multiple

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tracks on a special film and assumed that some of the loudspeakers would be placed at the sides and rear of the theatre.

Other ambitious productions — and systems — have used multi-channel sound since then. Cinemascope and Cinerama both provide for the round half-dozen channels, some behind the audience, and there have been scenes quite notable for their sonic impact: the thunderclaps in "Ben Hur;" the choir scene in "This Is Cinerama;" the chorus in "How The West Was Won," singing "Shenandoah" from behind the audience.

But is is interesting to note that, while the film industry has explored and applied multiple channel techniques, the impact on the audience has not been such as to warrent its general adoption or the installation of special sound equipment in other than the major theatres. At first glance, this would seem to suggest that the public generally is likely to be lukewarm to a sound system in the home more pretentious than they already have.

In fact, there is a vital and fundamental difference between the two situations. In the theatre, the presentation is dominated by the visual image on the screen, which is essentially in front of the audience. Logically, the sound must relate to this visual centre of attention and it is quite difficult to sustain, by audio alone, a dramatic dimension external to the illuminated screen.

In the environment of a hi-fi listening room, where there is no visual image to compete, the sound is free to stimulate the listener's imagination and to re-create the original environment. Its long-term impact and contribution to listening pleasure may therefore be far greater than in a cinema situation.

While the idea of four-channel stereo in the home may still seem rather outlandish, it is certainly much more practical now than its might have been, even a very few years ago. High fidelity fans can now buy compact amplifier and loudspeaker systems which stand ready comparison with the more cumbersome equipment of the previous decade. Furniture conscious members of the household have come to accept the more compact stereo units as part of the modern domestic scene.

It might not be an impossible step for the hi-fi fraternity at least to add a couple more "atmosphere" channels, especially if it transpired that they could operate within more modest power and frequency specifications than the main frontal channels — a subject which has already been debated with spirit in the U.S.A.

A couple of small enclosures on the rear wall would not pose any great problem, while the ever-diminishing proportions of amplifiers, relative to their ratings, would suggest that a couple of supplementary channels would almost be absorbed within presently accepted dimensions.

However, in saying this, it is essential not to lose sight of one very important matter: that of signal-to-noise ratio.

Experience has shown that, as extra channels are introduced into a listening situation, the gain and power specifications of the existing channels are not proportionately reduced. On the contrary, they are retained on the assumption that, at particular instants, any one of the channels may be called upon to handle the lion's share of the signal. In virtually all present-day stereo installations, each channel separately has as much or more acoustic output than the mono system which it most likely displaced.

Obviously, with two active channels, as in a normal stereo system, there are two sources from which hum and noise can be injected into the listening area during quiet musical passages or periods of silence. Visualise a four-channel system and the problem has doubled again.

In other words, for a given signal/noise ratio in the listening room, or for a given impression of "music out of silence," the individual channels in "all-round stereo" must be marginally better than those in the conventional two-channel system.

And this must include the signal source.

We are inclined to grumble at present about the hiss level on quarter-track two-channel stereo tapes; we would grumble even more if two extra tracks were allowed to add their quota of noise in the same proportion.

We are inclined to grumble about surface clicks from a disc recording, emanating randomly from either of two channels; add two more channels — if this were technically feasible — and we would be in for double trouble again!

At the very least, it would appear that manufacturers of discs and pre-recorded tapes would have to exercise extreme care to keep noise at a minimum and/or use the Dolby or other system, so that their products will have as little "built-in" noise as possible. The rest will be over to the equipment manufacturer and the user.

At first glance, ordinary quarter-inch quarter-track tape would seem to be the obvious medium to carry four-track stereo. The basics are already there and it would only be a matter of mounting enough heads on a deck in a suitable configuration and providing the appropriate amplification channels.

However, unless pre-recorded tape can achieve some kind of a breakthrough in cost, it would still be confined to the high-priced specialist market. This is due to the fact that tapes have to be individually copied from a master source, and individually checked and spooled.

The process can be cheapened somewhat by copying at very high speeds and possibly copying in different countries to minimise local duties and taxes. Unfortunately, measures like these, aimed at reducing costs, all too easily carry a penalty in terms of reduced signal/noise ratio and discourage hopes that high-quality four-track stereo tapes could be attractively priced — at least within the impending future.

What of discs?

Two-channel stereo in a single groove has worked out so well that it has virtually superseded mono recording. Whether it would be possible to come up with commercially attractive four-channel system on disc is another matter.

It would be easy to say that it is not practical but it is also necessary to bear in mind that the record industry has a huge investment in a basic system and any substantial de-

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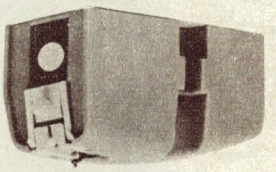
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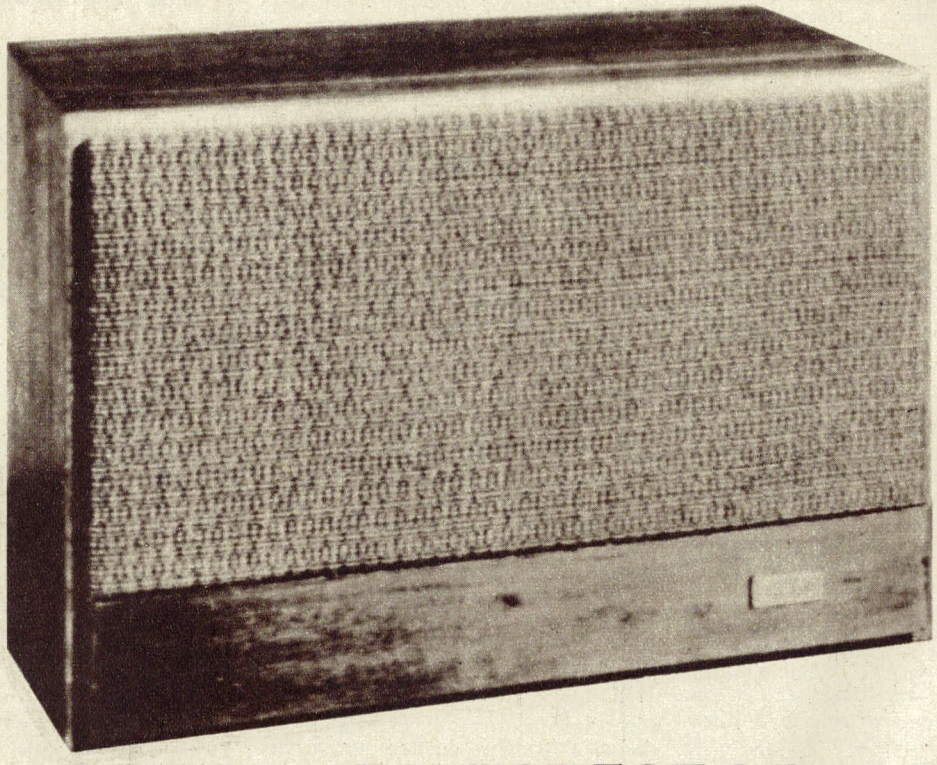
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mand for extra channels would pose an urgent and tremendous challenge for audio engineers around the world. Here it is appropriate to quote from an article by Bert Whyte in the December 1969 issue of "Audio" magazine.

He says:

"In this connection, it is worth noting that a story in 'Time' magazine reported that a bassoonist named Peter Scheiber had worked out a coding system to compress four channels into two, overlay them on tracks on either disc or tape and then retrieve them again. In fact, 'Time' claimed its music editors heard a demonstration of the four-channel disc, which 'was quite good but not as good as the equivalent tapes.'"

Whyte continues:

"The Scheiber process reportedly has one great commercial virtue: compatibility with existing hi-fi systems, for it required only an 'encoder' at the recording studio and a 'decoder' in the home of the listener (with all the additional speakers and amplifiers, of course).

"Whether this is a valid system is a moot point. A friend of mine who is chief engineer of one of the major record companies attempted to contact Scheiber, and actually reached him on the telephone, but Scheiber would give no information whatever regarding his system. ('Audio' Editor's note: Bert Whyte advised in a last-minute telephone call, that two very reliable sources said they heard the four-channel disc operate — and it works!)"

What the technical basis is for the reported four-channel disc is still not yet clear but it would probably have to be far more complex than the simple geometric separation which serves for two-channel stereo.

Quite a few years back, developmental work was carried out on a two-channel stereo system which involved the use of a "carrier" in the supersonic region, on which the left and right channels were to be multiplexed. It never got very far, mainly because the 45/45 system for disc, and parallel tracks for tape, were a far simpler proposition.

It seems possible that a four-channel system for disc could come from a marriage of the two methods, with the 45/45 system providing two separate signals as at present, but each carrying extra information modulated on to a carrier in the 30-40KHz region. Presumably, conventional pickups and systems would simply ignore the extra component and produce conventional two-channel out-in-front stereo. But special pickups and equipment, sensitised to the supersonic carrier, would make available the additional information for the rear channels.

Some audio experts are dubious about the durability of information in a groove at this very high frequency. They think that it would very rapidly be scuffed away by practical pickups and styli.

Others maintain that the high frequency content of practical discs seems to withstand a great deal more abuse than "alarmist" laboratory tests would indicate and that the more refined present-day recording and playback techniques are within striking distance of the objective. One more round of refinement would be all that would be necessary.

Either school of thought could be right but this much must be said: A four-channel stereo disc must be regarded as a definite possibility—a disc which would be pressed and packaged like any other disc, and which would be playable on older stereo and even mono systems. These systems would not sense the extra information, and might even scuff most of it off after a few playings, but this hazard is no different from what applies at present to compatible stereo/mono pressings.

As far as Australia is concerned, the question of four-channel FM/Stereo broadcasting is a purely academic one and will remain so until such time that the Federal Government decides that FM broadcasting should be set up.

In the meantime, FM/Stereo multiplex stations in the U.S. are looking over their shoulders at this new topic of conversation. Pairs of stations have broadcast four-channel stereo between them but no one would regard this as a logical or permanent practice.

It would be much more reasonable to assume that the FM stations — if they do anything — will multiplex the extra information by means of subcarriers on the main carrier. Whether they can do this within their allotted bandspace, or without sacrificing other separate mood music channels that some already carry, remains to be seen. The likelihood is, however, that FM stations could convert to four-channel stereo, one way or another, without sacrificing compatibility with existing two-channel and mono FM receivers.

Finally what resources of existing program material would recording companies have if a market opened up for four-channel stereo?

Some writers have dismissed this as a problem because the companies have, for years, been making their master recordings on wide-track tape or coated film stock having as many as 24 tracks for signal information, dynamic level control, etc. This information has been re-mixed in the studio to give the best — or the desired — result on a two-track system.

While all these tapes would still be available for re-processing, most of them would carry only front-of-the-audience sound, from microphones placed close to the performers or specifically aimed in their direction. For this material to be transcribed to a four-channel round-the-audience system, the ambience for the rear channels would have to be contrived by dubbing audience noises, using synthetic reverberation and such other trickery as is already practised in producing today's simulated stereo recordings from a mono original.

If genuine four-channel all-round stereo is going to appear on the market, it will have to be from material freshly recorded for the purpose—and in situations where the environment is genuinely appropriate to the performance. Sponsors, producers and recording engineers may have to learn a whole new set of ground rules . . . if the idea catches on!

Should readers of this journal, aspiring to a new stereo system hold off in case something comes of this four-channel scheme? I don't think so.

If it "takes off" at all commercially, it will either have to pass through a traumatic period of conflicting ideas and practices or await the establishment of official industry standards.

It will of necessity have to pass through a period of costly experiment and development before mass production can even start to bring the prices down and expand the catalogues of genuine all-round stereo material.

Before that, it will have to prove itself in open competition with present-day stereo practice. It will have to demonstrate that the average hi-fi fan, let alone the average listener, actually wants the extra channels.

If you need a new stereo system, buy it. My tip is that you'll enjoy a lot of listening before you have to follow the Jones' next door into a four-channel system. ■

Three questions . . .

Q.: Has not the idea of using four or more loudspeakers dispersed around the room already been promoted here in Australia?

A: Yes it has but the idea of having four distinct channels of information is quite different from simply feeding extra loudspeakers from the existing stereo.

Q.: Isn't this just a gimmick aimed at making more money for the hi-fi industry?

A: It's more than a gimmick. It is a development which, like microgroove and two-channel stereo, only became practical as techniques evolved. If it is widely accepted, some companies will make money out of it. But others could suffer and this could include the entire disc industry unless it can come up with a practical four-channel disc system.

Q.: Would not three channels serve much the same purpose?

A: Perhaps it could, to a considerable degree, but the fact that tape can conveniently offer four channels would probably set the pattern which disc and radio might have to follow.

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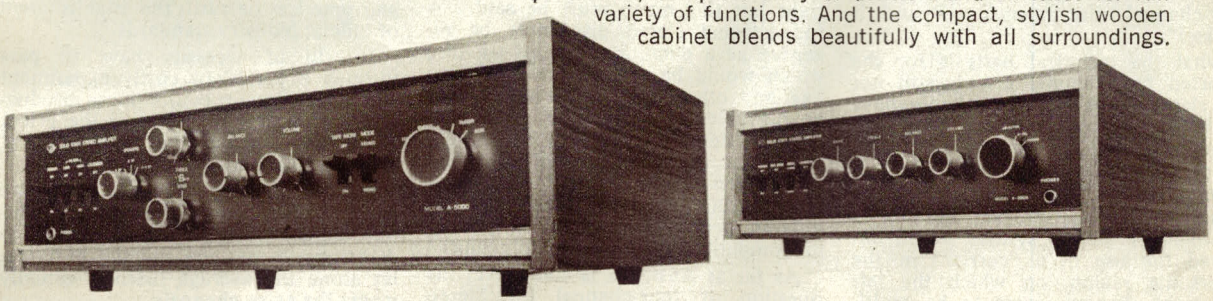
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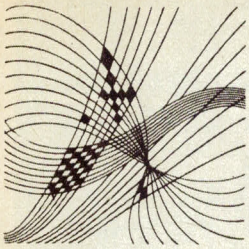
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Reviewed by Julian Russell

STRAUSS (Richard)—Der Rosenkavalier. Complete Opera. Regine Crespin (soprano); Manfred Jungwirth (bass); Yvonne Minton (mezzo-soprano); Helen Donath (soprano) and others with the Vienna State Opera Chorus and the Vienna Philharmonic Orchestra conducted by Georg Solti. Decca Stereo SET 418/21.

To attend a fine performance of Der Rosenkavalier in one of the world's great opera houses is to me always an exciting experience. Indeed I derive so much pleasure from the mere anticipation of going that I arrive at the theatre "sold in advance," so to speak. For Der Rosenkavalier has not only its glorious music to appeal to one sense alone. The period in which it is set — the early years of the reign of Empress Maria Therese of Austria — gives stage and costume designers scope to provide you with dazzling costumes and lordly sets. And to add to all this there is comedy galore in Hugo von Hoffmannsthal's witty libretto.

Although I attended an excellent performance at the 1969 Vienna Festival as recently as last June, and have for many years owned the first-class Columbia set wtih Schwarzkopf, Edelman and Christa Ludwig in the leading roles with Karajan conducting the Philharmonia Orchestra, I was still looking forward eagerly to the new recording advertised by Decca. It arrived in December and let me state at the outset that I think it quite wonderful. It is perfectly cast, the recording has such carefully realised balance between voices and orchestra that every detail of Strauss's marvellous orchestration is comfortably audible, and the whole production is an example of the very best team work by all concerned.

In the Vienna performance last June the conductor was Josef Krips. I have heard Krips conduct the work several times and he is always at home in—indeed he never fails to relish—the innumerable beauties of the score. His reading differs from Solti's, who conducts the new recorded performance with the same orchestra, the Vienna Philharmonic. And though I would hesitate to go so far as to say that I prefer the one interpretation to the other I must confess to finding just a trifle more vitality, more fire, in Solti's version. The orchestra could go far towards playing the opera without any conductor at all. Indeed, in the famous Ochs Waltz, Krips allows them to do just this.

He just lowers his hands and listens.

I must here point out that the Vienna Philharmonic play the work so often in the course of a year that one would not be surprised to find them a little stale in it. Miraculously, this never happens either under Krips or Solti. Indeed, such is their enthusiasm under Solti's direction that they might be playing the opera for the first time —and loving every note of it. Several of the principals in the Decca cast are new to me, but not so Regine Crespin whom I heard as the Marschallin in Paris in 1962. She was good then, though in those days she still had a tendency to "Frenchify" the role ever so little. This characteristic she has now dropped and is as genuinely Viennese as anyone could desire.

This is a most complex role to play, since she is supposed to be a great many years older then her boy lover, Octavian, a transvestite role sung by a mezzo-soprano. (Strauss, you may remember, cast many of his male roles to be sung by women). The Marschallin is aware that the affair cannot last much longer, though she still loves Octavian dearly, and must convey to the audience her hidden sense of bitterness at the fact. To this she must add the gay moments when she is enjoying the liaison with the threat of its end always clouding her pleasure. All this Crespin realises with the utmost artistry and unremitting vocal beauty. Hers has recently been described as the finest Marschallin since Lotte Lehmann. And after hearing her in this new set I heartily endorse the opinion.

The difficulty in casting Octavian is to find a singer experienced enough to sing and act the difficult role while still looking like a boy; and, what is more important, sounding like one. Most Octavians are mature women with a tendency to broadness of beam that must be hidden under a long jacket. The Octavian here, Yvonne Minton, looks deliciously young and beautiful in her photograph. Moreover, she sings with unceasing freshness and charm and projects the petulance of youth without giving the impression of a spoilt kid. A completely satisfying performance in every detail.

Then there is Baron Ochs, the boorish country squire, who is neverthless still a gentleman despite his churlish attributes. All these details of character are admirably realised by Manfred Jungwirth, together with a technique that permits him actually to sing, albeit with the customary difficult, the very low note at the end of the second act. This is, by the way, a low E, and I have heard many basses try to avoid singing it out by smothering their voice in a stein of beer and other devices. Octavian's young sweetheart and the recipient of the silver rose is Helen Donath, well known in the role and still fresh voiced and girlish. Importantly there is enough difference in the quality of her voice and Minton's to contrast them as the composer intended.

In the smaller roles you will find an impressive list of famous names—for example, Otto Wiener as Fanial, and Anton Dermota as the landlord of the third act inn. I have heard silkier voices than the tenor who sings during the hairdressing scene in Act 1. His delightful little ballad is a parody of Italian opera and calls for a true bel canto. Strauss even had the famous Caruso in mind for the part in the first performance but he asked too big a fee for the few bars he had to sing. Luciano Pavarotti is good, but I have heard better. Both the Italian conspirators, Anne Howells and Murray Dickie, are excellent. The whole show is gorgeously produced, Solti and the VPO are beyond praise and the handsome brochure that contains the libretto in German and English is also full of interesting information about the opera, its exponents and the background of its creation.

★ ★ ★

BERLIOZ — Romeo and Juliet. Dramatic Symphony after Shakespeare's tragedy. Patricia Kern (contralto); Robert Tear (tenor); John Shirley-Quirk (bass) with the John Aldis Choir and London Symphony Orchestra conducted by Colin Davis. Philips Stereo SAL 3695/6.

I find it very pleasing to return to "Electronics" after several months away overseas and find so many recordings that I can review with scarcely qualified praise. I feel the same enthusiasm you may have noticed in my "Rosenkavalier" review for this Philips performance of Berlioz's Romeo and Juliet, in which Patricia Kern, Robert Tear and John Shirley-Quirk join Colin Davis and the London Symphony Orchestra and Chorus in a grand account of a work too often neglected by modern conductors. As was the case with "Rosenkavalier," I have for many years owned an old set of the Berlioz work—by Monteux for Westminster—to which I am grateful for having given me so much pleasure. But again I prefer the new one to my old love.

Monteux's was a fine reading, sensitive, passionate and with a fitting sense of Berlioz's pure classical style. The Davis set has all its predecessor's merits plus superb recording that, once again, puts it ahead, in matters of detail, of its rivals. And Davis's reading is slightly bigger than Monteux's and such exhilarating scenes as the first fugue are pushed along with incomparable vitality. It is strange but nontheless true, that many English conductors have a better appreciation of Berlioz's music than all but very few French conductors; and to say that Davis is one of the best Berlioz conductors alive today puts him in a very high category indeed.

Another I would put in the same class is Australia's Charles Mackerras



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whom I heard conduct a magnificent performance of Berlioz's "Damnation of Faust" with the Sadler's Wells Opera Company in London last August, where it was hailed as one the finest musical events of the year. I am speaking of the musical side of the production. The staging I found pust a wee bit too smart and "with it." It would be interesting to hear what Mackerras would do with a recording of "Romeo and Juliet."

But to return to Davis—he has the London Symphony Orchestra playing like angels, whether in the almost unbelievable fragility of the Queen Mab scherzo, the bustle of the Ballroom Scene, the passionate, languishing love music or in the sad comment on the waste of a young life in the Funeral March. This last, if you are unfamiliar with the work, does not give up all its beauties at first hearing but only after several repetitions. Most of the rest of this "dramatic symphony" to use Berlioz's own description of a unique form of composition, should appeal to a wide audience without any preparation. That is, if you already admire Berlioz as one of the greatest composers—as I do.

The choral singing is first rate, even if occasionally an English diphthong does give a French vowel a strong cross-channel flavour. Patricia Kern opens her performance a trifle too mournfully but soon finds the right mood as she continues. Robert Tear makes the Queen Mab speech of Mercutio sparkle with quick-silver phrasing of perfect accuracy, despite the demanding tempo set by the conductor. And Shirley-Quirk keeps Friar Laurence's long lament from ever growing tiresomely sententious. But the factor that puts this new recording above any other of the work so far available is Davis's assured grasp of Berlioz' great design, and his ability to bring out detail without degenerating into fussiness. A must for all Berlioz lovers. A French/English text is included.

★ ★ ★

MENDELSSOHN—Elijah. Complete Oratorio. Theo Adam (bass); Elly Ameling (soprano); Annelies Burmeister (contralto); Peter Schreier (tenor). Gewandhaus Orchestra and Radio Chorus of Leipzig. Philips stereo SAL3730/2.

I first got to know "Elijah" when, as a small boy, I found a vocal score of the oratorio somewhere at home. I never did learn where it came from, since it was extremely unlikely that either of my parents could have sung in it. However it was quite different from any of the other sheet music we had at the time and laid the foundation for my score reading by way of transcribing the choral sections to the piano. I thought it an exciting work then and still think it has great virtues and is unjustly neglected. However I am not terribly keen on the way it is presented in this set.

The chorus is first rate and the choral singing admirably controlled. But some of the vocal soloists do not attain the same level of excellence. Theo Adam, who has a dominant role, often fails to dominate and Annelies Burmeister, though steadying later after an uncertain start, sings lifelessly throughout the work. The rest are adequate though to me uninspired. Personally I have an overwhelming preference for the comparatively recent H.M.V. set which has the incomparable Fischer-Dieskau, Nicolai Gedda, Janet Baker and Gwynneth Jones in the cast. German and English texts are included in the boxed Philips set.

★ ★ ★

PROKOFIEFF—Symphony No. 5 in B Major. Op. 100. Berlin Philharmonic conducted by Herbert von Karajan. DGG stereo 139040.

This is the best performance and best recording of the symphony that I have ever heard. It is a late work in which Prokofieff discards the angular asperities of his earlier period and uses a more Russian nationalistic style. The Berlin Philharmonic, always fine, excels here. The string quality, especially that of the violins, is particularly fine, and the first desk wind soloists are all admirable without undue spotlighting, so that they always remain in perfect balance with the rest of the orchestra, despite their prominence in the musical scheme. In short, a wholly desirable addition to anyone's library. There is, however, one tiny flaw that you'll probably notice for yourselves — the odd fluttering, rattle-like sound produced by the side drum.

But this can easily be forgiven when the splendid quality of the rest of the production is remembered.

★ ★ ★

SALUTE TO PERCY GRAINGER from Benjamin Britten, with Peter Pears (tenor): John Shirley-Quirk (baritone); the Ambrosian Singers, and the English Chamber Orchestra conducted by Britten. Decca stereo SXLA 6410.

I found this a most exhilarating disc. Britten starts off by conducting the orchestra in "Shepherd's Hey," immensely popular as a closing item at Sir Henry Wood's Promenade Concerts when I was a boy. Then it used to be played by a large symphony orchestra, and I remember that it finished with a long glissando in contrary motion that never failed to give me a thrill. This is absent from the version for chamber orchestra used by Britten but otherwise it is a splendidly invigorating performance. The Ambrosian Singers are fine, too, in the exquisite "My Robin Is to the Greenwood Gone," which I enjoyed so much that I treated myself to two encores when I first played the record.

Another fact worthy of special mention in a long and representative program is the beautiful, romantic horn solo at the beginning of "The Duke of Marlborough Fanfare," which is later taken up with eccentric harmonies added and splendid rhythm from the whole brass choir. It is all grand fun. "Let's Dance Gay in the Green Meadow" is in the form of a piano duo with Benjamin Britten and Viola Tunnard as the duoists. To get an idea of the vitality and originality of the arrangements play the Scotch Strathspey and Reel (band 3 on side 2). I can guarantee you not only a surprise but delighted astonishment. Shirley-Quirk's contributions I found consistently enjoyable. Not so, alas, those of Peter Pears. I have never been keen on the quality of his voice. But I always admired his unquestionable artistry. However, in the items he sings here his intonation is not always secure and his delivery often unsteady. Altogether there are 14 items, too many to enumerate here, and all are recorded superbly. An unusual and, to me, fascinating disc.

★ ★ ★

MUSIC OF THE COURT, HOMES AND CITIES OF ENGLAND Vol. 3 and 4. Record Society No. S/6319 and S/6320.

The first of these records is subtitled "Composers of Whitehall Palace and Wilton House" and includes pieces by William Lawes, A. Ferrabosco II, Henry Lawes, Nicholas Laniere, Richard Deering, Thomas Tomkins, Guillaume Tessier, Thomas Morley, Anthony Holbourne, John Dowland and Girolamo Conversi.

The second, subtitled "composers of Greenwich Palace and Ingatestone Hall," has pieces by William Byrd, Robert Johnson, A. Ferrabosco II, Thomas Campion, Giovanni Coperario, Thomas Campion and Giles Farnaby.

The works are so diverse in form and vary so much in the combination in which they are presented that I find it impossible to include details of them here. Some, indeed most, make for listening of the utmost charm, but naturally, in so wide a selection, there are also a few that are not quite up to the top standard. Some of the items are sung, some are instrumental arrangements in which instruments of the period (16th and 17th centuries) are used. The soloists are so numerous that it would take a whole column to set them out. So you will have to take me on trust when I write that these are two discs which no lover of the music of the period can afford to miss, especially when their club price is taken into account.

True, some of the singers tend to the ecclesiastical type of delivery that has come to be known as English oratorio style. Others sing purely and unaffectedly. The whole entertainment was arranged by Diana Poulton.

★ ★ ★

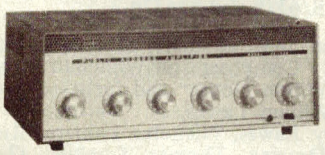
BEETHOVEN — Symphony No. 5 in C Minor. Op. 67. Symphony No. 8 in F. Major, Op. 93. Vienna Philharmonic Orchestra, conducted by Hans Schmidt-Isserstedt. Decca Stereo SXLA396.

Neville Cardus once complained to me: "What is there to say about the Fifth Symphony nowadays except that it is still in C Minor?" In a lifetime spent listening to and playing music I cannot guess how many times I have heard it. More than 100 I would think. This being so I had forsaken any hope of a thrill when I put the new recording on my machine. I thought it had long lost the power to "speak to my ear" to use a popular phrase of the late Arthur Schnabel. Yet a thrill is just what I got listening to this performance. It was like hearing it for the first time, so fresh is Schmidt-Isserstedt's reading. Yet he in no way seeks freakish effects. He sends the

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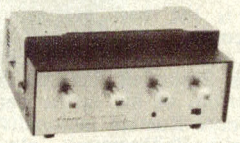
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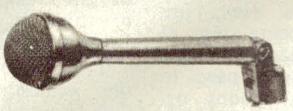


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first movement along with terrific drive and defiance but with no rhetorical bombast.

The slow movement has an unmatched serenity that I found altogether delicious. You may get a surprise when you hear the slow tempo at which he starts the famous scherzo but as soon as you hear the entrance of the horns — and how brilliantly they play! — you'll appreciate the whole design. And the holding back of the early part of the Finale makes a splendid preparation for a really formidable climax. I have heard more showy readings, and others perhaps comparable in profundity. But I know of none with the irresistible drive of this performance.

The 8th Symphony is usually treated as a miniature type of work. But Schmidt-Isserstedt gives it a broader stature without ever impairing its mood of sunny happiness. And the sound in both symphonies is first rate. An excellent buy even if you already own a favourite recording of the same coupling.

★ ★ ★

HISTORICAL RECORDINGS 1918-1927. Beniamino Gigli in excerpts from Faust; La Giaconda; L'Amico Fritz; Mefistofele; The Pearl Fishers; Rigoletto; Lucia di Lammermoor; La Boheme. E.M.I. mono HQM1194.

Lovers of bel canto singing will enjoy every note of this recording, which, in spite of the dates on which the originals were made, has been "refreshed" so skilfully that few would dare to guess their age. Most of them have a quite extraordinarily modern sound. All the excerpts are concerted items and in these Gigli is joined by such renowned singers of the past as Galli-Curci, Louise Homer, de Luca, Pinza and Titta Ruffo, to name only the best remembered. The record serves to remind one of how little singing of this type can be heard today — except in the form of re-issues of very old 78s. Should be a best seller.

★ ★ ★

VAUGHAN WILLIAMS — Sancta Civitas. Oratorio for tenor and baritone soloists, chorus, semi-chorus, distant chorus (boys' voices) and orchestra. Ian Partridge (tenor); John Shirley-Quirk (baritone), Boys of the King's College Choir, Cambridge; The Bach Choir and the London Symphony Orchestra conducted by David Willcocks.

Benedicite. For soprano solo, chorus and orchestra. Heather Harper (soprano); the Bach Choir and the London Symphony Orchestra conducted by David Willcocks. World Record Club stereo S/4599.

Admirers of Vaughan Williams will heartily welcome this splendid disc. Because of multiple difficulties in presentation Sancta Civitas is rarely heard in the concert hall. Indeed I never heard it until I received this recording. It offers Vaughan Williams at his most mystical, yet he was not a Christian in the accepted sense of the word. He was, to use his own phrase quoted in the annotations, a "Christian agnostic," whatever that

might mean. The text comes for the most part from the Book of Revelations "with additions from Taverner's Bible and others sources." And it is odd that, despite his denial of the true Christian faith, Vaughan Williams found so much to inspire him in Biblical subjects.

Despite its length, I found the work most inspiring. It is grand music, broad in scope, brilliant in drama, and singularly reverent in view of the nature of the composer's opinion of organised religion. In this majestic work of spacious beauty, Vaughan Williams uses his familiar modal vocabulary. It is music of acclaimation, heartlifting in its sincerity. I liked Shirley-Quirk's contribution enormously; Ian Partridge's somewhat less. The choral work is good and the London Symphony, conducted by David Willcocks, without fault.

You can enjoy the same spirit of acclamation in Benedicite, with the same modal moving from minor to major, a legacy from the Tudor music so much during his whole life. It would be difficult to imagine more jubilation on one disc. And Heather Harper makes a most beautiful and understanding contribution. The frequent melismata provide a link between Vaughan Williams's unique blending of ancient and modern styles.

★ ★ ★

TCHAIKOVSKY — Symphony No. 5 in E Minor Op. 64. Israel Philharmonic conducted by Zubin Mehta. Decca Stereo SXL6380.

This might be described as a standard reading without eccentricities except for an occasional tendency to linger a little too lovingly over the more juicy tunes. But I found it quite unexciting. I was particularly disappointed in the wiry tone of the Israeli violins. The waltz movement lacks brio and indeed the whole symphony doesn't really get going until Mehta comes to the allegro vivace in the Finale, which he sends along in great style. Another detail I disliked is the ultra-fat horn tone at the beginning of the slow movement. The sound is not out of the top drawer, despite the fact that the recording was made in the usually excellent conditions at the Kingsway Hall.

★ ★ ★

TCHAIKOVSKY — Serenade for Strings in C Major, Op. 48. Strings of the Israel Philharmonic conducted by Georg Solti.

DVORAK—Serenade for Strings in E Major, Op 22. Strings of the Israel Philharmonic Orchestra conducted by Rafael Kubelik. Decca Ace of Diamonds Stereo SDD205.

Again I can find little to recommend in the recorded tone of the Israeli strings, though their playing is efficient enough. I prefer the Dvorak playing to that in the Tchaikovsky, but that doesn't mean that I found any real enjoyment in either of the serenades. Characteristically where Solti displays a fiery temperament, Kubelik takes things more easily. After what I heard of the Israeli strings during their tour of Australia a few years ago, unless the personnnel has been changed, the poor quality must be attributed to the recording.

TCHAIKOVSKY—Violin Concerto in D Major, Op. 35. Pinchas Zukerman and the London Symphony Orchestra conducted by Antal Dorati.

MENDELSSOHN—Violin Concerto in E Minor, Op. 64. Pinchas Zukerman and the New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS Stereo SBR235343.

These two concertos have always made a popular coupling and have been recorded as such by most of the world's greatest violinists. It may therefore come as something of a surprise to you when I write that I consider these performances by a 21-year-old Israeli violinist as among the greatest I have ever heard. Zukerman combines the voluptuous tone of a Mischa Elma with the technique of a Jascha Heifetz. His sense of form is astonishing in one so young and he plays every bar with the assurance of a veteran. The orchestra in both concertos provides good accompaniments. A most impressive debut recording.

From Paul Frolich . . .

TCHAIKOVSKY: Serenade for Strings, op.48; Souvenir de Florence, op.70. The Academy of St. Martin - in - the - Fields; directed by Neville Marriner. Argo stereo ZRG 584.

One doesn't usually expect to find Tchaikovsky's music on an Argo disc, let alone played by the most fastidious of English orchestral ensembles. This music, however, is a far cry from the popular large-scale orchestral works by this much-played composer; these are chamber works and Tchaikovsky, as other composers, had to resort to small-scale ensembles when he dealt with intimate thoughts and ideas at a very personal level.

The Serenade is music of rare beauty which has never failed to move audiences and this reading of it is exquisite. The standard of string playing is truly remarkable, the more so when it is remembered that the group plays without conductor, led by its first violinist.

In addition to the fine playing as such, we are given an uncommonly sensitive and balanced performance, recorded with great warmth and felicity and I hasten to add that the playing and recording of the other work are equally fine. "Souvenir de Florence" is also fine music. But I cannot agree that it should have been performed in the manner chosen here. Tchaikovsky, well knowing the imitations inherent in a string sextet, deliberately scored this piece for six instruments. It was his intention to solve some of the problems inherent in such a combination and he discussed these problems in several of his letters. He did not quite succeed in his aims, buts his failure is not overcome by the use of a larged ensemble.

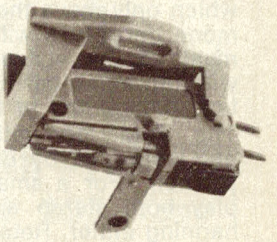
However fine the playing of the chamber orchestra, the weight of numbers has resulted in the blurring of some of the subtler details in this score; additionally, there are some fairly substantial cuts, made necessary by the need to accommodate both lengthy works on one disc.

To most listeners, these minor objections will matter little and I am indeed pleased to have so good a performance of this rarely-heard work; but I would hope that, sooner or later, a good performance by a sextet will be issued. The record, a far cry from what Tchaikovsky fans are used to, will delight lovers of fine chamber music. ■

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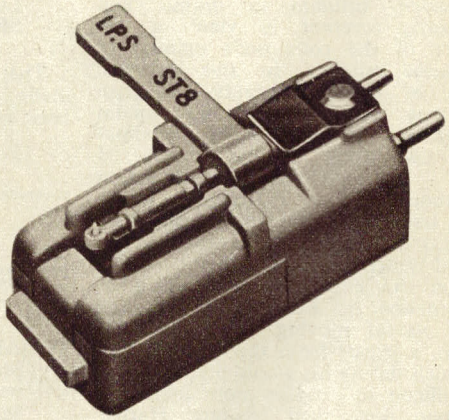


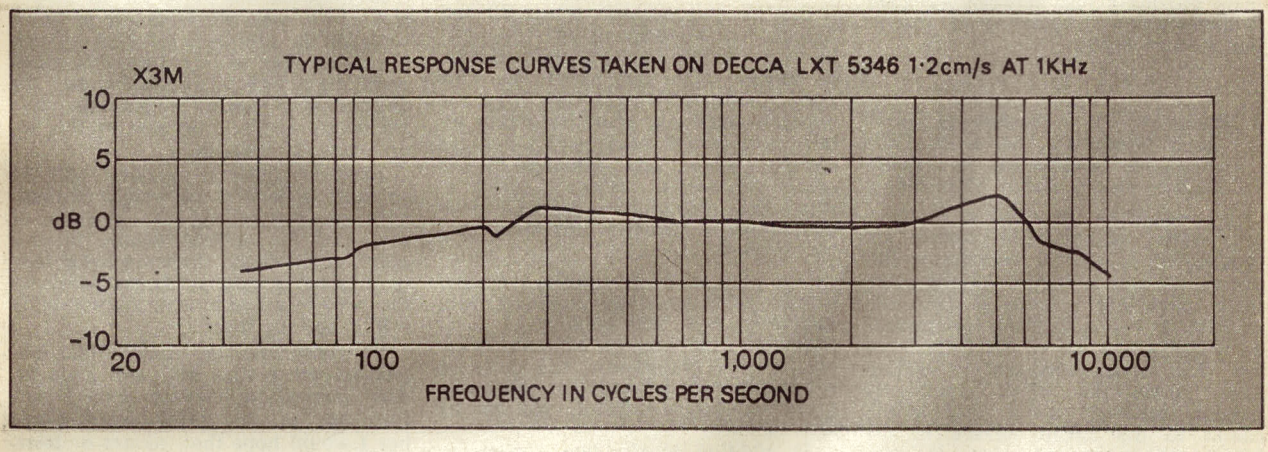
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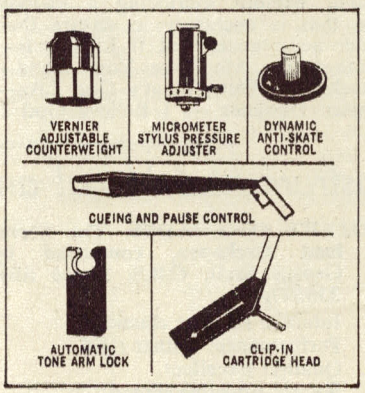
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By HARRY TYRER, FORBES CAMERON, NEVILLE WILLIAMS

Devotional recordings

MISA CRIOLLA (Creole Mass) and Seven South American Folk Songs. Los Huanca Hua. World Record Club stereo S/4605.

Interest: Vernacular Mass.
Performance: Professional standard.
Quality: Excellent.
Stereo: Normal.

Here is a fascinating example of the modern influences at work in the Catholic Church, which have given rise to such phenomena as the Folk Mass and the Rock Mass. This Creole Mass uses the Spanish liturgical text approved by the Catholic Church for use in Latin America to replace the traditional Latin used for centuries. The rhythms used are from the folk lore, as well as the instruments, which are guitars, with various local percussion instruments. The five sections are: Kyrie—Gloria—Credo—Sanctus—Agnus Dei. Despite the folk rhythms used, the harmonies are unmistakably ecclesiastical. I should also point out that there is no suggestion of irreverance introduced by the vernacular influences, the devotional character being fully maintained.

Since the Mass takes only one side, the second side is devoted to seven South American folk songs, which provides an opportunity to compare real folk style with the adapted style used for the Mass. The performers are presumably a fully professional group, to judge by the standard of their singing. The quality of the recording, by Odeon, Argentina, is excellent. (H.A.T.).

TELL IT LIKE IT IS. Composed and directed by Ralph Carmichael and Kurt Kaiser. Stereo, Light LS-5512-LP. (From Sacred Records Aust. Ltd., 181 Clarence St, Sydney and other capitals).

Interest: "Folk Musical."
Performance: Excellent young people's choir.
Quality: Right up to standard.
Stereo: Normal.

Having written and presented any number of modern Gospel songs, many of them with a youth appeal, Ralph Carmichael and Kurt Kaiser have combined their talents to come up with a complete score for a stage musical presentation. A note on the jacket indicates that the score is available from Bible Bookstores or direct from Word Inc., P.O. Box 1790, Waco, Texas, U.S.A. It contains vocal, keyboard and guitar chordings, together with instructions for staging, lighting and speech choir.

Not having a copy of the score to hand, I am not sure how much visual and spoken continuity is provided over and above the sound on the album but one would hope that this has not been stinted. The album is essentially a sequence of vocal numbers with very little connective dialogue. There is an element of question and protest, which is soon overwhelmed and the overall appeal would undoubtedly be to young people who are already on the Gospel fringe.

The numbers themselves utilise rock-folk rhythms that give them a modern sound, without sacrificing a melodic line that is necessary to ensure their wider acceptance: Tell It Like It Is—Brother, Let Me Take Your Hand—Check Him Out—What's God Like—Master Designer — I Believe God Is Real — Do As I Say — Rosy Tinted Glasses—Our Turn At Bat—The Good Old Days—When It's Gone—Consider The Lily—Conform—A New Mind—That's For Me—That's The Way It Is — Love Is Surrender – He's There Waiting—Pass It On.

An album that could go over well with the Saturday evening Gospel rally set, particularly those who have already seen an Australian performance. The album should not be confused, by the way, with a jazz album reviewed elsewhere on these pages by Forbes Cameron. (W.N.W.).

★ ★ ★

SWEETER AS THE DAYS GO BY. Old-fashioned Revival Hour Quartet. Stereo, Word WST-8438-LP. (From Sacred Productions Australia, 181 Clarence Street, Sydney, and other capitals.)

Interest: Memorial to Dr Fuller.
Performance: Effective 4-part harmony.
Quality: Excellent.
Stereo: Used well.

According to the jacket notes, the last occasion on which this quartet recorded for the Old Fashioned Revival Hour was in February, 1958, when rising costs forced a curtailment of the musical support for the session. Thereafter, their separate careers made it increasingly difficult for the members to maintain the quartet's identity and they had not sung together for eight months prior to the making of this recording.

Incentive for the recording was as a memorial to the late Dr Charles E. Fuller. The titles, the style and even the piano accompaniment are as they were in the heyday of the well-known world-wide broadcast: I Will Not Forget Thee—Lily Of The Valley—My Heavenly Home—He Is So Precious To Me—Moment By Moment— Jesus Is Mine—I Would Be Like Jesus — Praise To The Lord, Almighty—In Heavenly Love Abiding—How Sweet The Name Of Jesus Sounds—Sweeter As The Years Go By—Softly Now The Light Of Day.

Particularly in the first number, I noticed that the voices were less intimately interwoven than in earlier years and this makes for a somewhat different sound, but I don't think that followers of the Old Fashioned Revival Hour will quibble about that. As a memorial or as a performance in its own right it is well up to standard. (W.N.W.).

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MOZART SERENADES. The Cleveland Orchestra, conducted by George Szell. C.B.S. Stereo SBR 235327.

Interest: Popular classics.
Performance: Rather rigid.
Quality: Excellent.
Stereo: Effective spread.

Two Serenades are included here, the perennial favourite "Eine Kleine Nachtmusik" and the equally delightful "Posthorn" Serenade (No. 9 in D major, K.320).

In general, I am a great admirer of Szell and his Cleveland Orchestra, so it was with great anticipation that I played this disc through. I can only say that I was disappointed by Szell's approach to Mozart. There is plenty to admire in the precision of the orchestra as a whole, and the individual virtuosity of the players, but I found the tempos too fast and the playing too relentlessly precise for this lighthearted music. This reaction is, of course, purely subjective, and no doubt many other listeners will find this type of music to their taste. If in doubt, the best thing would be to try to hear an extract before buying. I suggest track 2 on side one, the beautiful Romanze from the "Nachtmusik," since this was the section which I reacted to most unfavourably—if you like the way this is played, I feel you will have no complaint with the rest. (H.A.T.)

PHILADELPHIA ORCHESTRA GREATEST HITS, Volume 4. Conducted by Eugene Ormandy. Stereo. CBS SBR-25317.

Interest: As per title.
Performance: Usual high standard.
Quality: Very clean.
Stereo: Excellent spread.

To have four albums in succession all titled "Greatest" would seem to be over-working the superlative, but it is probably excusable. As the jacket notes point out, the Philadelphia Orchestra has been producing orchestral recordings of a high standard for so long that there is an abundance of material from which to choose popular classical excerpts.

Those featured on this album are Trumpet Voluntary (Purcell—Grand Valse Brilliante (Chopin)—Traumerei (Schumann)—March Of The Boyars (Halvorsen)—Bacchanale (Saint-Saens)—Pomp And Circumstance No. 1 (Elgar)—Prayer (Humperdinck)—When Johnny Comes Marching Home (Traditional)—Habanera (Bizet)—Wedding March (Mendelssohn).

The surface is quiet, the quality completely clean and the overall balance good. Need I say any more? If the selections appeal, hi-fi enthusiasts can buy with every confidence. (W.N.W.)

★ ★ ★

BANG BANG — Xavier Cugat and his Orchestra. Calendar (Festival) Stereo SR 66/9626 (also in mono).

Interest: Latin American dance music.
Performance: Functional.
Quality: Average sound.
Stereo: Normal balance.

Xavier Cugat, for many years, led one of the best and most popular commercial Latin American bands in the U.S.A. Presumably, his tempos and rhythms are functionally very good but, judged as music for listening, it quickly palls. The main fault lies with the unimaginative and heavy-handed arranging by Dick Jacobs and the lack of light and shade in the textures.

The tunes include well-established favourites like "Zorba," "Spanish Eyes," "Quiet Nights" and "Call Me." But the most appealing tracks are "The Phoenix Love Theme" and the haunting ballad "Almost There."

I imagine that this kind of album, with strong and infectious Latin American rhythms, would be well received at a party. However, for this purpose the playing time is a bit light at 30 minutes. (T.F.C.)

★ ★ ★

THE ITALIAN JOB — Quincy Jones. Paramount Records (Festival) Stereo SPML 933543 (also in mono).

Interest: Film soundtrack.
Performance: Probably better with film.
Quality: Superb recording.
Stereo: Evenly spread.

Albums of soundtrack music are very difficult to assess out-of-context from the film for which the score was specifically composed. By all accounts, the film in question, "The Italian Job," is first rate and, no doubt, the music by Quincy Jones adds significantly to the impact of the action.

All that can really be said about the album is that Matt Monro sings the ballad "On Days Like These" very

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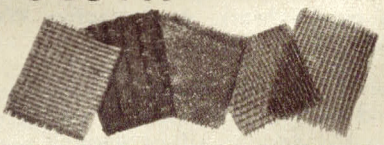
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smoothly and professionally; Pete King, the English tenor saxist, takes a splendid solo on the instrumental version of the same song; Quincy Jones appears, as usual, to have written some aptly dramatic (and humorous) music for the film; and the playing-time is a meagre 26 minutes. (T.F.C.)

★ ★ ★

THOSE WERE THE DAYS.—Pete Fountain. Coral Records (Festival) Stereo SCL 933,342, (also in mono).

Interest: Commercial Fountain.
Performance: Easy listening.
Quality: Very well recorded.
Stereo: Normal balance.

The flood of Pete Fountain LPs on the Australian market continues with this latest album, featuring recent hit songs and some lesser-known material like Tony Hatch's "American Boys" and the title tune of the Broadway success, "Dear World."

Some of Pete Fountain's recordings are obviously aimed more at the jazz market, although I have never considered him to be a convincing jazz soloist. He is probably on much safer ground on commercial, middle-of-the-road albums like this, where his immaculate technique and pleasant tone take him comfortably through undemanding material.

The tracks include recent hits like "Wichita Linesman" (Glen Campbell), "Those Were The Days" (Mary Hopkins), "Cycles" (Frank Sinatra), "Les Bicyclettes De Belsize" (Englebert Humperdink) and "Folsom Prison Blues" (Johnny Cash). The arrangements by Bud Dant are competent and pleasant without ever going much further.

If you enjoy the more commercial clarinet - playing of Pete Fountain, you should not be dissapointed with the music on this LP. It should be noted, however, that the playing-time is only 29½ minutes. (T.F.C.).

★ ★ ★

BLAZING LATIN BRASS — Nick Perito. Universal Record Club Stereo SUAL 932427 (also in mono).

Interest: Popular Latin American numbers.
Performance: Well played.
Quality: Well recorded.
Stereo: Gimmicky (see below).

The basic idea behind this LP appears to have been not so much the music but the stereo gimmickry. The sleeve-note is mainly devoted to detailed explanations of the complicated stereo effects, including channel switching and reversing, panning from left to right and the rest, most of which is quite effective in the context.

The music itself is pleasant, with long-established L/A favourites like "Malaguena," "The Continental," "April In Portugal" "Anna" and "Quien Sera." The mood, as the title suggests, is brassy but the twelve tracks are well played by excellent musicians like Jimmy Nottingham, Doc Severinsen, Urbie Green, a four-piece percussion section, Al Caiola on guitar and the duo pianists, Ferrante and Teicher.

Universal Record Club members with new stereo record-playing equipment will be particularly interested in this album which plays for 30 minutes. (T.F.C.)

FAMOUS COMPOSERS OF OUR TIME—New Dimension Orchestra and Voices. Festival Stereo SFL-933271 (also in mono).

Interest: Mainly show tunes.
Performance: Pleasant listening.
Quality: Excellent recording.
Stereo: Well balanced.

The sleeve-note gives no information about the New Dimension Orchestra and Singers, but they certainly are first-rate studio musicians (probably English) with good crisp arrangements of the 12 tracks.

Six great composers—Harold Arlen, Hoagy Carmichael, Irving Berlin, Duke Ellington, Cole Porter and Jerome Kern — are represented. Most of the songs are well-known standards and they include "A Pretty Girl is Like A Melody," "I Won't Dance," "All of You" and "There's No Business Like Show Business."

The album makes for easy, pleasant listening and is very well recorded. But this is a full-priced $5.75 release and, these days, popular albums, fully comparable in quality, are available at much lower prices. (T.F.C.)

★ ★ ★

MANDOLIN MAGIC. Don Martone. Columbia Worldwide Series (EMI) stereo SCXO 6336.

Interest: Italian melodies.
Performance: Stylish.
Quality: Very good.
Stereo: Well spread and balanced.

Records by mandolin bands which have come my way have usually been disappointing, so I was not expecting too much from this one. However, many of the discs in this Worldwide series so far encountered have produced surprises, and invariably pleasant ones; this disc is no exception. In the first place, despite the title, the music is played by a full instrumental group, with accordians, guitars and vibraphone playing prominent parts. The use of the mandolin is minimal, and when it is used, it is just enough to give atmosphere. The arrangements are tasteful, and the musicians of excellent standard, so all in all, this is a most pleasant disc. The tunes, some familiar, others unfamiliar, are all very listenable, but I feel it is the established favourites such as "O Sole Mio," "Santa Lucia" and "Mattinata" which will give the maximum pleasure.

Also included in the very generous 14 tracks are: Tarantella Siciliana — Ciribiribin — Funiculi, Funicula — Neapolitan Nights — Capriccio Italiano — La Spagnola — Marannini. These beautiful Italian melodies cannot fail to please. (H.A.T.)

★ ★ ★

WITH LOVE—Boots Randolph. Monument Records (Festival) SPL 933,385 (also in mono).

Interest: Ballads.
Performance: Smooth.
Quality: Excellent sound.
Stereo: Needs careful balancing.

The very successful tenor saxophonist, Boots Randolph, is probably best known for this unbearable series of "Yakety-Sax" recordings. But on this album, he is featured with strings on 11 late-night ballads.

Despite his obvious technical abilities, Randolph's fruity tone and exaggerated vibrato can certainly become irritating after a time. However, it cannot be denied that this album, like all Randolph's records, is well produced and recorded.

The tracks include "I'm In The Mood for Love," "Tenderly," "Strangers In the Night," "The Nearness of You," and "Love Is Blue." If you enjoy Randolph's tenor playing, the 30 minutes of this LP would clearly provide enjoyable and relaxed midnight listening. (T.F.C.).

★ ★ ★

ROMANTIC RHAPSODIES — Midnight String Quartet. Universal Record Club Stereo U-1010.

Interest: Recent popular songs.
Performance: Late-night listening.
Quality: Superb recording.
Stereo: Excellently balanced.

The group of Hollywood studio musicians who record under the name of the Midnight String Quartet are very popular both in America and Australia. This is understandable for their music is beautifully scored and played.

This LP includes some popular successes of recent years like "Strangers In the Night," "Shadow of Your Smile," "A Lover's Concerto," "Love Is Blue" and "Young Girl." In all, there are 12 tracks, but the playing-time is short at 30 minutes. Nevertheless the music on this Universal Record Club album can be recommended for relaxed late-night listening. (T.F.C.).

Mr. Trumpet — "enjoyable, polished"

HELLO MR TRUMPET — Roy Etzel with the Gerd Wilden Orchestra. Decca (EMI) Stereo SKLA 7654.

Interest: European trumpeter.
Performance: Enjoyable LP and well produced.
Quality: Superb sound.
Stereo: Very effective.

Roy Etzel is a new name to me but he is, apparently, a well-known — and certainly accomplished — German trumpeter. On this LP, he is accompanied by the very polished Gerd Wilden Orchestra.

European popular music is riding very high in popularity, at the present time, with the recordings of leaders like Paul Mauriat, James Last, Bert Kaempfert and Gunther Kallman.

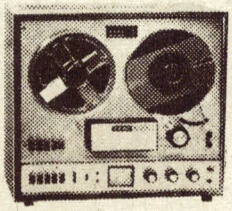
The names of Roy Etzel and Gerd Wilden can certainly be added to that list of distinguished musicians and arrangers.

Etzel displays an excellent technique, with good control and well-rounded tone, as he works through a number of recent popular songs — and some older standards. They include "Love Is Blue," "Those Were The Days," "Dream A Little Dream Of Me" and Gershwin's " 's Wonderful." A number of German and Italian compositions are also featured like "Heidschi Bum Beidschi." "Two Happy Muchachos" and "Heimat, Deine Sterne."

The playing time of this well played, polished and enjoyable album is 33¼ minutes. (T.F.C.)

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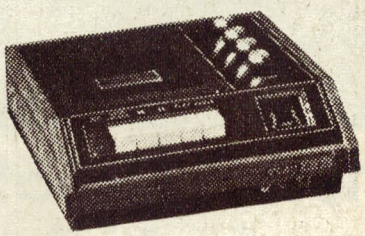


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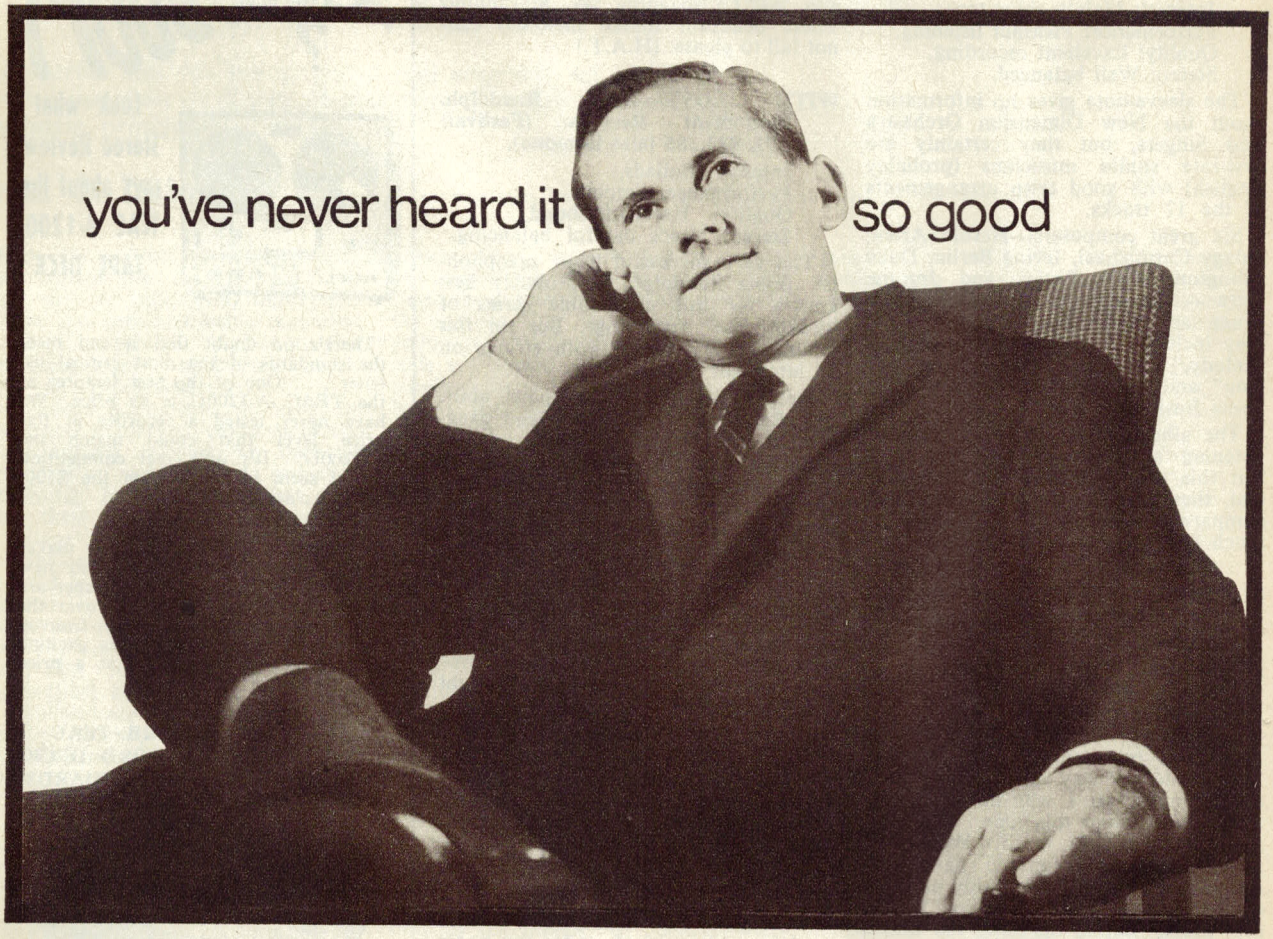
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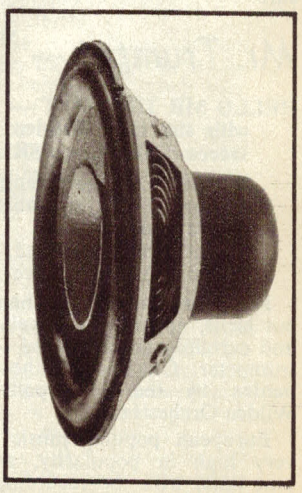
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HAIR. Australian cast recording. Spin, distributed by Festival stereo SEL-933544.

Interest: Rock musical.
Performance: Some good features.
Quality: Very good.
Stereo: Good spread.

This performance of the songs from the rock musical "Hair" by the Australian cast inevitably invites comparison with the American version, which was first on the scene by several months. The sounds projected in this album may be regarded as adequate for a theatre audience, but it lacks some of the all-enveloping excitement which the original Broadway cast succeeded in projecting in their recording. Despite this, there are some really good solo tracks in this album which easily stand comparison, such as Sharon Redd's "Easy to be Hard"; the surreallist tracks "Walking in Space" and "Three Five Zero"; and the triumphant tribal song "Let the Sunshine in." Maximum interest in this version will lie with those who have seen the Australian version. (H.A.T.)



Seen my guitar anywhere, dad?
("TV Times")

CHOOSE YOUR OWN. Barry Hall at the Conn Theatre Organ. Stereo, RCA Camden CAMS-148.

Interest: Popular South Australian artist.
Performance: Capable.
Quality: Good.
Stereo: Normal.

Being a resident of Sydney, I have to rely on the jacket note which introduces Barry Hall as compere of "Choose Your Own"—a radio session claimed by 5DN Adelaide to be one of the longest running of its type in the history of Australian radio. Apart from being a popular compere and organist for 5DN, Barry Hall also features on Adelaide television NWS 9.

In this album, he presents a varied program on the Conn model 642. The voicing and phrasing is strongly reminiscent of the traditional theatre organ but Kevin Roper on drums and Ray Wooding on guitar add a "group" sound that belongs more to the present than to the past.

Playing for just under the half hour, the tracks can well be accepted as favourites with Adelaide's listeners and viewers: Puppet On A String—Release Me—Bluebird Of Happiness—Chitty Chitty Bang Bang—The Last Waltz—Consider Yourself—The Lights Of Adelaide—Christina Waltz—Please Don't Go—Sound Of Music.

The quality is good except in the last track, where the heavy chords seemed to have pushed something in the system too close to overload. I imagine that the album will find ready acceptance in South Australia and, at the Camden price, it should have good appeal in other States as well. (W.N.W.)

★ ★ ★

TO LOVE SOMEBODY. Nina Simone. RCA Victor Stereo LSP-4152.

Interest: Folk singer.
Performance: Highly emotional.
Quality: Excellent.
Stereo: Well spread.

Nina Simone brings to her singing of folk songs all the supercharged emotions of the Negro gospel singer and allies this with some very original arrangements. She is obviously a great admirer of Bob Dylan, and has moulded her basic style and intonation closely on Dylan's, although her dynamic personality is in complete contrast to the lack-lustre one affected by Dylan. Moreover, she has a lively musical imagination, which results in some interesting and sometimes startling effects — the sudden entry of a sepulchral organ in "The Times They Are A-Changin' " being particularly effective. The other tracks are: Suzanne—Turn! Turn ! Turn! — Revolution—To Love Somebody — I Shall be Released — I Can't See Nobody — Just Like Tom Thumb's Blues. An interesting record which should have its maximum appeal to the younger generation. (H.A.T.).

★ ★ ★

DELECTABLE DIONNE—Dionne Warwick. Universal Record Club Stereo U-1000.

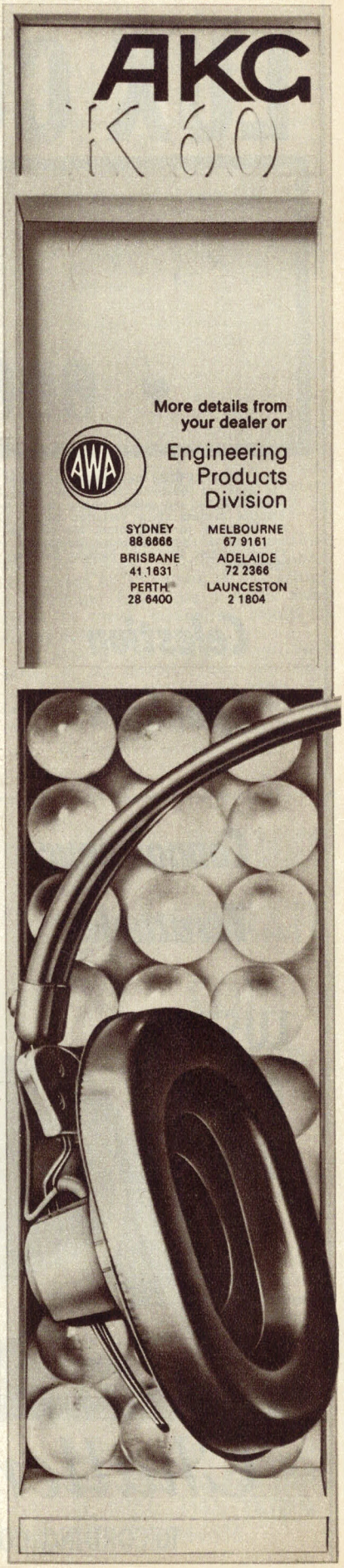
Interest: Superb contemporary singer.
Performance: Excellent collection.
Quality: Well recorded.
Stereo: Normal balance.

In the past few years, Dionne Warwick has made a sizable number of recordings which have established her as one of the most talented and successful singers in the business, an artist of unusual consistency and quality.

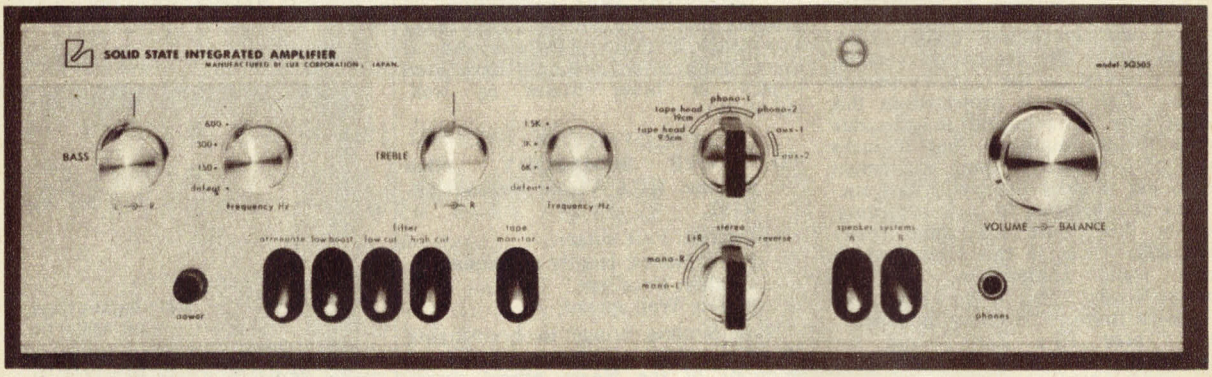
The Universal Record Club issue contains five recent recordings (three of them Burt Bacharach compositions) including "Promises Promises," "This Girl's In Love With You" and the recent Bobby Russell hit "Little Green Apples." On these tracks, which have been superbly scored, Miss Warwick is in magnificent voice.

The other side of the album is rather less impressive. For one thing, the tracks are not new recordings and, unusually, there are no Bacharach compositions among them. They include, for example, Jerome Kern's "The Way You Look Tonight," "Baubles, Bangles and Beads," "I Believe In You" and a very sensitive reading of Kurt Weill's beautiful ballad "My Ship."

Overall, this is not quite Dionne Warwick at her best. At the attractive club price, however, it represents very good value. (T.F.C.).



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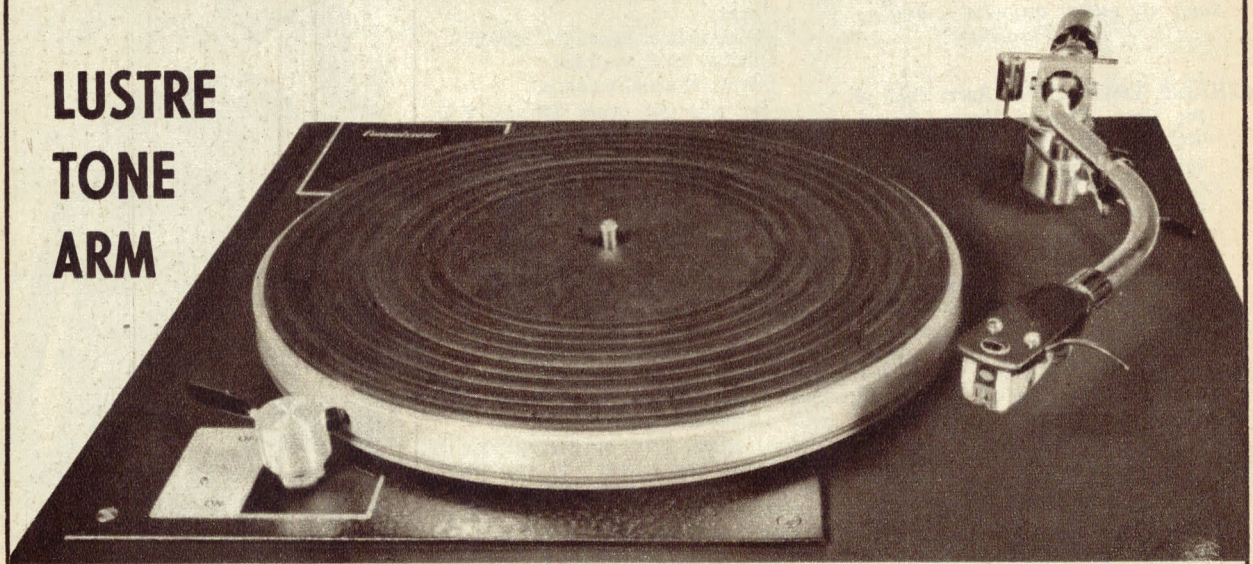
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DOES ANYBODY MISS ME?—Shirley Bassey. United Artists (Festival) SUAL 933397 (also in mono).

Interest: Popular English singer.
Performance: Disappointing.
Quality: Well recorded.
Stereo: Normal spread.

Shirley Bassey is, without doubt, an electrifying artist on the concert stage or, even better, in a nightclub. But without personal communication, her albums are often disappointing and her mannered singing style can, in the end, become rather irritating.

This album suffers even more from weak material and run-of-the-mill arrangements by Artie Butler—surprising in view of the fact that Dave Pell produced the sessions. Among the better tracks are the Rod McKuen/Henry Mancini composition "We;" Bert Bacharach's recent success "I'll Never Fall In Love Again;" Bert Kaempfert's lovely "My Way Of Life;" and "Hold Me, Thrill Me, Kiss Me," a hit song of some 15 years ago.

But, overall, the LP is uninspiring and it can be recommended only to the most enthusiastic Bassey collectors. In addition, the playing time of 28 minutes is poor for an album which retails at $5.75. (T.F.C.)

★ ★ ★

SONGS I SING ON THE JACKIE GLEASON SHOW. Frank Fontaine. Stateside (E.M.I.) mono only OSL 10066.

Interest: Mainly for senior folk.
Performance: Sentiment, plus.
Quality: Good mono sound.

Perhaps you will know Frank Fontaine better under the name he uses for his appearance in the Jacky Gleason show—Crazy Guggenheimer. If so, you will also know that his rubbery, lop-sided face, with its squint-eyed gaze and drooping grin is quite out of character with the rich and resonant bass voice with which he sings the kind of sentimental ballads of yesteryear included in this selection: When Your Hair has Turned to Silver —I'm Forever Blowing Bubbles—That Old Gang of Mine—Daddy's Little Girl—If You Were the Only Girl in the World—Mary's a Grand Old Name — Heart of My Heart — I Wonder Who's Kissing Her Now—Beautiful—If I Had My Way—Always—Easter Parade. Mainly for those with nostalgic memories of the period when these songs originated, I feel, and rather too syrupy for modern tastes. Incidentally, this mono only disc is a reissue from about five years ago, so the price tag of $5.50 seems a bit hard. (H.A.T.).

★ ★ ★

SOUVENIR D'ITALIE. Robert Goulet with orchestra conducted by Don Costa. Stereo, CBS SBP-233737.

Interest: Singer and his songs.
Performance: Robust.
Quality: Excellent.
Stereo: Normal.

The robust, masculine voice of Robert Goulet is so well known in Australia that it is hardly necessary to comment, except perhaps to say that he is a singer to whom I, personally, enjoy listening.

In this album he returns to the theme of his earlier (and only) "gold" recording "Amore Sousami." In a program of Italian songs, he presents: Souvenir d'Italie — Love Theme from "La Strada"—Non Dimenicar -- Just Say I Love Her—Come Back To Sorrento — Mala Femmina — You Don't Have To Say You Love Me—Autumn In Rome—Come Prima—Core 'Ngrato.

Here and there the orchestra is just a bit too enthusiastic and Robert Goulet's excursions into Italian will probably be less acceptable to Australian listeners than the English words. But these minor criticisms notwithstanding, I must rate this as an excellent album. (W.N.W.)

Recommended

THE WORLD OF JOSEF LOCKE. Stereo, Decca SPA-21.

Interest: Songs, pleasant and varied.
Performance: Well sung.
Stereo: Normal.
Quality: Clean and well balanced.

In an era when vocalists rely so heavily on aids and gimmicks, it is pleasant to come across an album where the artist relies on sheer old-fashioned ability—good voice control, good diction, a good sense of pitch and the ability to cope with a wide range of material.

Here are the track titles: How Small We Are—Blaze Away—Danny Boy—Edelweiss—Try A Little Tenderness—Just Loving You—A Tear, A Kiss—Galway Bay—Marta—How Can You Buy Killarney? — The Last Waltz — Little Altar Boy.

If you enjoy the sound of a good, pleasant baritone voice, buy this album. It is excellent value at $2.50. (W.N.W.).

★ ★ ★

ROD McKUEN AT CARNEGIE HALL. Two record set recorded at a live performance. Warner Bros.—Seven Arts Records (Australian Record Company) Stereo 2WS-1794.

Interest: Folk singer in concert.
Performance: Went over well.
Quality: Good standard.
Stereo: Adds atmosphere.

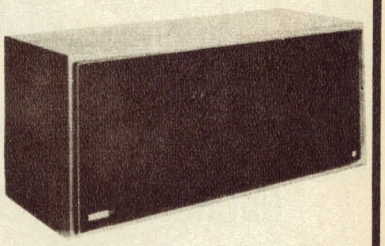
As a composer of tunes and writer of lyrics, Rod McKuen is now top of the tree, but as a vocalist, his talents are very modest. For this reason, it is a pity he did not enlist some experienced vocal aid for his Carnegie Hall appearance. Despite his limited vocal ability, he obviously went over very big, to judge by the enthusiastic response of the audience to every number. I judge that many buyers of this set will be carried along on this wave of enthusiasm, and will obtain the enjoyment they expect from the performance.

The program is presented in two parts each part beginning with a short orchestral "Overture" with brief excerpts from some of the songs to be presented. McKuen then carries on single-handed, without benefit of master of ceremonies or any supporting artists. Record 1 has the following: So Long, Stay Well—The Importance of Rose—I've Been to Town—Everybody's Rich But Us—A Cat Named Sloopy — Bend Down and Touch Me—Joanna—The Things Men Do—Gee. It's Nice To Be Alone — Trashy—Stanyan Street—If You Go Away—Seasons In The Sun. Among

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Extract of review in the authoritive Dutch magazine "Disc."

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bottom 27.
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10. "Y" 56.5

Extract from review in "HI-FI Sound": "It was difficult to realise sometimes that so small a loudspeaker was really producing such well-defined low frequency sounds. It goes without saying that the treble performance was fully up to standard of the H.F. 1300."

Extract from review in "The Gramophone": "The listening tests made an excellent impression. Treble was bright and forward: the bass was clean and powerful enough to produce a good balance."

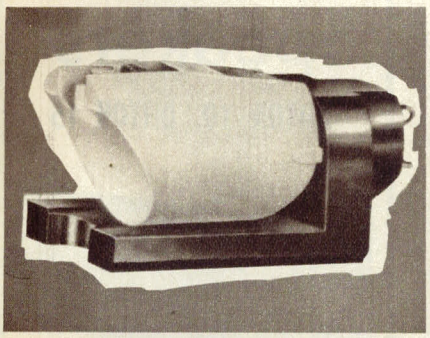
Extract of review from "HI-FI News": "The quality of bass sound was above average; plenty of bass, but always clean and clear . . . a very wide range of program material was enjoyed, and nothing caught it out, or gave cause for reservation."

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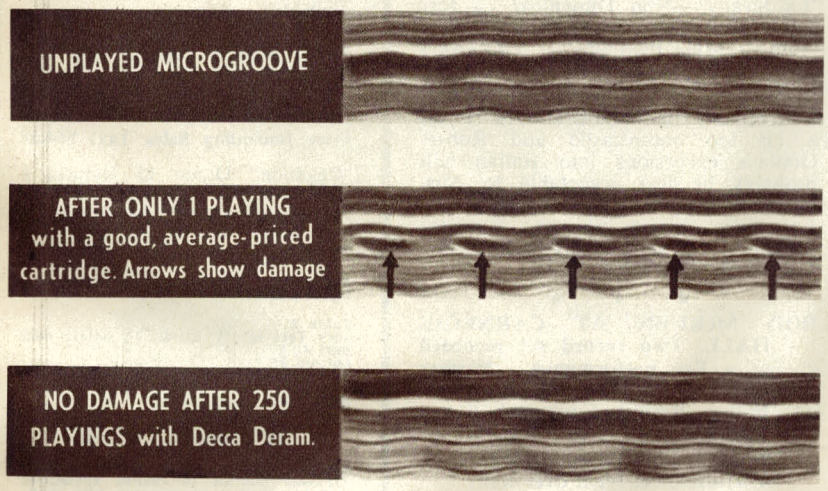
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the 16 numbers included in record 2 are: Kaleidoscope — Ally, Ally Oxen Free—I'll Catch The Sun—We—The Ivy That Cling To The Wall—Champion Charlie Brown—Merci Beaucoup —Jean.

Suitable anecdotes and remarks are sprinkled throughout the performance, and the recital closes with the usual note of thanks to the "wonderful audience." In other words, this is a typical Carnegie Hall concert, greatly enjoyed by the audience. (H.A.T.)

★ ★ ★

THE PIANO STYLE OF—Nat "King" Cole. Capitol (E.M.I.) Encore Series Mono ENC-9460.

Interest: With Nelson Riddle.
Performance: Very pleasant.
Quality: Acceptable.

As most readers will know, the late Nat Cole originally made his reputation as a jazz pianist in the late 1940s. At that time, he mainly led a trio and his solo style was very much in the Earl Hines/Teddy Wilson tradition.

No recording date is given for this album but it was almost certainly in the mid-1950s and on the 16 tracks, Nat Cole's piano (no vocals) is backed by the Nelson Riddle Orchestra.

The songs are all popular standards —"Love Walked In," "Imagination," "Stella by Starlight," "April in Paris," "Tea For Two," "Just One of Those Things" and ten more.

Although Nat Cole was a very talented pianist, the apparent object of this album was rather to provide uncomplicated pleasant listening. However, King Cole occasionally breaks out, particularly on the uptempo tracks with some crisp, swinging improvisations. With the normal Encore Series price of $2.50 and a generous playing-time of 45½ minutes, this LP represents unusually good value. (T.F.C.)

★ ★ ★

BLACK AND BLUE—Lou Rawls. World Record Club Stereo S/4602.

Interest: Young blues singer.
Performance: Good album.
Quality: Well recorded.
Stereo: Normal spread.

Low Rawls is, without doubt, one of the biggest names on the American scene today. He started out with a gospel group in Chicago and toured with the late Sam Cooke. In recent years, however, he has broadened his field with more commercial material, while retaining a strong affinity for the blues.

This album, his second from memory, is much closer to the blues than his recent recordings. The tracks include, for example, Count Basie's "Goin' To Chicago Blues," Richard M. Jones' classic "Trouble In Mind," Pete Johnson's "Roll Em Pete" and Leroy Carr's "How Long Blues."

I certainly preferred Rawls' singing during that period and this LP is, I think, his best to date. His confident, very personal singing is well matched by Onzy Matthews' arrangements, which are particularly effective on "Kansas City" and the title track.

This album can be recommended to all readers who prefer Lou Rawls, the blues singer to Rawls, the watered-down star of TV shows. The LP was very well produced by Nick Venet and the playing time is 35¼ minutes. (T.F.C.)

Memento of an era

THE GREAT DAYS OF MUSIC HALL. Mono, Music For Pleasure. MFP-A-8093.

Interest: Music Hall memories.
Performance: Well-known artists.
Quality: Clean but no treble.

If I had to pick a figure out of the air, I'd say that this album is for the over 55s — at least! Would anyone younger remember much of the old music halls, the artists and the music they produced. But if you qualify, the numbers on this album will stir quite a few memories.

Remember "The Spaniard that Blighted My Life?" Or "The Good Ship Yacki Hicki Doola?" These are two of the four numbers sung by Billy Merson, with chorus and orchestra.

If you can't remember those, what about "Now I Have to Call Him Father" or "Daddy Wouldn't Buy Me A Bow Wow?" Vesta Victoria is the artist who presents these two, along with four others of the same period.

Among Charles Coburn's numbers are "The Man Who Broke The Bank At Monte Carlo" and "Two Lovely Black Eyes."

Side 2 features Florrie Forde with 11 song snatches including "She's A Lassie From Lancashire" and "Pack Up Your Troubles."

Harry Champion whips off a half-dozen of the comic songs that always delighted the audience, while Ella Retford rounds off the 40-minute concert with "Ship Ahoy," "Blighty" and a couple of others.

Needless to say, all these come fom old recordings, made between 1929 and 1933. After filtering to remove distortion and noise, the treble is notably down but the surface noise has been eliminated and the diction is still adequate.

Album photographs and detailed-notes by Wee Georgie Wood round off an economy-priced and well presented piece of entertainment history. (W.N.W.)

TOUCH 'EM WITH LOVE. Bobby Gentry. Capitol (EMI) stereo ST 155.

Interest: Mainly C and W.
Performance: Pleasing.
Quality: Excellent.
Stereo: Normal.

The husky voice of Bobby Gentry and the simple type of country and western material presented here make a most entertaining combination. The songs range from folk blues (In the manner of her first big hit "Ode to Billy Joe") to a soulful version of a previous Dusty Springfield success "Son of a Preacher Man." Also on the album is her present chart topping "I'll Never Fall in Love Again." The rest of the material is routine, but pleasant enough: Greyhound Goin' Somewhere — Natural to be Gone — Seasons, Come, Seasons Go — Glory Hallelujah, How They Sing — I Wouldn't Be Surprised — Where's the Playground Johnny — You've Made Me So Happy. Gentry fans will no doubt be delighted by the cabinet size portrait on the back of the cover. (H.A.T.)

★ ★ ★

JULIE LONDON. Sunset Records (Festival) SLS 96018 (also in mono).

Interest: Talented popular singer.
Performance: Excellent.
Quality: Fair sound.
Stereo: Adds little.

It is hard to realise that Julie London's first big hit "Cry Me A River" was recorded 15 years ago. She is a warm, intimate singer with an instinctive flair for phrasing and moving slightly around the melody.

No recording date is given for these tracks but, like the other $2.95 Sunset albums, it is presumably not a newly-recorded LP.

The tracks are mainly "torchy" ballads like "Laura," "Spring Is Here" "I'm In the Mood for Love" and "that Old Feeling," which suit Julie London perfectly. But there are some up-tempo numbers on the LP like "Baby Come Home," "Tain't What You Do" and "Bill Bailey."

The arrangements — probably by her husband Bobby Troup — are good throughout, particularly the solo guitar on "Blue Moon," "Spring Is Here" and "I'm In the Mood for Love" (Barney Kessel?). The only serious criticism of this attractive LP is the disappointing playing time of 23 minutes. Even at a retail price of $2.95, the record-buyer deserves better value. (T.F.C.)

★ ★ ★

TODAY MY WAY. Nancy Wilson. World Record Club Stereo S/4534.

Interest: Stylish popular singer.
Performance: Not the best Wilson.
Quality: Well recorded.
Stereo: Normal separation.

This Nancy Wilson LP was probably recorded some three years ago. As always, she sings with great feeling and style, but this album cannot be counted among her finest recordings.

Some of the eleven songs are on the dull side and appear to be unsuitable for her range. But there are at least four very good tracks in "My Love, Forgive Me," "You've Lost That Lovin' Feelin,' " "Love Has Many Faces" and "If I Ruled The World." The arrangements by Sid Feller are adequate.

Even at the concession WRC price, this album is scarcely essential buying, particularly with the very poor playing time of 25 minutes. (T.F.C.)

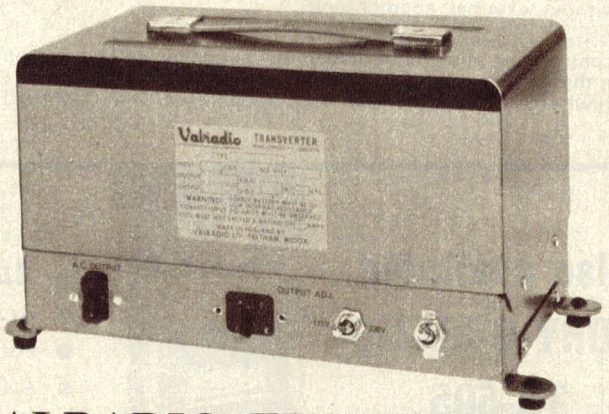
★ ★ ★

GOLDEN GREATS — Gloria Lynne. Sunset Records (Festival) SLS 96,006 (also in mono).

Interest: Talented modern singer.
Performance: Worth hearing.
Quality: Well recorded.
Stereo: Not much in evidence.

Gloria Lynne is a 38-year-old New York singer, who emerged as a "quality" artist in the late 1950's, after several years of obscurity, when she worked mainly in the R and B

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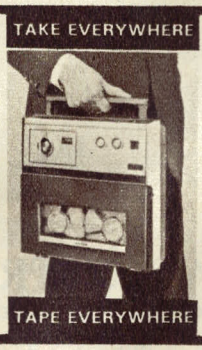
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market. Her singing is reminiscent at times of Ella Fitzgerald and Carmen McRae and she displays good control and intonation with a sensitive feeling for lyrics.

This LP, which has been locally released on the $2.95 Sunset label, was probably recorded a few years ago. The tracks include standards like "April In Paris," "Fly Me To the Moon," "I'll Take Romance" and "Mack The Knife." Unfortunately neither the backing musicians nor the arrangers on the sessions (some are "live") are identified, but they do a very adequate job.

This LP is certainly worth hearing, especially if you have not yet had an opportunity to hear Miss Lynne. The playing time is 33 minutes. (T.F.C.)

★ ★ ★

THE NEW WORLD. The New World Trio. Parlophone (E.M.I.) Stereo PCSO 7556.

Interest: Australian folksingers.
Performance: World class.
Quality: Excellent.
Stereo: Normal.

Devotees of the successful "Showcase" production on television will need no introduction to this folksinging group. They were regular performers for three years, and had the incredibly bad luck to be beaten into second place in two Grand Finals, thus missing out on an expenses-paid world tour. Now they have decided to try their luck in England at their own expense, leaving this disc as a souvenir for their numerous admirers in Australia. Their art is certainly of a very high order, and this record is the equal of any of this type available from overseas sources. Their recordings of "Try to Remember," which has already had conspicuous success, and will be known to many prospective buyers of this album, is a pretty fair sample of what to expect.

In the same appealing style, they present the following selection, to their own guitar accompaniments: It Was a Very Good Year—There is a Curious Paradox—Try to Remember—I'll Catch the Sun—Somewhere—I'm Just a Country Boy—Little Play Soldiers—Walking on the Green Grass—Feed the Birds—Black Girl—Softly As I Leave You—The World I Used to Know—The Water is Wide—Welcome to My World. If I have anything at all to complain about, it is the rather similar nature of the whole of the material, which is slow and on the dreamy side. A few livelier numbers might have given the touch of variety which an L.P. requires to be entirely successful. But I feel many of the Trio's fans will not agree with me, as it is this type of material which has won them so many heats in the "Showcase" series. (H.A.T.)

Popular Jazz

TELL IT LIKE IT IS—George Benson. A and M Records (Festival). SAM 933,492 (also in mono).

Interest: Modern jazz guitarist.
Performance: Very commercial.
Quality: Well recorded.
Stereo: Evenly spread.

George Benson, the 26-year old Pittsburgh guitarist, has made some very successful recordings with the organist Jack McDuff (for Prestige) and with his own quartet (for Columbia). Particularly after the tragic death of Wes Montgomery, Benson has been hailed as perhaps the most exciting new talent on guitar.

But on this LP (his first for A and M Records) he has regrettably fallen into the clutches of producer Creed Taylor, and the results, from a jazz point of view at least, are not impressive.

For a start, the material is commercial—R and B standards like "Soul Limbo" and "Land of 1,000 Dances"; together with some new compositions in the same idiom by Don Sebesby and Benson himself.

No credit is given on the sleeve-note for the arrangements, which feature a conventional rhythm section, three extra percussionists, four reeds and trumpet. In any event, they are used mainly to cushion Benson's guitar, although Joe Farrell, Sonny Fortune and Jerome Richardson take some useful solos.

Benson sings on three tracks—"My Woman's Good to Me," "Out in the Cold Again" and the title track but his voice is no more than a pleasant carbon-copy of Sam Cooke. Only one track "Jackie, All" really does justice to Benson's undoubted talents on guitar although, from time to time, glimpses of his potential can be seen.

The album plays for 32 minutes, with each track carefully timed for maximum radio air-play.

Readers who have been impressed by Benson's playing in the past would be well advised to hear his album before purchase. We can only hope that the production of his next LP will do justice to his abilities. (T.F.C.)

★ ★ ★

THE BEST OF BECHET—Sidney Bechet with Claude Luter and his Orchestra. Vogue Records (Festival). Stereo SVL 933453 (also in mono).

Interest: Early 1950s material.
Performance: Good Bechet.
Quality: Poor recording sound.
Stereo: Adds little.

In 1949 Sidney Bechet, the great New Orleans clarinet and soprano sax player, settled in France and over the next 10 years, until his death in 1959, he became almost a national institution and legend.

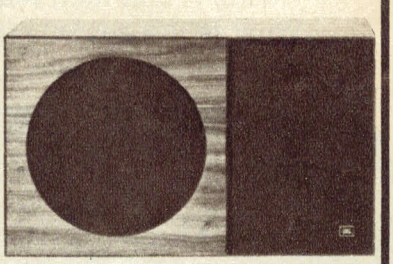
During this period, he frequently recorded with French musicians (mainly Claude Luter.) No dates are given for the 10 tracks on this LP but they were, in fact, made between October, 1950 and November, 1952.

Bechet himself played very well indeed on these French recordings (all soprano) but at times the enthusiastic but rather inadequate Claude Luter Band dragged him back from the peaks of his great creative abilities.

As usual, Bechet dominated the ensembles and his solos were generally exciting and inventive. He is particularly effective, for example, on his quartet features "Summertime," "September Song" and "Embraceable You."

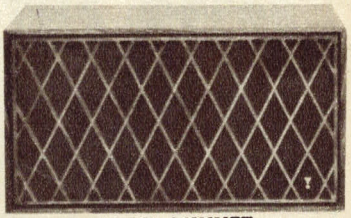
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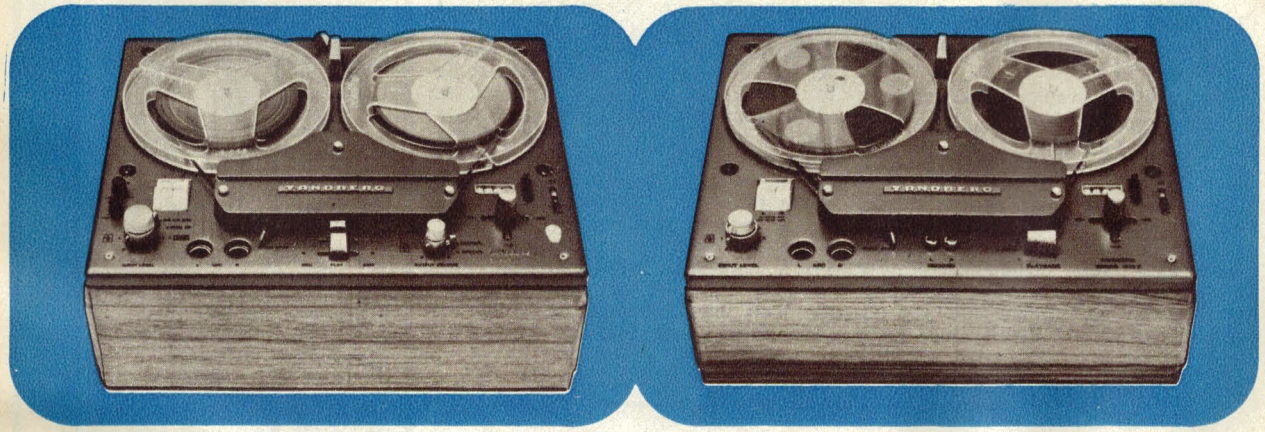
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The other tracks are mainly classic standards and include "12th Street Rag," "Royal Garden Blues," "Frankie and Johnny" and "Bill Bailey."

Bechet collectors will be aware of the shortcomings of his French recording sessions. However, this LP can be recommended to all readers who are interested in the career of the greatest soprano saxophonist in the history of jazz. The playing time is 44 minutes. (T.F.C.).

★ ★ ★

THE ZIMBO TRIO. Universal Record Club Stereo U-1008.

Interest: Brazilian modern jazz.
Performance: Promising.
Quality: Four recording sound.
Stereo: Adds little.

The Zimbo Trio, a Brazilian modern jazz trio, features three musicians whose names are new to me, in Amitton Godoy (piano), Luiz Chaves (bass) and Rubin Barsotti (drums).

The setting of their music is Bossa Nova and all twelve tracks have underlying Latin-American rhythms. But it is clear that the trio has been strongly influenced by modern jazz developments and their music is very much closer to this idiom than to their native Brazilian sounds.

The pianist has listened to a lot of jazz and his style incorporates elements of Oscar Peterson, Denny Zeitlin and even Ramsey Lewis. The bass player is very accurate with good tone and time, while the drummer is lively and interesting, if a little busy at times.

I doubt whether a piano trio of this kind, with little variety in mood, can really sustain interest over an LP but the music is pleasant and easy listening.

The best track's are Bonfa's "Flower Miss" and "Girl From Charme"; Luiz Chaves' original composition "The Sad Thing"; Baden Powell's "Consolation"; and Jobim's "I Live Dreaming."

Overall, then, the Zimbo Trio shows distinct promise and any Universal Record Club member who enjoys Brazilian music will probably find this album attractive. (T.F.C.).

★ ★ ★

THE BLUES. Pete Fountain. Universal Record Club Stereo UJ566.

Interest: With big band.
Performance: For Fountain enthusiasts.
Quality: A bit flat.
Stereo: Well balanced.

Pete Fountain recorded this album in 1959/60, just after he completed his two years as featured soloist with the Lawrence Welk Orchestra.

On all twelve tracks, Fountain is backed by a 16-piece band under the direction of Bud Dant. The band included some first-rate musicians like Eddie Miller (who took all the tenor solos), Babe Russin and an impressive rhythm section of Stan Wrightsman (piano), Morty Corb (bass) and Jack Sperling (drums).

But the arrangements are dull and unimaginative and the big band is little more than a back-drop for Fountain's solo clarinet. On this album, he comes closer to playing convincing jazz than on any other LP which I have heard. But his main asset is still his remarkable technique rather than any flair for original ideas.

The tracks are mainly traditional jazz standards like "St. Louis Blues," "Lonesome Road," "Memphis Blues," "Beale Street" and "Wabash Blues" and the album plays for 37½ minutes.

Pete Fountain enthusiasts will certainly want to add this to their collection, especially at the concession Club price. For the less committed, even one of Pete Fountain's best LP's would scarcely hold much appeal.

Miles Davis . . . "magnificent"

FILLES DE KILIMANJARO—Miles Davis. CBS Stereo SBP 233703.

Interest: Some tracks with new quintet.
Performance: Magnificent.
Quality: Well recorded.
Stereo: Normal balance.

Apart from the obvious importance of any new recording by Miles Davis, this LP is particularly significant for at least two reasons. In the first place, it is the first time since the "Kind of Blue" album that Davis himself has written all the themes and secondly, two of the tracks feature Chick Corea and Dave Holland, the new pianist and bass player in the Quintet.

It is, I think, by far the finest album that Miles Davis has made since "ESP" which heralded a new freedom (both from the rhythmic and harmonic viewpoints) in the music of the Quintet.

Herbie Hancock and Ron Carter play on three of the five tracks and Chick Corea and Dave Holland are featured on the remaining two compositions. No one could deny that Carter's departure from the Quintet represents a serious loss but the young English bass player, Dave Holland, plays well enough to suggest that he will make the grade. Surprisingly enough, Hancock seems to have been very adequately replaced, in the context of the Quintet, by Chick Corea, a more fundamental and bluesier pianist.

Both pianists and bass players, incidentally, mainly use electric instruments on this LP and they are employed with great skill and effect. Miles Davis is, as usual, the dominant soloist on the LP and he plays brilliantly throughout the album, apparently relishing the musical freedom and cohesion which the quintet has attained. Wayne Shorter, too, is now a completely mature tenor saxophonist, who can follow a solo by Miles Davis without any obvious break in the tension. Tony Williams, as always, is superb—a sensitive, lightning-fast drummer who feels and reacts to every subtlety around him.

This album is an emotional experience, evocative of mystery, movement, beauty and peace. It is certainly an LP which will repay serious and constructive listening. Highly recommended. The playing time, incidentally, is 56 minutes. (T.F.C.) ◘

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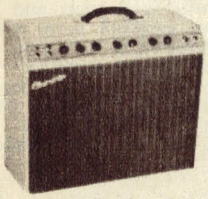
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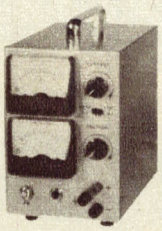


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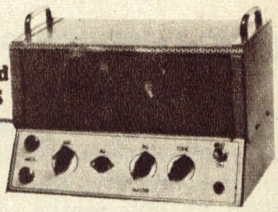
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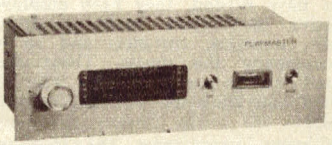
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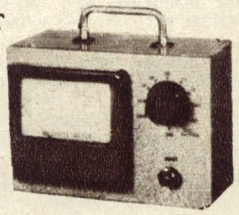
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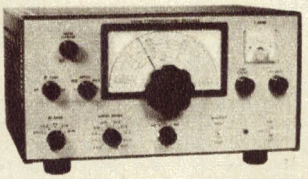
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TRADE REVIEWS AND RELEASES

AUTOMATIC RHYTHM GENERATOR

The NDK Rhythm generator is a completely electronic source of rhythm accompaniment for use with electronic organs, pianos and the like. It can generate 12 named rhythms, with variable tempo which, according to the manufacturers' leaflet, would involve the use of nine distinct percussion instruments.

For just about as long as theatre organs have existed, they have employed percussive instruments such as drums, cymbals, triangles, castanets and so on, to accompany the music. These were operated electro-pneumatically, with the musician activating the circuits from the console.

For many years now, the electronic organ industry has provided the home and small theatre organist with scaled-down versions of these percussive sections. Of these, one of the best known was the Wurlitzer Side-Man. This had a variety of valve oscillators and format networks to simulate the various percussive instruments.

The Wurlitzer Side-Man used a complex motor-driven switch to key the various circuits in a cyclic fashion so that they would simulate a wide variety of dance rhythms, such as Rhumba, Cha-Cha, Waltz, Tango and so on. The speed of the motor was variable, allowing the overall tempo to be varied.

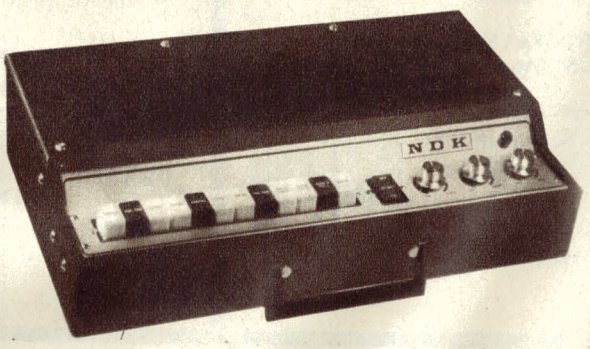
The NDK Generator, while not as ambitious as the Wurlitzer instrument, is intended for the same purpose. However, valves and motor-driven switches have given place to fully solid-state logic style circuitry. The tempo of the basic rhythms is controlled by a free-running oscillator, whose output frequency is controlled by the Tempo potentiometer. The output from this oscillator is coupled to a chain of flip-flops and thence to a decoding matrix which, by means of the rhythm selector switches, provides the basic rhythm patterns.

The various percussive sound signals are generated by a variety of oscillators and accompanying filters. The oscillators appear to be a "one-shot" twin-T arrangement whereby the oscillation decays at a controlled rate. The brushed cymbal appears to be produced by gating a transistor "white" noise generator. The rhythm selector push-button switches already mentioned determine which of the percussive instruments is keyed for each of the rhythms.

Besides the twelve rhythm push-button switches and the Tempo control, the instrument has a volume control and power switch, a conventional "top-cut" tone control and two stop-start switches, one on the panel and one at the end of a plug-in cord for foot operation. The circuitry is so arranged that the start switch always initiates the selected rhythm at the start of a bar.

Of Japanese manufacture, the NDK is encased in a vinyl-covered cabinet measuring 18 x 11 x 4¾ inches deep, including rubber feet. The control panel is finished in brushed aluminium.

The unit is mains-operated, the mains cord being accommodated, when not in use, in a small compartment in the side of the cabinet. Also accommodated in the compartment is a lead with a telephone jack fitted at each end to couple the output from the rhythm generator into an external amplifier and loudspeaker system. The unit itself does not incorporate an amplifier and loudspeaker.



The NDK rhythm generator, available from ACE Radio for $145.00. All the well known rhythm patterns are available at the push of a button.

The rhythm generation circuitry is accommodated on a large double-sided printed board measuring approximately 11¾ x 5¾ inches while the percussion oscillators are accommodated on a separate printed board measuring 5¼ x 9¾ inches.

MUSICAL EVALUATION: Because of the specialised nature of the unit, and the fact that we had not previously reviewed anything like it in these columns, we went to special lengths to secure reactions to it from professional musicians.

A drummer checked out each of the 12 basic rhythms and gave his okay to the basic rhythm patterns. He drew attention, however, to the fact that there seemed to be no provision for either 2/4 or 6/8 tempos but a little experiment established that these could be obtained by simply using the Tempo control to speed up the march and waltz tempos provided on the push-button switches.

The switches are arranged so that depressing any one releases whatever other switch has been depressed. It is possible, however, to manipulate them so that two or more buttons lock down simultaneously to produce composite rhythm patterns. While some of these are of no potential interest, others had the drummer intrigued and he obviously would have liked a few hours to experiment and study, to see whether some of the rhythms could have been adapted for actual performance.

Quite apart from this, he pointed out the possible value of such a device for training would-be drummers, both in terms of rhythm patterns and in maintaining a suitably strict tempo for certain types of music.

One point of criticism emerged, namely that the range of the Tempo control did not extend far enough in the "slow" direction and, in the sample unit at least, it was not possible to accommodate a jazz waltz or slow foxtrot at the usually accepted tempos or certain other music of the "mood" type. This was verified by comparing tempos with those on typical Victor Sylvester recordings.

At our suggestion, A.C.E. Radio examined the circuitry and found, as anticipated, that the low frequency limit of the basic Tempo oscillator was determined in part, by the maximum value of the control potentiometer. Where tolerances have conspired to raise the minimum frequency unduly, as in the unit submitted, it is a simple matter to substitute a somewhat higher value potentiometer, lowering the bottom limit of the range, without affecting the upper limit. A.C.E. Radio propose to make the change wherever necessary.

As far as the sound itself was concerned, the drummer gave as his opinion that the simulation was very good and such as to present no problem in a musical situation. We preferred it with some bass and treble boost in the amplifier — a setting that carried only one penalty: There is some hum in the output of the unit which can be objectionable with boost unless the unit is operated into an "auxiliary" channel (say 100-200mV sensitivity) and with the output control well advanced.

A pianist and an organist who had not previously had experience with a percussion unit, found some difficulty at first in staying with the very strict rhythm which the unit produces. They had to learn the hard way that the unit would not yield to them or help phrase passages in the way that a group would normally do.

They had some difficulty also in starting on beat with the unit and in anticipating the tempo which would emerge when the "start" button was pressed. Musically, they would have been much happier had the Tempo control been marked as a metronome rather than in the electronic convention of 10 little strokes around an arc. There was some discussion also as to whether the technique of starting on the down beat was easier or harder than the approach adopted in some other units of playing and starting to a winking light.

However, the problem of using the instrument to best advantage is largely one of practice and familiarity and our guess was that the pianist at least had emerged from the session as a potential customer!

In all, the unit appealed to us as being well built and attractively priced and one that should merge well into musical situations — provided steps are taken to ensure that the very slow rhythms can be accommodated.

Priced at $145 retail, the NDK Rhythm Generator is available from A.C.E. Radio, 136 Victoria Road, Marrickville, N.S.W. to whom all inquiries should be directed (L.D.S. and W.N.W.)

STROBE FLASH FOR CINE WORK

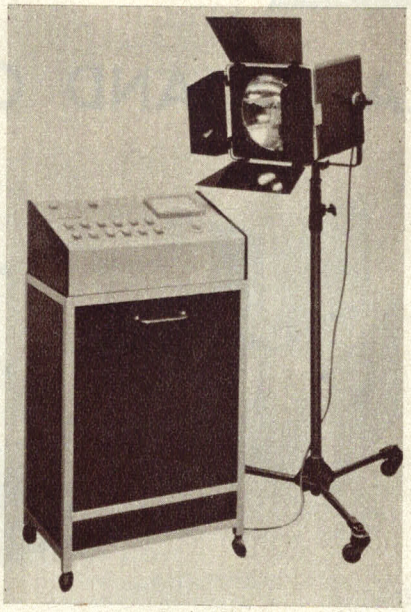
An advanced design of stroboscopic flash unit for use with professional cine cameras, made in the U.K. by Dawe Instruments Ltd., is available in Australia from Astronic Australasia Pty. Ltd., 161-173 Sturt Street, Melbourne, 3205

The equipment consists of three basic units: Control Unit Type 1240A with plug-in unit matched to camera; Lamp Unit Type 1240-1A; Variable Contactor Unit Type 1200-3A or photo pick-up. Up to 10 lamp units may be used with one control console, as well as two scene viewing lamps. The system is suitable for use with most professional cine cameras, in either a high-intensity or anti-flicker mode. In the high intensity mode, the exposure value does not change by more than one half stop over the range 10 to 30 frames per second.

The lamps have an extremely short flash time of 2 microseconds for an output of 2 joules. The system is therefore particularly suitable for filming commercials where stop action sequences are used, to eliminate the blurr which occurs when using normal lighting. Mean power dissipation per flash tube is equivalent to only 40 watts continuous lighting, so that the heat problems associated with tungsten type lighting are avoided. This feature is particularly valuable when filming items such as ice cream, butter or beer.

Facilities are provided for separate viewing lights when reflex cameras are involved, and the equipment is to be used in the high intensity mode. The working light is automatically switched on when the camera is stopped. This light is automatically switched off when the camera comes operational, or the operator may control its brilliance by a built-in dimmer. The whole system can be run "wild" for scene setting, if desired.

An anti-flicker, plug-in unit is available for use with live action, if the flicker rate is objectionable. This operates the lighting at twice the shooting rate for a maximum shooting rate of 25 frames per second. The light output on flicker-free operation is one stop less than for normal running, and viewing lights are not required.



An Interim Data Sheet giving further details of the unit is available from Astronic Imports at the address above.

SIMON GRAY DISTRIBUTE SANSUI

Our January issue carried a brief announcement to the effect that Simon Gray Pty. Ltd. had been appointed exclusive distributor for Sansui Electric Company Ltd., Tokyo, Japan, for the A.C.T. and all Australian States except Western Australia. Our pre-Christmas printing schedules prevented us from carrying a photograph of the Japanese style "celebrations" which E.A. representatives attended in Melbourne and Sydney. Pictured (left to right) are Mr Wulf Gray; Geruko, one of the three hostesses; Mr Clarrie Pearce, Manager Consumer Division; Mr Jack Muroi, Sansui Electric Co. At the functions, a wide range of audio equipment was on display—amplifiers, tuner/amplifiers and loudspeakers. Mr Clarrie Pearce announced a marketing policy aimed at stabilising prices for Sansui products, together with a distributor-backed guarantee on parts and workmanship.



LAFAYETTE

OF U.S.A.

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GUIDE TO EVERYTHING IN ELECTRONICS

★ AMATEUR RADIO
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★ 27MHz 2-WAY RADIO
★ COMPONENTS

THOUSANDS OF INTERESTING ITEMS. The 1970 catalogue of Lafayette Radio Electronics Corporation of U.S.A. details 1,000s of items of interest to the amateur, technician, hi-fi enthusiast, experimenter, hobbyist, engineer, student, serviceman . . . fully illustrated. Many items are available from Australian stocks—list included—others are available for shipment from the U.S.A. Many exclusive LAFAYETTE lines, not available elsewhere, are featured.

The small charge for the catalogue is to cover import duty, postage, etc., and will be refunded on receipt of an order for $25 or more.

Mail Coupon below or write.

LAFAYETTE ELECTRONICS,
Division of Electron Tube Distributors Pty. Ltd.,
94 HIGH STREET,
ST. KILDA, VIC., 3182.

Please send me Catalogue 700. I enclose Chq./P.O. for $2.50, which is refundable with my first order for $25.

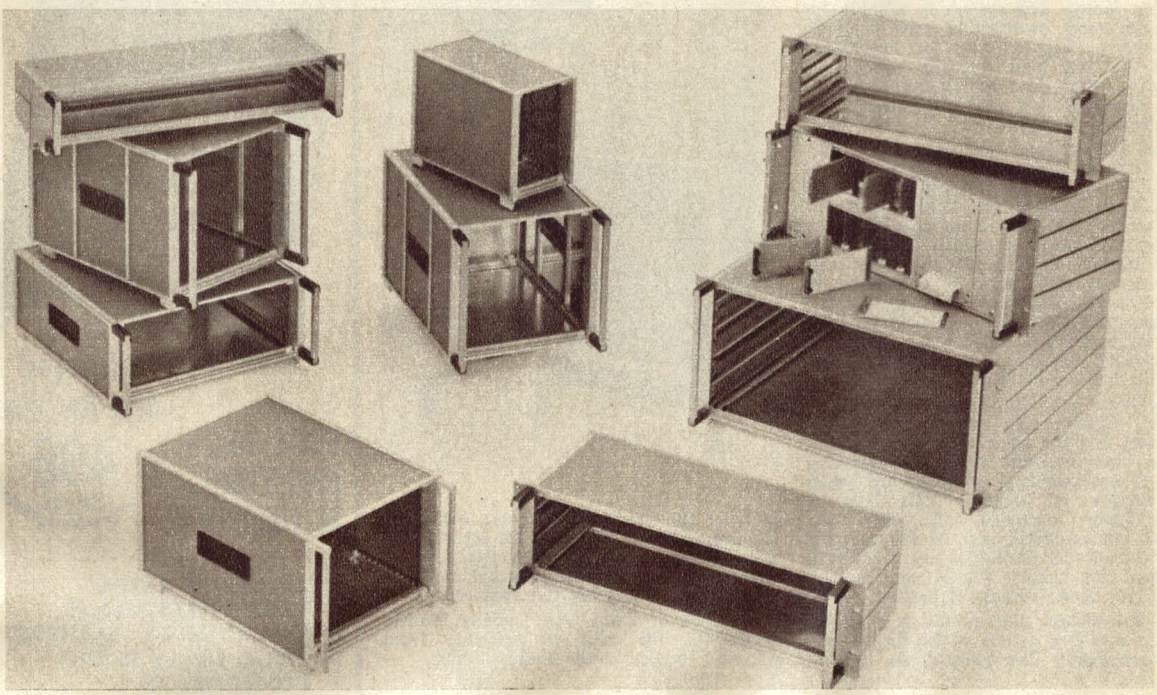
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ELMASET SYSTEM

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An extremely versatile system of enclosure designed to be completely flexible and accommodate existing cards and plugs.

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The Elmaset unit system ranges from plug-in cards, card magazines, partial plug-ins, built-in housings, small rack units, to the more complex 19" housings.

But the full range is so extensive and adaptable.

Ask about it from—

ASSOCIATED CONTROLS PTY. LTD.

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14 Enterprise Avenue,
PADSTOW, N.S.W. 2211.
Phone: 771 3833.

Victoria
2 Vicki Street,
BLACKBURN SOUTH, VIC. 3130.
Phone: 878 6555.

HEAT SHRINKABLE PLASTIC TUBE

Heat shrinkable plastic tubing—tubing that shrinks on the application of heat—is now being made and marketed in Australia by Storewide Spectaculars of Crows Nest, N.S.W.

Heat shrinkable plastic has a very wide range of applications in the electronics industry. The ease with which it can provide encaspulation, mechanical protection, strain relief and electrical insulation makes it partcularly attractive to almost every phase of the industry.

One of the best known applications is the encaspulation of individual components, such as capacitors, resistors, diodes, coil etc. However, it is equally suitable for use over connectors and their associated cables to provide strain relief, over busbars to provide both insulation and colour coding, and over cable harnesses, splices, etc., to provide moisture protection mechanical protection, and circuit identification.

Heat shrinkable tubing possesses an inbuilt tension which, when subjected to a temperature in excess of 265°F for a few seconds, is suddenly released. The release of this molecular tension causes a shrinkage that provides a high contact with any object being covered. The tubing will conform to all irregular shapes, the new shape is permanently retained, and subsequent exposure to the same temperature will not re-expand the tubing, Longitudinal shrinkage is held at about 5pc of the supplied length.

The locally produced material is Thermotite, a thin wall P.V.C. tubing, but the same company also offers a variety of imported heat reactive material including irradiated Polyolefin, Teflon, Silicon Rubber, etc. as well as heat shrinkable polyester tape and Zippertubing, a tubing incorporating a zipper type closure.

The amount of shrinkage varies according to the particular type of material, ranging from 50pc (i.e., shrinkage to half the original diameter) to 20pc. The lower shrinkange factor is still adequate in many applications, while the particular type of tubing may have other qualities which make it more suitable for a particular job.

For example, certain properties are comcom to most plastics, such as high dielectric strength, chemical resistance etc., but other properties vary considerably from type to type. Maximum continuious operating temperature is one of these and may be an important consideration in a particular design. Some idea of the variation can be obtained from the following list of materials which this firm markets, showing maximum operating temperatures.

Thermotite and Drakavita P.V.C.	85°C
Scotchtite P.V.C.	105°C
Irradiated Polyolefin	135°C
Kynar Flurocarbon	175°C
Teflon T.F.E.	250°C

High temperatures can permanently impair desirable physical properties. For example Scotchtite P.V.C. can operate continuously at 105°C, but taken to 120°C its quality is reduced. At 175°C it may flow, drip, or crack.

Thus, while heat shrinkable tubing is relatively easy to use, certain precautions in regard to the application of heat, must be observed if best results are to be obtained. The safest and most convenient method of applying heat is by means of a heat gun. This is a small portable hot air blower which can provide a hot air blast at a temperature of up to 1000°F.

The use of gas flames as a source of heat is not recommended. The temperature of a gas flame varies considerably according to many factors and, in addition, may be highly localised in application. As well as creating uneven shrinkage, localised overheating can occur resulting in melting or cracking.

Although materials can be shrunken rapidly at hotter temperatures it is preferable to slow down this operation to obtain the optimum result.

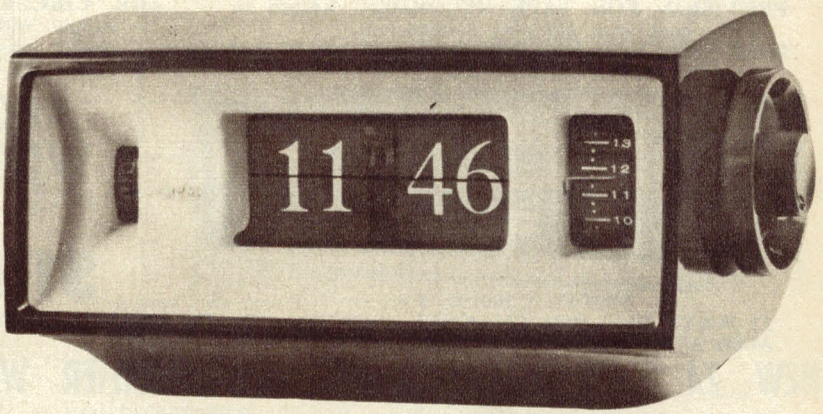
The company marketing these materials also market two models of heat gun. For heavy duty industrial use they recommend the "Thermogun Mark I". This is built in a cast aluminium housing, finished in black crackle. It features a double jacketed nozzle for cool operation, operates from 240 volts, and is fitted with a continuously rated induction motor and a heavy duty heating element. It is of rugged construction throughout. It is priced at $78.

A somewhat lighter duty model, suitable for small workshops and laboratories, is the Major Heat Gun. This is of pressed metal construction, and features a continuously rated motor and heavy duty element. It is priced at $64.

As previously implied, heat shrinkable tubing is available in a wide variety of types, each having specific characteristics which make it best suited for a particular job. Since use of the right material for the job is important for satisfactory results, Storewide Spectaculars provide an industrial advisory service to help manufacturers select the most suitable material. Anyone requiring advice or assistance in this regard is invited to contact the firm direct and discuss the problem with them.

All inquiries should be addressed to, Storewide Spectaculars, 138 Willoughby Rd., Crows Nest, N.S.W. 2065. (P.G.W.)

DIGITAL READOUT CLOCK



Direct Imports (N.Z.) Ltd., who are agents for "Caslon" clocks, submitted to us a digital clock, as pictured, for inspection. This is one of a range of styles available and it is housed in an attractive, moulded case. The time readout, either 12 or 24 hour, is by four cleverly designed digits, which flip over at the appropriate time. Alarm facilities are also included and operation is for 240V, 50Hz. We tried this one on the mains, where it performed as one would expect. We also tried it on the output of the Crystal Clock Drive Unit, as described in June, 1969. Again, operation was quite satisfactory, except that the Drive Unit could not supply sufficient power to operate the alarm in a satisfactory manner. However, even under these conditions, the motor continued to run. Supplies are available from Direct Import (N.Z.) Ltd., P.O. Box 72, Hastings, New Zealand. (I.L.P.)

GE Semiconductor Devices

Available through leading radio stores in all States

2N2160 U.J.T.	$2.49	SC45D " 10A	8.60
2N2646 "	1.79	SC50D Triac 15A	$10.09
2N2647 "	4.92	SC141D " (Plastic) 6A	3.64
A14P Diode 1A/1000V	$2.70	SC146D " " 10A	4.69
A15D Diode 3A/400V	1.82	ST2 or ER900 Diac	1.22
D13T1 P.U.J.T.	1.59	PA230 I.C. 800mw Amp.	3.67
D13T2 "	3.31	PA222 I.C. 1W Amp.	9.29
C106B1 S.C.R. 200V	2.36	PA237 I.C. 2W Amp.	6.44
C106F1 " 50V	1.95	PA246 I.C. 5W Amp.	9.09
C106Y1 " 30V	1.70	TD717 Tunnel Diode	2.39
C20D " 7.4A/400V	5.15	3N84 S.C.S.	3.47
C122D " (plastic) 10A L100U	$3.50	PA40 8A/400V Bridge	5.88
SC40D Triac 6A	6.65	PB40 25A/400 Bridge	9.10

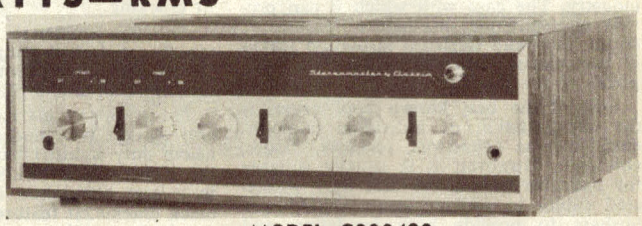
All prices include sales tax and postage within Australia.

Distributors: WATKIN WYNNE PTY. LTD.

32 Falcon Street, CROWS NEST, N.S.W. 2065. Phone 43-1912, 43-2107

NEW ALL TRANSISTOR STEREO AMPLIFIERS
ULTIMATE IN DESIGN—LONG DEPENDABILITY
USING ALL SILICON TRANSISTORS
36 WATTS—RMS

SPECIFICATIONS:
POWER OUTPUT: 18 watts per channel R.M.S. Total output 36 watts R.M.S.
FREQUENCY RESPONSE: From 20 cycles to 20,000 ± 1db.
HARMONIC DISTORTION: Less than 1 per cent at 14 watts output.
HUM AND NOISE: Aux. 70db, Mag. 50db.
INPUT SENSITIVITY. Mag. 3mv. Aux. and tuner 200 mv.
SPEAKER IMPEDANCE: 8 oms.
EQUALISED: Mag. RIAA.
TONE CONTROLS: Bass 50 c/s ± 12db. Treble 10 kc/s ± 12db.
LOUDNESS CONTROL: 50 c/s 10db.
SCRATCH FILTER: (High filter) at 10 kc/s 9db.
RUMBLE FILTER: (Low filter) at 50 c/s 5db.
PROVISION FOR TAPE RECORDER. Record or play-back with din plug connnection.
PROVISION FOR HEADPHONES with headphone/speaker switch on front panel.



MODEL C300/20

$119.00 FREIGHT EXTRA.

DIMENSIONS: 16½in v 5½in x 11in deep.

Mounted in oiled walnut or teak veneered cabinet, with metal trim and matching knobs.

THE CIRCUIT INCORPORATES regular power supply with transistor switching protection for output transistors. 26 silicon transistors plus 5 diodes are used.



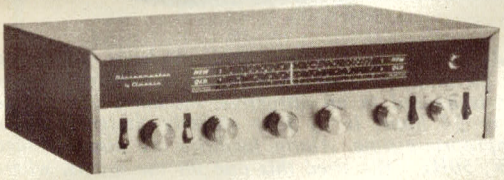
MODEL C300/20/T

ABOVE AMPLIFIER WITH INBUILT A.M. TUNER

$144.00 FREIGHT EXTRA

12 WATT RMS PER CHANNEL VERSION OF ABOVE AMPLIFIERS AS PREVIOUSLY ADVERTISED ALSO AVAILABLE. $134.00 WITH TUNER.

NEW 24 WATT R.M.S. TRANSISTOR AMPLIFIER WITH INBUILT A.M. TUNER



MODEL C250

$118.00 FREIGHT EXTRA

DIMENSIONS 15¾in x 4½in x 11in deep.
Cover finished in teak or walnut wood grain.
Incorporates 24 low noise silicon transistors plus 5 diodes.

SPECIFICATIONS:
POWER OUTPUT. 12 watts per channel 24 watts R.M.S. total (48 watts music power).
FREQUENCY RESPONSE. 20 Cycles to 20,000 ± 1db.
HARMONIC DISTORTION. Less than 1% at 10 watts.
HUM AND NOISE. Aux. 70db. Mag. 50db.
INPUT SENSITIVITY. Mag. 3mv. Aux. 200mv.
SPEAKER IMPEDANCE. 8 ohms.
EQUALIZED. Mag. RIAA.
TONE CONTROLS. Bass 50c/s ± 12db. treble 10kc. ± 12db.
LOUDNESS CONTROL. 50c/s 10db.
SCRATCH FILTER. (High filter) at 10kc. 9db.
PROVISION FOR TAPE RECORDER. Record or play back with standard din plug connection.
TUNER. This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1,600 K.C. Calibrated dial available for all States.



$118.00 FREIGHT EXTRA.

MODEL C200V. BASED ON THE PLAYMASTER 118 WITH TUNER

Dimension 16½in x 5½in x 11in.

CABINET IN OILED WALNUT OR TEAK WITH METAL TRIM.

This amplifier is based on the Playmaster 118 circuit as featured in "Electronics Australia," to which has been added the following features:

- Inbuilt high gain A.M. tuner with a coverage of 530 to 1,600 K.C.
- Loudness control giving bass boost at low volume.
- Provision for tape, record and play-back, with din connector.
- Calibrated dial available for all States.
- EM84 tuning indicator giving accurate tuning with ease.

POWER OUTPUT: 9 watts per channel R.M.S. FREQUENCY RESPONSE: 20 to 20,000 cycles incorporating Ferguson O.P.412 gain oriented output transformers. VALVES USED: 4-6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2 silicon diodes.

CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145

TRADE RELEASES – IN BRIEF

RUTHERFORD ELECTRONICS PTY. LTD., 62 Jackson Court, Doncaster, Vic. 3108. Agents for National Semi-conductor Corp., U.S.A. **Read Only Memories.** The National 1024-bit read only memories has been programmed in five different ways for five different applications. The MM421/521 is a 256-word 4-bit memory, and the MM442/522 is a 128-word 8-bit memory. These can be purchased as: the MM522BM, a sine look-up table; the MM522BN, an arctangent table from 0 to 45 degrees; the MM522AP, an IBMCD (1-2-4-8-AB) to ASC11 converter; the MM522CF, a BCD-to-Selectric converter; and the MM522CG, a Selectric-to-BCD converter. The same circuit goes into the three package character display kits, the SK0001 for faster scan and the SK0002 for vertical scan systems. All circuits are available in either full military temperature range (MM421 and MM422) or in industrial temperature range (MM521 and MM522).

KIT-SETS AUSTRALIA, P.O. Box 176, Dee Why, N.S.W., 2099 has opened a sales department for counter sales, trade inquiries, and wholesale distribution of the company's electronic components. The office is situated at Shop 14, Stones Arcade, 673-675 Pittwater Road, Dee Why, 2099 (telephone Sydney 982-5571). The mail order section now offers a 24-hour despatch service to clients.

SIMPLEX INTERNATIONAL TIME EQUIPMENT PTY. LTD., Box M61, P.O., Sydney Mail Exchange, N.S.W. 2012. **Scan-Card Attendance Recorder:** Produces printed attendance records in a form acceptable for use with optical scanning equipment. It is essentially a method of collecting time recording information in the same way as conventional time clocks while, at the same time and on the same document, it produces automated input to a computer system without any clerical processing.

STANDARD TELEPHONES AND CABLES PTY. LTD., Moorebank Avenue, Liverpool, N.S.W. 2170, announced that discussions took place recently concerning the $3-million contract awarded to the company for the supply and commissioning of Australia's first electronics trunk exchange. Those taking part included: Mr F. Pepermans, chairman and managing director of Bell Telephone and Manufacturing Co., Antwerp, Belgium; Mr J. L. Knott, director-general of the Australian Post Office; Sir Samuel Jones, chairman and managing director of STC and members of the Australian Post Office Board and engineering groups.

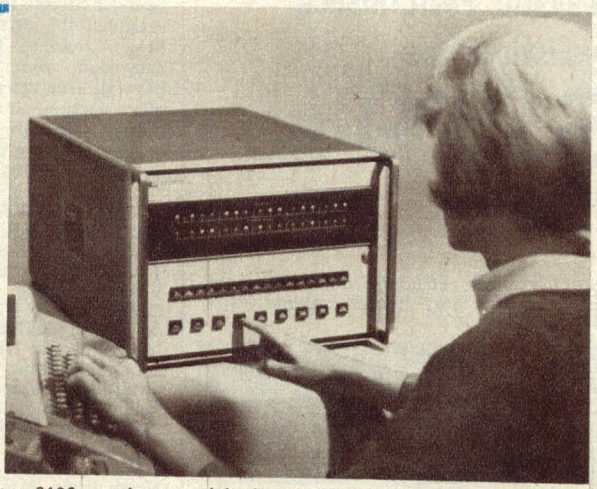
This will not only be the first electronic trunk exchange in Australia, but also be capable of growing to several times the capacity of current types of trunk exchange. It will cater for the long distance telephone needs of Sydney's users for many years to come, including the provision for the expansion of S.T.D. facilities to keep pace with the city's growth. The exchange will also provide facilities to route telephone traffic to and from the Overseas Telecommunication Commission's international circuits. It includes features which will be compatible with signalling over communication satellites, and provides for the possibility of subscriber dialling of overseas calls at some future time. It will cater for growth up to many thousands of trunk lines, and be capable of handling calls more rapidly than existing equipment to considerably reduce delays in trunk calls.

The new exchange, known as the I.T.T. 10C, has been developed by the International Telephone and Telegraph Corporation, of which STC is the Australian associate company. The exchange will be manufactured in Belgium by the Bell Telephone Manufacturing Co., but plans are well advanced for the manufacture of subsequent exchanges by STC. Other Australian manufacturers may be licensed when ordering levels justify this.

RACAL ELECTRONICS PTY. LTD., 47 Talavera Road, North Ryde, N.S.W. 2113, has announced the following appointments: Mr Brian E. Harris, formerly company secretary and chief accountant, as assistant general manager; Mr Richmond Jeremy, formerly technical manager (systems) as manager systems division.

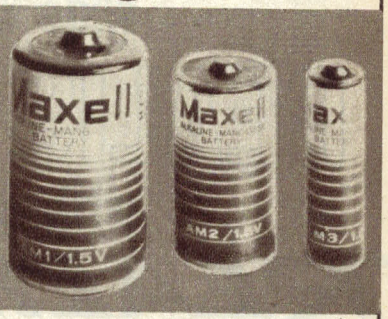
PYE PTY. LTD., 105-107 Reserve Road, Artarmon, N.S.W., 2064, has announced the completion of the company's new crystal production plant at Clayton, Vic. with radical production methods and increased manufacturing capacity. The company now offers improved delivery times on all crystal products, irrespective of quantity requirements. A 6-page illustrated brochure is available, and enquiries on prices and deliveries are invited. A complete technical advisory service is available on the application of crystal products in a wide variety of equipments.

HEWLETT-PACKARD MINICOMPUTER

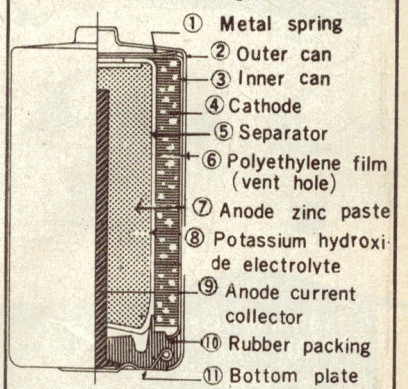


Pictured is a new "minicomputer" introduced by Hewlett-Packard recently. Called Model 2114B, it features a direct memory access option which provides a high-speed data channel, assignable under program control to any of the computer's seven input/output channels. An optional 56 - channel multiplexed I/O system is available. The computer has a memory capacity of 4096 16-bit words, expandable to 8192, and a memory cycle time of 2.0 microseconds. The computer is intended mainly for original equipment manufacturers, and data communication, instrumentation and educational systems.

up to ten times longer life



MAXELL Alkaline Dry Cell – this unique new design concept features high capacity and durability that surpasses the performance of the world's top dry cell batteries. The construction of the Maxell Alkaline Dry Cell differs greatly from conventional types of carbon ZINC cells. However, the Maxell Alkaline cells can be used where you normally use a carbon ZINC cell. MAXELL ALKALINE CELLS are especially suitable where there is a demand for increased current, combined with durability and little voltage drop. Even near the end of the cell life the discharge capacity is large and stabilized.



Exclusive new construction minimises leakage. Double cans are used and rubber sealing with the unique spring safety device. (see diagram)

Interior drying is prevented by hermetic sealing, therefore long storage periods are possible (over two years). Even then Maxell Alkaline cells are in the same condition as when they left the production line. These cells will withstand severe temperature changes. Rigid tests have shown extremely stabilized capacities from the low temperature of -4F to the high temperature of 150F at which temperatures dry cells would fail to operate satisfactorily.

Prices:
AM1 ..... 75c
AM2 ..... 50c
AM3 ..... 40c

Trade enquiries to
TASMANEX PTY. LTD.
376 Pittwater Road, Harbord 2096



Bring in the whole wide world



REALISTICALLY with the REALISTIC DX 150 Communications Receiver

SW/CW/SSB/AM



Transistorised. All solid state

4 Bands .535 to 30 MHC (includes Broadcast)

240V AC or 12V DC operation

This is the BIG performance set that obsoletes tube receivers . . . a professional-looking set that appeals to amateurs and short wave listeners alike. The DX 150 gives long-range, world-wide realistic reception on 4 bands, including Broadcast. Fully transistorised—all solid state—no warm-up delays; the DX 150 will run on dry cells if current fails or is not available; will operate from a car's cigarette lighter or any 12V DC service. A 240V AC power supply is also built in. Over 30 semi-conductors—product detector for SSB/CW, plus fast and slow AVC—variable pitch BFO—illuminated electrical bandspread, fully calibrated for amateur bands—cascade RF stage—ANL for RF and AF—zener stabilised—OTL audio—illuminated "S" meter—built-in monitor speaker plus front panel jack for external (optional) matching speaker.

Realistic Performance
Realistic Price
$229-50

Attractive silver extruded front panel, solid metal knobs, grey metal cabinet, size 14⅛" x 9¼" x 6½".

CONSULT YOUR LOCAL RADIO DEALER, OR

MAIL THIS COUPON *today*

Please forward free illustrated literature and specifications on Realistic

Name.....

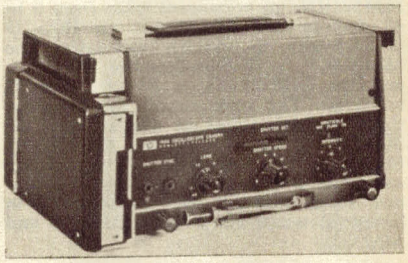
Address.....

Weston electronics PTY LTD. SYDNEY, AUSTRALIA

(A unit of Jacoby Mitchell Holdings Ltd.)

376 EASTERN VALLEY WAY, ROSEVILLE, 2069. Cables and Telegraphic Address: 'WESTELEC,' Sydney. Phone: 40 1212

HEWLETT-PACKARD AUSTRALIA PTY. LTD., 22-26 Weir Street, Glen Iris, Vic. 3146. **Oscilloscope Camera model 198A.** Can be focused with an external indicator that eliminates the need for through-the-lens sighting. It used a Polaroid back and standard flat-pack self-processing film. Shutter and lens controls are readily accessible on the outside of the camera housing. Shutter speeds range from 1/60 second to 1 second. Shutter operation closes a contact so that the camera can trigger the oscilloscope or other equipment the instant the shutter opens. The



shutter also has a B (bulb) mode. For time exposures, a simple turn-lock on the shutter release cable can hold the shutter open indefinitely. The camera uses a 75mm f3.5 lens with a 1:0.85 object-to-image ratio to allow a full 8cm x 10cm trace to be photographed. A battery powered lamp illuminates the CRT face to delineate the black graticule of no-parallax internal graticule tubes. Illumination from the bulb is directed by mirrors in two beams, each illuminating half the CRT face. The lamp and mirrors move with the lens to give uniform illumination only when the lens is focused properly. A dark or bright vertical line on the CRT shows the operator that the camera is unfocused. The camera can also be used for conventional photography whenever the object to be photographed can be placed in the camer's focus range —the lens has a focus travel of 15mm.

TECHNICAL & SCIENTIFIC EQUIPMENT PTY. LTD., 243 Collins Street, Melbourne, 3000 has been appointed agents for Perini and Scott (A'sia) Pty. Ltd. in Victoria and Tasmania. Perini and Scott is a Sydney-based manufacturer of laboratory, industrial and component-style DC regulated power supplies. Perini and Scott is represented in South Australia by Compar Distributors Pty. Ltd. and in Western Australia by W. J. Moncrieff Pty. Ltd.

RADIO PARTS PTY. LTD., 562 Spencer Street, Melbourne, Vic., 3000, has extended the existing building at Spencer Street, trebling the previous area. The showroom, dispatch and storage areas have all been extended. A new hi-fi section, office section, and a separate service and testing area have been included. Three decks, including the roof, allow space for more than 50 cars for customer parking.

VARIAN PTY. LTD., 38 Oxley Street, Crows Nest, N.S.W., 2065, has announced a new Varian affiliate, Communications Transistor Corp. (C.T.C.) located in Varian's Eimac division facility in San Carlos, Calif., U.S.A. C.T.C. will initially develop, manufacture and market silicon transistors for UHF/VHF and microwave communications systems. The company's ultra-modern clean room manufacturing facility was due for completion on February 1, 1970.

RCA LTD., 11 Khartoum Road, North Ryde, N.S.W., 2113, has established a magnetic products division, under manager Mr Richard Blackett, to market disc packs, and computer, video and instrumentation tapes.

New Releases From Warburton Franki

Brief specifications of new products from various international manufacturers, who are solely represented in Australia by Warburton Franki, have been supplied by that company.

ELESTA AG ELEKTRONIK, Switzerland. **Electronic Counters.** A range of counters featuring solid-state circuitry, luminous numerical display, compact size and high reliability. Included are bidirectional counters, digitisers for bidirectional counters, predetermining and measuring counters, digital control programmers, sensors and accessories for counters.

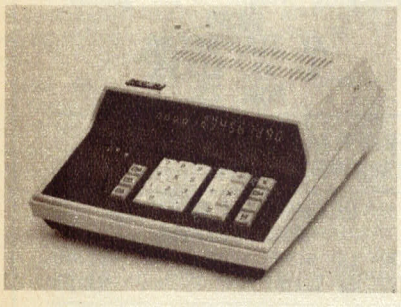
RIKADENKI KOGYO CO. LTD., Japan. **Desk Top Multi-Pen Recorder,** KA Series. Features: 4, 5 or 6 pen versions; Z-fold paper; 1/3 sec pen response; continuous attenuator; guarded input system; remote control of chart speed.

GLENN PACIFIC, U.S.A. **Voltage Regulators,** seriels LVR-20. High power automatic line voltage regulators. Features: ratings from 3KVA to 288KVA single phase and from 9KVA to 249KVA three phase; zero waveform distortion; output voltage adjustable plus or minus 2½ per cent: accuracy within 0.75 per cent from zero to full load and for 10 per cent input voltage fluctuation; convection air cooled; overload to 200 per cent of rated load for 20 minutes and to 150 per cent for 100 minutes. **Variable Transformers,** ratings from 10 to 2500KVA, any voltage to 2.4KV, frequencies from 10 to 450Hz, single or three phase.

MICRO ELECTRONICS LTD., Hong Kong. **Semiconductors.** A wide range is available including field effect transistors, differential amplifiers, dual transistors, silicon photo-darlington amplifiers (light detectors), and programmable unijunction transistors. A wide range of devices is manufactured in packages with overall dimensions of less than 1/10in.

GENERAL RADIO, U.S.A. **DC Recorder,** type 1522. Features: 2mV/in and 0.2-uA/in sensitivity; 65in/sec writing speed; 0.25 per cent linearity; 0.5 per cent accuracy; programmable writing functions. **Strobolume Electronic Stroboscope,** type 1540. Features: brilliant white light; 0 to 25,000 flashes/minute; wide beam-flood area for photographs.

NATIONAL CASH REGISTER CO. PTY. LTD., 14-16 York Street, Sydney, 2000. **Electronic Calculator model NCR 18-1.** Features: 14-digit display; half-size display of non-significant zeros; working registers and one memory; solid state construction for reliability and compactness; measures 10½in x 14in x 4½in; weight



only 8.8lb. Model NCR 18-3. A larger unit with 16-digit display and two memories. It includes an automatic square root feature that operates in a fraction of a second. Both calculators offer fully automatic addition, subtraction, multiplication, and division with automatic round-off under switch control.

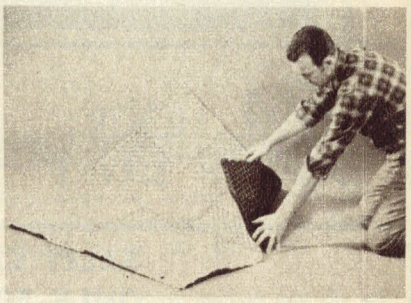
ZENITH ELECTRIC WORKS, England. **Automatic Voltage Regulators,** with ratings from 1.44KVA to 12.96KVA single phase and to 75KVA three phase, and featuring up to 70V/sec response and zero waveform distortion.

INTERNATIONAL RECTIFIER CORP., U.S.A. **Power Semiconductors,** including silicon controlled rectifiers with current ratings from 4.7-7.4A to 400-550A RMS, pressure-assembled SCRs with ratings from 180 to 740A RMS, Logic-Triacs (for AC and DC power control) from 50 to 200A, and power control assemblies.

WARBURTON FRANKI. Minifin Heat Sink. Measuring only 3-7/8 x 1¾in, this anodised heat sink has a perimeter measurement of about 46in. Thus, a 3in length provides 138sq. in of heat sink area within 2in of a semiconductor. Available in standard lengths of 2in, 3in, 4in and 6in; special lengths on request.

Inquiries should be addressed to Warburton Franki Industries Ltd., P.O. Box 35, South Melbourne, Vic. 3205, or branches in all eastern mainland States.

IRH COMPONENTS PTY. LTD., The Crescent, Kingsgrove, N.S.W. 2208. Agents for Emerson & Cuming Inc., U.S.A. **Eccosorb FBC.** An extremely lightweight surface resistive fabric formed into an array of pyramids for use as a drapable microwave absorber. The fabric can be sewn to form large blankets for easy handling when used to cover equipment such as



sensitive electronic equipment, antennae, radomes, etc. The blankets are rugged, drain and dry quickly, and can be rolled up for storage. The first of a series, it is useful above 2.4GHz, weighs 0.1lb/sq. ft. and has 1in x 1in x 1in pyramids which are black inside and yellow outside. Reflectivity is about 17dB down from that of a metal plate.

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THE BIG POWER IN TRANSISTORS



1400 V.
Ic 3 amps
Silicon



50 amps
Ic 80 V.
Germanium

Cut costs through the circuit simplification possible with Delco *conservatively rated* high power transistors. Ring Melbourne 792 0111; Sydney 212 1722; Adelaide 49 6166; Brisbane 47 3277; Perth 23 2768; for a catalogue listing performance characteristics of a wide range of Delco High Power Transistors. These include such items as 10 amp/500V. Silicon transistors. Many items are available from stock.

DELCO RADIO

Industrial & Domestic Equipment Company

Distributors: Anodeon Sales; N.S.W, VIC, S.A, Dresser — S.I.E, QLD.

33/DEL70

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Only **$5.50.**
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Interchangeability List.
Latest Edition, **$1.**
MINIWATT VALVE AND TRANSISTOR DATA BOOK
Latest (7th) Edition, **$3.05.**

COMPUTER BOARDS
Containing a variety of NPN and PNP germanium transistors and a host of other components, these 4in x 2½in boards are supplied with free technical information on all parts. Each board has a minimum of 4 transistors.

	PRICE POST
100 Boards	20c ea. 50c
25-99 Boards	25c ea. 25c
10-24 Boards	30c ea. 25c
1- 9 Boards	35c ea. 10c

BARGAINS

2N3054	$1.90
2N3055	$1.90
BC108	50c
BC109	60c
BF115	65c
AC125	80c
AC126	80c
AC127/128	$1.75
AC187/188	$1.85
AD161/162	$3.20
EM404	30c
BA100	35c
OA91	20c

PACK AND POST 10c ANY ORDER UNLESS INDICATED.

E.A. 10 PLUS 10 STEREO AMPLIFIER
Nov. 1968

Complete kit	$58.00
Built and Tested	$68.00
Freight	$1.00

Magnetic Pre-Amp Kitset
As in E.A., Oct., 1965.
All parts supplied.
Use for pick-up or tape heads.
Mono **$4.90.** Stereo **$9.00.**

INTEGRATED CIRCUITS
Plessey SL403A/Sinclair 1C-10
10w Peak.
5w R.M.S.
$10.50
Post 25c.

MODULAMPS . . . ea. **$4.00**
Small 1W transistor audio amplifiers by Pre-Pak.
Supply volts . . 6-12v DC.
Input sensitivity 1v P-P.
Freq. response 50Hz-20KHz.



G.T.S. CAPACITOR
Discharge Ignition
by Summit.
A MODEL TO SUIT EVERY MOTOR.
6 months' guarantee.

Deluxe	$39.95
Competition (higher output)	$48.00
Marine	$64.00

LOOK
for details next month about the new, bigger 1970 pre-pak Electronics catalogue.
Complete with pictures and diagrams.
Available March 1.
See March E.A. for details.

Hi-Fi TWIN-CONE SPEAKERS
8ohm or 15ohm.
6½in 30Hz-15KHz
6w R.M.S., **$11.20.**
8in 30Hz-15KHz
8w R.M.S., **$12.**
10in 30Hz-15KHz
10w R.M.S., **$12.40.**
12in 30Hz-15KHz
10w R.M.S., **$12.84.**

TWEETERS
3½in 5KHz-16KHz
12w R.M.S., **$3.30.**
3½in 5KHz-18KHz
15w R.M.S., **$4.10.**
Post 50c.

HIGH-POWER SPEAKERS
Suit guitar amps., etc.
12in Aust. 15w Twin Cone, **$20.00.**

12in Imported 40w	$30.00
12in Aust. 50w	$50.00
15in Aust. 30w	$50.00

Freight $1.00 ea.

STEREO HEADPHONES

SDH-7 25Hz-15KHz	$7.50
SDH-8 20Hz-17KHz	$9.50

MAGNETIC CARTRIDGES
At 66.
20Hz-20KHz ± 2db.
Tracking weight .5-2.5 grams.
$8.50.
At 215, **$11.50.**
At 33, **$13.95.**
Post 25c.

NEON MAINS TESTING SCREWDRIVERS . . . **$1.00**

SELENIUM BRIDGE RECTIFIERS

20v 1a KAI	$1.00
20v 2a LT91	$1.50

SUN-LITE DELUXE
2 STATION INTERCOM
Supplied with 100ft wire and 9 volt battery.
$11.25
Pack. and Post. 50c.

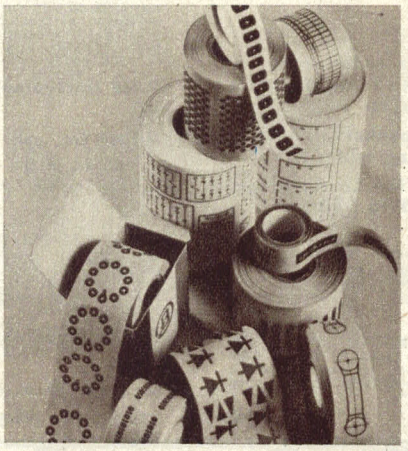
PHILIPS INDUSTRIES LTD., 69-79 Clarence Street, Sydney, 2000, has announced the following revised marketing arrangements. The joint range of professional broadcast equipment of Electronic Industries Ltd., Pye Ltd., and Philips Industries Ltd. is now sold through the newly formed broadcast engineering division of Associated Telecommunications of Australia Ltd. (A.T.A.), a company jointly owned by the three companies. The joint range of Philips and Pye Unicam electrochemistry equipment (consisting of laboratory and industrial pH meters and conductivity meters) is now marketed by Philips Electrical Pty. Ltd. The Pye pH meters were formerly marketed by Astronics Australasia Pty. Ltd., which will continue to be responsible for other Pye Unicam products.

STANDARD TELEPHONES AND CABLES PTY. LTD., 252 Botany Road, Alexandria, N.S.W. 2015, has established a maintenance and spare parts depot for servicing teleprinters and allied STC data equipment under clean, temperature-controlled conditions. The spare parts store is open to the trade for the sale of teletype and other spares, and so provides a back-up to the service station. In addition to covering work on STC hire equipment and computer time sharing terminals, service is available at the new depot to users of data equipment on contract or casual basis. The telephone number is 69-0444, extension 424 (service and maintenance) or 617 (spare part sales).

ROYSTON ELECTRONICS PTY. LTD., 22 Firth Street, Doncaster, Vic. 3108, has appointed Mr Robin V. Mackie as applications engineering and marketing manager of the newly formed microelectronics sales division. This division will market the semiconductor products of Hughes Aircraft Co., of California, U.S.A., in particular the Hughes range of bipolar and MOSFET integrated circuits. It will also be concerned with bonding and microwelding equipment, used in the manufacture of microelectronic devices. Mr Mackie, who is 30, is a graduate of the University of Sydney, with degrees in Electrical Engineering (with Honours) and Physics.

DISTRIBUTORS CORPORATION PTY. LTD., 24 Johnston Street, Fitzroy, Vic., 3065, has been appointed distributors for Singer Ballantine (AC measuring instruments) and Techni-rite Electronics Inc. (analog and event time recorders, and digital voltage measuring instruments).

CIRCUIT COMPONENTS (A'SIA) PTY. LTD., P.O. Box 70, Bexley, N.S.W. 2207. Agents for Bishop Graphics Inc., U.S.A. **Pressure Sensitive Artwork Patterns.** Frequently used symbols and patterns are pre-drawn to customer specifications and stocked ready for use, eliminating time-consuming repetitive drawing. Available transparent red and blue, and in opaque black, symbols are printed on rolls of

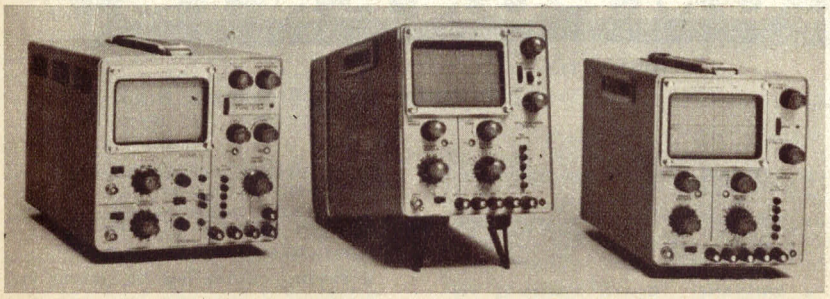


1.5 mil acetate film. A pressure sensitive adhesive backing makes positioning and application clean and effective. To order special patterns, a customer supplies a dimensional drawing or master artwork from which a line negative can be made. Bishop will prepare artwork at cost from customers' specifications. Symbols less than 4in x 4in are packaged 250 to a roll. Larger sizes are printed on matte acetate sheets.

PLESSEY ELECTRONICS PTY. LTD., formerly of 13-17 Botany Street, Redfern, is now located at Faraday Park, Railway Road, Meadowbank, N.S.W., 2114 (telephone 80-0111). This consolidates its activities on the same site as Plessey Telecommunications Pty. Ltd., to provide increased efficiency and service, together with ample customer parking. The company has modernised its equipment unit factory in Richmond, Vic., with improved layouts for the manufacturing area, the tape recorder head manufacturing and reconditioning section, and the drawing office. The research and development laboratory has also been provided with improved facilities for prototype design and manufacture.

TEKTRONIX AUSTRALIA PTY. LTD. 80 Waterloo Road, North Ryde, N.S.W. 2113. Agents for Telequipment Ltd., U.K. **Oscilloscopes, series 54.** This series includes the dual-trace model D54, and the single trace model S54A and S54U. The latter is capable of being operated from internal rechargeable NiCd batteries, from an external 11.5 to 30V DC source, or from the AC line. The S54A and the D54 operate only from an AC source. The series features solid-state design, including FET inputs.

The basic specifications of the three instruments are identical: vertical bandwidth from DC to 10MHz; deflection factors from 10mV/cm to 50V/cm in 12 steps; bandwidth is 10MHz at 10mV/cm sensitivity; sweep rates from 200nS/cm to 2S/cm in 22 steps; 6cm x 10cm display; versatile triggering including TV line and field. The D54 dual-trace oscilloscope has four operating modes: channel 1 only; channel 2 only; alternate; chopped.



Telequipment oscilloscopes models D54 (left), S54A (right) and S54U.

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THE METALWORK SPECIALIST

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SONICS

High performance speakers at moderate cost

It goes without saying that your radio, tape recorder and stereo system will give much better performance with separate speakers.

The Sonics range are all quality speakers in beautifully finished "furniture-look" enclosures.

The selection below is typical of the Sonics range. Others are available from $22.50 to $98.50.

Model AS-61 A true "Slim-line" enclosure with four bass/mid-range speakers and a high frequency tweeter. A truly remarkable multi-speaker system for such a low price.
Price (including Sales Tax) $39.50

Model AS-202 The system comprises a 3-speaker set: 8in high compliance woofer, 6½in mid-range speaker and a high frequency tweeter. Easily capable of handling 10 watts (R.M.S.), with 20 watts peak. Enclosure is of beautifully hand-finished teak or walnut. 20⅛in x 11⅝in x 11⅝in.
Price (including Sales Tax) $46.50

Model AS-220 This excellent system comes in teak/walnut enclosure with matching fret carved wooden grille (20⅛in x 11⅝in x 11⅝in). Features 8in bass woofer, 6½in mid-range speaker and a high frequency tweeter. Capacity: 10 watts (R.M.S.) with 20 watts peak.
Price (including Sales Tax) $56.50

Model AS-303 This famous system has capacity of, plus 15 watts (R.M.S.) with very wide frequency response. The 3-way crossover system comprises a 12in woofer (with long-throw voice coil) providing excellent bass resonance, a 6½in mid-range speaker, and an exponential horn type tweeter. Enclosure in teak/walnut measures 25in x 14¾in x 11in.
Price (including Sales Tax) $69.50

Write (or call in) for a copy of a review which appeared in the September, 1969, issue of the authoritative English "Audio Record Review."

Model AS-251 This system, with a frequency range of 40-20,000Hz, features a 3-way crossover network for smooth response. The top quality speakers comprise a 10in bass high compliance woofer, a 6½in mid-range speaker and an exponential horn type tweeter. The furniture finished enclosures measure 13in x 22½in x 11½in.
Price (including Sales Tax) $78.00

Mr Alex Encel is at present abroad looking at the very latest foreign equipment

ENCEL

ELECTRONICS (STEREO) PTY. LTD.

Head Office: 431 Bridge Rd., Richmond, Victoria. 3121. Tel. 42 3762.
Sydney Store: Ground Floor, 2SM Building. 257 Clarence Street, Sydney, N.S.W. 2000. Tel. 29 4563, 29 4564.
Australia's Greatest Hi-Fi Centre ■ Wholesalers ■ Trade-ins accepted ■ Terms



GOT PROBLEMS? COSTLY RECALLS?
DISSATISFIED CUSTOMERS? CUT PROFITS?
ENJOY COMPLETE CUSTOMER SATISFACTION
FROM FITTING GENUINE TELECOMPONENTS PARTS

TELECOMPONENTS

PTY. LTD.

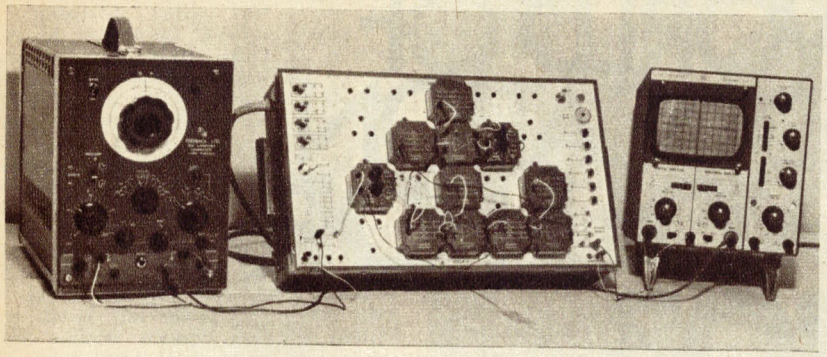
A Member of the Hawker Siddeley Group

752 Pittwater Road, Brookvale, N.S.W.

- **SYDNEY:** Standard Components Pty. Ltd., General Accessories Pty. Ltd., Lawrence and Hanson Electrical Pty. Ltd., Electronic Parts Pty. Ltd., George Brown and Co. Pty. Ltd., Mellor Bros., Universal Car Radios Pty. Ltd., Trade Teletuners Pty. Ltd.
- **NEWCASTLE:** Martin de Launay Pty. Ltd.
- **WOLLONGONG:** Martin de Launay Pty. Ltd.
- **GOSFORD:** Lawrence and Hanson Electrical Group.
- **MELBOURNE:** Television Replacements. Radio Parts Pty. Ltd., Douglas Radio Co., General Accessories Pty. Ltd., Warburton Franki Industries (Melb.) Pty. Ltd.
- **BRISBANE:** General Accessories Pty. Ltd., Telcon Australia Pty. Ltd.
- **TOWNSVILLE:** General Accessories Pty. Ltd.
- **ADELAIDE:** Telcon Australia Pty. Ltd., General Accessories Pty. Ltd.
- **MT. GAMBIER:** Stewart Day.
- **PERTH:** Carlyle and Co. (1959) Pty. Ltd.

No. 54

Analog and Digital Training Systems



An Analogikit set up for an experiment with a waveform generator and an oscilloscope.

Feedback Ltd., of the U.K., has introduced an analog teaching system, the Analogikit, to complement its digital logic trainer, the Logikit. The analog and digital elements are interchangeable and can be assembled side-by-side on the same mounting deck. For advanced work, they can be combined to simulate hybrid controls found in industry.

The analog units use IC techniques in the operational amplifiers, and occupy the same small space as multiple gates in the digital system. Simple interconnections with jumper leads enable a student to quickly construct a circuit. Power supplies are automatically connected when a unit is plugged into the mounting deck.

An introductory handbook covers the arithmetic of summing, scaling and integration, with simple illustrative experiments leading to the construction of differential equations with practical examples of simulated systems. The advanced book deals fully with the mathematical aspects for degree course students. Details are given of a number of hybrid constructions.

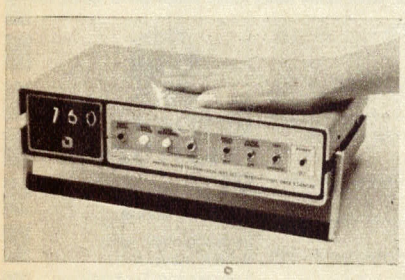
A complete analog teaching system costs $468, including the mounting deck with power supplies; five operational amplifiers; 13 ancillary summing, scaling and feedback elements; handbooks and connecting leads. For those already possessing a Logikit system, the analog plug-in units and extras cost $199.

Feedback Ltd. is represented in Australia by Ronald J. T. Payne Pty. Ltd., 385-387 Bridge Road, Richmond, Vic. 3121, to whom all inquiries should be addressed.

IRH INDUSTRIES LTD., The Crescent, Kingsgrove, N.S.W. 2208, has announced that its cable and wire division, Conqueror Cables Pty. Ltd., has been awarded a contract for telecommunications cable, worth more than $1 million, by the Australian Post Office. The polythene insulated cable will be used in underground networks linking exchanges and subscribers.

AURIEMA (A'SIA) PTY. LTD., 443 Kent Street, Sydney, 2000. Agents for International Data Sciences Inc., U.S.A. **Pseudo-Noise Transmission Test Set, model 1000.** For automatic testing of digital data transmission systems, modems, digital multiplexing systems, error control systems, and advanced communication systems. Designed for on-site testing, the test set enables an untrained operator to check out and evaluate a transmission system within one minute.

Each test set contains a transmitter and receiver with the capability of operating with simplex, half-duplex or full duplex systems. The transmitter generates a repeating 2047-bit pseudo-random sequence representing the most noise-like pattern possible. The receiver synchronises itself



with incoming data, and tests each bit for error by comparing the received sequence with a locally generated sequence. An error counter is actuated each time an error is detected, and the error count displayed on a front panel display.

HAWKER SIDDELEY ELECTRONICS LTD., 752 Pittwater Road, Brookvale, N.S.W. 2100, has appointed Mr Harry W. Jones as finance manager. He will continue as secretary of the company and its subsidiaries—Ferris Bros. Pty. Ltd. and Allied Capacitors Pty. Ltd.

WARBURTON FRANKI LTD., 372 Eastern Valley Way, Chatswood, N.S.W 2067, has been appointed sole Australian representative for N.F. Circuit Design Block Co. Ltd., a Japanese company specialising in negative feedback techniques as applied to electronic instruments. The company manufactures precision electronic equipment including autoranging voltmeters, function generators, and synclators.

FAIRCHILD AUSTRALIA PTY. LTD., 420 Mount Dandenong Road, Croydon, Vic. 3136, has announced the following appointments: Mr Tony Furse, formerly project engineer, as project manager, responsible for the design and construction of computer systems, specialising in the application of small computers; Mr Rollie Cearns, formerly with the Weapons Research Establishment, as project engineer involved in the computer hardware program; Mr Bernie O'Shannassy formerly senior applications engineer, as product marketing manager.

INFORMATION ELECTRONICS LTD., Mort Street, Braddon, A.C.T. 2601, has commenced production of high-quality multi-layer and plated-through printed circuit boards using the Dupont Riston Photopolymer Resist System. This system comprises three parts—the Riston photopolymer resist film; laminating equipment; and developing solvent and processer. It was developed by the Dupont Chemical Co. to meet demands for more advanced and more closely packed circuit patterns. It is said to be the best method of reducing yield losses, which contribute to the high cost of quality circuit boards, particularly multi-layer units.

ELECTRONIC DESPATCH

P.O. BOX 149, AUBURN 2144

9 - 1 DAILY AND SAT.

16 SHERIDEN ST., GRANVILLE.

MAIL ORDERS WELCOME

Please Add Postage

RESISTORS from 1 ohm to 10 ohms now in stock, ¼W at **8c**, ½W at **6c**. 1W 1-10 ohm **8c**.

TRANSISTORS

The following are always in stock:

BC 107	70c	OCP 71	$3.50
BC 108	60c	AC 127	95c
BC 109	75c	AC 128	85c
BC 148	55c	AC 127/128	$1.80
BC 178 SI PNP	65c	BF 179	$1.50
		200 V Video amp	
		BF 115	70c
Comp. to 108		FET 2N 549 (MPF 105)	$1.20
AD 161/162	$3.60		
AD 161	$1.80	UJT D13T1	$1.20
AD 162	$1.80	2N 3055	$2.50
SCR BTY 79/400R		10A 400 V	$3.75
OA 91	27c	BA 100	35c

BRIDGE S1 RECTIFIER

MB 1 . . $1.60 100V PIV . $1.80

SPECIAL

2N 526 (2G 526) GE PNP
225 MW F 6.5 MHz BV cbo 45V
BV ceo 30V BV ebo 15V 1c 500 MA
40c each

SPECIAL ELECTROS

80 MFD 4V 15c
4 MFD 100V 10c

CO AXIAL FANS

Ex computers PABST outer Rotor motors 240V $5.00
Large range of silver mica capacitors in stock 20 per cent to 1 10c 10 per cent and better 15c. **Please ask for full list.**
For personal shoppers large range of computer parts in stock. Power Supplies, transformers, edge connectors, contactors, tape decks, memory cores and various other parts.

COMPUTER BOARDS

10c per transistor.
2½c per diode
Data sheet for most transistors and diodes supplied.
Reed relays
Hamlin DRG2 1A 250V DC . . 80c

SPECIAL TRANSFORMERS

190-220-235V input.
Isolated output 110V 10A, 220 V 5A and 24-26V at 5A, $25. Free on rail.

TORRINGTON BLOWERS

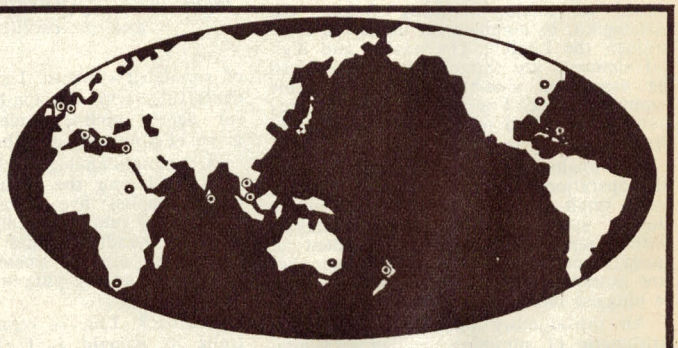
Twin blower 200 cfm each side
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Solid-state servicing . . . "most useful"

SERVICING THE SOLID-STATE CHASSIS. By Homer L. Davidson. Published by TAB Books, Blue Ridge Summit, PA. 17214, U.S.A. Stiff paper covers, 256 pages, 8½ x 5½ inches, freely illustrated by diagrams and photographs. Australian price $6.15 or $9.95 for the hard cover edition.

If there is a shortage in Australia of good television repair technicians, there is a far greater shortage of technicians who can tackle solid-state equipment with any degree of confidence. Yet solid-state circuitry is universal in portable receivers, is coming on strongly in audio equipment and beginning to make its presence felt in TV receivers.

This book is likely to contribute as much as any book can to an appreciation of the special problems involved in servicing solid-state equipment. It is written by an author who claims 23 years in practical servicing situations and who maintains, quite rightly, that servicemen either have to "stay with it" or go into the discard. What he has to say is for servicemen and expressed in terms which servicemen will understand and appreciate.

After an initial chapter on the problems of identifying and replacing faulty transistors, as distinct from faulty valves, the author takes a long, section-by-section look at television receivers, making comparison and contrast with the more familiar valve practice.

Succeeding chapters, in turn, deal with small, portable transistor receivers; with AC and DC, AM-FM and multi-band receivers; chapter 7 deals with the problems of auto radios, their installation, removal and repair. Appropriately enough, the next chapter takes a look at tape players of the type used in cars.

The book is rounded off with chapters on simple domestic stereo players and amplifiers, hi-fi systems and domestic style tape recorders. The final chapter deals with the problems of printed circuit boards, how to spot and repair troubles, replace faulty components and so on.

Profusely illustrated by diagrams and photographs, it appeals as being a most useful text to expand and up-date the knowledge of practising servicemen. A first edition, printed only in April last, the book itself is up to date. Our copy came from Grenville Publishing Co. Pty. Ltd., 401 Pitt Street, Sydney. 2000. (W.N.W.)

Reading skills

EFFICIENT READING. Jonathon Anderson, Berry H. Durston and Millicent E. Poole (all University of New England). Published by McGraw-Hill Book Company, Sydney. Paper covers, 9in x 6in, 147 pages. Price $1.50.

If early civilisation was based on the wheel, our latter-day society owes its development to the printed word. In view of this, it is surprising that such a basic skill is almost entirely neglected in formal teaching establishments, once a child has been taught the rudiments of the business. As soon as a child can recognise words, and can piece them together into sentences, he is on his own, and it is largely a matter of chance whether he ever becomes a fast, skilful and efficient reader.

It is only fairly recently that any sustained attempt has been made to improve basic reading skills and it has largely been confined to an extra-curricular activity, by specialised teaching establishments who charge high fees. The aim of this book is to give those who wish to improve their reading the necessary information on which they can base a self-organised course. In view of its modest size, it can do no more than point the way, but this it does very well, explaining the mechanics of eye movement associated with reading activity, and showing how this knowledge can be applied to acquire the various types of reading skills.

The use of the plural "skills" in the previous sentence should be noted, since the authors point out that there are different reading methods, each suited to a particular requirement. These are defined as (1) pre-reading, to obtain a general outline of the subject matter, (2) skimming, to pick out wanted facts from the mass of information presented, (3) key-reading, used to locate key ideas, and (4) reading for recall, when a subject matter has to be learned, for example, for examination purposes. It is pointed out that "efficient reading" is not necessarily fast reading; in fact, it is recommended that the type of reading under (4) be undertaken fairly slowly. The main idea is to utilise the time available for reading in the most efficient manner possible to extract the maximum of benefit in the shortest possible time.

The subject matter, after the preliminary discussion, is arranged to teach the reader the rudiments of each method, so that he can from then on practice the methods outlined until the best possible degree of efficiency is obtained. An outline of the method is followed by simple exercises. Since these are few in number, and by the nature of the tests can be used only once, the reader will have to find examples in ordinary reading material for further practice.

Having dealt with the main subject matter, the authors branch out into the related subjects of vocabulary, where they propose methods for the reader to increase his "word power"; difficulties experienced in reading by some people, and suggestions for overcoming them; "Readability," concerning the ease with which some prose can be read, because of its clarity of style, compared with the awkward, often prolix, style affected by some authors; "Reading for Comprehension," which explains the best way to ensure that the reader understands what he is reading; and "Reading in Specific Content Areas," in which some hints are given as to the best ways to approach the different subjects likely to be encountered in formal education. A self-evaluation test is given at the back of the book, and some suggestion for further subject matter which could be used as a source of additional exercises.

The reviewer found this book very easy to read, with the subject matter clearly explained in concise and simple terminology. One is left with the feeling that it could have been much more comprehensive, and that a larger amount of space devoted to further exercises would have been an advantage. However, as a first attempt at filling what is virtually a vacuum, it is a most welcome book. This reviewer expects with confidence that a revised and enlarged edition will make its appearance within a few years.

Our review copy came direct from the publishers, and copies should be available from comprehensive booksellers by the time this review appears. (H.A.T.)

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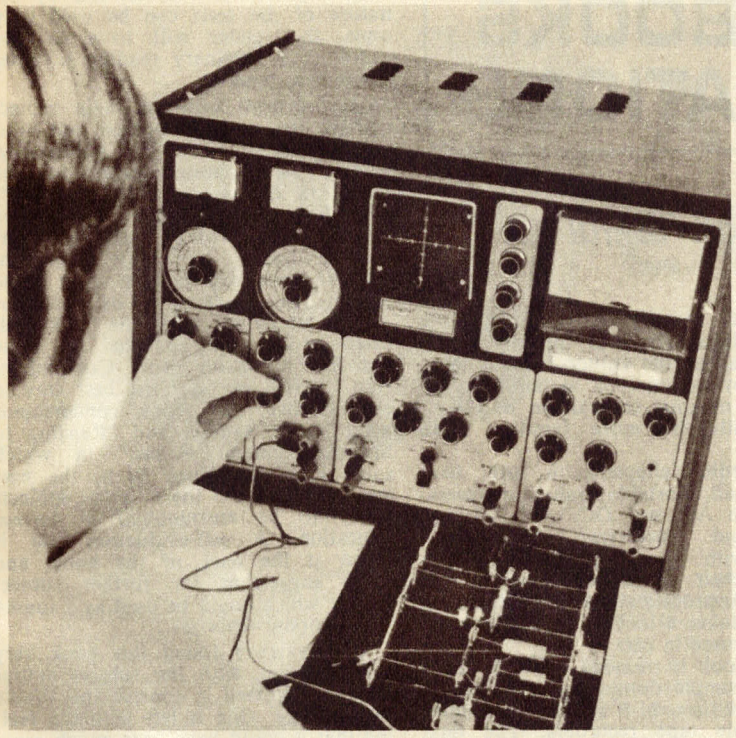
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Computers

COMPUTERS AT WORK. By John O. E. Clark, B.Sc., A.R.I.C., Hamlyn all-colour paperback, published by Sun Books, Melbourne. Stiff paper cover, 160 pages, 7 x 4¼ inches. Price in Australia and New Zealand 99c.

If you want to know how a computer works, this is not the book for you. You will need something far larger and more expensive than a 99c paperback, and you will need an appropriately larger measure of time and concentration.

To most people, the circuitry and the processes that go on behind the grey panels are a mystery and a further recitation of all the things computers can do will most likely only increase the mystification.

Whether or no, John Clark's book simply sets out to acquaint the lay reader with the roles and the tasks that are currently being performed by modern computers. He explains what needs to be done and then, by means of diagrams and text written at "popular science" level, shows how the computer correlates the input data to produce the desired end result.

Subjects covered include aircraft and navigation; money; traffic control; power stations; printing; travel bookings; weather data processing; medical automation; computer design; information retrieval; industrial; crime; freight handling.

To people who are regular readers of this and similar journals, it will not be news that computers are being used in these and other fields and the information will be found to be along parallel lines to magazine articles. But if you are relatively new to the electronic field, or would like a resume of what is going on, this book should meet your need. Our copy came from the publisher but the book should be available through most comprehensive bookshops. (W.N.W.)

Railways

TRAINS, by John R. Day. A Paul Hamlyn book, published by Sun Books Pty. Ltd., 346 St. Kilda Road, Melbourne, 3004. Paper covers, 7in x 4¼in, 160 pages, profusely illustrated with colour illustrations and diagrams. Price in Australia and New Zealand, 99c.

Readers of these columns will already be aware of the main characteristics of the Paul Hamlyn series of paperbacks, of which the present volume forms a part. These are, mainly, a fairly superficial treatment of the subject to provide a broad outline rather than a detailed study; and a multiplicity of illustrations in full colour.

This style of treatment lends itself admirably to a book on railways (which, incidentally, this book is concerned with, so that the title is not 100 per cent accurate). Even looking through at the illustrations alone, and disregarding the text, one can learn quite a lot — for example, the use of horse-drawn trains, some with treadmill type drives, was widespread before the development of the steam locomotive; the development of rolling stock from the style of the horse carriage to the streamlined monsters in use today; the shape of things to come in the form of air cushion trains and magnetically suspended types. The attractive coloured illustrations and diagrams present these facets of the subjects very well, and a skim through the book makes a very good impression.

Electronics and electricity is only incidental to the subject but we'd be very surprised indeed if the average electronic engineer did not find a great deal in the book to interest him.

The text, although, as previously mentioned, is fairly superficial, is nevertheless wide in scope, beginning with the first known form of rail transportation (used by the Greeks for moving ships across the Isthmus of Corinth 2,500 years ago) and progressing through the gradual development of the world's rail systems until the present day. The author has also found space to add some fascinating snippets of information which the average reader might not know about — for example, the true pioneer of the steam locomotive was not George Stephenson, as generally supposed, but one Richard Trevithick, who pioneered the use of high-pressure steam, the turning of the exhaust steam into the chimney to improve the draught in the fire-box, and the return flue boiler. Notes on dates of principal developments, the beginnings of the rail system of the major countries, and the route miles at various times are also given.

The historical survey is followed by a summary of railway practice in use today, with information on the permament way techniques now employed, and signalling systems. The latter half of the book is concerned with future developments, mainly based on experimental systems which already exist. The book succeeds in its limited aims very well. It is well written, with an air of authority (the author's family has been concerned with railways for over 100 years); it is beautifully illustrated and production is first class. Our review copy came direct from the publisher, but stocks are held by booksellers. (H.A.T.)

Amateur Tests

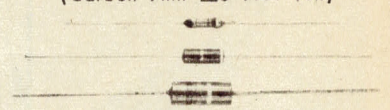
AMATEUR TESTS and MEASUREMENTS, by Louis M. Dezettel, W5REZ. Published by Editors and Engineers Ltd., New Augusta, Indiana. U.S.A. Paper covers, 206 pages, 8½in x 5½in. Photographs, drawings, tables and formulas. Australian price approximately $6.85.

Last December, I reviewed a book dealing with antennas for amateurs and at the risk of repeating myself, the publishers, Editors and Engineers, always seem to present only material of the highest order. This new book dealing with many aspects of tests and measurements more or less specifically for amateurs, is no exception. The author, although not well known in this country, is obviously well known in the United States and enjoys a good reputation as a writer in the field of electronics.

Although it is possible to turn up the pages on test equipment in a number of excellent amateur text books, the subject is never fully

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200mf	29c	23c	100mf	19c	15c
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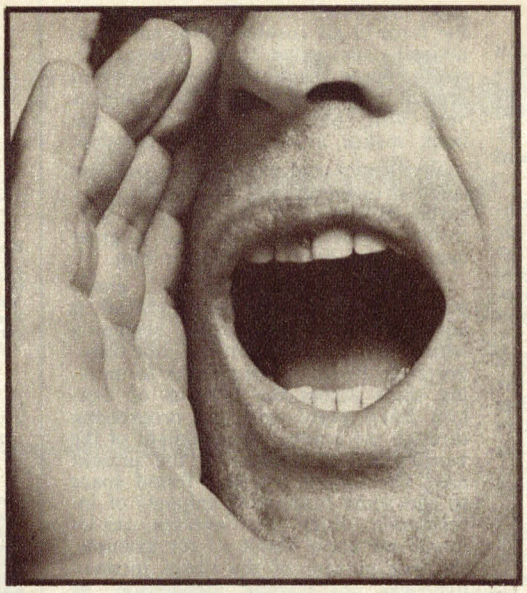
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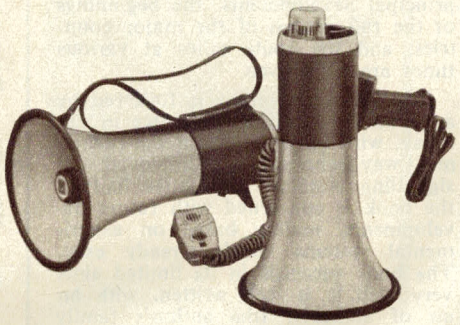
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covered and quite often it is necessary to conduct a search for information on the type of test or measurement one wishes to make. Even after a short perusal of this book, the impression is soon gained that here is practically all the information likely to be needed in this field, between two covers.

As the table of contents is rather extensive, it would occupy too much space to attempt to enumerate all the items listed. To give some idea however, here is a list of the seven chapter headings.

Chapter 1. — DC Measurements; Chapter 2—AC Measurements: Chapter 3 — Tube and Transistor Testing; Chapter 4 — Receiver Measurements; Chapter 5— Transmitter measurements; Chapter 6 — Antennas and Feeders; Chapter 7 — Instruments Every Amateur Should Have. At the end of the book, there is also a useful index to the subject material.

As the above list is very brief, here is a detailed list of subheadings for Chapter 4. Measuring Instruments —Measuring Sensitivity — Sensitivity Hookup — Stage-by-Stage Gain — Measuring Selectivity — The Selectivity Hookup — The Sweep Generator for Selectivity — Reading The Scope — The Sweep Hookup — Adding Markers — Measuring Image Response —Noise Figure — Input Impedance — Receiver Alignment AM and CW Receivers — SSB Receivers — Sweep Generator — BFO Adjustment—SSB Carrier Insertion Adjustment — Receiver Calibration — Front-End Alignment — Using The Noise Generator — High-Priced Receivers.

The above detailed list is a representative one and it gives a good idea of the amount of information which is given on any one main subject.

Apart from the fact that the author gives much information on testing, etc., there are many items which are so detailed as to enlighten the reader who may have been wondering for years, just how or why a certain method of testing is in common use. This may relate to the use of a "dummy antenna" in receiver measurements, or the need for specialised radials for a vertical antenna. Many other instances could be quoted. The uses to which the familiar GDO may be put to advantage are many, while testing of solid state devices is dealt with at some length.

As the title suggests, this book is intended primarily for amateurs. While this is so, there is a lot of material on testing and measuring procedures which could be of interest to many others including professionals, who happen to have parallel needs and interests.

The book is well written and easy to understand, although it would hardly be something for the beginner. In summing up, I feel that any self-respecting amateur would like to own a copy and I suggest that you take steps to obtain one when you are near your technical bookshop.

The copy of this book for review came direct from Howard Sams in the United States. However, by the time this review appears in print, this book should be available from all large technical booksellers in Australia. (I.L.P.)

LITERATURE—in brief

EMERSON & CUMING INC., U.S.A., has published three technical bulletins describing the company's general purpose casting resins, Stycast 2651 series. These resins are Stycast 2651 (Bulletin 7-2-10), 2651MM (7-2-10A) and 2651-40 (7-2-10B) The series consists of low viscosity, epoxy resins with excellent adhesion to metals, plastics, and ceramics. They are normally black, but can be colour-coded to specifications. Injuries to IRH Components Pty. Ltd., The Crescent, Kingsgrove, N.S.W. 2208.

CODASYL COBOL — JOURNAL OF DEVELOPMENT 1968, NBS Handbook 106, 344 pages price $2.75 (U.S.) plus 25 per cent postage. Published by the National Bureau of Standards (U.S.A.) Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. A report on the work being done to develop COBOL (a COmmon Business Oriented Language) by CODASYL (the COnference on DAta SYstems Languages) since 1959. The purpose of such a language is to permit the development and maintenance of computer programs with a minimum of time and programming effort, thereby solving a major problem in the use of electronic data-procsesing equipment.

The handbook has been prepared by CODASYL's Programming Language Committee to inform the COBOL community about developments to July, 1968. Contents are divided into three sections. Section 1 presents a brief history of the CODASYL organisation and of the development of COBOL since its beginning in 1959. Section II outlines the philosophy of COBOL use, including the major objectives of COBOL's designers, guidelines to its use, and background discussion of language features whose data-processing concepts are not always evident. Section III, which makes up the bulk of the work, is a complete formal, semantic description of the COBOL language specification. It is intended to provide a thorough description of the language unencumbered by discussion of the philosophical issues relating to design criteria.

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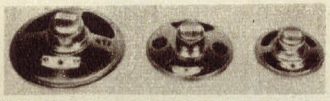
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HIGH STABILITY RESISTORS

	EACH	100
RJ ¼ WATT	8c	5c
RK ½ WATT	8c	5c
RL 1 WATT	10c	7c

MINIATURE SPEAKERS



Size	Voice Coil	Power	Price
2"	8 oHm	100 mW	2.00
2½"	8 oHm	200 mW	2.00
2½"	8 oHm	300 mW	2.50
2¾"	8 oHm	300 mW	2.50
3"	8 oHm	500 mW	3.00
3½"	8 oHm	500 mW	3.25
4"	8 oHm	800 mW	3.50

MULTITESTERS

DE-200H $11.50
DE-MVA-4 ..... $16.50
DE-MVA100 ..... $39.50
DE-CT-500 ..... $14.95

PLUGS AND SOCKETS

2 PIN DIN SOCKET 25c
2 PIN DIN PLUG 35c
3 PIN DIN SOCKET 25c
3 PIN DIN PLUG 35c
5 PIN DIN SOCKET 30c
5 PIN DIN PLUG 40c
2.5mm PLUG AND JACK 40c
3.5mm PLUG AND JACK 40c
PHONE SOCKET 30c
PHONE PLUG 50c
BANANA SOCKET 15c
BANANA PLUG 15c

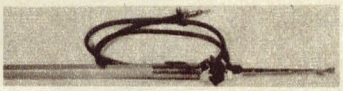
MINIATURE VOLUME CONTROLS

16mm STANDARD 35c
12mm MINIATURE 40c
16mm NATIONAL 40c

IF TRANSFORMERS

1st IF 10mm or 7mm $1
2nd IF 10mm or 7mm $1
3rd IF 10mm or 7mm $1

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4 SECTION LOCKDOWN, 2' 6" $4.95
5 SECTION LOCKDOWN, 3' 4" $5.25
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24-DRAWER 12½" x 10½" x 6" $9.50
(Postage 50c, 75c, $1)

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SGLE. TIER C DRAWER $2.50
SINGLE TIER D DRAWER $2.50

CASSETTE TAPES

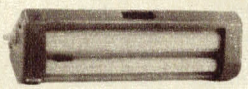


C—60 (2 x 30 mins) $1.75
C—90 (2 x 45 mins) $2.75
C—120 (2 x 60 mins) $3.00

AC POWER ADAPTORS

6 or 9V DC 100MA $8.90
6 or 9V DC 300MA $12.50
(Post 60c ea.)

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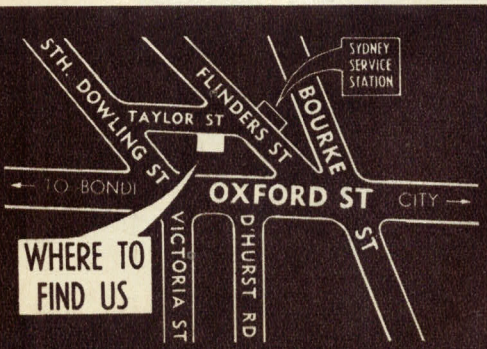


Battery Operated Fluorescent Light.

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12 volt .6A 6 watt .. $16.50 $1 Ea.
12 volt 1 A 8 watt .. $16.80
12 volt 1.25A 13 watt $18.00

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REFER TO THE NOVEMBER, 1969, ISSUE PAGES 101-108 (incl.)

MINIWATT DIGEST, Vol. 7, No. 11, July-Sept., 1969. Published by the Miniwatt Electronics Division of Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. 2064. Contents: Miniwatt Norbit decade counter with preset control and numerical indicator tube readout; The Norbit timer unit TU60 featuring extended time delay; The "Wired-OR" capability of the FC family of integrated circuits; The Triac — modern controller of electrical power.

APOLLO 11: PRELIMINARY SCIENCE REPORT, NASA SP-214. Published by the National Aeronautics and Space Administration (NASA), U.S.A. Available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151, U.S.A. Price $3 (U.S.) plus 25 per cent post and packing. This summary of the scientific findings of the first manned lunar landing last July is a 203-page account with 237 illustrations providing preliminary gross analysis of the samples returned along with measurements and photographs obtained on the mission.

The flight is reviewed in a series of photographs followed by the observations of the astronauts. In separate chapters, principal investigators in the scientific program describe the geologic setting of the lunar material brought back, the soil mechanics investigation, the passive seismic experiment, the laser ranging retro-reflector, and the experiment to determine the composition of the solar wind. According to a summary chapter, "The most interesting and unexpected surface features discovered and photographed by the astronauts are glassy patches on the lunar surface that are described by the astronauts as resembling drops of solder." Professor T. Gold, of Cornell University, discusses the various suggested explanations of these blobs in a chapter on the close-up stereoscopic photography.

GENERAL ACCESSORIES LTD., 443 Concord Road, Rhodes, N.S.W. 2138, has published a 16-page illustrated catalogue of some of the items in the company's range of products. A price list covering these items will be available shortly. The products include: turntables, amplifiers, loudspeakers, record players, tape recorders, audio components, microphones, radios, meters and test equipment, and various domestic products. Manufacturers and trade names represented include: Pioneer, Peak, Palace, Hitachi, Piezo, and Foster. Inquiries to branches or agents throughout Australia.

TELECOMMUNICATION JOURNAL, Vol. 36, No. 12, December 1969. Published by the International Telecommunication Union (I.T.U.), Place des Nations, 1211 Geneve 20, Switzerland. This 200-page issue is devoted to computers in telecommunications. Government telecommunication administrators and operating companies in 17 I.T.U. member countries have contributed the 30 articles which cover: the computer as part of a telecommunications network; the use of computers for administrative purposes; the use of computers for technical matters; supplementary information. A key to the subjects dealt with in the articles is included in tabular form.

In addition to the computer articles, this issue contains: a report of a meeting of C.C.I.T.T. Special Autonomous Working Party No. 5, which studies economic conditions and telecommunication development; a report of the C.C.I.T.T. Working Party on the revision of the Telegraph Regulations; a description of the I.T.U.'s pavilion at the Valais Fair held in Martigny, Switzerland; new accessions to the I.T.U. cinema library; news of telecommunications developments throughout the world; table of telecommunication satellites in orbit at 31 August, 1969; and official announcements of the I.T.U.

MI CONTACT, issue 13. Published by Marconi Instruments Ltd., U.K. Inquiries to Amalgamated Wireless (A'sia) Ltd., P.O. Box 96, North Ryde, N.S.W. 2113. Contents: Major new developments in power measurement; Accurate AF power meter has built-in voltmeter; M.I. extends range of television transmission test gear; Major order for M.I. television test gear; Planning the next moves; Making sense of servicing; £20,000 contract for repair and calibration; Microwave sweep oscillator with 2ppm stability; Paris Components Show.

SOME APPLICATIONS OF THE JOSEPHSON EFFECT, by R. A. Kamper, L. O. Mullen, and D. B. Sullivan, National Bureau of Standards (U.S.A.) Technical Note 381, issued October 1969, 63 pages, price 65c (U.S.) plus one-fourth postage. Order from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. The authors have developed a permanent, rugged tunnel junction between thin films of niobium and lead, with electrical characteristics that show great promise for instruments based on the Josephson effect. The technique for making these junctions, which can survive thermal cycling and storage at ambient temperature and exposure to the atmosphere for many months without measurable deterioration, is described in detail.

The note describes the probable mechanisms of the process and the performance of the junctions. Also included are an investigation of the theoretical limitations of noise thermometry using the Josephson effect and the construction of a practical noise thermometry system for use in the milliKelvin range.

NEW DEVELOPMENTS, Issue BO46, December, 1969. Published by Jacoby, Mitchell and Co. Pty. Ltd., 469-475 Kent Street, Sydney, 2000. Contents: Kienzle digital printer; Alfred sweep/signal generator, Wiltron programmable attenuator; CIL pre-setting electromagnetic counters and elapsed time meters; Telonic plug-in variable frequency marker and miniature rotary attenuator; Weinschel square wave oscillator and noise suppressors; Dana ratiometer/voltmeter; Sefram oscillographic pen recorders; TRW microwave transistors; Hansen multimeter; Jayem multitester; Siliconix field effect transistors.

VARIAN SPECTRUM, Vol. 2, No. 6, December 1969. Published by Varian Pty. Ltd., 38 Oxley Street, Crow's Nest, N.S.W. 2065. Contents: Computerised NMR spectroscopy; Aerograph 1440 series gas chromatographs; Aerograph LCS-1000 ion exchange liquid chromatograph; Prince Philip prize for Australian designs to Techtron model AA-5.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD., Private Mail Bag, Ermington, N.S.W. 2115, has a number of RCA product guides available free on application under company letterhead. **Product Guide Linear Digital ICs,** 40 pages, contents include: Linear types — quick selection chart, differential amplifiers, high-gain wide-band amplifiers, subsystems, operational amplifiers, arrays, power-control circuits; Digital types — COS/MOS, ECCSL, decoder-driver, low-power DTL, medium-power DTL; Linear and digital—high-reliability integrated circuits, dimensional outlines, socket information, technical bulletins and applications notes. **Industrial Receiving-Type Tubes,** 24 pages, contents include: introduction, application guide, types for mobile and fixed-station communications, types for other industrial applications, terminal diagrams, socket and connector information, industrial receiving types vs prototypes, interchangeability list. **RF Power Transistors for HF-VHF-UHF Applications,** a 6-page short-form catalogue of the RCA range of "overlay" transistors for RF power applications.

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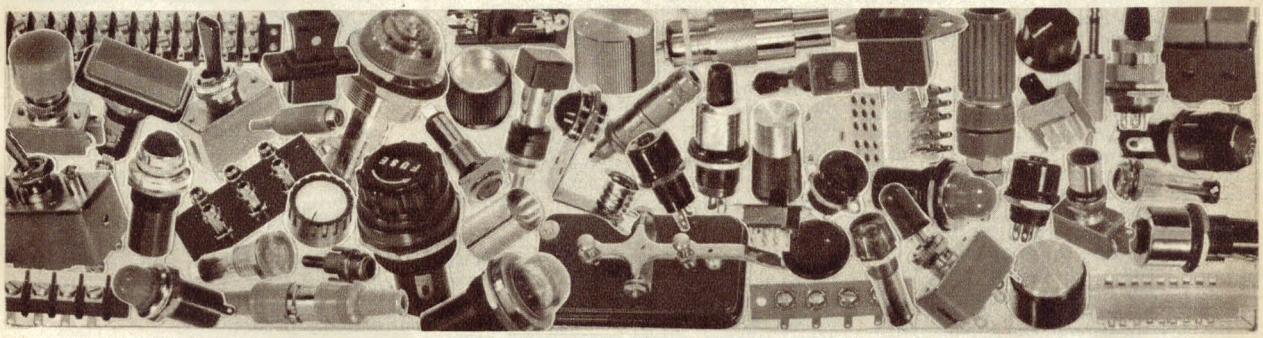


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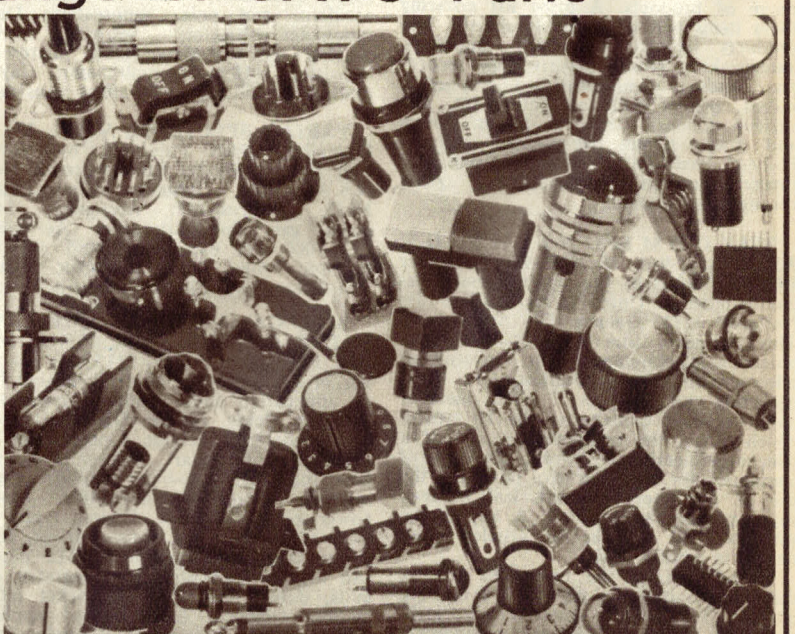
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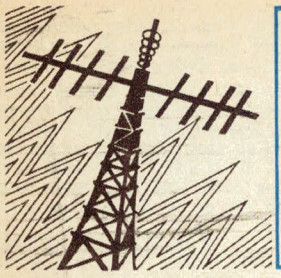
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BOTH STORES OPEN SATURDAY MORNING



AMATEUR BAND NEWS AND NOTES

New Australian Record on 1296MHz

On Sunday, December 7, 1969, two portable amateur stations held a 2-way contact on 1296MHz over a 149-mile path. Dick Norman VK2BDN (ex-VK2ZCF) and Bill Cox VK2ZAC established what is believed to be an Australian record for this band between Mount Ginini in the A.C.T. and Mount Canobolas near Orange.

by Pierce Healy, VK2APQ

VK2ZAC on Mount Ginini reported at the start of their 30 minute contact at 0900 that the skies were overcast, a 15-knot westerly wind was blowing and the temperature was 35 deg. F.

Initial contact was made at 0830 on the 144MHz liaison frequency with fade-free R5/S9 signals; the subsequent 1296MHz signals were at an equivalent level also without fade. Mode for the 1296MHz transmissions was NBFM and it is especially worth noting that the equipment at each station was 99 p.c. "home brew."

ANTENNA DETAILS

VK2ZAC/P and VK2BDN/P both used parabolic dishes of similar light timber-ribbed construction, having a diameter of 50", a focal length of 48" and with ¼" wire mesh as reflector. In each case the dish was fed from a 4-turn left-hand helix giving an overall gain estimated at greater than 20dB for each antenna system. The weight of these antennae is only about four pounds each.

It had been determined that the best position for the feed was with the 6in diameter reflector disc one to two inches beyond the optical focal point of the parabola. This is fairly standard practice and some textbooks have noted that such spacing also applies when using a two element Yagi and similar feed antennae.

At the Mt. Canobolas end VK2BDN's 50-ohm co-ax feeder was matched to the helix by means of a ¼-wave co-axial transformer, while at Mt. Ginini VK2ZAC's was matched via a ¼-wave shunt stub of adjustable length. In this case the 50-ohm co-ax feeder and the helix are both tapped onto the stub and a match obtained by the length adjustment.

The VK2ZAC version of the array is divided into four quadrants for car-boot transport and on-site assembly. VK2BDN has left his dish in one piece and with feed antenna removed, it travels flat on the car roof-rack.

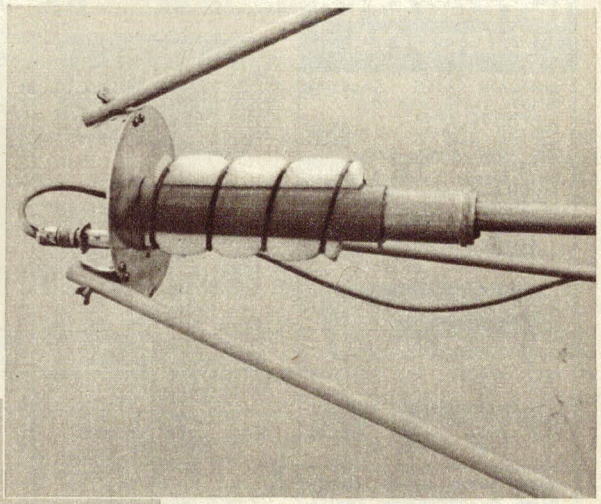
VK2BDN's transimtter provides 9 watts RF output from a varactor-tripler exciter from his 13-watt 432MHz transmitter, also using a varactor multiplier.

VK2ZAC's transmitter is a heavily-edited version of the 1296MHz varactor unit in the ARRL UHF handbook with 2 watts output and excited from a 432MHz varactor transmitter also of ARRL origin. Much rework has been done regarding the output filter and 2nd harmonic suppression.

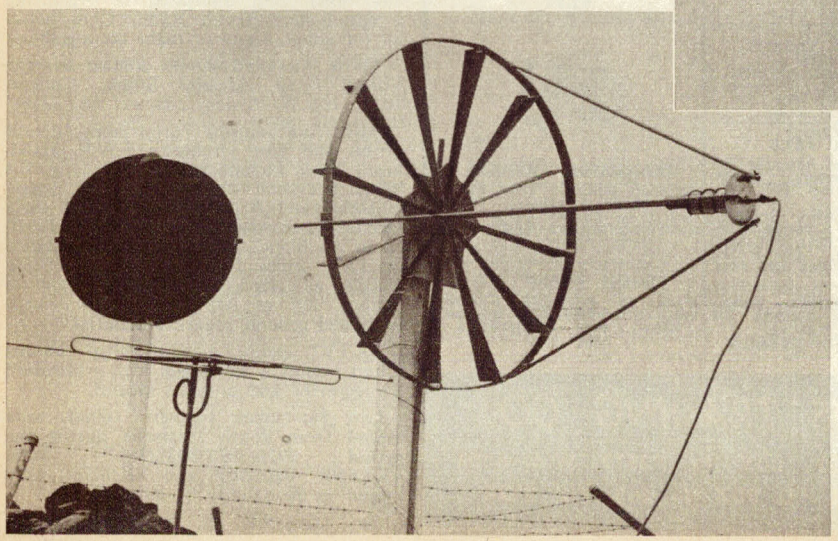
Similar receivers were used at both ends of the path, having basically crystal mixer input circuitry and various IFs into FM discriminators. The VK2BDN receiver has a 144MHz first IF down to a 7MHz receiver. By contrast VK2ZAC converts first to 14MHz then into a tunable converter giving 1600KHz to a broadcast receiver.

In each case audio output is obtained from a narrow-band discriminator on 455KHz.

Congratulations to both Bill Cox VK2ZAC and Dick Norman VK2BDN for this fine effort which, as can be seen, did not merely "happen by chance." There is no doubt that, with the perseverance and keenness shown by these and other UHF amateurs, the 1296MHz record will soon be broken again. It would be no surprise to hear that this had happened during the Field Day weekend of February



The antenna system used by Dick Norman, VK2BDN, on Mount Canobolas, for the record-breaking 149-mile contact with Bill Cox, VK2ZAC. Inset picture is an enlarged detail of the helix and feeder cable.



News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W. 2200.

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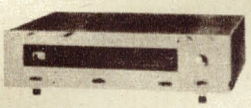
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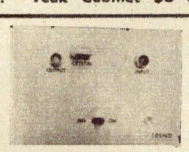
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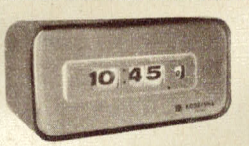
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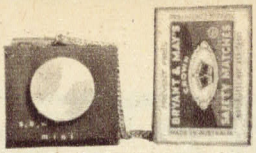
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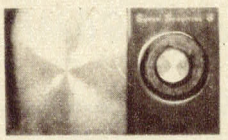
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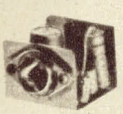
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7 and 8, 1970, when a large number of VHF and UHF stations will be on choice mountain locations throughout the nation.

UHF enthusiasts in the Sydney area will be pleased to know that Dick Norman and Bill Cox will be delivering a lecture-demonstration on their 1296MHz portable equipment at a N.S.W. VHF and TV Group meeting early this year, with both stations to be set up in the hall as at a field location.

Peter Carter, VK2ZPC

AUSTRALIAN HONOURED

Ivan Thomas an Australian amateur operator from Mordiallac, Victoria, who was the chief radio operator for a United States Antarctic expedition in 1962, has been honoured by the Australian Government for his work during that expedition. Ivan operated under the call sign KC4AAC from the Wilks base.

Ivan was notified a short time ago by the Minister of Supply, Mr Anderson, that he had been awarded the Polar Medal for his part in the 1962 expedition.

In recent years, Ivan has been worked by Australian operators under his call sign VE8WT, in the Arctic Circle. Ivan is married with two children and at present is chief instructor and manager of Niagara Helicopters Ltd., of Chippawa, Canada.

RANDWICK BOYS' HIGH SCHOOL

On December 6 members of the Randwick Boys' High School Short-wave Listeners and Amateur Radio Club held an all-night meeting to introduce senior students of the school to amateur radio and short-wave listening.

The meeting was held at the Marcellin College with the club leader, Peter Vernon, VK2BPV as the operator. Single-sideband equipment was loaned to the club for the meeting by Dr L. H. McMahon, VK2AC and E. W. Renout, VK2AWR, both of whom visited the club during the meeting.

Other visitors were David Jeanes, VK2BSJ, supervisor of the W.I.A. Youth Radio Scheme in New South Wales and Steve Riley, VK2BSI, who assisted members to erect a 14MHz inverted "V" dipole antenna. Club members Seth Greening, Kim Orchard and Mike Biber assisted in supervising the proceedings, Mike conducted an astronomical group meeting during the same period.

During the course of the meeting members were shown how to operate and read a frequency meter, and participated in several DX contacts with stations in Canada, U.S.A., Japan. Many short and medium-wave broadcast stations were logged from all parts of the world.

Club members would like to hear from any other club interested in organising a nation-wide Youth Radio Club hook-up for either a day or night get-together.

Those interested should contact Samson Voron, 7/30 Arcadia Street, Coogee, 2034, N.S.W. Sydney, phone 665-3319.

Also from Samson Voron comes details of his and Kim Orchard's S.W.L. activities. These include monitoring, daily, the lower television channels and six metre amateur band. At the time of writing, early December, television station AKTV2 located in Auckland, New Zealand, a distance of 1,470 miles from Sydney was being received as early as 2125GMT with picture pattern and as late as 1100GMT with news and general program material.

AKTV2 operates on Australian channel 0 and reception was made with a standard TV receiver and antenna system.

Late November, six-metre signals were logged from South Australia during the period 0920GMT-0932GMT when VK5ZNR, VK5ZEX and VK5ZDX were logged at readability 5, strength 7.

On December 8, maximum-strength

News received of Australis Oscar V launch

By now the Australian Amateur Satelite, Australis Oscar V, should be orbiting the earth, and the telemetry data transmitted on 144.050MHz and 29.450MHz available to amateur tracking stations round the world.

Communication links on phone, CW and teletype have been set up to pass such data to the project co-ordinators in Melbourne.

One of the prominent overseas stations participating in the preliminary co-ordination of communications with the Melbourne group is G6JF, operated by the English amateur G. R. Wigg, of Yabbacombe Farm, in Devon. He is working in co-operation with Bill Browning, G2AOX, the regional director for the Australis Project in Europe and Africa. Bill maintains contact with the AMSAT organisation in the United States, while a teleprinter link is maintained between G6JF and VK3NR in Melbourne.

In a November, 1969, issue of the English publication, "Electronics Weekly," the activities of G6JF were given some prominence.

"Milking is not the only thing that calls for early rising on Yabbacombe Farm in Devon, for even before the cows are stirring amateur radio enthusiast G. R. Wigg is establishing a RTTY link with VK3NR in Melbourne, Australia.

"Mr Wigg's station, G6JF, is devoted entirely to teleprinter working. He has two modified 4336 RCA transmitters and two modified AR88 RCA receivers. His RTTY equipment includes two 7B machines, two 54s and a 75, all of Creed manufacture.

"His main aerial is a 'V' beam, four wavelengths per leg, on 14.100KHz. It is located on a hill and fed from the farmhouse in the valley, by an 800ft, 600-ohm open wire line."

The Australis satellite is the test bed for seven telemetry channels and the first attempt by amateurs to achieve stability and overcome the usual fading of signals caused by rotation of the package while in orbit. Plans are being made to build a VHF repeater satellite to permit communication by amateur stations located thousands of miles apart. It will be powered by solar cells.

For details on the progress of the Australis Ocar V project listen to the Wireless Institute news broadcasts each Sunday morning on 7146KHz, or contact the Chairman, Project Australis, Richard Tonkin, 5/39 Tooronga Road, East Malvern, Victoria, 3145.

signals were heard between 0800GMT and 1030GMT on the eleven-metre amateur band. Stations heard were VK3AUR, VK3AUJ on AM and VK3ATX on single-sideband.

CANBERRA RADIO SOCIETY

Members of the Canberra Radio Society met for the Annual General meeting on Friday night, November 21. Following presentation of the reports on activities during the past year, office-bearers for the ensuing year, were elected.

In addition to the appointment of eight committee members the following office-bearers were elected.

President. Ted Pearce. VK1AOP; vice-president, Col Harvey. VK1AU: Secretary. Ross Elliott. VK1AN; Treasurer, Eddie Penikis, VK1VP.

AMATEUR RADIO AS OCCUPATION THERAPY FOR THE DISABLED

The above was the title of an article by E. G. A. Jackson, B.Sc., M.B., B.Ch., D.P.H., reprinted from "The Medical Officer" of May 16, 1969, published in the Region 1 News.

The article is included in these notes as an illustration of benefits that amateur radio can offer as a worthwhile hobby. Several individual cases where similar assistance has been given are known in Australia, but as far as can be ascertained no permanent organisation has been formed in this country.

"Many invalids, disabled persons and the blind find it difficult to adjust themselves to their new situations. Boredom and depression may develop, which often begins a vicious circle, further hindering a return to partial physical activity.

"Having been an amateur radio enthusiast for many years I have personally seen how the hobby has helped to transform many disabled persons from a state of introspection and depression into a well-adjusted and useful member of society. It is one sphere in which the disabled can be on complete equality with others of like interests.

"Amateur radio is a varied hobby: some prefer constructing equipment, others listening on short-waves to amateur and commercial broadcasts from all over the world. Perhaps the third and most interesting sphere is where actual transmissions are made to others with similar interests on a world wide basis. Even those with speech problems can communicate by means of the Morse code.

"A transmitting licence is issued by the Post Office after an elementary examination in radio theory and, for the full licence, a simple test in Morse code is necessary also. Only average intelligence is needed, and home study with perhaps a handyman's flair for electrical repairs will quickly equip one with the necessary knowledge and skill for Post Office requirements. Most people start with a simple receiver covering the amateur short-wave bands. Interest often develops into enthusiasm in those suited to the hobby and long hours of boredom are relieved.

"Three case histories follow and range from the casually interested listener to the full 'Radio Amateur'.

"W.W. Age 52: For over thirty years the patient has suffered from gradually progressive muscular dystrophy. For many years he lived with an aged father, but on his death, spent some time in a geriatric ward where boredom and depression were a constant problem. Eventually he was found a place in a Cheshire Home.

"While at a holiday camp, he met a group of radio amateurs who helped him acquire a short-wave receiver and enrolled him as a member of the Radio Amateur Invalid and Bedfast Club. (An account of the club's activities is given later) He then found companionship and pleasure listening to other club members, many of whom were personal friends. In the patient's own words, 'My morale received a wonderful boost and I began to take a greater interest in the outside world.' Now he is so busy with other occupational therapy that he gets little time for his radio hobby.

"R.M. Age 68: As a young man he was a Cornish stonemason, but developed silicosis at an early age. He moved to Sussex and started a small business. He was an active local man and an enthusiastic Red Cross worker. Ten years ago he had a severe coronary thrombosis and had to retire at 58 years of age. The sudden

ON TELEX

from



Bob Cunningham

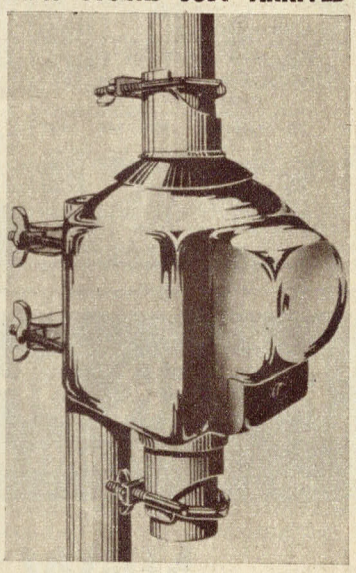
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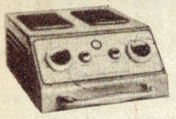
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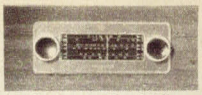
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WHISTLE FILTER for above set for 8Kc band width (can be altered to 9, 10 or 11Kc). No. 128, $4. Post 10c.

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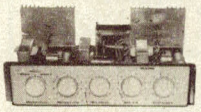
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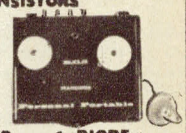
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change in circumstances, with no leisure activity to occupy his mind, caused severe depression.

"Quite by accident one day he heard a Cornish amateur speaking on his radio receiver. Soon afterwards, he heard of the R.A.I.B.C. on the B.B.C. 'Home This Afternoon' program. The club helped him to procure an improved short-wave receiver and other local amateurs helped him to set this up; soon he was able to join in listening to the Club's twice-weekly 'get together,' as well as much other daily amateur activity. He describes how the constant interest lifted him out of a state of depression and apathy and enabled him to adjust to a life of restricted activity.

"Paul Bates, age 34. While an army officer in Malaya and at the age of 20 he was stricken with severe poliomyelitis. Paralysis was complete, including respiration. Many times he was near death. Positive pressure respiration via a tracheotomy has been necessary ever since; his only voluntary movement remaining is in two fingers of his left hand, neck and speech. His story is well known and graphically recounted in his book 'The Horizontal Man.'

"Paul Bates was first introduced to short-wave radio reception when local radio amateurs in Singapore loaned him a receiver. He became thrilled at hearing broadcasts and amateurs speaking from England and elsewhere.

"When he returned to this country (England) and eventually settled in his own home, he determined to take up the transmitting side of the hobby. He took the examination orally and his answers were recorded on tape. The Morse code test was also taken at home, using the two fingers he could move. The Post Office telegraphist tapped out the code for him to read. The full licence was obtained and friends modified equipment so that he could operate it, using a stick held between his teeth.

"Paul Bates was now able to speak unseen and on equal terms to people all over the world and has made many friends. He received much psychological benefit and it also helped him as a form of speech therapy. In his own words, 'For the disabled it keeps the mind active and, in some severe cases, can call for physical feats which encourage and give self-confidence, both of which assist in further activities.'

"I might add that he is now the sales representative for a firm of surgical bed makers. Prospective clients come to his home for personal demonstrations. The bed's position can be varied by an electric motor activated by the well known Patient Operated Selector Mechanism (P.O.S.M.).

"Here are three examples where I am positive that amateur radio has played an important part in their individual rehabilitation.

"The Radio Amateur Invalid and Bedfast Club is a voluntary organisation run by amateurs to help invalids, the disabled and the blind. It was founded in 1954 by a few invalids, but has grown to over 300 members, with a further 300 supporters who visit members in their areas and help keep their equipment in working order.

"A monthy newsletter is circuated and there are twice-weekly 'get togethers' on 80 metres, when news and views are exchanged. This gives much pleasure to the listener who has not yet passed the exams to enable him to transmit. The club also gives active help to those wishing to obtain the transmitting licence; books and recorded lessons are loaned out, as well as Braille information. All this work is done by the invalids themselves. Braille transcription is done voluntarily by prisoners at two of H.M. prisons in their spare time. The club is supported entirely by voluntary subscriptions and, as illness and disability know no barriers, it is classless and non-denominational.

"There are flourishing club stations at some orthopaedic hospitals schools for the disabled, and at Cheshire Homes.

"This is not a hobby for men only; many women find it equally rewarding. The only requirements are the initial interest and a little aptitude."

JOHN MOYLE MEMORIAL FIELD DAY

The Federal Contest Committee of the Wireless Institute of Australia invites all Australian Amateurs and Short Wave Listeners to participate in this Annual Contest, which is held to perpetuate the memory of John Moyle, whose efforts advanced the Amateur Radio Service.

There are two divisions of this contest, one of 24 hours' continuous duration, and one of six hours' continuous duration. The six-hour period has been included to encourage the operator who is unable to participate for the full 24-hour period. The 24-hour continuous operation is to be chosen by operator from the 26-hour period.

Operators using 25 watts or less input to the final stage will be considered for a certificate where their activity warrants its issue.

DATE:

From 0600GMT, 7th February, 1970, to 0800GMT, 8th February, 1970.

OBJECTS:

The operators of Portable and Mobile Stations within all VK Call Areas will endeavour to contact other Portable/Mobile and Fixed Stations in VK Call Areas and Foreign Call Areas.

RULES

1. There are two divisions, one of six (6) hours', and one of twenty-four (24) hours' duration. The six-hour period for operating may be chosen from any time during the contest, but the six-hour period so chosen must be continuous. In each division, there are six sections:—

(a) Portable/Mobile Transmitting, phone.
(b) Portable/Mobile Transmitting, CW.
(c) Portable/Mobile Transmitting, open.
(d) Portable/Mobile Transmitting, Multiple Operation, open only.
(e) Fixed Transmitting Stations working Portable/Mobile Stations, open only.
(f) Reception of Portable/Mobile Stations.

2. All Australian Amateurs are encouraged to take part. Operators will be limited to their licensed power. This power shall be derived from a self-contained and fully portable source.

Portable/Mobile Stations shall not be situated in any occupied dwelling or building. Portable/Mobile Stations may be moved from place to place during the contest.

No apparatus shall be set up on the site earlier than 24 hours prior to the contest.

All Amateur bands may be used, but no cross-band operating is permitted. Cross mode operation is permitted.

Entrants in Section (d) for Multiple Operator Stations can set up separate transmitters to work on different bands at the same time. All such units of a Multiple Operator Station must be located within an area that can be encompassed by a circle not greater than half a mile diameter.

For each transmitter of a Multiple Operator Station a separate log shall be kept with serial numbers starting from 001, and increasing by one for each successive contact. All logs of a Multiple Operator Station shall be submitted by the operator under whose Call Sign the transmitters are working. No two transmitters of a Multiple Operator Station are permitted to operate on the same band at any time.

3. Amateurs may enter for any section.

4. One contact per station for phone to phone, also one for CW to CW per band is permitted. Cross mode operation will be accepted for scoring.

5. Entrants must operate within the terms of their licences and in particular observe the regulations with regards to portable operation.

6. The exchange of serial numbers, consisting of RS or RST report plus three figures, commencing with 001 and increasing by one for each successive contact by the VK Station, shall be proof of contact.

7. **SCORING:**

(a) **Portable/Mobile Stations:**
For contacts with Portable/Mobile Stations outside entrant's Call Area, 15 points.
For contacts with Portable/Mobile Stations within entrant's Call Area . . 10 points.
For contacts with Fixed Stations outside the entrant's Call Area . . . . 5 points.
For contacts with Fixed Stations within the entrant's Call Area . . . . 2 points.

(b) **Fixed Stations:**
For contacts with Portable/Mobile Stations outside entrant's Call Area, 15 points.
For contacts with Portable/Mobile Stations within entrant's Call Area 10 points.

8. The following shall constitute Call Areas: VK1, VK2, VK3, VK4, VK5, VK6, VK7, VK8, VK9 and VK0.

9. All logs shall be set out under the following headings: Date/Time (GMT), Band, Emission, Call Sign, RST/No. Sent, RST/No. Received, Points Claimed. Contacts must be listed in numerical order.

In addition, there shall be a front sheet showing the following information:

Name ..... Address .....

Call Sign ..... Section .....

Division ..... (6-hour or 24-hour)

Points Claimed .....

Call Sign of other opr.(s) (if any) .....

Location of Portable/Mobile Station .....

From ..... hours to ..... hours

A brief description of equipment used, and points claimed, followed by the declaration:

"I hereby certify that I have operated in accordance with the rules and spirit of the Contest."

Signed ..... Date .....

10. The right is reserved to disqualify any entrant who, during the contest, has not observed the Regulations and the Rules of this contest, or who has consistently departed from the accepted code of operating ethics.

11. The decision of the Federal Contest Manager of the Wireless Institute of Australia is final and no disputes will be entered into.

12. Certificates will be awarded to the highest scorer of each section of each division. Additional certificates may be issued at the discretion of the F.C.C. The six-hour certificates cannot be won by a 24-hour entrant.

13. **RETURN OF LOGS:**

All entries must be postmarked not later than 28th February, 1970, and be clearly marked "John Moyle Memorial National Field Day Contest,1970," and addressed to:

Federal Contest Manager, W.I.A.,
Box N1002, G.P.O.,
Perth, W.A., 6001.

(EXAMPLE OF VICTORIAN S.W.I.'s LOG)

Date Time (GMT)	Band	Call Sign Heard	RST No. Sent	Station Worked	Points Claim
7/2/70					
0600 GMT	80m	VK2AAH/P	59001	VK3ATL/P	15
0610	80m	VK3ATL/P	59006	VK3QV	10
0620	40m	VK2AAH/P	599004	VK6VF/P	15
0640	20m	VK3QV	59010	VK5QX/P	*
0900	20m	VK4OF/P	59040	VK4OX/P	15

* No claim, fixed station.

RECEIVING SECTION

14. This section is open to all Short Wave Listeners in VK Call Areas. The Rules shall be the same as for the Transmitting Stations, but may omit the serial numbers received.

Logs must show the Call Sign of the Portable/Mobile Station heard, the serial number sent by it, and the Call Sign of the Station being worked.

Scoring will be on the same basis as for Transmitting Stations. It will not be sufficient to log a station calling CQ. A portable/mobile station may be logged once only for phone and once only for CW in each band.

Awards: Certificates will be awarded for the highest scorer in each Call Area, for the 6-hour and the 24-hour divisions.

CALLING ALL PROSPECTIVE AMATEURS

The N.S.W. Division of the Wireless Institute of Australia announces that the 1970 personal classes will commence on February 12. Applications will be accepted in their order of receipt.

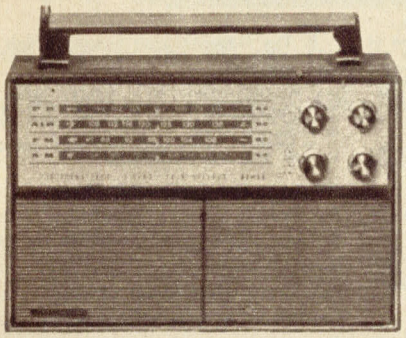
CORRESPONDENCE COURSES ARE AVAILABLE THROUGHOUT THE YEAR.

For further information write to:

THE COURSE SUPERVISOR, W.I.A.
14 ATCHISON STREET,
CROW'S NEST, N.S.W. 2065

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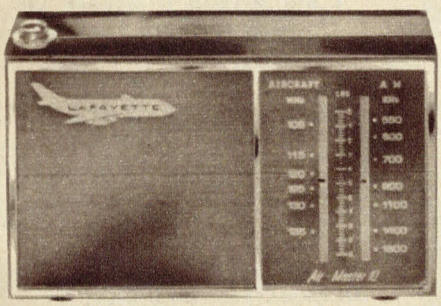
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- Aircraft Band 108-136 MHz AM.
- VHF Band 147-174 MHz FM.
- Inbuilt Batteries or 117 VAC.

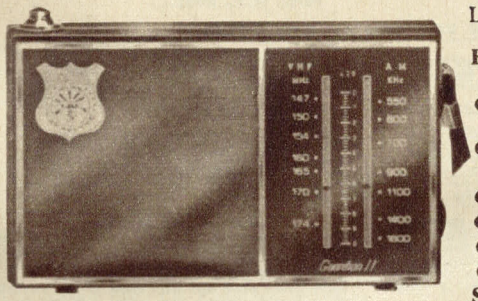
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W.I.A. ACTIVITIES

All members of the Wireless Institute of Australia are reminded that agenda items for the Federal Covention to be held in Adelaide at Easter must be submitted to their divisional secretaries to enable such matters to be sent to Federal Executive before February 13.

The result of the 1969 Remembrance Day Contest, details of which are published on p. 167, show that Tasmania won the contest for the second year in succession.

NEW SOUTH WALES

Members of the N.S.W. Division are reminded that with the commencement of a new year the time for payment of annual subscriptions draws near, February being the end of the division's financial year. Then comes the election of council for the ensuing year.

At the January meeting the election takes place of the federal councillor to represent the division at the Federal Convention at Easter. The convention this year is to be held in Adelaide.

SOUTH AUSTRALIA

The November issue of the South Australia "Wireless Institute Journal" gave details of a useful service to members which read:-

Antenna and Tower Erection Gang

"As a service to members, the institute operates an antenna and tower erection gang. This is mainly intended to prolong the life of our older members but is available to any member in trouble in this department. An insurance policy has been taken out to cover damage to buildings and injury to members of the gang during erection.

"This is a free service, but should the user feel indebted for it, it is suggested that he make a donation to the building fund, Y.R.S. or some other field of institute activity. Inquiries for the gang should be sent to Geoff Taylor, VK5TY."

WESTERN AUSTRALIA

Ted Gabriel, VK6TG, WICEN co-ordinator for the Western Australian Division, gave further details of the organisation in the November issue of the division's news bulletin. Amateurs wishing to participate in this service to the community are invited to contact one of the following, controllers or deputies.

Perth area	Clem Patchett	VK6CW
Albany area	Aub Keightley	VK6XY
	Tom Reed	VK6TR
Bunbury area	Jack Burrows	VK6BU
Narrogin area	Les McGeoch	VK6WL
	Don Benck	VK6DB
Goldfields area	Glen Hufner	VK6ZFH
North-West Net	Doug Pannell	VK6EP
	Chris Todd	VK6CT
	John———	VK6DR

All-India Amateur Radio Convention

At the time this issue was in course of preparation, our Amateur Correspondent, Pierce Healy VK2APQ, was in India, attending the First All-India Amateur Radio Convention. The following notes have been received from Pierce in Bombay.

The trip to Bombay from Sydney was excellent. I was met by Dave Dalrymple VU2OLK/G3OLK (my host); T. P. Sheth (Tip) VU2TP; M. B. Vasubevan (Vasu) VU2VZ. The welcome I received was more than could be expected and it was 4.30 a.m. Bombay time Xmas morning before we finally retired.

Xmas Day was spent by a tour of Bombay, followed by a visit to the Radio

Exhibition, held in conjunction with the convention. This is staged at Birla Kreeda Kendra, a large building on the waterfront, built for this type of function. It is located at Chowpatty and contains a large display area, auditorium and restaurant.

The exhibition had been opened on December 23, and in addition to a display of amateur equipment and the convention station VU2HAM there were commercial displays by Philips Radio; Bush Radio; S.R. Standard Radio; Murphy Radio; RCA (valves and projectors); Telerad Radio and Television; Tata Electrical Ltd.; Asian Electronics Ltd. The main interest to the public was closed-circuit TV staged by Bush, Telerad and S.R. Standard.

The amateur equipments displayed were all home constructed items with the exception of the FL 200B and HQ18 Receiver belonging to VU2OLK used as the convention station VU2HAM. This station operated continuously during the convention and several hundred thousand persons saw it in operation. In all, 495 DX contacts were made, many with Australian stations and the gear was several times operated by myself (VK2APQ).

The opening session of the convention was held 1200-1500 hrs on December 27, 1969, with informal addresses by Shri Y. A. Fazalbhoy, Chairman of Steering Committee and by Shri B. S. Dutt, VU2AJ, Chairman, Executive Committee. At 1700 hrs followed the inauguration of the convention by Prof. Sher Singh, Minister of State for Communication. I was introduced to him as the guest of honour from Australia. The Minister gave a very interesting and encouraging speech relating to amateur radio in India. Also present was the Wireless Adviser to the Indian Government (whose name eludes me). Both these gentlemen showed interest in Australia and amateur radio.

The evening was devoted to a traditional Indian dinner in the open-air garden at which I was honoured by sitting at the official table with the Minister and other distinguished guests.

On Sunday, December 27 the second session commenced at 9 a.m. This was a seminar on amateur radio in India. Chairman was Brig. B. M. Chakravarti, VU2BU, and Co-Chairman Lt. Col. Daly S. Major VU2MD. Principal speaker was Shri Saad Ali VU2ST. Several interesting papers were read and discussions took place (to be reviewed later) and this was followed by a Seminar on "Technical Aspects of Amateur Radio." There were over 200 delegates present. Both these seminars were attended by the Wireless Adviser to the Government.

On Sunday evening I had the privilege of addressing the gathering, including the Wireless Adviser and other prominent officials, on various aspects of amateur radio in Australia including WICEN, the Youth Radio Club Scheme, and Australis Oscar V. Colour slides and a VHF Field Day film were shown. Afterwards, I had to answer many questions on all subjects. (It lasted about 2½ hours).

On Monday December 29th, two seminars were held:

1. Amateur Radio and the Nation.
2. The Union of Amateurs.

A number of interesting papers were read on many aspects of amateur radio in India; these will be reviewed later.

The evening session was a well-presented lecture, by Major J. K. Deshpande VU2ED, on crystal grinding and making an SSB crystal filter.

The convention concluded on Tuesday with a meeting, at which resolutions relating to the domestic side of amateur radio in India were unanimously adopted. The final session was presided over by Shri N. C. Srivatsava, Secretary, Ministry of Communication.

At this session I was invited to sit at the official table with the President, Chairman and the Secretary, Ministry of Communications when, in accordance with Indian custom, I and the other VIP guests were given beautiful sheafs of flowers. During the presentation of prizes I was given two bound volumes of a radio publication, and a present for my wife.

Each evening, for the duration of the convention, I was invited to join the Government representatives and other guests of the convention committee at informal discussions and dinner.

Modern amateur equipments and commercially built equipments such as SSB transceivers are practically unknown in India. The ingenuity of the Indian amateurs is of an extremely high standard. Radio components are manufactured in India but are expensive and beyond (in by far the greater number of cases) the pocket of the average amateur. Disposal junk, as we in VK know it, is the main source of equipment; 1625's are being used as linear amps for home-constructed SSB rigs. CW is therefore used quite extensively. The keenness of those interested in amateur radio under such circumstances has amazed me.

There is no VHF activity in Bombay due to lack of suitable components—taxis are **not** radio controlled so there are no car phones. Valves like 3/20's, 6/40's, 6CW4's and FETs are just names.

1969 Remembrance Day Contest Results

The results of the 1969 Remembrance Day Contest held in August showed Tasmania the winner for the second year in succession. Their success was due to the high percentage of logs received from participants within the State, also the good scores of the six highest scorers.

The highest score in the contest was made by G. F. Pooley, VK9DJ, 1969 points, for approximately 22 hours of operation.

The results compiled by the W.I.A. Federal Contest Committee follow. Highest individual scores in each State:—

New South Wales including Australian Capital Territory

Phone		CW	
VK2ASZ	1256 pts	VK2QL	405 pts
VK1JG	1105 "	VK2VN	292 "
VK2XT	1054 "	VK2BF	255 "
VK1VP	1002 "	**Open**	
VK1AN	991 "	VK2BO	1173 pts
		VK2PU	519 "

Victoria

Phone		CW	
VK3VK	880 pts	VK3XY	278 pts
VK3ADW	817 "	VK3APN	277 "
VK3AMK	764 "	VK3AUT	214 "
VK3AXM	750 "	**Open**	
VK3WW	749 "	VK3QI	687 pts
		VK3ARM	481 "
		VK3CDR	275 "

Queensland including Papua and New Guinea

Phone		CW	
VK9DJ	1969 pts	VK4KX	445 pts
VK4EQ	1312 "	VK4LV	367 "
VK4LT	1283 "	VK4XW	252 "
VK4WW	1279 "	**Open**	
VK4DP	908 "	VK4DB	658 pts
VK4LZ	908 "	VK4UA	352 "
		VK4GW	335 "

South Australia including Northern Territory

Phone		CW	
VK5FT	1160 pts	VK5XK	322 pts
VK5NN	1103 "	VK5FH	249 "
VK5BI	1039 "	VK5PC	162 "
VK5QX	982 "	**Open**	
VK5TY	973 "	VK5GW	1172 pts
VK5EJ	885 "	VK5FO	1167 "
		VK5KG	995 "

Western Australia including Christmas Island

Phone		CW	
VK6CT	931 pts	VK6WT	472 pts
VK6ID	812 "	VK6AJ	82 "
VK6TR	782 "	VK6ZZ	50 "
VK6ZK	740 "	**Open**	
VK6TG	705 "	VK6CW	1136 pts
VK6DA	683 "	VK6BE	1031 "
		VK6MA	818 "

Tasmania

Phone		CW	
VK7AZ	1236 pts	VK7CH	287 pts
VK7KJ	1180 "	VK7GC	248 "
VK7JV	1173 "	VK7MZ	175 "
VK7TX	1164 "	**Open**	
VK7FB	836 "	VK7ZZ	750 pts
VK7MD	819 "	VK7AL	720 "
		VK7OM	56 "

Listeners' Section

New South Wales

T. Hambling	848 points
D. Grantly	537 "
J. Hillard	513 "

Victoria

St. Paul's College Radio Club	1053 points
R. Hanel	763 "
A. Cox	611 "

Queensland

C. Kenny	864 points
K. Cunningham	741 "
M. Joyce	573 "

South Australia

L. Earl	1677 points
S. Ruediger	1342 "
T. Hannaford	502 "

Western Australia

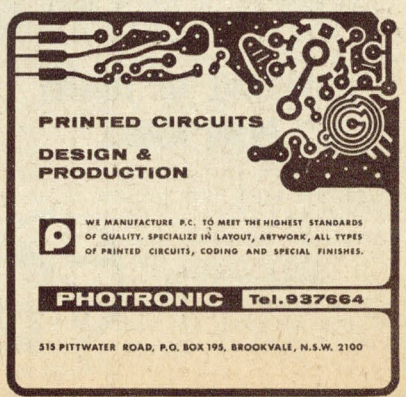
P. Drew	1576 points
R. Wake	350 "
D. Smedley	113 "

Tasmania

R. Mutton	1318 points
A. Dixon	1031 "
B. Livingston	928 "

Details of Divisional Scores

Division	Log entry	Licensees	% participation	Average top six logs	Total State Points	State Score
VK2+VK1+VK9	111	1972	5.6	1071	32,984	2926
VK3	82	1785	4.6	781	21,014	1746
VK4+VK9	79	752	10.7	1276	33,463	4544
VK5+VK8	89	769	11.4	1024	25,337	3920
VK6+VK9	56	436	12.4	916	17,456	3083
VK7	59	238	24.7	1068	15,810	4987

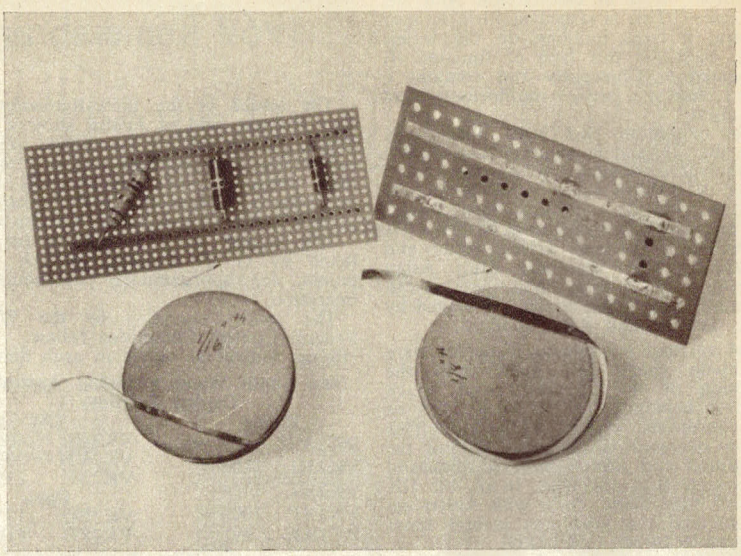


DESPITE the initial reservations felt by many people, particularly with reference to servicing, the printed circuit is now firmly established in most types of electronic equipment, ranging from the incredibly cheap pocket radios that have flooded the country in recent years, to some of the most sophisticated professional equipment available. Its origins lie in weaponry — a heritage unfortunately common to many good "electronic" ideas, but printed circuitry is, and indeed has been for some time, an attractive system for the amateur who constructs his own equipment, for it solves the mechanical problems of component mounting and eliminates the chores of wiring — as well as facilitating a neat and workmanlike job. For the amateur who has so far shied away from etching his own boards, a new system is now available, which is both economical and easy to use, yet with care, is capable of excellent results. Known as **Cir-kit,** the system utilises bakelite boards, similar to those used commercially, in conjunction with self-adhesive copper strip. This is 1/16in or 1/8in wide — easily cut with scissors or a model knife — and attaches to the boards rather like a piece of **Sellotape.** The adhesive is very efficient, although the bond is not quite as good as that on pre-laminated boards — which means that care is needed when soldering not to overheat the copper. However, anyone who is competent to solder a transistor or capacitor without causing damage should have no trouble, and the adhesive improves with aging, so that long-term stability is satisfactory. Layouts can normally be planned using the theoretical circuit diagram as a guide, and boards may be pre-punched or drilled according to requirements. With the pre-punched board, the strip can either be laid over the holes, and then punched through with a small drill or a watchmaker's screwdriver, or it can be laid alongside the holes and component leads are inserted through the board, folded over and soldered (see photo). The former method permits a more compact layout.

A few tips on planning layouts. Always be sure that the component spaces you allocate are adequate — it is preferable to purchase the bits before embarking on this task, although capacitors are available in literally dozens of shapes for board mounting and resistors are more or less of standard size, dependent on ratings. Avoid siting adjacently on to your layout components which are in different stages —as this can lead to instability. If instability does occur, of course, **Cir-kit** does permit alterations to be made, although it is as well to investigate the problem before redesigning sections of the board for it may not prove necessary.

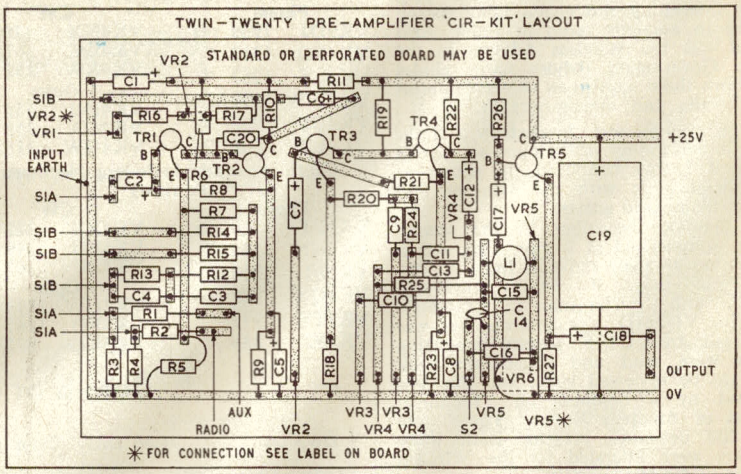
The excellence of the system, however, lies in its versatility, for it enables the home constructor to produce a wiring board on a one-off basis for most of the circuits described in this and other journals, and while it will no doubt encourage many to "try their hand," it will also enable many who already build their own equipment to achieve neater, more reliable results with a minimum of fuss.

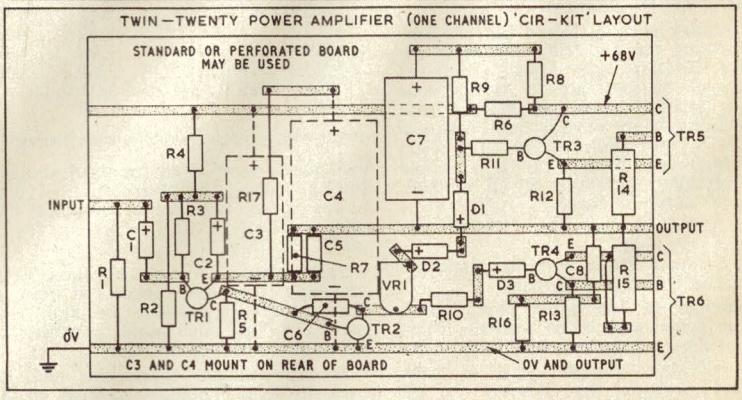
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W.I.A. SUMMER FIELD DAY

The W.I.A. Summer Field Day, usually held on the New Year weekend, is to be held this year in February, at the same time as the John Moyle Memorial National Field Day. The alternative date has been chosen on a trial basis to improve VHF/UHF and activity and DX possibilities in both events, and to avoid interference with family arrangements over the festive season.

1. INVITATION. The Contest Committee of the N.S.W. Division W.I.A., VHF and TV Group invites all amateurs and short-wave listeners with VHF and/or UHF equipment to participate in this year's Summer Field Day.

2. OBJECTS. Amateur operators in the VK2 and VK1 call areas will try to contact as many other amateur stations as possible and over as great a distance as possible, with the emphasis on portable/mobile operation. Contacts may be made on any one or more of the authorised Australian amateur bands from 52MHz and above. An "incentive factor" in the scoring is a simplification of the system successfully used in the June 1969 Midwinter Contest.

3. DATE/DURATION. A total of 20 contest hours are made up of eight hours from 1400 to 2200 EAST Saturday 7/2/70 plus 12 hours from 0400 to 1600 EAST Sunday 8/2/70.

4. AWARDS will be made to the highest scorers in the various sections of rule 5.3 under each of the following band groupings: 52MHz, 144MHz, 420/576MHz, 1215/2300MHz, 3300MHz and above.

There will be the usual award to the outright highest scorer for the whole contest, additional to any other awards the same entrant may win. There is also an award for the highest overall scorer in the six hour division, not being the above winner. A special Merit Award will be given for the best entry submitted by an operator who has held a callsign for the preceding 12 months or less and who has not previously won a similar award in N.S.W.

Any licensed amateur is eligible for all these awards, including amateurs outside Australia.

5. RULES

5.1 TWO DIVISIONS will be available: (T) the total period and (S) any six consecutive contest hours. Entries may be made in both but the winner of division "T" is not also eligible to win division "S" in the same band/class category.

The six consecutive hours may bridge the Saturday night rest period. If entering division "S" the start time of the six hours is to be written in the correct column on the entry form, against the bands used. Note that operators may enter but not win both divisions in any band.

5.2 THREE CLASSES of operation are available: home station, portable/mobile station, listener unrestricted. Entries may be made under more than one class under the one callsign if satisfying the conditions for each class. E.g., one may operate from home then go mobile or portable. Licensed amateurs may enter the listener class only if they make no transmissions during the actual contest hours. Everyone unable to transmit for any reason but who can receive, is encouraged to enter this class.

On the entry form mark an "X" in the correct position to show classes entered against bands used.

5.3 SECTIONS AVAILABLE from the combination of divisions and classes are: Home Total Period, Home Six Hours, Portable/mobile Total Period, Portable/mobile Six Hours, Listener Total Period.

On the entry form write the score for each band used in the correct column for the division entered.

5.4 PORTABLE/MOBILE is defined for this event as follows: station to be at least one mile from home station of any operator in the station crew; station not to be at the "shack" of another amateur; any power source is permitted. Note that AC mains are allowed for this contest but not for the National Field Day being run concurrently. Stations may move position during contest but the location is to be identified on air in each contact and in the log entry for each contact.

5.5 CROSSBAND OPERATION is only permitted if at least one of the stations in contact is on 420MHz or higher and then only if the two stations cannot have a normal one-band contact. This contest has no restrictions on crossmode operation but note that no HF transmissions may be used as an aid to the contest.

5.6 NET FREQUENCY contacts between any pair of stations will count for any one contact over the whole contest period in any one band. Net operation is however encouraged for arranging scoring contacts.

5.7 CONTACTS via REPEATERS or TRANSLATORS do not score in this contest but are also encouraged as above for arranging scoring contacts. As with direct net usage, operators should have due regard for the etiquette and good practice required in net operation.

5.8 ONE CONTACT PER CLOCK HOUR per station is allowed for each band, excepting for net frequencies which are covered in rule 5.6. A clock hour is from say, 1300 to 1359. It is not necessary to wait a full hour to have a second scoring contact with the same station on the same band, unless the first contact occurred right on the new hour. E.g., "A" works "B" at 1250; they may then work again any time from 1300 to 1359; their subsequent contact can be any time between 1400 and 1459, etc.

5.9 INCENTIVE FACTOR and MULTIPLIER. The various bands have been allocated incentive factors which take into account the possibility of DX, the need to encourage more activity, the difficulty of having the contact and so on. These incentive factors apply to the station transmitting in each contact. The sum of the incentive factors of two stations in contact gives the multiplier for that contact. The following table shows the incentive factors:

BANDS	HOME	MOBILE PORTABLE
52MHz (incl. nets	—	2
144MHz (incl. nets)	2	3
420MHz and 576MHz	6	9
1215MHz and 2300MHz	12	16
3300MHz and 5650MHz	18	22
10GHz and 21GHz	30	34

Note there is no incentive factor for 52MHz home stations so that the distance factor (rule 5.12), applies direct in the case of two 52MH-home stations being in contact. See also rule 5.13. Two metre band portable stations appear to have the best opportunity for high scoring on the basis of recent average participation but 52MHz could balance this with the increased possibility of distant contacts. 420MHz has the usual 3 to 1 scoring ratio over 144MHz.

5.10 AMATEUR TV incentive factor is the video band factor multiplied by two for monochrome and by three for colour. The audio channel may be on any band from 144MHz and above with no effect on scoring.

5.11 SERIAL NUMBERS are to be exchanged before points may be claimed for a contact. These numbers start in the usual way with the R/S report followed by a three-digit number staring at 001 for each different band used and increasing by one for each successive contact. A net contact when scoring is to be given its serial number from the same sequence used for the band containing that net. From ATV stations the serial number is to be passed over the video, not the audio channel.

5.12 DISTANCE FACTOR is based on airline separation of the two stations in contact and is one point per 10 miles or part thereof, on any frequency. The minimum distance for scoring is one mile. E.g., 1 to 10 miles equals 1 point; 50 miles equals five points; 51 miles equals six points, etc.

5.13 SCORE CALCULATION for each contact is simply made by adding the incentive factors for the two stations in contact (this being the multiplier) and by multiplying the distance factor by that sum.

For example: A 420MHz portable station contacts a 144MHz portable station 51 miles away. Adding the incentive factors of nine and three respectively (from the table in rule 5.9) gives a multiplier of 12. Their separation of 51 miles has a distance factor of six (rule 5.12) which, applying the multiplier, gives six mult. by 12 equal 72 scored for that contact.

5.14 IN LISTENER CLASS all scoring contacts may be logged, the clock hour rule 5.8 having no direct application to this form of participation. In this class distance factor is derived from the airline separation between the station heard and the listener's station. The multiplier to be used is the incentive factor of the station heard as in rule 5.9.

For example: If the listener heard the 420MHz portable station of the case quoted in rule 5.13 passing his serial number and that station was 25 miles away from the listener, we have: distance factor for 25 miles is three, multiplied by nine equals 27 scored by the listener. The listener must log the serial number transmitted, to score any points and the log should also show the second station in the contact concerned. If heard, the second station may also be logged for a score.

5.15 ENTRIES should be set out on the entry form supplied, or a close copy of it and should reach the Secretary, VHF/TV Group, 14 Atchison Street, Crow's Nest, N.S.W., 2065, by Friday night, March 6, 1970. Placings will be announced on Sunday, 15th March over broadcasts with full results and statistics being published in the April Bulletin and "E.A." for May or thereabouts.

Logs are required only for entries in the listener class but transmitting entrants may send their logs if desired. In any case, they should be made available to the committee if needed. Any logs submitted will be returned to operators who request this with their entry.

Field stations would help in the preparation of statistics if they include with their entry a list of the different callsigns worked (complete with "/M" or "/P" where applicable) if a log is not being submitted. This list would preferably show the callsigns worked, against the respective bands.

5.16 Only one callsign may be used from any one station. Each participant must operate within the terms of his/her licence, abide by the rules and spirit of the contest and sign the declaration at the foot of the application form.

SAMPLE ENTRY FORM

Location . . . . . Call sign used . . . . . .

Operators names and call signs . . . . . .

Bands	Approx. RF pwr. output & mode	Antenna type, size & height	Mark "X" for class entered			Division entered				
						Total period		Six consec. hours		
			Home	Portable	Listener	No. QSOs	Score claim	6 hrs from:	No. QSOs	Score claim
52MHz incl. net										
144MHz incl. net										
420MHz 576MHz										
1215MHz 2300MHz										
3300MHz 5650MHz										
10GHz 21GHz										
420MHz A.T.V.										
Other										
							Score totals:			

Notes: Exceptional QSOs, records, comments, suggestions:

Declaration: I hereby certify that I have operated in this Field Day in accordance with the conditions of my licence, the spirit of the event, and the rules of the contest.

Signed . . . . . Call sign . . . . . Date . . . . .

Note: When completed, please send this entry form, with or without log, to VHF & TV Group, Contest Committee, 14 Atchison Street, Crows Nest, N.S.W. 2065, by Friday, 6th March, 1970.

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ESTABLISHED 1940

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PHONE 51-1011

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Knobs for concentric shaft. Dozen **$1.20**
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SPEAKERS

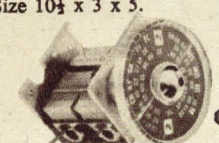
MSP 8-inch dual cone	$6.50
MSP 12-inch dual cone	$8.50
MSP 7 x 5 15 ohm	$4.00
MSP 3½-inch 3 ohm	$2.00
Rola 6 x 4 15 ohm	$3.50
Rola 5 x 3 15 or 27 ohm	$2.50
MSP 6 x 9 15 ohm	$5.00
3-inch single cone 15 ohm	$4.20
6 x 4 33 ohm	$3.00
MSP 20 Watt	$19.75
MSP 12-inch 8 ohm	$8.50
MSP 2-inch 15 ohm	$2.00
MSP 8-inch dual cone, 8 ohm	$6.50
MSP 12-inch-3.5 ohm	$6.00
MSP 4-inch large magnet 8 ohm	$2.50
MSP 3-inch 150 ohm	$2.50
MSP 3-inch 15 ohm	$3.00
National 8-inch built-in tweeter and crossover network	$12.75

MSP Electro Dynamic, 8in, **$4**, or 6 x 9.
MSP 6 x 2 15 ohm, **$3.**
MSP 6 x 4 15 ohm, **$3.50.**

Peak 6o7 16 cm Hi-Fi Dual Tone 6in	$7.50
MSP 20-watt radial beam 12pqb	$21.50
Magnavox 8 ohm 4in tweeter	$2.50
2 gang tuning condenser	$1.00
Peak H50 horn type tweeter	$12
MSP 8-inch speakers	$4
Pioneer 15-inch 8 ohm 60 watt	$40

SPEAKER CABINETS complete with radial beam MSP 20 watt speaker and horn type tweeter with cross over network .. .. **$70 each**
Solid oiled teak 23½ x 17 x 12.

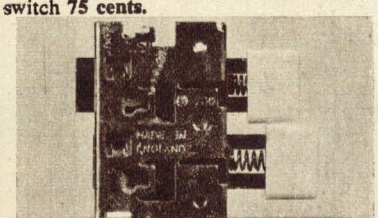
RADIOGRAM CHASSIS 4 valve including valves and speaker, **$15.50.** Size 10½ x 3 x 5.



SMALL 2-GANG TUNING CONDENSERS

Complete with direct drive scale **$1.75**
TV IF STRIPS .. .. .. **$5** each.

ENGLISH PANEL LAMP with toggle switch **75 cents.**



English push-button on/off switches, **75c** each. Pack and post **10c.**

TRANSFORMERS

240 to 32 volts 400 watts **$10.00**

TRANSISTOR AMPLIFIERS. Peak stereo in oiled teak cabinets 3½ watts per channel **$39**
POWER TRANSFORMERS 200 mil 385 aside **$8**
Curled expanding shielded wire approx. 7 yards **$1.50**

Miniature valve sockets 7 and 9 pin **15 cents** each.
Speaker Crossover network Condensers 2 MFD — **60 cents.**

Philips IFT's 455KC	75c each
Aerial and oscillator coils	50c each
Transistors 2Niio	40c
Silicon diodes HR	50c
OA diodes	40c
OA Diodes	40c

Transistor IFs, medium size, **75c** each



PORTABLE PHILIPS RECORD PLAYER
$7.75 6 Volts.

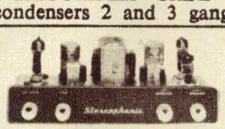
Speaker transformers 15,000 and 25,000 to 3 ohms 6 watts	$1.50 each
5,000 to 3 and 15 ohms	$1.25 each
Transistor speaker chokes	$1.50 each

POTS

1 meg. 2 pole switch	95c
100K switch 2 pole log	50c
10K carbon or wire wound	50c
1.5 linear	50c
½meg log	50c
½meg switch 2 pole 1 in	50c
20K switch	75c
10K switch	75c
1.5 dual ganged log	$1.00
0.25 dual ganged log	50c
Dual 3 meg ganged log	$1.00
500 ohm WW	50c
50K Lin	50c
15K T5K	50c
Dual ganged concentic 2 meg log 2 pol	$1.25
7.500 log	50c
200K 1in	50c
250K log	50c
2K 1in slotted	25c
50 ohm	50c
250K 1in	50c
100K 1in	50c
½meg 1in	50c
50 log switch	75c
1 meg dual ganged log	$1.25
2 meg 1in	50c



TAPE RECORDER CASE $7.00
Tuning condensers 2 and 3 gang **$1.00**



STEREO AMPLIFIER KIT SETS

TU 10, 3.5 watt per channel	$19
TU 11, 3.5 watt per channel, has facilities for tape and microphone channels	$23
TU 12, 5 watt per channel	$22.00
TU 13, 5 watt per channel, with TU 11 facilities	$27

Each kit set includes valves and all components. Front face plate, if required, **$1** extra.
Single stage amplifier kit set:

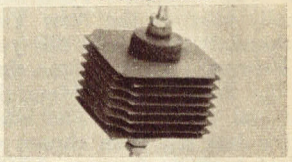
5 watt per channel	$22.00
Transistor ear plugs	3 for $1.00
Tag strips, mixed types	Dozen, 60c
Switches, oak 4 position	50c each
2 position	40c each

¼ and ⅛ AMP. FUSES $3.50 100.
Din Plugs, 3 or 5 pin .. .. 50c each.

ELECTROS:

3 in one		
50	250	415
8	350	415
10	350	415

75 cents each.



METAL RECTIFIER, 150 watt, ½ amp, **$1 each.**

All types **$3.50** to **$20.00** plus post.
TV aerial lead in .. .. .. **10c** yard
Tuning Condensers, 2 gang or 3 gang —**$1** each.

2 amp fuses .. .. .. **$3.50** per 100
Special, 12in speaker, 2 ohm Rola, **$6.00** pack and post, **75c.**
Transistor plastic outer case, **50c** each
Transistor carrying straps .. **20c** each
Stereo pick-up arms, with Xtal, **$6.00** ea.
Metal rectifiers for battery and electric portables .. .. **50c** each, post **10c**
Pilot lamp holders .. .. **60c** per doz.
TV or cabinet castors .. 4 for **$1.00**
100 Mixed Knobs including TV channel changers **$10.00**
3½ amp Fuses .. .. .. **$3.50** per 100
10 for **50c**

AMPLIFIERS SOLID STATE
8 watts R.M.S. per Channel .. **$65.00**

STEREOGRAM CHASSIS
7 valve microphone and tape recorder **$50.00**

OA 70 diodes .. .. **40c** ea.
Morganite and IRC resistors. At least 33 values. Suit transistors, radios, TV etc., **$2.00** per 100. Pack and post, **25c.**
3, 5, and 10 Watt IRC wire wound resistors. Many values. **20c** each, 12 for **$2.00**
100 mixed condensers, micas, ceramics, tubular. Fresh stock. **$2.00.** Pack and post **25c.**
50 + 24, 350 vw + 100 mf 25 vw, **75c** each
30, 30mf 300 vw 350vp .. **75c** each
Many others. Invaluable for service.

2 meg. Lin Pots **50c**
R.C.A. 7 INCH TAPE SPOOLS 75 cents

ALPHA 200VAC ½ amp push-on switches, **30c** each. Ideal for fridges.
90 deg. PICTURE TUBE SOCKETS **25c** each. 152 valve sockets, **25c** each.
Transistors AC127, 2N384, 2N217, 2N218, OC71, OC75.
$1.00 each. Post and pack **5c.**

THREE WATT AMPLIFIERS, complete with speaker.
NEW. $10.00.

Electros 1.8 x 0. 9 MF — 20c each

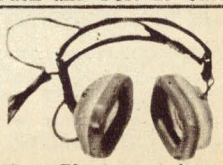
AUDIO TRANSFORMERS
18-4294, 28-4536 .. .. **75 cents** each

PILOT LIGHTS, Plug in .. **10 cents**

SWITCH WAFERS
20 cents each.

B.S.R. Record Changers Ua 25.	$25.00
B.S.R. UA 70	$40.00
B.S.R.MA 75	$50.00
Garrard at	$50.00
Elac	$25.00

TRANSISTOR speaker and Case, Plastic, 5-inch speaker with plug and lead, **$4** each. Pack and Post 25 cents.



Stereo Head Phones, good quality, **$9.00**
Discaton chassis **$2.50**

NEW VALVES

12AU7	$1.25	SSJ7	$1.25
6SA7	$1.25	6BH5	—
6BU8	$1.25	6D6	$2.00
6BM8	$1.50	EL33A	$2.00
1S5	$1.00	6B4	$2.00
1T4	.50	17Z3	$1.50
6CJ6	$1.50	QVO4-7	$2.00
6L18	$1.00	1954	$2.00
ECL85	$1.25	12AX4 G.T.B.	$1.50
SP61	$1.00	9A8	$1.50
UU9	$1.00	6W6	$1.50
12BE6	$1.00	6ACT	—
6AU4	$1.25	12AN7	$1.25
6U9	$1.25	12AH8	—
6Y9	$1.25	6ES6	—
6X9	$1.25	6N7	—
6AQ5	$1.25	6DA6	—
1B3	$1.50	6CJ6	$1.50
1S2	$1.50	6T8A	—
5AS4	$1.25	UL84	$1.50
6DQ6	$1.50	EL81	$1.50
12AT7	$1.25	EF39	—
12Ax7	$1.75	6CH5	$1.25
6B8	$1.25	17 BFH	$1.50
6CH6	—	6BX7	$1.25
6AU5	—	12FR8	$1.00
6SL7	—	6CK5	$1.25
6BW8	—	3OAE3	$1.50
6DC8	—	6AH4	$1.25
6CK6	—	UCL82	$2.00
6Y9	—	6JN8	$1.25
6BH8	—	EF41	$1.50
35W4	—	50EH5	$1.50
6BC8	—	6CD8	$1.25
PCL81	$2.50	25Z5	$1.50
12AH8	$1.25	UF 41	$1.50
6DC8	—	7AN7	$1.50
6BN4	—	UF 41	$1.50
PCL83	$2.00	X148	$1.50
12FX8A	$1.50	EY86	$1.50
6DS8	$1.25	6BA8	$1.50
9U8	$1.25	PCC 85	$1.50
ECH 42	$1.25	15A6	$1.50
6ET6	$1.25	Z759	$1.50
1AR11	$2.50	EY 51	—
6DJ8	$1.50	1U4	$1.00
7FC7	$1.50	6DB5	$1.25
UY 85	$1.50	PCF 80	$1.25
12AQ5	$1.25	6S2	$1.25
12AV6	—	23Z9	$1.50
6BD7	$1.25	EF6	$1.25
6AM8	—	6AM5	$1.25
6AT6	—	EM85	$1.25
ECH35	$2.00	EA50	$1.25



TV IF COILS, IDEAL FOR COIL FORMERS .. .. **$1 dozen**



SPEAKER CABINETS

13 x 6¼	$5.00
10 x 6 x 4½	$3.50
12½ x 8¾ x 6	$5.00

Fuse holders .. .. .. 50 cents dozen
Octal valve sockets .. 50 cents dozen
Chokes 18 Henry 30 mill **$1.50**

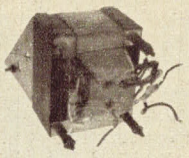
M.S.P. 6in SPEAKERS, 3 or 15Ohm **$4.00**



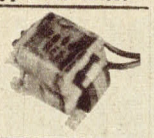
Car radio push button tuner .. **$4.50**
Pack and post 30c, Interstate 60c.

DIAL DRUMS, 5 inch, 3½, 3¾, **50c ea.**

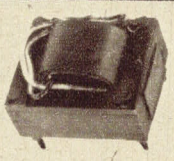
ELECTROS 20 MFD 200 P.V. .. **20c**



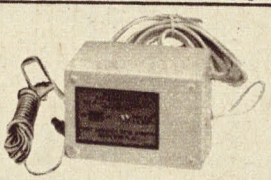
TV POWER TRANSFORMER, $8. 300 mil. Two 6.3 windings, 200 volt secondary for Bridge Type Rectifier.



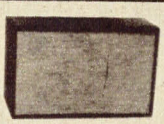
50 M CHOKE $1.
Pack and Post 30 cents, Interstate 60 cents.
300M Choke $2.50.



VOLTAGE DOUBLER POWER TRANSFORMER. 200 mil 240 volt x 105-110 secondary 6.3V 15 amp .. **$8**

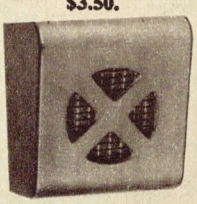


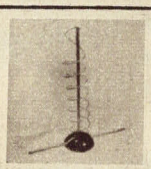
BATTERY SAVER, 6 or 9 volt DC 100MA **$8.50;** 300MA, **$10.00.**



SPEAKER ENCLOSURE, complete with 8in M.S.P. dual-cone speaker, 8 or 15 ohm **$15.80**
Cabinet without speaker **$10**
Cabinet size 16 x 10 x 8.

TRANSISTOR EXTENSION CABINETS
Complete with 5-inch speaker and lead. **$3.50.**





INDOOR TV AERIALS $1.50.
Pack and Post 25c.

STEREO AMPLIFIER 10 watts per channel solid state AT6 Garrard record changer, oiled teak cabinet, complete unit **$125**
Same unit with Garrard 3000 changer, **$115.**

TAPE RECORDER COUNTERS $1.75

POTS

1 meg. Dual Ganged Log	$1.25
1 meg. Dual Ganged Lin	$1.25
½ meg. Switch Pot double pole log	75c

6 VOLT PILOT LIGHT, screw in .. .. **ea. 10c**

RESIN CORE SOLDER 5 yards 75c

N.E.C. Cassette tape recorder cost $89. Sell new **$59.00**

Tab pots 500 ohm 1in .. .. .. **20c ea**

Electrolytic Capacitors
8MFD 450 WK 550 surge. **4 for $1.00**

AMPLIFIER OR TUNER CABINETS, oiled teak 10½ x 5¾ x 3 .. .. **$2 each**
Pack and Post, 30 cents.
Interstate 60 cents.



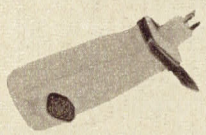
Ducon 2 pole dual concentric switch pots log 500K CT 100K 1 meg **75c**

STEREO SPEAKER LEAD, 10 cents yd.

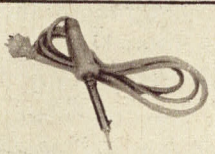


SPEAKER BOX, unpolished, suit 8in speaker **$3.75.** Pack and post 50 cents.

2N 1108, 2N 1110, 2N 1111. Transistors .. .. **50 cents each**



GARRARD PLUG IN STEREO CARTRIDGE, $6.00



ROBINSON SOLDERING IRONS, 30 WATT **$6.00**
40 watts **$6.00**
60 watts **$6.25**

2 ONLY TRADED-IN STEREO AMPLIFIERS, $18 each.
3½ watts per channel.

Speaker Cabinets size 10 x 7 x 4¾. **$3.50**

Pots 50 ohm switch .. **50 cents each.**

American or Japanese 2 pin power plugs rubber complete with 2½ yards flex **50** cents. Pack and post 10 cents.

MICROPHONES MAGNETIC OR CRYSTAL **$1.75**

SPEAKER CABINET, 16 x 10 x 8, complete with 6 inch M.S.P. dual cone Speaker tweeter, 3 inch and Crossover network **$18.75**

MAGNAVOX 8 WR, 10 WR 12 WR. Tweeter 3, 4 or 5 inch.

Speaker Plugs, 4 pin .. .. .. **15 cents**
Speaker Sockets .. .. **15 cents**

PUSH PULL AUDIO TRANSFORMERS 10,000 CT 15 ohm .. **$3.00** each

RADIOGRAM CHASSIS STEREO Complete with valves 3½ watts per channel **$25**

POWER TRANSFORMERS

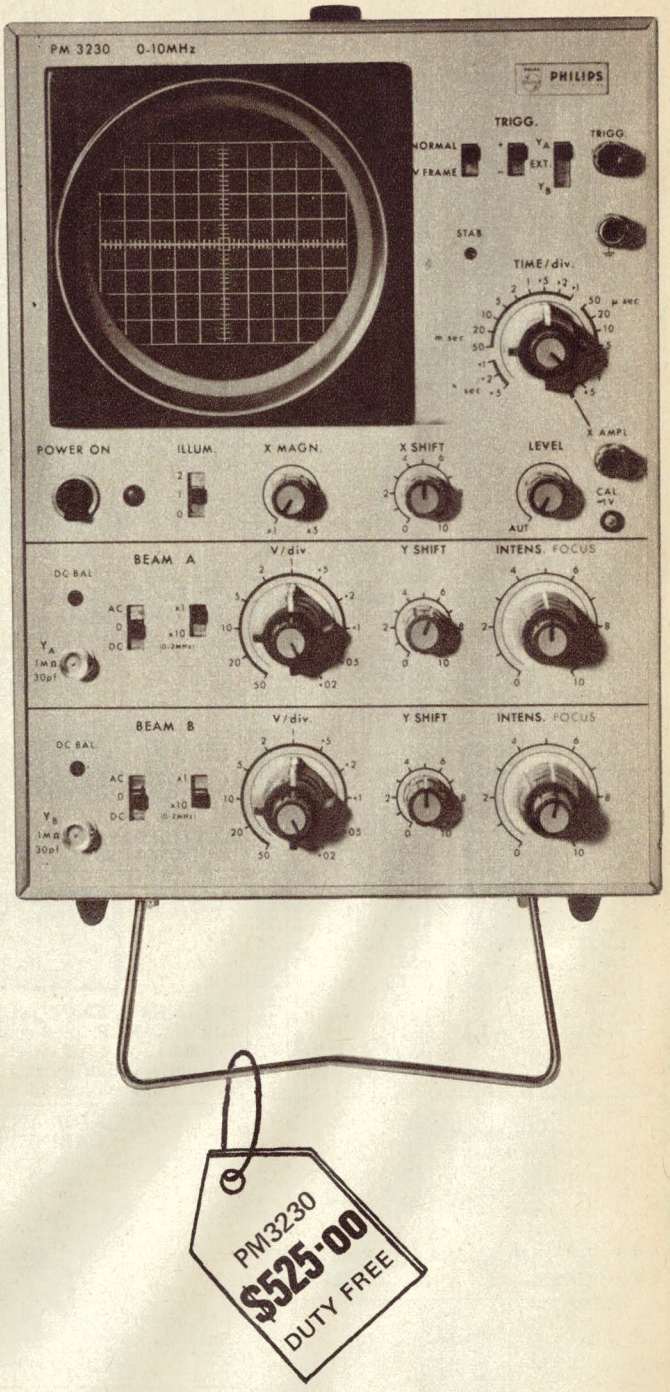
100 mil 6.3	$5.00
30 mil 6.3	$2.50

MSP 6 inch dual. cone — **$.50** each. MSP 3 inch tweeter — **$3.75.**

MULLARD BOOKSHELF SPEAKER CABINETS, $10 each.

STEREOGRAM CHASSIS, 5 watt per channel, complete except speakers, **$35.**

PHILIPS 10mV 'SCOPE HAS TWO GUNS WITH FULL SCREEN COVERAGE.



The popular PM 3230 is the world's best selling double beam oscilloscope combining reliability and full features with a moderate price tag.
It employs a cathode ray tube in which the guns cover the full display area.

The incorporation of wide bandwidth and high sensitivity together with a comprehensive range of sweep speeds makes the instrument ideally suitable for an extremely wide field of applications between low frequency and pulse techniques.

The controls are conveniently and sequentially located, less adjustment is necessary and measurement accuracy is increased. Drift and instability are practically non-existent (½ division/24 hours) with FET's in the input and triggering circuits. Other specifications are:

□ Display area 10 x 8 div. (both guns). One division equals 8mm. □ 4 kV acceleration voltage. □ Internal triggering from either amplifier. □ D.C. Coupled Amplifier. □ FET input stages with overload protection up to 500 volts.

Bandwidth	Sensitivity
D.C. — 10HMZ	20 mV/div
D.C. — 2HMZ	2 mV/div

For more complete information, contact
Philips Electrical Pty. Limited,
69 Clarence Street, Sydney,
or your nearest Philips office

PHILIPS
test and measuring instruments

PHILIPS

38.8783

LISTENING AROUND THE WORLD

Two Manila stations now testing

Two gospel stations in the Philippines, Radio Veritas and the South East Asia Radio Voice, have been heard with test transmissions in the 19-metre band.

by Arthur Cushen

The test transmissions of the South-East Asia Radio Voice have been in operation for some years on a spasmodic basis. The transmitter uses 15420KHz. The test period is 1100-1200GMT directed to India and Pakistan, and 1245-1400 with programs beamed to China. The program consists of light classical music with a taped announcement each 15 minutes.

The station announcement is: "This is a test transmission from the South-East Asia Radio Voice to English listeners in Malaysia, India and Pakistan, on 15420KHz, 19metre band. This test transmission will be conducted every day from 1100 to 1200GMT. Another test transmission to Chinese listeners will be heard from 1245 to 1400GMT on this same frequency. Reception reports are welcomed. Address them to S.E.A.R.V., Box 4148, Manila, Philippines."

Following a cablegram from Vatican Radio we have recently been monitoring a series of test broadcasts by Radio Veritas in Manila. The Philippines station uses two 100KW transmitters on short-wave and 100KW on medium-wave.

In recent weeks we have heard communication between Vatican using 2160-KHz and Veritas using 21690KHz. These tests have been planned in order to find clear frequencies for broadcasts to South Asia. The present schedule of Radio Veritas is carried on two frequencies, 11830 and 15170KHz and is as follows:

GMT	Target Area
0500-0530	Thailand
1130-1200	Japan
1200-1230	Indonesia
1230-1300	Vietnam
1300-1330	Vietnam
1330-1400	Vietnam
1400-1430	Thailand

The station confirms reception by a card and the full address is Philippine Radio Educational and Information Centre, Inc., 1000 Gen. Solano (or P.O. Box 132), Manila, Philippines.

VL8BM USING 11880KHz

A new station in Port Moresby, Papua-New Guinea, has been heard by Samson Voron, Coogee, N.S.W., testing on 11880-KHz. That station, which uses the call-sign VL8BM, has been heard in the period 0100-0200GMT. Signals have been noted at 0054GMT with a tone on the frequency before the program commences at 0100GMT. VL8BM operates from the Central News Room, and is used by the Administration Broadcasting Service to broadcast information to outlying stations. The program is usually of news in slow English, local music, commentary from the House of Assembly, and other official announcements. Information is also transmitted in Pidgin. The transmission is for the eight Administration stations which can rebroadcast the programs.

The transmitter is also used for normal communications between points in Papua and New Guinea. Reception reports can be sent to VL8BM, Administration Broadcasting Service, Department of Post and Telegraph, Port Morseby, Papua. Our verification confirming the reception of VL8BM gives the power used as 10KW, and the transmissions as Monday to Friday 0100-0200 and 0430-0530GMT.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are GMT. Add 8 hours for Perth, 10 hours for Sydney 12 hours for Wellington.

ENGLISH FROM VIENNA

It is expected that the Austrian Radio, Vienna, will add English programs to its schedule this month. This is expected to cover the DX session which was introduced to the schedule last May. The present transmission times of the DX session, at present in German only, is as follows:—

GMT	KHz
0040	6155, 9770, 15145.
1102	6155, 7245, 9770, 17855.
2112	6155, 7245 11925.

The DX session is broadcast on the second Sunday of each month. Best reception in the Pacific area is of the transmission at 1102GMT on 17855KHz.

NICARAGUA USING 5935KHz

Radio Nacional de Nicaragua at Managua has been heard at our listening post on the new frequency of 5935KHz with a broadcast extending past 0800GMT. We reported reception of this station when using 11875KHz, and heard around 0300GMT, during our winter. Reports to the station should be sent to Apt. 1731, Managua, which (according to the World Radio Handbook) verifies by letter.

The station was heard with typical Latin American music and a recorded station announcement, which is played about every 15 minutes. Reception on this frequency in New Zealand is excellent, and the signal is not troubled by the severe side-band interference which we noted on 11875KHz.

JEDDAH BACK ON 11855KHz

After a period of inactivity, the short-wave service of the Saudi Arabian Broadcasting Service has again been heard on 11855KHz. Our reception has been best in the period 0430-0530GMT when the program is in English.

The program up to 0430GMT is a typical Arabic transmission. At 0430GMT, following station identification, music is played to 0445GMT when a news bulletin of ten minutes is presented. Recorded music continues to 0530GMT when the station leaves the air. A woman announcer is generally employed and the broadcasts are very similar to those of Radio Kuwait. In the closing announcement, reference is made to the broadcasts on medium-wave 704 and 1594KHz, and on short-wave, 11855KHz. The next program is scheduled for 2 p.m. Saudi Arabian time, 1100GMT, with English news and commentary at 1130GMT. The final English program is broadcast 1700-1900GMT. Reports should be sent to Saudi Arabia Broadcasting Service, Ministry of Information, Airport Road, Jeddah, Saudi Arabia.

ENGLISH FROM ETLF

The Voice of the Gospel, station ETLF, Addis Ababa, Ethiopia, has a new schedule for its daily transmissions in English.

GMT	KHz
Transmitter 1	
0530-0555	11890
1330-1345	15315
1655-1710	6065
1930-2015	11910
Transmitter 2	
0400-0425	9725
1330-1400	15255
1700-1715	9695
1800-1855	9705

CHANGES AT BONAIRE

Trans World Radio, Bonaire, has been observed on some new frequencies in recent weeks. Our reception of the transmission on 6195KHz has been at 0930GMT. At this time the service in German ends, and the station leaves the air. Reception of the Colombian station HJEZ is then possible and free from interference.

The Radio Nederlands relay at Bonaire is using 15215KHz, reports Bob Padula in Melbourne. The station moved to this frequency from 15220KHz and was heard with French to Africa at 2045GMT. This change makes it possible to hear the Bonaire signal free from the interference of Radio Australia.

Trans World Radio, Bonaire, now vacates 6110KHz at 0900, reports John Cordor, Fairlie, N.Z. The station moves up to 6195KHz at this time to avoid interference from the B.B.C., London, which uses this frequency to the Pacific.

DELHI USING 17380KHz

All India Radio, Delhi, has been heard at our listening post on the off-band frequency 17380KHz with a transmission from 1000GMT. This frequency is in the middle of radio-telephone traffic and suffers from considerable interference. India and Pakistan both seem to use frequencies outside the assigned bands to try and overcome interference, but in the case of 17380KHz (and often other frequencies also), they run into interference from commercial traffic which is authorised to operate on the frequency.

All India Radio in its General Service from 1000 to 1100GMT has programs in English to North East Asia on 15105, 17380, and 21485KHz. The service to Australia and New Zealand is on 15205,

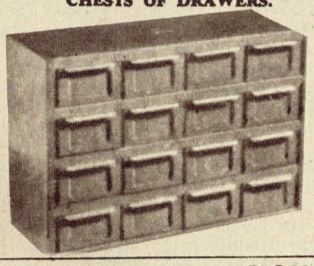
CHEST OF DRAWERS

Three types of Galvanised Chests measuring 17⅛in x 6¾in x 11⅞in, containing 16 drawers, each measuring 6⅝ x 3¾in x 2⅛in.

- **TYPE C.D.1. With 16 undivided drawers.**
- **TYPE C.D.2. With 16 triple compartment drawers.**
- **TYPE C.D.3. With 8 triple compartment drawers, and 8 undivided drawers.**
- TYPE C.D.4. A 17⅛in x 11⅞in Galvanised Chest containing 4 full-length dawers each measuring 15¾in x 6⅝in x 2½in.

The Chests are finished in blue hammertone stoving enamel, are complete with identification cards and packed in strong corrugated cartons. Provision is made for all units to be bolted together in tiers.

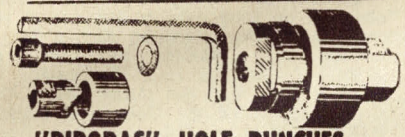
WRITE FOR FREE CATALOGUE AND PRICE LIST OF TOOL BOXES AND CHESTS OF DRAWERS.



COLOUR TELEVISION

With particular reference to the PAL system by G. N. PATCHETT

This book now available $5.95



"PIPGRAS" HOLE PUNCHES

"PIPGRAS" Hole Punches are made from Alloy Tool Steel, and cut clean and accurate holes in sheet metal. They make a smooth, perfect hole without reaming or filing.

SCREW TYPE, ROUND

Supplied with "UNBRAKO" High Tensile Socket Screws and Wrenches. Cut holes in sheet metal up to 18 gauge.

Type No.	Nominal Size	Actual Size	Water Pipe Size	Pilot Drill Size	Price Each
32.S	⅛in	0.507in	—	¼in	$2.17
40.S	5⁄32in	0.618in	¼in	5/16in	$2.17
48.S	¾in	0.742in	⅜in	5/16in	$2.80
56.S	7⁄32in	0.884in	½in	⅜in	$3.80
64.S	1in	1.008in	—	⅜in	$4.10
72.S	1⅛in	1.133in	¾in	⅜in	$4.53
76.S	1 3/16in	1.172in	—	⅜in	$4.53
80.S	1¼in	1.258in	—	⅜in	$4.97
88.S	1⅜in	1.382in	1in	7/16in	$5.97

With Heat Treated, High Tensile Steel Hex. Head Bolt and Nut.

Cut holes in sheet metal up to 16 gauge.

96.S	1½in	1.512in	—	9/16in	$6.68
112.S	1¾in	1.762in	1¼in	9/16in	$7.60
128.S	2in	2.014in	1½in	9/16in	$8.33

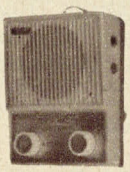
BELLPHONE



Pick up the receiver and dial push number desired.

Large $13.50 per pair
Small $10.12 per pair

KALTRO SVC TV-RADIO REMOTE CONTROL LISTENER



This TV-Radio Remote Control Listener is a combination of an extension speaker and a remote control station to regulate the sound of both the TV, Radio, Phono, or Hi-Fi set and the speaker incorporated in the Listener itself. In addition, up to two earphones can be attached for listening to the sound of the TV, Radio, Phono, or Hi-Fi set without disturbing others around you. Unwanted commercials can be easily cut off by merely turning down the control of the TV-Radio Remote Control Listener. A modern designed plastic cabinet with easily adjustable fingertip controls ideal for use in home, office and business. Complete with earphone, 20ft of lead wire and installation instructions.

Price $8.75

Trade enquiries prices available on application

★

Free parking at Rhodes

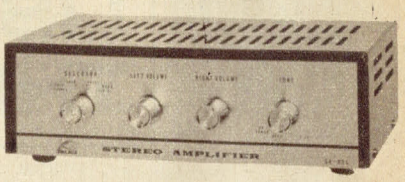
★

Phone:
73-0211 Rhodes
29-4451 City
73-5586 Sat. Morning.

THIS MONTH'S SPECIALS

Radar 1XR Power Supply	$30.60
Radax 05XR Power Supply	$20.40
Lapel Microphone X67 ..	$00.90
Table Microphone BM3 ..	$ 7.50

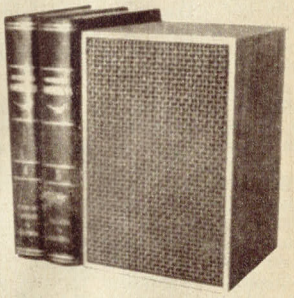
8 WATT STEREO AMPLIFIER MODEL SA-80S



SPECIFICATIONS

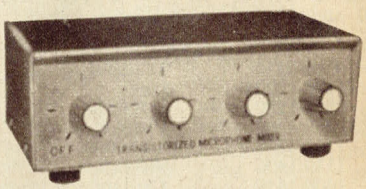
Output Power: 8 Watt, 4 Watts per channel.
Frequency Response: 60 to 15,000 cps. plus or minus 1 db.
Harmonic Distortion: Less than 3%.
Hum and Noise: 52 db below rated output.
Sensitivity: Phone (Crystal) 100mV 250K ohm.
Tuner 100mV.
Tube Complements: 12AX7x1, 30A5x2, 1S315x1 (Silicon Rectifier).
Dimensions: 5.1lb. 9¾in x 6¼in x 3in.

BOOK SHELF TYPE SPEAKER SYSTEM MODEL SP-4S



Speaker: 4in, 8 ohms.
Frequency Response: 70-13,000 cps.
Sensitivity: 93dB.
Power Input: 8W (Music Power).
Cabinet Size: 9⅞in (H) x 6¼in (W) x 5¾ (D).
Finish: Walnut lacquer.

MODEL M6 FOUR CHANNEL TRANSISTORISED MICROPHONE MIXER



All four inputs accept standard two circuit Phone Plugs, while the output jack accepts a standard circuit Phone Pin Plug.

SPECIFICATIONS:

● Input Impedance: "Hi" Impedance for Crystal Microphone, etc. ● Gain: Approximately 6 db. ● Maximum Input Signal: 1.5 volts. ● Maximum Output Signal: 2.5 volts. ● Output for Minimum Distortion: 2 volts. ●Hum: 0. ● Battery: 9 volts.

Mono $6.75 Stereo $9.75

GENERAL ACCESSORIES

(A DIVISION OF ELECTRONICS INDUSTRIES)

116-118 CLARENCE ST., SYDNEY 29-4451 443 CONCORD RD., RHODES 73-0211

BOTH STORES OPEN SATURDAY MORNING FREE PARKING SPACE AT RHODES FOR CUSTOMERS

11775, 15430 and 17820KHz, with best reception on 15205KHz.

The transmissions in English from All India Radio, beamed to the North East Asia area, include services for morning reception as well as the 1000GMT transmission listed above.

GMT	KHz
2245-0045	9530
2245-0015	7235
2245-2315	3905
2330-0115	11710
0030-0115	15235
2245-0115	11895
2245-0015	9615
0030-0115	15340

DX 69 CONTEST

Radio South Africa, in Johannesburg, ran an interesting contest last November for world-wide reception. The contest included the use of three powers radiated on three frequencies by the Johannesburg station. Listeners had to hear the transmissions at 0500, 0515, and 0530GMT, when the power was reduced from 250KW to 100KW, and finally to 20KW. Code words and the announcer's name, plus a musical item had to be identified in each segment of the contest. Awards were made for the best entries from North America, Europe, Africa and the Pacific area. The winners in the last section were:

1. Stephen P. Doudoub, Kwajein, Marshall Islands.
2. Christopher D. Jones, Beaumont, South Australia.
3. Tony Marr, Auckland, New Zealand.

The competition for the best entry from a DX club was awarded to:

1. Association of German Radio Clubs.
2. American Short-Wave Listeners' Club.
3. Australian Radio DX Club.

The frequencies were chosen by four members in various parts of the world who formed the contest committee. They were Allan Thompson (Neath, Wales), Richard Wood (Honolulu, Hawaii), Bob Padula (Melbourne, Australia), and Arthur Cushen (Invercargill, New Zealand).

DROPPING CALL SIGNS

Some readers refer to the lack of call signs in station announcements on short-wave, and ask the reasons for the trend in recent years. The major reason is that the frequency, wavelength and the call sign was thought to be too much for the short-wave listener to digest in one announcement, and so call signs have disappeared from most station announcements.

The International Radio Frequency Bureau at Geneva still requires each station frequency to be allocated with a call sign, but that is as far as it goes. Some stations, such as Radio New Zealand, use the call signs in printed material, while several stations have adopted a common call sign for all frequencies such as HCJB, ORU and others. The Voice of America makes its transmitters known by location in schedules. Switzerland had many calls in the old days, and even Radio Australia had its VLA, VLB and VLC in use.

The loss of the call sign has caused some difficulties in counting verifications. The frequency in use, as shown on the verification card, is now recognised as the dominant part of a verification. This seems to be the only way to overcome the position, as it is not possible to count the stations by any other means. The fact that HCJB can be verified on several channels in the 31-metre band means that they now have more than one transmitter working on the band at the same time. This is the case at 0800GMT when transmissions are on 9585, 9605, 9655, 9705 and 9745KHz the frequency changing according to the season.

More than one transmitter is involved in these seasonal changes, so that the counting of frequencies overcomes this problem. To try and count verifications by call sign or by the designated transmitter, means research into transmission schedule, and this information is not always available.

NEW SCHEDULES OPERATING

ENGLISH FROM BERLIN

Radio Berlin International broadcasts from East Germany in English on the following schedule:

GMT	KHz	Area
1730	6080, 6115, 7185, 7300, 9730.	Europe
2015	6080, 6115, 7185, 7300, 9730.	Europe
2200	6080, 6115, 7185, 7300 9730.	Europ
2300	6080 6115, 7185, 9730.	Europe
0100	9730, 5955.	North America
0230	9730, 5955.	North America
0345	11820	Africa
0615	9500	Africa
1215	21600, 21475.	Africa
1315	21600, 21475.	Africa
1815	15390, 15145.	Africa
2000	11810	Africa
0645	21465	Far East
1115	21540, 17880	Far East
1200	21540, 17880.	Far East
1330	21540	Far East
1430	17880	Far East
1515	17880	Far East
1245	21540	Far East

BROADCASTS FROM BEIRUT

The Lebanese Broadcasting System, Beirut, is operating to the following schedule:

GMT	KHz	Area	English
1830-2030	11970	Africa	1830-1900
2300-0100	11810	South America	———
0130-0400	11790	North America	0230-0300
0430-0730	5980	Omnidirectional	———
1625-1820	5980	Omnidirectional	———
0925-1600	9545	Omnidirectional	———

JAMMING CONTINUES

The continuation of jamming and its disruption of short-wave reception is a matter of concern. In our recent visit to Europe we found it much more severe than we experience it in this part of the world. Austrian Radio recently supplied me with information showing some extent of the jamming as observed in Vienna. The O.R.F. Monitoring Service near Vienna listed continuously operating jamming stations as follows:

Band	Number
49M	2
41M	3
31M	2
25M	4
19M	7
16M	5
13M	—
11M	—

The total jammers thus recorded (23) were sufficient in their coverage to render 69 frequencies unfit for reception of short-wave transmissions.

LISTENING IN THE FUTURE

Some aspects of future DXing and general reception were discussed at the International DX Parliament at Halmstad, Sweden, when three experts in this field formed the guest panel on a technical discussion. This panel brought to light many interesting ideas for the future of the hobby, and briefly discussed the receiver, the aerial, and the reception prospects with new transmission techniques.

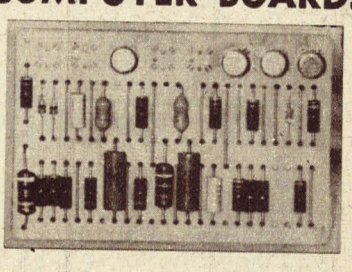
The panel consisted of Herbert Kuhnle of Austria Radio, Jukka Kivi of Finland Radio; and Jim Vastenhoud of Radio Nederlands. The representative of Finnish Radio spoke about the new pulse code modulation and the advantages it will hold for the DXer. When broadcasters were prepared to switch from AM to PCM, interference free reception would be possible, with the development of the necessary wideband equipment.

The Radio Nederlands spokesman predicted in five years' time improvements in the intermediate frequency stage of the receivers by applying newly developed bandpass filters and a decrease in bandwidth to cope with the ever increasing problem of station interference. Single side-band transmissions for international short-wave services were also forecast as a possibility in the future. Also predicted was the increased use of ceramic filters, which are expected to be relatively cheap shortly, and their application in transistorised portable receivers.

All three panel members agreed that satellite communication for relaying short-wave programs was something which could be realised in the future, with direct home reception possible by 1975. The DXer would then use a high-gain directional antenna. New aerials for receiving short-wave signals were predicted.

The tendency for stations to operate relay stations nearer the primary target of the broadcasts is increasing — this seems more effective when the relay station is built near the equator. Another point was the anticipated extension of the short-wave bands. The expansion of the international bands will be possible with the

BIG SAVING ON COMPUTER BOARDS



1-10 BOARDS 35c per board, pack and post 25c.
11-25 BOARDS 30c per board, pack and and post W.A. 35c, Interstate 50c.
26-100 BOARDS 25c per board, p. and p. W.A. 50c, Interstate 80c.
100 BOARDS and OVER 20c per board, p. and p. W.A. 80c, Interstate $1.00/100.
Average 3-4 transistors per board.
Technical information supplied with order.
ADEQUATE STOCKS FOR IMMEDIATE DELIVERY

COLSTOK ELECTRONICS
Box 178, KELLERBERRIN 6410

NEW RANGE OF RESISTORS CONDENSERS AND POTENTIOMETERS

The resistors are mainly I.R.C. and Morganite and are in a wide range of values from 100 ohms to 3 meg. in ½, 1 and 2 watt and include wire wound. LIST PRICE $9.00 per 100. OUR PRICE $2.00 per 100. Post and packing 35c extra.

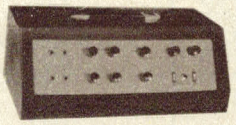
The condensers are in most popular brands and include Polyester, Paper, Mica, Ceramic and Electrolytic in values up to 8mfd. LIST PRICE **$11.00** per 100. OUR PRICE **$2.00** per 100. Post and packing 65c.

The pots, are all current types and include switch pots, and dual concentric, tandem, tab pots. etc. LIST PRICE **$12.00** per dozen. OUR PRICE **$2.50** per dozen. Post and package 60c extra.

FREE With each lot of resistors, condensers or pots. we will supply one new valve. Type 6U7G, 1T4, 6K7G, or 6X5GT.

SOLID STATE GUITAR AMP.

Here is a fully solid state guitar amplifier rated at a nominal 50 watts continuous power. Featuring two totally independent tone control channels and tremolo facility, the amplifier offers unique flexibility in a light and compact unit. (Featured in July-August issue Electronics Aust.)



Complete kit of parts to Electronics Aust. specifications supplied with foot control switch and lead for remote tremolo. Cabinet finished in black vinyl and control panel in black and silver with matching knobs.

COMPLETE UNIT WIRED and TESTED **$114.00**

COMPLETE KIT OF PARTS **$98.00**

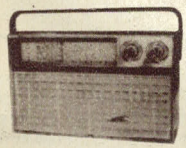
LEADER SIGNAL GENERATOR LSG11



240V A.C. operated, 6-band 120KC to 390 Megs. Provision for crystal.
Post N.S.W., 75c; Interstate, $1.25. **$32**

NEW TRANSISTOR 8 KIT SET

SPECIAL PURCHASE ENABLES US TO OFFER THIS KIT SET AT $24.00



- Complete kit of parts with circuit and full instructions.
- Eight transistors.
- Magnavox 5X3 speaker gives excellent fidelity.
- High sensitivity, suitable for city or country use.
- Heavy duty battery for economical operation.
- Modern design, plastic cabinet with gold trim.
- Dial calibrated for all States.
- Available in colours of off-white, red, black.

DIMENSIONS 9" x 5" x 3" deep

Post N.S.W., $1.25; Interstate, $1.75.

New Electrolytic Condensers

These condensers are miniature pigtail type insulated new stock in packets of 12, each packet containing 3 16 mfd 300 V.W., 2 32 mfd. 300 V.W., 1 25 mfd. 450 V.W. and 6 low voltage electrolytics. **$2.50.**

Post and packing 20c extra.

NEW IMPORTED 4" P.M. SPEAKERS

Available with a 4 or 16 ohm voice coil. **$2.00.**
Post and packing 30c extra.

NEW ENGLISH & AMERICAN TRANSISTORS AT ¼ LIST PRICE

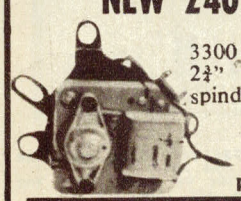
PACKET OF 12 FOR $3.00

Ideal for the experimenter and service man. Each packet of 12 contains 3 each of the following types.

Mazda XA 101. Equivalent	OC45
Texas 2N1108. Equivalent	OC44
Texas 2N1111. Equivalent	OC75
Texas 2N1110. Equivalent	OC45

Post and packing 25c extra.

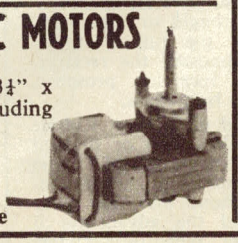
NEW 240V ELECTRIC MOTORS



3300 R.P.M. Size 3¼" x 2¾" x 3¼", including spindle.

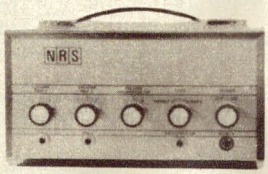
$2.75

plus 60c postage



NEW P.A. AMPLIFIERS

These amplifiers are suitable for installation in clubs schools, restaurants, factories, etc. Wherever the amplification of speech or music is required.
All amplifiers have two microphone and radio or pick-up inputs with mixing facilities and can be supplied with tapped line or voice coil output.

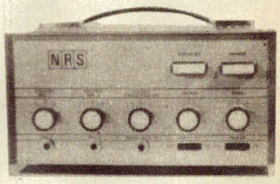


Standard Amplifier

25 WATT

Valve amp. using 2-6CA7, 2-12 AX7, EF86 valves. Dimensions 11in x 6in x 8in. Weight 23lb.

$61.00 Freight extra.



Amplifier with Bass and Treble Controls

45 WATT

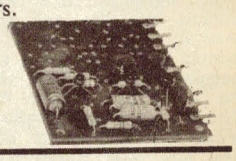
Solid state amplifier using 9 transistors, with separate bass and treble controls. Dimensions 12in x 6in x 9in. Weight 22lb.

$79.00 Freight extra.

A TRANSISTOR PREAMP FOR MAGNETIC PICK-UP OR TAPE HEAD

Using 3 transistors per channel as featured in Electronics Aust. Complete kit of parts including transistors. P.C. board and resistors and condensers.

Circuit and full details supplied.
Stereo Kit **$12.00.**
Mono Kit **$6.50**
240V Power Supply **$7.00.**



NEW MIDGET POWER TRANS. $3.75

40mA prim., 240v. Sec 225 x 225 with 6.3v Fil. Winding. 30mA 240v. Prim. Fil. Winding.
Postage: N.S.W., 25c; Interstate, 45c.
150 x 150v. Sec. with 6.3v.
Postage: N.S.W., 35c; Interstate, 60c. **$3.75**

NEW AMERICAN TWIN TELESCOPE TV AERIAL. Extends to 36in, each section can be used singly for car or portable **$1.50.** Post 20c. **SINGLE TELESCOPIC** Aerial, 12in extends to 33in. **60 cents.** Post 10c.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398

increasing use of satellites by commercial stations freeing parts of the fixed bands for short-wave broadcasting.

GERMAN RADIO HISTORY

The Voice of Germany, Deutsche Welle, on the occasion of the 40th anniversary of broadcasting on short-wave in Germany, released a history of short-wave transmissions from that country.

The present Deutsche Welle is a continuation of the old German short-wave service which was called the German World Short-wave Service. It began operating on August 26, 1929 with a 5KW transmitter in the 31M band. The transmitter was at Koenigswusterhaussen, on the southern edge of Berlin. After test transmissions, the station relayed the home program of the German Radio. Power was increased to 8KW before the end of 1929, and during the Christmas period the programs were relayed by 21 other stations. Directional aerials were then put into service. After a year foreign language broadcasts were added to the station schedule.

During the period 1933 to 1945 the station was under the control of the State. Many will remember the broadcasts from Zessen, using such calls as DJA and DJB, which we verified in 1935.

Today Deutsche Welle has 10 transmitters of 100KW, and soon a 500KW transmitter is to be added to the lineup. The foundation stone for a new transmitting site near Mindelheim has been laid. More powerful transmitters will come into service in the future at this site.

SUNSPOT COUNT

The sunspot count shows a slow decline and, from a report of the Swiss Broadcasting Corporation, it is now taking a steady path towards the mimimum some six years hence. The sunspot predictions for the next months are:

February 83.
March 82.
April 80.
May 79.

RADIO NORTH SEA

A pirate radio station, calling itself Radio North Sea International, is expected to be operating on medium-wave, short-wave and FM this month. The station, operated by two Zurich businessmen, will be located on a ship in the North Sea with a reception area covering Holland, Germany, France and Britain. The station should also be received world-wide on its short-wave frequency.

In a recent broadcast from the Swiss Broadcasting Corporation, the following information was given about the new pirate radio station, located off the coast of Holland. It will have one medium-wave, two short-wave and one frequency modulation transmitters on the Swiss vessel Mebo-2. This has been transformed into a self-contained radio station with generators to provide power for the four transmitters.

A sister ship will service the station, with a shipment of 40 tons of diesel oil and 35 tons of drinking water each trip. The programs will be in French, Dutch, German and English, with 80 per cent of the program live from the ship and the balance recorded in the Zurich studios. A 150ft antenna has been installed on the vessel. The frequency and power details are:

Medium-wave	1605KHz	105KW
Short-wave	6210KHz	13KW
Frequency-modulation	102MHz	

FLASHES FROM EVERYWHERE

EUROPE

CYPRUS: The Cyprus Broadcasting Corporation has altered its frequency for its weekday service to Britain. The station now uses 1910KHz in place of the former 15260KHz. Transmission time, 1900-2105GMT, remains the same. On Sunday the broadcasts are radiated on 17870KHz and from 0900 to 1600GMT. Transmissions are in English and Greek. Reports are welcomed by the station at P.O. Box 1824, Nicosia.

POLAND: Radio Warsaw has transmissions in English for listeners in Europe, Africa and North America. We received the new frequency 6035KHz at 0700-GMT. with a transmission beamed to the United Kingdom. This new frequency is well received in a 30-minute program, which can also be heard on 7125KHz. The complete schedule of Radio Warsaw. Poland in English for listeners in Europe is:

GMT	KHz
0700-0730	7125, 6035
1100-1125	9675, 7145
1830-1900	7145, 6135
1930-1957	7125, 6035
2030-2055	7145, 6135
2230-2300	11955, 9540, 7285, 5995.

GERMANY: Radio Bremen has increased its power, according to a report in Sweden Calling DXers. The station uses 6190KHz. and now has the power of 10KW. Reception has been possible at 0700GMT in New Zealand. The full schedule is 0500 (Sunday 0600) to 2300GMT. The station is interested to receive reception reports on this increased power.

Radio Deutsche Welle, has been heard in New Zealand on the new frequency of 6130KHz. Signals are fair when transmission opens at 0800GMT. The program is for reception in Yugoslavia.

FRANCE: Listeners have observed a rapid expansion in the O.R.T.F. short-wave services in recent weeks. A report from Paris states that six high-power medium-wave transmitters will be put into service this year with a considerable increase in the short-wave transmitter facilities.

UNITED NATIONS: The United Nations Radio, which uses the facilities of the Voice of America for relays of the meetings in New York, has its equivalent in Europe, where U.N. programs are carried by several countries. The Swiss DX Session lists the present transmissions as follows:

Monday to Friday, from Geneva, Switzerland, 1830-1840 in Russian on HBX, using 7443Hz. From 1845-1900-GMT broadcasts are in Arabic from the French Radio transmitters at Allouis, on 15160KHz. From Rome a transmission is broadcast from 1920-1930GMT using 11800, 15400, 17770KHz.

AFRICA

SUDAN: Radio Omdurman is on the air with programs in Arabic from 0400-2200GMT using 4994, 6150, 7200, 9505 and 11835KHz. A program in Arabic and English for local reception is on the air for the period 1600-1900GMT. A broadcast in English to Europe from 1730-1800GMT is on the offband frequency 15720KHz.

SEYCHELLES: The Far East Broadcasting Associates, on the air with 3KW on a test basis, is now trying to concentrate the tests on India and Pakistan. The present schedule of the tests is:

GMT	KHz
0030-0330	15150
1300-1630	17755
1700-2000	21635

Reports should be sent to F.E.B.A., Victoria, Seychelles.

ASIA

CEYLON: Radio Ceylon has been heard by Gerhard Rosam, Berkeley, N.S.W., on 17830KHz. The program was in English from 1100GMT with a news

(Continued on page 180)

Registered Trade Mark

ELECTROLUBE

FREEZER SPRAY

FOR ISOLATING FAULTS IN TRANSISTORS, DIODES AND OTHER SEMI CONDUCTORS, FINDING DRY JOINTS AND BAD CONTACTS. PROTECTING HEAT SENSITIVE COMPONENTS WHILST SOLDERING, CHECKING THERMOSTATS AND THERMAL CUT-OUTS.

ELECTROLUBE IS NON-TOXIC AND WILL NOT EFFECT ANY PAINTS, PLASTICS, OR RUBBERS.

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PHONE 51-3845
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136 VICTORIA ROAD MARRICKVILLE — 51-3845

PORTABLE ELECTRIC ORGAN BASS

2 Octaves. C1 to C3
Modes,
Mellow, bright, sustain, percussion.
Slow and fast decay.
Fine Tuning adjust for orchestra.

$74.50

K 20 CT330



K 20 CT500

C.T.330 20K. OPV

D.C. Volts 6, 6, 30, 120, 600, 1,200, 3,000, 6,000 A.C. Volts 6, 30, 120, 600, 1,200. D.C. Current .06-6, 60, 600mA. Resistance, 6K, 600K, 6meg., 60meg., D.B. minus 200 to plus 62, 5 Ranges. Specially suitable for transistor use.

$16.45

C.T.500 20K. OPV

D.C. Volts, 2.5, 10, 50, 250, 500, 1,000 A.C. Volts, 10, 50, 250, 500, 1,000. D.C. Current, .05, 5.50, 500mA. Resistance, 12K, 120K, 1.2meg., 12meg. D.B. minus 20 to plus 62.

$13.25

KAMODEN—100B

100,000 O.P.V.

D.C. Volts, .5, 2.5, 10.50, 250, 500, 1,000.

A.C. Volts, .25, 10.50, 250, 500. 1,000.

Mils., 0.1, .25, 2.5, 25, 250, ID.A Res., 20K, 200K, 2M, 20M:OHM. DB minus 20 to plus 62. 5 Ranges

$29.75 POST $1.00

200H 20K. OPV

D.C. Volts, 5, 25, 50, 250, 500, 2,500 A.C. Volts, 10, 50, 100, 500, 1,000. D.C. Current, 50uA, 2.5, 250mA. Resistance, 6K, 600K, Capacitance, 2 D.B. Ranges.

$10.95 Post 50c

PANEL METERS

EDGE METERS, 1mA.
Scaled V. & U.S.
Tuning Stereo, Bal. **$2.50.**
A FULL RANGE OF UNITS.
85 Types, 1¼in to 3½in.
FROM $3.25.
Send for full list.

TV CAMERA

Fully Transistorised
Monitor on Standard TV Set. High quality wide angle lens.

$335.00

TAPE CASSETTE
8 TRACK
CAR STEREO PLAYER

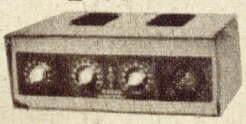
4 watts per channel
12V operation. Neg. earth.

$69.00

4 track 240V unit 8 watts per channel.

$79.00

AMPLIFIERS
Public Address Range
240V-AC



MINIATURE P.A. AMPLIFIER
15 WATTS OUTPUT

Multi Match Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing P.P. EL-84 output **$42.50**
30 Watt. As above, EL-34 P.P. **$57.50**
40 Watt. As above, EL-34 P.P. **$85.50**
60 Watt. As above, 6DQ6 P.P. **$105.50**

LINE OR VOICE COIL.
SOLID STATE
240V A.C.

20 Watt **$49.50**
50 Watt **$69.50**
50 Watt 240 A.C. plus 12V. D.C. Plus Self Battery Charging. **$95.00.**

All have inputs for 2 microphones or 2 Magnetic or Crystal P.U. With Mixing.



P.A. SPEAKERS

8 WATT.
8in Units in Waterproof Projection Horns.
15 Ohm Voice Coils.

$15.25

Line Output Transformers to suit. **$1.75 extra.**

MICROPHONE GOOSE NECKS. SATIN

9in	$2.75	MIC. STAND.	
12in	$3.50	Floor Model,	
18in	$4.35	$11.75.	
24in	$5.00	Table mod.	$3.65

LOW LOSS MIC. CABLE
15c per yard or $10 per 100yds.

50 WATT SOLID STATE GUITAR AMPLIFIER

E.A. July & August Issue.
Kitset, including Cabinet,

$98.00

Wired and Tested,

$114.00

Speaker Enclosures to suit
4 M.S.P. Speakers,

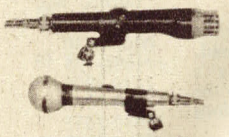
$104.00

2 Pioneer 15in Speakers,

$94.00

2 Rola 50 watt speakers

$128.00



Model UDM-105 Cardioid. 50K-600 ohms. **$16.95**
Model DM-304 50K-600-ohm **$14.95**
Model DM-108 .. .. .. **$11.95**

DX-129 .. .. **$12.75**
Hi Imp Dynamic DM 401 **$8.75**
Hi Imp Dynamic DM 203 **$8.75**
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Crystal Pencil BM-3 .. . **$7.50**
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HI-FIDELITY TWIN CONE SPEAKERS

Aust. made,	8	to 16	ohms.
6in ..	$9.00	12in	$11.75
8in	$7.50	Postage:	
8in ..	$9.50	Interstate	80c
10in ..	$10.75	N.S.W..	50c

NEW SPEAKER SPECIALS

8 to 15 ohms			
2in ..	$2.75	6in ..	$4.00
2¼in ..	$2.75	4 x 2in	$3.30
2¾in .	$2.85	5in x 3in	$3.30
80mm .	$2.85	6in x 4in	$4.25
3½in ..	$3.95	9in x 6in	$.5.95
5¼in ..	$3.20	N.SW. 25c	
		Interstate 40c	

Magnavox 10in Twin Cone 8 ohm **$6.75**

STEREO RECORD CHANGERS

Latest Model, 4-speed.

$28.75

De Luxe Model.
Fully machined and balanced.
Heavyweight turntable. Ceramic Cartridge.

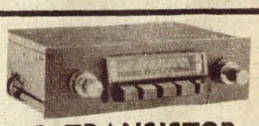
$34.00

Post: N.S.W. $1.25. Interstate $1.75.

De Luxe Model
with mechanical cueing device.
Calibrated stylus. Pressure control.
Adjustable counter balance.
Two spindles.

$46.50

Fully Auto. Player
All Refinements
Magnetic Cartridge, **$65.**



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R.F. Stage for long range reception. 6 or 12 volt operation. On ordering please state polarity requirements complete with lock down aerial and lead.
Speaker Selection. 5", 6", 8", 7" x 5" or 6" x 9".
De Luxe Push Button Model, **$55.75**
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Car Aerials complete with lead. Top cowl mounting, 3", 6", **$2.75**
Lock Down, 3" 6" **$4.75**

V.T.V.M. MODEL TE-40 MILLIVOLTER

Spec. AC.V Imv.—300 Vrms, 10 ranges. Accuracy 5 cps-1 2 mc, plus-minus 2db, 10 cps-1 mc, plus-minus 1db 20 cps-250 KC, plus-minus 0.2dB.
dB. Scale: 40-30-20-10-0, 10.20, 30-4 50 dBm, 240 V.A.C.

$48.75

MODEL TE-65 V.T.V.M.

DC, V 0-1, 5-5-15-50-150-500-1,500 V. Rms. A.C.V. 0-1.5, 5.5-15-50-150-500-1,500. V. Rms. 0-1.4-4-14-400-1400-1400-4000 V. P.P. Resistance: RX10 .100.1K .10K, .100K, 1M 10M, Decibel — 100db minus-plus 65dB.
240 V.A.C.

$43.75

TECH. P.V.58, $40.50.

ORGAN KEYBOARDS

49-Note. Complete with Switching System.

$72.00

13-Note, Pedal Claviers, Complete with Switches.

$39.95

HI-FI STEREO HEADPHONES

8-OHM.
Range 25c to 17Kc.

$9.75

Post 35c.

TAPE CASSETTES

TENSILISED MYLAR

C 60	$1.25
C 90	2.00
C120	$2.75
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NEW RECORDING TAPE

Most Popular Brand

3in	Correspondence ...	50c
3in	Mylar L.P. 300ft ..	$1.05
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5in	Mylar L.P. 900ft ..	$2.50
5in	Mylar D.P. 1200ft ..	$3.15
5¾in	Mylar L.P. 1200ft	$3.15
5¾in	Mylar D.P. 1800ft .	$3.50
7in	Mylar L.P. 1800ft ..	$3.75
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7in	P.V.C. 1200ft	$2.50

Postage: N.S.W. 15c.
Interstate 25c.



GUITAR AMPLIFIERS

10-Watt, Two-Channel, with Twin Cone Speaker $53.55
14-Watt, 4 Inputs. Base and Treble Boost, 2 Twin-cone Speakers, $63
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35 WATT

4-Channel, Bass and Treble Boost, 4 Twin-cone Speakers . $109.05
Vibrato with foot control and 2 preset controls for frequency and intensity. $10.50 extra on above models.

REVERBERATION UNITS

Latest design to suit organs, stereo, guitar, any hi-fi equipment.

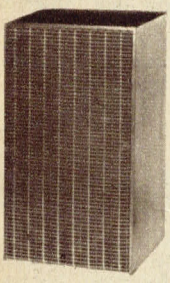
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FUZZ BOX, E. AND A. AUG. WIRED AND TESTED.
$15.
Post 75c.

REVERB UNIT

COMPLETE with AMPLIFIER. E.A. October issue. Kitset $39.95. Wired and tested, $41.95.



MULLARD MAGNAVOX

BOOKSHELF ENCLOSURE
Maple, Teak or Walnut
Complete $24.75
SUPER BOOKSHELF
$36.75.
Post: N.S.W. 50c, Interstate $1.00.
CABINETS ONLY.
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BOOKSHELF UNITS

6in	8in	10in	12in
$27.75	$33.50	$39.75	$42.75

PLAYMASTER 127 STEREO CONTROL UNIT

For tape replay. Magnetic, disc. and crystal cartridge input. Radio fully described Nov. 69 issue E.A.



KIT SET $49.50
Wired and Tested $59.50.
Pack and Post 75c.

128 STEREO AMPLIFIER

64 watts per channel
Kit Set $95.00
Wired and Tested $109.00

PIGGY BACK GUITAR AMPLIFIER

Excluding Speakers

30 Watt $79.75
45 Watt $99.75
60 Watt $119.75
4 Inputs. Bass and Treble Boost Vibrato if required, $10.50 extra.

PIGGY BACK GUITAR AMPLIFIER

Complete with Speakers & Cabinet

30 Watt Lead $138.75
30 Watt Bass $146.75
45 Watt Lead $158.75
45 Watt Bass $166.75
50 Watt Lead $218.00
60 Watt Bass $234.00
Vibrato if required extra $10.50

119 STEREO TAPE ADAPTER

Suits all Playmaster Stereo amplifiers and others that accept crystal P.U.

Kitset $79.00
Wired and tested $96.00

10 + 10 STEREO AMPLIFIER

With Overload Protection Circuit
Kit Set. $62.75.
Wired and Tested $72.75

WIDE BAND OSCILLOSCOPES

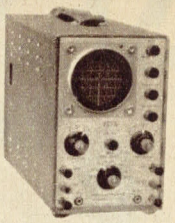
SPECIFICATIONS

VERTICAL AXIS

Deflection Sensitivity (at 1 kc) 0.1 V p-p/cm.
Frequency Characteristics, 1.5 cps—1.5 MC.
Input Impedance, 2 M ohms 25pF.
Calibration Voltage IV p-p/cm.

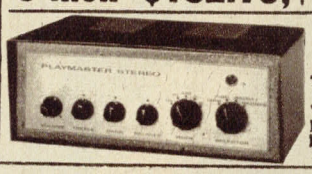
HORIZONTAL AXIS

Deflection Sensitivity 0.9V p-p/cm.
Frequency Characteristics 1.5 cps —800 KC.
Input Impedance 2 M ohms 20 pF.
Sweet Oscillator (5 Range) 10 cps —300 KC.
Synchronisation Devices Internal (Positive and Negative, External).
Power 240v AC 50/60 cps.
Cathode Ray Tube 3KF1F.



5 Meg Bandwidth Push-Pull vertical and Horizontal Amplifiers, 8 positions, high sensitivity, vertical Amplifier Frequency Compensated on all positions. Calibrated .02 to 600 volts. Hard time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch $102.75; 5-inch $118.75



PLAYMASTER 115

The new Solid State Stereo-Amplifier. April issue.
Wired and tested $104.00
Kit Set $90.00
Pre-amp to suit magnetic Cartridge $12.00



AUTOMATIC RHYTHM BOX

12 RHYTHMS.
9 PERCUSSIVE INSTRUMENTS
240v A.C. OPERATION.

$145.00



MUSICOLOUR

Sound control of coloured lights. As described E.A. Oct., 69.
Kit set $46.05
Wired and Tested, $54.00.

NEW COMMUNICATIONS RECEIVER

Kit-Set $190.00
Wired and Tested $230.00

ALL SILICON TRANSISTOR SOLID STATE STEREO AMPLIFIER



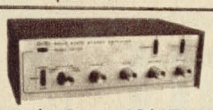
240V AC powered, 8 watts RMS per channel inputs for magnetic, ceramic, and crystal cartridge, also recorder and radio tuner. Hi-Fi frequency response speaker matching 4-16 ohms. Size 10½in x 6½in x 3½in. Attractive oiled teak cabinet.

$54.00 Pack and Post $1.50.

240V. A.C. INPUT

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240v A.C. POWERED SOLID STATE STEREO

T.S.135

18 Transistor, 15-watt per channel. Inputs for Tape. Mag. P.U. Ger. P.U., Radio Aux. Freq. Range 30c to 20KC. Max. Sensitivity 3 MV. Speaker matching 4 to 15 ohms.

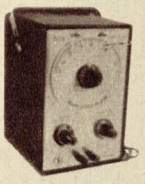
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SIGNAL INJECTOR

Transistorised. Fountain pen-sized Unit for Signal Tracer in Radio, TV and Amplifier Service.
$5.75. Post, 25c.

3" VERNIER DIAL

8:1 Ratio
$2.95, Post 25c.

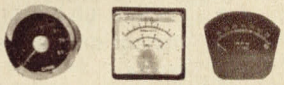


AUDIO GENERATOR

De Luxe Model TE—22D.
Freq. range, Sine 20 cps—200 KC. SQ. 20 cps—25KC. Output voltage. Sine 7V. SQ. TV P.-P. Output Impedance 1000 ohms. Acc. 5 per cent. Distortion less than 2 per cent. 4-range attenuation. 1/1, 1/10, 1/100, 1/1K. Printed circuit. 240V A.C.

$42.95

TACHOMETERS



Mullard ACE, scaled for 5.7 or 9K $20.75
With Dwell Angle $23.75

OHNAR

240-degree Circular Movement.
Scaled 6K or 8K $24.75
Standard Scale 6 or 8K .. $19.75
Postage N.S.W. 50c, Interstate 75c.

G.D.O. UNITS

Post: N.S.W. 50c, I'state 75c.
T.E. 15 Transistorised, 7 Band, 360 Kc to 270 Megs.

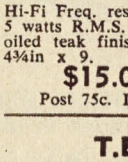
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TV BOOSTER

240VAL. Especially designed for fringe area reception. Also up to 3 TV sets can be operated off common aerial for improved signal strength. **$15.95** Post Free.

NEW GRAMMO MOTORS

240V. A.C.
3 Speeds, $2.75.
Post: 40c.



NEW LOOK SPEAKER ENCLOSURES

Hi-Fi Freq. response. Power rating 5 watts R.M.S. Attractive, modern, oiled teak finish. Size 14½ in x 4¾in x 9.

$15.00 EACH
Post 75c. Interstate $1.25.

SIGNAL GENERATOR

De Luxe Model TE20D.
Freq. Range 120 KC—500 Mcs. 7 Bands. Accuracy 2 per cent. Output 8V. Provision for Xtal Suitable for self-calibration Marker generator. Printed circuit. 240 T.E.20. $25.50. V.A.C. **$31.75**

HIGH POWER LOW FREQUENCY SPEAKERS

Suit Bass and Organ

15in imported. 30 watts RMS $30.00
15in Local 25 watts RMS $47.50
12in Rola 50 Watts RMS $46.50
12in Rola Twin Cone 50 watts RMS $52.50

T.E. 46 RESISTANCE-CAPACITANCE

Bridge and Analyser.
Capacity 20pf to 2000mfd.
Resistance 2 ohms to 200 megs.
Also tests power factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs. at 600V.
Indications by eye and meter.

$53.75

VOLT. A.C.

VARIABLE TRANSFORMER.

0-260V, 10 amp. $49.50
0-260V, 5 amp. $37.50
0-260V, 2½ amp. $25.50

KEW-SNAP

SNAP-AROUND VOLT-AMMETER



The KYORITSU range of four Tong Testers allows quick and accurate measurements from 6 to 900 amperes, voltage to 750 volts and resistance to 25 ohms or 300 ohms midscale; according to the model.

Jaw openings are to 1⅞" and are snap positive in their movement.

Prices range from **$19.00** to **$50.00** plus sales tax, if applicable,

Pocket-sized, the instruments have features which enable electricians, service maintenance men and engineers to trace faults and investigate operating conditions **without** shutting down equipment.

KEW-SNAPS—

- Are safe to use.
- One hand operation.
- Thumb selection of ranges.
- Rotating scales show only the range in use.
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PERTH	28-1102
LAUNCESTON	2-5322

JACOBY MITCHELL
EQUIPMENT FOR INDUSTRY AND RESEARCH

bulletin at 1130GMT. The station address is Ceylon Broadcasting Corporation, P.O. Box 574, Colombo, Ceylon.

MONGOLIA: According to a letter from Radio Ulan Bator, the present transmissions in English are:

GMT	KHz
1220-1250	15440, 17780
2200-2230	11860, 9540

These are daily broadcasts in English. The station confirms reception with a verification card and letter. The mailing address is Radio Ulan Bator, C.P.O. Box 365, Ulan Bator, Mongolia.

THE AMERICAS

CHILE: Chilean stations are now using summer-time, with their clocks put forward one hour. Bob Padula, of Melbourne, reports that stations are now heard around 0900 to 0930, instead of opening between 1000 and 1100GMT. Fair to good signals have been observed at 0930GMT.

9570KHz Radio Porteles, noted with popular music 0930-1000GMT.

9590KHz Radio Presidente Balmiceda, sign-on at 0930GMT with signals mixed with Trans World Radio, Monaco.

9690KHz Voz de Chile, opens at 0930-GMT with "Pomp and Circumstance" theme.

9752KHz Radio Mineria, sign on at 0930GMT with identification.

ECUADOR: Radio HCJB, Quito, has made frequency changes from December 14. This includes the deletion of the 13M band to Europe. The times and frequencies of the new programs are as follows:

GMT	KHz
0330-0700	9525
0330-0700	11780
0500-1100	9645
1800-2145	17780, 15300, 11780

BROADCAST BAND NEWS

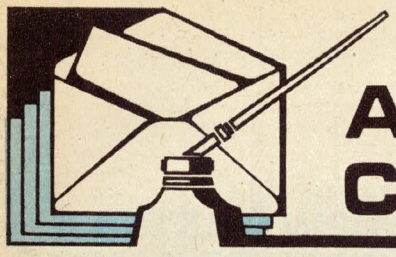
DYWN VERIFIES: One of the most sincere and appreciative letters of verification we have received for many months came to hand recently, from Bacalod City, on 1470KHz with the call DWYN. This handwritten letter was from Miss Edna Baldonado, of the station staff.

We learn from the letter that the station is one of two operated by the Bacalod Broadcasting Centre. The other, DYNA with 1KW, is a "good-music" station. DYWN was first located on the roof of the main building of West Negros College, but moved to the gym auditorium in the college. It is now an action and information station. DYNA now occupies the old studios of DYWN. The staff of the station are all very young. The director is Geor Agustin, and his family own the stations.

Broadcasts have been heard on 1470KHz from about 1000GMT to after 1500GMT in its all-night transmission.

Our report was the first the station had received from any distance and the first from New Zealand. They were delighted to learn that their 5KW could be heard at such a distance. The mailing address is Radio DYWN, Bacalod Broadcasting Centre, West Negros College, Bacalod City K501, Philippines.

AMERICAN SAMOA: Station WVUV has verified our reception after a wait of 18 months. This station was widely reported from this country in May, 1968, when it increased power to 10KW on 1120KHz. According to the verification card the station is located at Pago Pago, American Samoa 96920, and the card is signed by V. Williams, manager. The station is owned and operated by the Government of American Samoa, and can be heard at around 0900GMT during the winter months.



ANSWERS TO CORRESPONDENTS

COMMUNICATIONS RECEIVER: I have been following with interest the series of articles leading up to a communications receiver. May I make the following suggestions: 1, Modular (preferably plug-in) construction. 2, Alternative front ends for particular preferences, e.g., amateur bands only, with a longer sweep near 28MHz, for use with VHF converters. 3, Cheapest possible construction. Relating to the last point, I have drawn a circuit which combines parts of the circuit of the Receiver IF System (Nov., 1969), with the LM372 IC amplifier used in the Micro-One, described in April, 1969. I am sure there are real cost advantages to be had in using microcircuits where possible. Perhaps you could use it in Reader Built It (though I have not actually built it), or even tie the LM372 into your present developmental amplifier. It appears impossible to feed the BFO into the LM372 without upsetting the AGC action. Therefore, I have added your product detector with BFO, after the LM372, for CW-SSB reception. If this arrangement will work, I would be pleased to read about it in Answers To Correspondents. **(R.H., Townsville, Qld.)**

● Thank you for your interest and suggestions R.H., these are always appreciated. The modular construction is a good idea and indeed, we can claim to be doing just that by using major subassemblies in the new receiver. We have not used plug-in techniques as this could be expensive and of doubtful value. The alternative front end request is an understandable one. However, there could be as many ideas on front-end needs as there are readers and so we must compromise with what we have found to be perhaps the most desirable in the circumstances. As for changing the band sweep width within a given design, this could be complex and costly. Our new receiver incorporates a tunable IF of 3MHz (3-6MHz) and this, or one of the many other 3MHz ranges, could be used for VHF converters. Regarding costs, we have been very mindful of this in the new design and every effort has been made to keep costs to a minimum, consistent with meeting a design objective. The circuit which you submitted appears to be sound as far as tying in the switched ceramic filters with the LM372 is concerned. However, we agree with the difficulties presented by trying to feed the BFO directly into the detector part of the LM372. Your suggestion to add the product detector and BFO after the LM372 output is not a sound one and regretfully, we must reject it. Relating to costs and microcircuits, we always endeavour to keep this one in mind when arriving at a design. Sometimes there are cost advantages, but not always. There are other points to be considered as well. Sometimes there is not an IC available to do the job required. Also, unless ICs are handled properly, there can be a real danger of instability troubles, where individual builders are concerned. Your idea is not suitable for "Reader Built It," as a prime requirement here is that the reader did, in fact, build it. By the time this appears in print, presentation of the communications receiver will have already begun and you will be able to judge the design for yourself.

RECORDING TAPES: Thank you for the very good article recently on loudspeakers and enclosures. Could there be another one on the various types of tapes used in recorders? Because of the very great price difference between the various brands, there is apparently a lot more to to it than just putting any old tape on to a recorder. A comparison with playing time for an L.P. record would come in useful. Also, can you comment on the fact that most pre-recorded tape is on 7-inch spools while most of them intended to play at 7½ips will fit easily on a 5-inch reel? **(L.B., Pennant Hills, N.S.W.)**

● The last matter was referrred to in "Forum" some time ago. For the most part, the content of pre-recorded tapes is identical with the equivalent L.P. albums and the amount of tape on the reel is a direct indication of the playing time — something that is not obvious from first glance at a disc. The idea of using a 7-inch reel and box is apparently a packaging convention which, admittedly, is open to question. Regarding tapes, some of the differences stem from thickness and material, and reflect in the stretch and breakage characteristics and the playing time which can be accommodated on a spool. Associated with this may be the thickness of the coating, which can have a bearing on recording characteristics, as explained at length in the October issue. The precise characteristics of the coating are rather harder to pin down and may result in one tape being marginally better for one machine than another, largely because of the precise level to which the bias happens to be set. Over and above all this is the matter of sales and job lots which may result in premium quality tape reaching the consumer at a marked down price. We can have a look at the idea of a full scale article on the subject but it may be difficult to be definitive about the matter. Your reference to the playing time of L.P. discs would seem to suggest that you believe this to be standardised. In fact, it varies tremendously from album to album. Some of them play for no more than about 13 minutes per side; others can run to three times this figure. It is a matter of how closely the grooves are packed together.

VHF RECEIVER: Have you published a converter or a transistor receiver cover-108 to 136MHz? **(K.S., Hornsby, N.S.W.)**

● We have not described a converter covering the band you specify. The nearest designs to this have been a number intended for the 144MHz amateur band which you may be able to adapt to your requirements. The latest of these is the "Crystal Locked Converter" of March, 1963 (File No. 2/CV/17.). We have not described a transistorised receiver to cover the VHF band, but we did publish the "1967 Fremodyne Four" in March, 1967 (File No. 2/SW/40). This is a valve receiver which should otherwise meet your specification. The circuits mentioned are available through the Information Service for 20c each.

LCR BRIDGE: As one who has supported "Electronics Australia" for a long time, I was recently taken aback by being reminded that you have not to date described, a really comprehensive LCR bridge. With modern day circuits making such extensive use of inductors and high value capacitors, this type of bridge is

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: For a 20c fee, we will supply data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for project data will be answered more speedily if the projects are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to six months old the cost is the face value, plus 5c surcharge. From seven to 12 months, 10c surcharge; over 12 months, 20c surcharge. Package and postage is 10c extra per issue. Please indicate whether a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

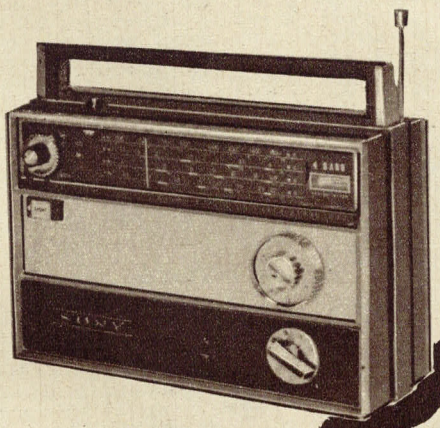
COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

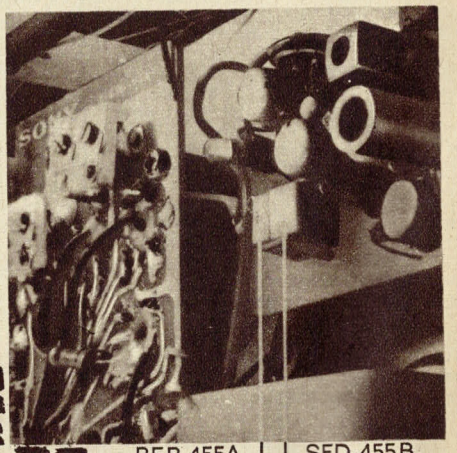
REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W. 2001. 5/69

Sony replaced IFT in this 4-band transistor radio

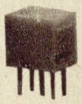
with the new Murata ceramic filter SFD-455B.





BFB-455A ⌋ ⌊ SFD-455B

muRata



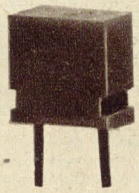
ACTUAL SIZE

SFD-455B

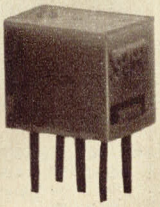
Throughout the world electronic design engineers have begun to realise the many benefits offered by Murata Ceramic Filters. These include high gain, low spurious response, negligible ageing characteristics (0.4% over 10 years) and, since no alignment is necessary, considerable cost saving in production.
Sony engineers have taken advantage of these benefits and have incorporated two Murata Ceramic Filters SFD-455B and BFB-455A in the quality model TR-1000 4-band transistor radio.

Combining excellent overall response and selectivity characteristics with space saving and production economy, the Murata Ceramic Filters are proving superior to conventional IF transformers.

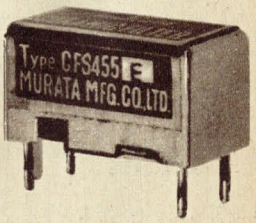
Include Murata Ceramic Filters in **your** next design.



MODEL BFB-455A improves the selectivity of transistor radios when used as an emitter by-pass in transistor IF Stages.



MODEL SFD-455B is a resonance type filter of 455 Khz. It replaces the transistor radio's IFT or can be used in combination with IFT's.



LADDER TYPE Ceramic Filters CFS-455 and CFP-455 (Popular Type) are ideal for IF stages of high quality communication receivers.

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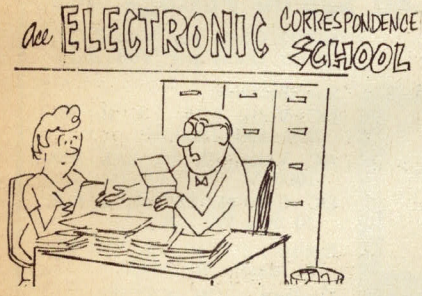
ANSWERS – continued

essential in the workshop. Despite this remark, I still vote the magazine as first rate and wish you and your staff every success for the future. **(M.D., Levin, N.Z.)**

● We have certainly described bridges but nothing as comprehensive as you apparently have in mind. We have thought about it on a number of occasions but, each time, have come up against particular difficulties or more urgent items. Perhaps we should think of the subject again!

RADIO INTERFERENCE: I am interested in the fact that my radio receiver picks up a whirring sound from our floor polishing machine. The sound is most obvious when the receiver is tuned in between stations. Also, I would like information regarding small plastic boxes for mounting meters. These were available from "Clarks" rubber stores but have been sold out and will no longer be stocked. Could you tell me where I can get these and for what price? **(E. K., Bentleigh, Vic.)**

● The interference caused by the polishing machine and other, similar, motors is a common occurrence. It is caused by arcing between the brushes and commutator in the motor. It will be most noticeable on a receiver when it is tuned off a station because in the absence of a signal, the receiver will have maximum sensitivity. So far as the boxes are concerned, we are not able to help as we are not conversant with every product available commercially, nor do we have catalogues listing prices. And, because of possible variations of prices of particular items from different suppliers, we have a firm policy of not supplying cost information.



"To Mr John A. Cook, Alameda, New Mexico. Dear Mr Cook: Yes, you may put in the plug." ("Radio-Electronics.")

PHONOGRAPH HISTORY: In the container of an old cylinder record, I found reference to a sapphire reproducing stylus. Also an advertisement for a reproducing head featuring spring tension. The explanation runs: "the extra spring tension — carrying the reproducer point down into every finest indentation." **(D.B., Windsor, N.S.W.)**

● Cylinder records pre-dated our present technical staff, but we gather that sapphire styli were commonly used for cylinder records. The modulation was hill-and-dale (vertical) and the stylus pressure and inertia ideally needed to be such as to allow the stylus to "fall" at a rate at least as great as the most steeply sloped downward excursion. The extra spring pressure was apparently intended to assist in this direction, but at a price in terms of extra stylus wear.

TRANSISTOR EQUIVALENTS: A situation has arisen where each producer has a unique system of coding his transistors which may be similar to those of another producer with a completely different coding. If one sticks rigidly to circuit diagrams when building a project, it is easy to run up an unnecessary bill for transistors where alternatives already purchased could be reclaimed from unwanted earlier projects. I would appreciate, therefore, a list of transistors and their equivalents (if this is possible) or information which will help in regard to this problem. **(P.S., Claremont, W.A.)**

● You are not the only one concerned with this problem. It is one which is worrying everybody from the transistor manufacturers themselves, through the industrial users down to the home constructor like yourself. The manufacturers are hoping to find some solution to the problem and, so far, have at least avoided duplication of numbers for different devices which would present a far greater problem! If you watch our book review pages you will see that several publishers regularly produce books giving transistor equivalents. Alternatively, if you want to keep to the transistors of one manufacturer, you could probably obtain an equivalents list from that company or its agents. Several of our regular advertisers in "Electronics Australia" are manufacturers of semiconductors or agents for overseas manufacturers. We suggest that you contact one, or more, of them.

SQUARE-WAVE GENERATOR: I am trying to collect a kit of parts for the 1MHz Square-wave Generator described in February, 1967. My main problem is the power transformer, which my dealer does not seem able to recognise. Could you advise the make and type number of the unit used in the prototype? **(W.M., Merrylands, N.S.W.)**

● The transformer used in the prototype was made by Ferguson Transformers and the type number is PF2439. It does appear that these transformers have not been stocked by many dealers, but they are available from R.C.S. Radio Pty. Ltd., 651 Forest Rd, Bexley, N.S.W. 2207.

IGNITION SYSTEMS: Congratulations on your article in the November 1969 issue on the subject of capacitor discharge ignition. I fitted ordinary transistor ignition to my Holden 179 waggon at 2,000 miles; it now has 40,000 miles up. In the unit I fitted, it is not necessary to disconnect the capacitor. Also, I set the plugs at .045 and found that after 10-15,000 miles, they had opened to .055. However, I found that the engine performed better with the normal .035 setting. I suffered my first plug failure at 34,000 miles after fitting. My verdict about transistor ignition is that plug and point life is extremely good but fuel economy is only significant if the vehicle is driven a lot at high speed. It would also be worthwhile in heavy, long-distance trucks. **(A.J., Morningside, Qld.)**

● Thanks for your observations, which have been summarised for the interest of other readers. We also feel that claims about fuel economy have often been greatly exaggerated. However, any small economies of this nature are a welcome bonus.

FUZZ BOX: Can you send me a circuit diagram for a Fuzz Box to connect between the amplifier and a guitar. **(A.R., Mansfield Park, S.A.)**

● We published a Fuzz Box for electric guitars in August, 1967. Copies of the article are available through the Information Service for 20c. File No. 1/GA/10.

UNITED TRADE SALES
PTY. LTD.

TRANSISTOR V.H.F. CONVERTER
Tunable 108-136 Mhz Aircraft Band 1F-600Kc to 1,000Kc. No connecting wires needed, 9V Battery, self-contained, just place alongside broadcast radio. Price only **$14.40** plus **45c** postage.

TRANSISTORS
2SC73, 2SD65, 2T76, OC66, 2T65 **25c** ea. or in 100 lots **20c** ea.

LSG11 SIGNAL GENERATOR
120KHZ to 260 MHZ New in sealed carton **$35**, postage **$1**.

POWER SUPPLIES
600V. 400 mA. Complete with 2 x 866A Rectifiers. 2 x 500mA Filter Chokes on 19in Rack Panel. Good condition. Weight approx 50lb.
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Freight extra.

RESISTORS. Mixed Values only in Bags; **$2** per 100, or 50 for **$1.**
3,000 Type Relays. New stocks. **50c** each. Plus postage.

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80 for $2 in Poly Packed Bags.
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Cassette Recorder Type Replay Heads. 2-track Mono Current Manuf.
New $1.50 ea.
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MILLER TRANSISTORISED IF STRIPS
455 Kc Selectivity 5 Kc at 6db down. Power 6 Volts 2mA gain 50db.
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NU-METAL SHIELDS
To suit 5BP and other 5in CRTs mfd. by Magnetic Shields Ltd. **Brand-new, $5 ea. plus 30c pack. and post.**

3,000 TYPE RELAYS.
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6A8	$1.50	6SQ7	.60
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6B6	$1.50	6X4	.60
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6BF6	$1.00	12AT7	.50
6CH6	.50	85A2	.75
6G8	$1.50	815	.70
6H6 Metal	.20	833A(used)	$6.00
6J6	.30	872A (used)	.75
6J7	.50	844	$1.50
6J8	$1.75	6939 QQV02/5)	$2.00
6K7	.50	ECC33	.50
6K8	$1.00	ECC35	$1.00
6SA7	$1.00	KT61	$1.50

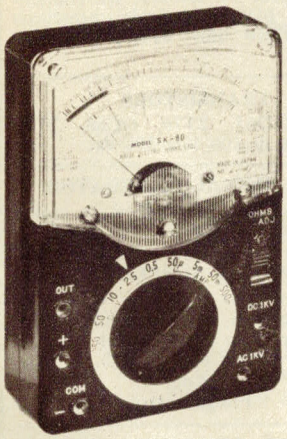
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RECEIVERS, TRANSMITTERS
TEST EQUIPMENT.

280 LONSDALE STREET,
Melbourne. Phone 663-3815.
(Opposite Myers)

NEW RH (Radio House) RANGE OF MULTIMETERS

Model RH-80 $18.00 Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current: 50uA, 5mA, 50 mA, 500 mA

Resistance. 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ

Decibels. —10 + 62 lb

Accuracy. DC±3%, AC ±4% (of full scale)

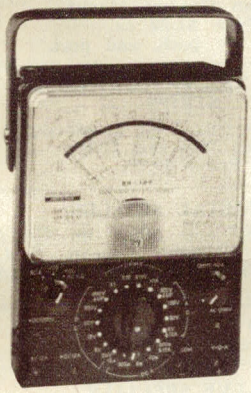
Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

Model RH-100 $39.75 Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

● Overload Protected by Dual Silicondiodes ● Double-jewelled ± 2 per cent Meter ● ±1 per cent Temperature-stabilised Film Resistors ● Polarity Changeover Switch ● Mirror scale, instruction for operation with circuit diagram.



SPECIFICATIONS:

DC Volts: **0.6, 3, 12, 60, 300, 600, 1200V (100,000 /V)**

AC Volts: **6, 30, 120, 300, 1200V (10,000 Ω/V)**

DC Current: **12μA, 300 μA, 6mA, 60mA, 600mA, 12 amps DC and AC Current 12 amps.**

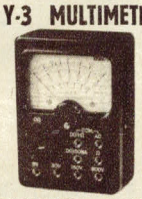
Resistance: **20KΩ, 200KΩ, 2MΩ, 20MΩ**

Decibels: —20 to + 17, 31, 43, 51, 63.

Accuracy: DC±3 per cent, AC± 4 per cent (of full scale)

Batteries: Two 1.5V dry cells, size AA, "Eveready" 915

NEW TYPE Y-3 MULTIMETER



MEASURING RANGE: D.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). A.C. Voltage: 6V, 30V, 150V. 600V (2000 ohms/V). D.C. Current: 150 mA. Resistance: 0-100,000 ohms. Complete with 1.5 volt battery and test leads. Size: 3¾" x 2¾" x 1⅜".

Checked, Packed and Posted — $9.50. Limited Stocks.

TAPE RECORDER



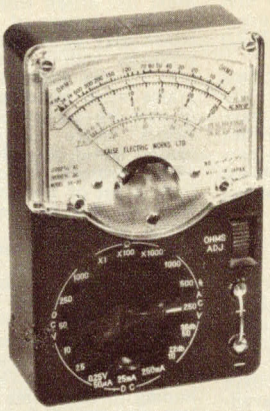
$20.50

BOOK TYPE

The latest model portable Taperecorder. 4 transistor, 3in reels, 2 tracks. Instruction manual. Size 10½in x 7in x 1½in.

Just open the book and record. Supplied complete with tape, microphone and batteries. Special discount price, **$20.50, posted anywhere.**

Model RH-20 $15.00 Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000 (20,000/V)

AC Volts: 10, 50, 250, 500, 1000 (10,000/V)

DC Current. 50 uA, 25mA, 250mA

Resistance. 7kΩ, 700kΩ, 7MΩ

Decibels. —10 +22 (at AC/10V) +20 +36 (at AC/50V). Upper frequency limit 7kc.

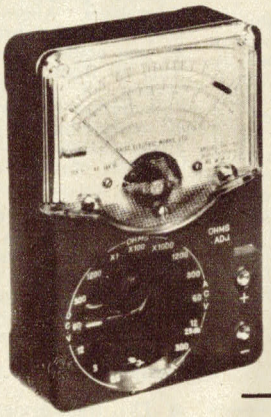
Accuracy. DC ±3%, AC ±4% (of full scale)

Batteries: Two 1.5V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes.

● Double - jewelled ±2% meter. ● ±1% temperature-stabilized film resistors.

Model RH-55 $20.00 Postage 50c



30,000 Ohms per Volt DC
14.000 Ohms per Volt AC

SPECIFICATIONS:

*DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V (30,000 ohms/V.

*AC Volts: 12V, 60V, 300V, 1200V (14,000 ohms/V).

*DC Current: 60 A, 12mA, 300mA.

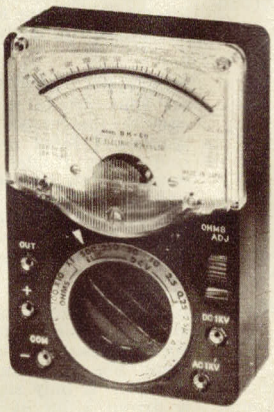
*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.

*Decibels: -10 db +23 db.

*Meter Sensitivity: 23 A.

● Overload-protected by dual silocon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

Model RH-60 $25.00 Postage 50c



50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 25 uA, 5 mA, 50 mA, 500 mA

Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ

Decibels. —10 +62 db

Accuracy: DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915

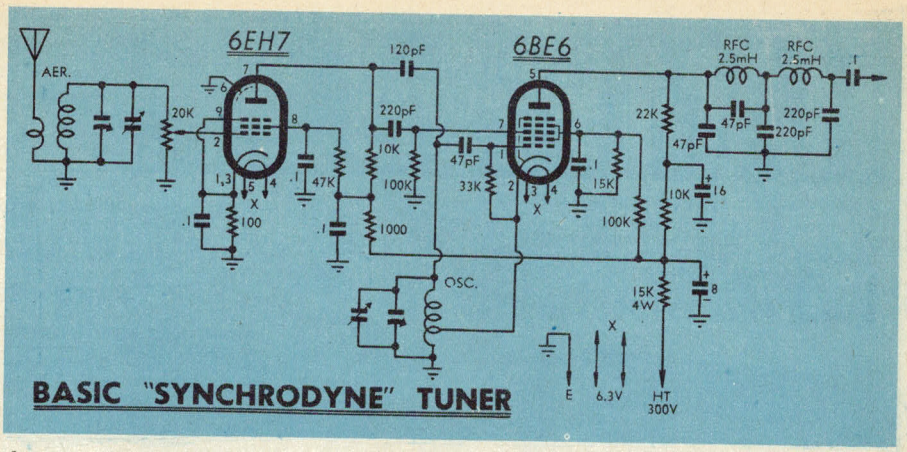
● Overload-protected by dual silcon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

Just arrived. New stocks of the latest model Crystal Radios. Price $3.95 plus postage 35c. Complete with earphone, aerial clip and attractive plastic case.

RADIO HOUSE PTY. LTD.

306-308 PITT STREET: 6 ROYAL ARCADE & 760 GEORGE STREET, SYDNEY

ANSWERS — continued



BASIC "SYNCHRODYNE" TUNER

As a circuit arrangement applicable to radio tuners, the synchrodyne has been the subject of argument for decades. Some regard it as a cranky, thoroughly impractical arrangement. Others maintain that it could have won acceptance, had it been given even a fraction of the attention that has been lavished on superhet tuners. An article on the synchrodyne tuner, together with instructions how to build one, appeared in the September, 1963 issue of "Radio, Television and Hobbies," the name by which our journal was then known. While the circuit is shown, readers should not try to construct it without first studying the descriptive article. The oscillator coil, for example, is not the type used in a superhet tuner. Copies of the article are available for 20c. Letters should be addressed to the Assistant Editor, "Electronics Australia," Box 2728 G.P.O., Sydney, 2001. (Please quote file number 2/TU/21.)

SURPLUS PARTS: Since the war, I have acquired many radio sets and components, some of war disposals origin. I would be pleased to give them away to interested beginners. Please specify Saturdays only. **(P. W. Butler, 1 Darley Rd, Randwick, 2031).**

● Thank you for your kind offer. It is pretty certain that beginners will be only too glad to take advantage of your generosity.

PLAYMASTER COMPONENTS: Can you please tell me where I can buy the printed circuit board 69/p9 for the Playmaster 127 Control Unit, and how much it will cost. If they are available through you, will you mail one to me, and I will pay by return post. **(P.S., Bandiana, Victoria.)**

● All components for projects featured in "Electronics Australia" are available through trade channels. Suppliers of components who specialise in parts for our projects advertise in every issue of the magazine. We suggest you examine the advertisements in your current issue, and decide which supplier is most convenient for you to deal with. We cannot quote prices, which must be obtained from the supplier concerned. Readers should note that "Electronics Australia" does not deal in components of any kind.

WALKIE-TALKIES: Have you ever published any articles on the construction of a "walkie-talkie" transceiver with a power output within the P.M.G.'s Department limits where an operator's licence is not required. **(P.H., Kingsgrove, N.S.W.).**

● We have not described the construction of any "walkie-talkies" P.H., and we must also point out that the concept of a power rating which does not require a licence is completely wrong. All transmitters, no matter what their power rating, must be licensed. The penalties for use of unlicensed transmitters can be severe.

PREAMP FOR SOUND PROJECTOR: Can you tell me the availability of an article publised in "Electronics Australia" describing an amplifier or preamplifier for use with a 16mm sound projector. **(L.G.K., Wodonga, Vic.)**

● We published the design for an optical/magnetic preamp for sound projectors in April, 1967. Copies of the article are available through the Information Service for 20c — please quote 1/PRE/17.

ELECTRIC FENCE: I have just been through the indexes from 1956 looking for a circuit for an electric fence, preferably solid state, but could not find one. Have you ever published such a circuit? **(M.S., Auckland, N.Z.)**

● You would need to look a lot further back than that, M.S. We did publish a circuit for an electric fence in Februarv. 1940. A copy of this is available through the Information Service for the usual 20c fee. File No. 3/MS/1.

AMATEUR LICENCE. I am 15 years old. and I am very interested in radio and electronics. Can you tell me at what age I can gain the Amateur Operator's Certificate of Proficiency and what knowledge is necessary to pass the P.M.G.'s examination? Can you recommend some pamphlets or books that would help me gain this knowledge? **(T.H., Mudgee, N.S.W.)**

● The qualifying age for the A.O.C.P. is 15 years. The knowledge required is specified in the P.M.G. publication "Handbook for Operators of Radio Stations in the Amateur Service," as follows:

(a) A knowledge of wireless telegraphy and wireless telephony and electrical principles; and

(b) A knowledge of such of the Radio Regulations for the time being in force under the Telecommunication Convention and the Wireless Telegraphy Regulations as relate to the operation of amateur stations.

We suggest you obtain a copy of the publication referred to above, from Radio Branch, P.M.G.'s Department, Box 6004, G.P.O., Sydney, 2001. It contains a large amount of useful information on the subject. Send 30c to cover cost and postage. Also, we suggest you get in touch with the N.S.W. Branch of the Wireless Institute of Australia, 14 Atchison Street, Crow's Nest, N.S.W. 2065, for details of instruction courses leading to the A.O.C.P. Our own "Basic Radio Course" will give you a groundwork of basic knowledge upon which you can build. This is obtainable from this office for $2.20 posted.

Old Recordings: First of all, thank you for such an informative magazine. I would like to know where I can obtain information regarding two circuits. I have a large collection of old recordings on tape and I want to clean up the sound, I need a circuit which can clip the noise between modulation. Secondly, I would like to know how to construct an echo chamber to give my recordings more presence. Finally, can you tell me where I might obtain copies of historical broadcasts. **(I.H., Brisbane, Qld.)**

● Unfortunately we are not able to be of much assistance on this occasion, I.H. It would be very difficult to arrange circuitry which would differentiate between

PROFESSIONAL LOOKING NAMEPLATES---6 MINUTE PROCESS WITH

ALUMINEX

ALUMINEX is coloured, anodized aluminium from .003 thru. .125 thick with photo sensitive etch resist on one side. Simple exposure in daylight of Aluminex material with a transparent master provides a photographically exact etch resist. Developing and etching dips are entirely non-critical and will produce professional results.

LUNA AGENCIES and DISTRIBUTING COMPANY 259 Jasper Road, McKinnon, Vic. Telephone 97-4111.

BRISBANE: Starlight Recording Company — Queen St. Tel. 27336.
P. E. & F. J. Wilkins — 90 Brisbane Corso. Tel. 43880.
WEST. AUST: Everett Agency Pty. Ltd., 17 Northwood St, W. Leederville. Tel. 84137.

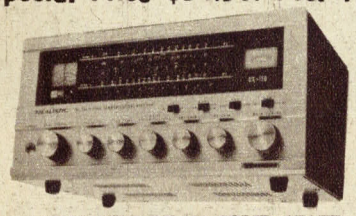
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7 WATT SOLID STATE STEREO AMPLIFIER

10 Transistor, 3.5 Watts per channel, Crystal/Ceramic input (250mV), Frequency Response 50-20,000 c/s, 8 and 16 ohms output, polished wood case, metal front panel. Dimensions: 8½in x 3in x 5 3/8in.

Special Price $34.50. Post 75c

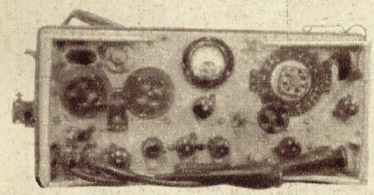


REALISTIC DX-150 SOLID STATE COMMUNICATION RECEIVER

Features:
240V A.C. or 12V D.C. operation.
30 Transistors and Diodes.
535 Kc. to 30 Mc. in 4 Bands.
Bandspread tuning, "S" Meter, AM/CW/SSB. Product Detector for SSB. Compact size 14 1/8in x 9¼in x 6½in. Polished metal panel, small internal speaker.

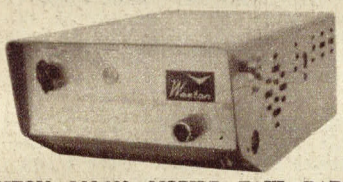
F.O.R. PRICE: $229.50

Matching external speaker $13.30 extra.



No. 62 TRANSCEIVERS. Wireless set No. 62 Mk.2 (PYE) Frequency Range 1.6 to 10 McS, in 2 bands, inbuilt 12-volt Genemotor Power Supply. Clean condition. Fully air tested on Transmit and Receive.

F.O.R. PRICE: $49.50



WESTON LM-330 MOBILE TAXI RADIO.

Low Band A.M., 60 Kc. Bandwidth, 70-80 Mc. Crystal Channel Locked, Single Channel, Inbuilt Transistor Power Supply, 12-volt operation, suit country taxi service or conversion to Ham Bands, inc. microphone and cradle.
AS NEW AND AIR TESTED.

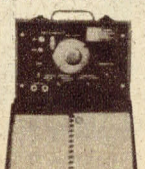
F.O.R. PRICE: $45. Packing 50c

LAFAYETTE * 5 WATT C.B. TWO-WAY RADIO

MODEL HE-20. FULLY TRANSISTORISED, SOLID STATE, 13 Transistors, 10 Diodes, 27.240 Mc. Provision for 23 channels, CRYSTAL channel locked, Push-pull Audio Modulator, 455 Kc. mechanical filter, spotting switch for accurate reception, TV1 Trap, 230V A.C. and 12 Volt (positive or negative ground). Inbuilt P.A. Amplifier. IDEAL FOR FIXED BASE STATION OR EMERGENCY MOBILE, including microphone and mobile cradle.
* Subject to P.M.G. approved licence.

F.O.R. Price: $169.50. Tax Paid

Fibreglass Helical Aerial 4ft high, cowl mount, for mobile use $16.50 extra.



BENDIX BC-221 FREQUENCY METER. 125Kc. to 20 Mc. including A.C. power supply. CRYSTALS, Calibration Book etc. V. clean condition.

F.O.R. Price: $49.50. P'ckg. 75c



MODEL C-1000 POCKET MULTIMETER, 1000 ohms/per Volt. AC Volts: 0-10/50/250/1000 (1000 opv). DC Volts: 0-10/50/250/1000 (1000 opv). DC Current: 0-100mA Resistance: 0-150K ohms (3K centre). 2 colour scale. Range Selector Switch. Dimens.: 3½ x 2¼ x 1in.

PRICE: $6.50 post free



MODEL 200H MULTIMETER, 20,000 opv, DC Volts: 0-5/25/50/250/500/2500V (20,000 opv) AC Volts: 0-15/50/100/500/1000V (10,000 opv) DC/Amps: 50uA/2.5mA/250mA. Resistance: 0-60K/6M ohm (scale centre 300 ohm—30K ohm. Capacitance: 10uuf to .001uF/.001uF — .1uF, D3 scale 20 db to plus 22 db. Size 4½ x 3¼ x 1 1-8.

PRICE: $11.25 post 30c.



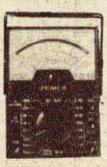
MODEL CT330 MULTIMETER, 20,000/OPV, DC Volts. 0-6/6/30/120/600/1.2K/3K/6K Volts, AC Volts: 0/6/30/120/600/1.2K Volts (10K/OPV), DC/Amps: (0-0.06mA/60mA/600mA. RESISTANCE: 0-6K/600K/6M/60M/600Megohm. (30/3K/30K/300K ohms) centre scale: Capacitance: 50 uf to .01 uf .001 to 0.2 uf. Decibels: —20 to plus 63db size approx. 5½ x 3 5/8 x 1¾.

PRICE: $16.75 post 30c.



MODEL OL-64D MULTIMETER. 20,000/OPV, DC Volts: 0-0.25/1/10/50/250/500/1000V at 20K/OPV, 5000 volts at 10K/OPV, AC Volts: 0-10/50/250/1000V at 8K/OPV, DC/A: 50uA/1mA/50mA/500mA/10 amps. RESISTANCE: 0-4K/400K/4M/40Megohm. DB Scale: —20 to plus 36db. Capacitance: 250pF to .02uF. Induct. 0-5000H. size 5¾ x 4 1/8 x 1¾in.

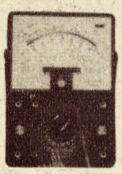
PRICE: $19.50 post 30c.



NEW MODEL US-100. Overload protection, Shockproof Movement, polity switch. DC volts: 0.25/1/25/10/50/250/1000V (20K/OPV AC Volts: 0-2.5, 10/50/250/1000V (5K/OPV), DC/Amps: 1mA/25mA/500mA and 10A. AC/Amps 10A. RESISTANCE: 0-50M/ohms (centre scale 50) R X 1/10/100/1K/10K, db scale —20 to plus 10 plus 22/plus 35/plus 50 db.

PRICE: $28.75 post 40c.

Mirror Scale



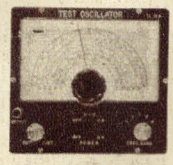
MODEL AS100/DP HIGH SENSITIVITY
100,000/ohms/volt DC, Mirror Scale, PROTECTED MOVEMENT, SPECIFICATIONS: 6/20/120/300/600/1200 Volts A.C. (10K/OPV), Volts D.C.: 3/12/60/120/300/600/1200 (100K/OPV) D.C. Amps: 12uA/6mA/60mA/300mA/12 Amps., RESISTANCE: 2K/200K/20Mg/200Meg, Decibels: —20 to plus 63db. AUDIO OUTPUT: 6 Volts/30/120/300/600/1200V A.C., Size: 7½in x 5½in x 2¾in.

PRICE: $34.50. Post 75c



MODEL A10/P, GIANT (6½-inch), METER, CIRCUIT TESTER 30,000/OPV D.C. with inbuilt signal injector, overload protected, Specifications: A.C. Volts: 2.5/10/50/250/500/1,000 (10,000/OPV). D.C. Volts: 0.5 Volts/2.5/10/50/250/500/1000 at 30,000/OPV, 5000V at 10,000/OPV. D.C. Current: 50uA/1mA/50mA./500mA./1 Amp/10 Amp/A.C. Current: 1 Amp/10 Amp. Resistance: 10K/100K/1 Megohm/100 Megohm. SIGNAL INJECTOR: Blocking Oscillator circuit with a 2SA102 Trans. DECIBELS: —20 to plus 63db. SIZE: 6½in x 7¼in x 3¾in.

PRICE: $55 Tax Paid. Post 75c



TE-16A TRANSISTORISED TEST OSCILLATOR. Freq. Range: 400Kc. to 30MC. in 5 bands. Modulated: 800 c/s sine wave. Modulation: 30 p.c. approx. Output Imp.: Low impedance. Dimensions: 5 7/8in x 5 7/8in x 3 5/8in. Weight, 1.5lb.

PRICE: $23.75. Tax Paid. Post 75c.

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

4 band receiver covering 550 Kc/s to 30 Mc/s, continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW. ● ANL ● Variable BFC ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1.5 W ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7 x 15 x 10in. With instruction manual and service data.

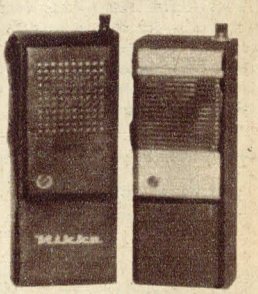
PRICE $175 inc. Sales Tax.
Speaker to suit type SP5D inc. tax.



02S Large Rubber Earpiece. 20-12,000 c/s (as per photo). **$6.75**

03S As above. Larger earphone. 20-18,000 c/s. **$9.25**

04S Deluxe model Individual Tweeter and Woofer control. **$12.95**



"NIKKA" 1 WATT TRANSCEIVERS

P.M.G. APPROVED. SOLID STATE 14 Transistor Circuit inc. R.F. Stage.
27.240 Mc (Provision for 2 Channels).
Range Boost Circuit.
Up to 10 miles in open country or water.
Buzzer Type Call System.
Squelch Control.
Complete with leather carrying case.

$165.00 PAIR

ANSWERS – continued

modulation and noise on a recording. In any case, we feel that this is a job for a recording engineer and a little beyond the facilities of the hobbyist, as the efficient salvage of old recordings would probably involve a variety of measures. We have described various reverberation devices in past issues, but we have not described an "echo chamber" device. No doubt the A.B.C. and commercial broadcasting organisations would have copies of old and historical recordings but they would probably not be willing to make these available and much of the material would be covered by copyright anyway. Recording companies do release copies of historical recordings from time to time, though not necessarily the type of material you are looking for.

MULTIMETER: Can you send me a wiring diagram for a multimeter with the following ranges: 0-240V AC and DC; 0-1A; 0-10A; 0-10K; 1K-1M. **(.D., Erina, N.S.W.)**

● We have described several multimeters, M.D., and one of them would probably meet your requirements. However, this is an expensive way of obtaining a meter as the cost of parts alone could be more than the cost of a typical imported multimeter. In our Trade Review pages for September and October 1969, we described two very similar multimeters which might meet your needs at a reasonable price.

FELLOW ENTHUSIASTS SOUGHT: I am 12 years of age and I have constructed the crystal set described in the July issue. I have obtained excellent results from it. Have you described any one or two-valve receivers? I think you have a fine magazine, well worth 40c. Would you please publish my name and address, as I would like to hear from other boys of my own age. **(Robert White, 49 South Rd., Brighton Beach, Victoria, 3186 Phone 92-2066).**

● Glad to learn that you have such success with the crystal set, Robert. As you can see, we have published your full name and address, the rest is up to the readers. It is some years since we described any small valve sets, particularly in the battery operated line. With the advent of transistors, most experimenters preferred the simpler circuitry and lower cost which they made possible. The last 2-valve receiver we described was the Three Band Two; a mains operated broadcast and shortwave receiver of fairly simple design described in October, 1966 (File No. 5/ACR2/8). Thank you for your kind remarks about the magazine; we trust it will continue to prove interesting at all levels.

WALKIE-TALKIES. Does a walkie-talkie (27MHz) have to be used for useful purposes, eg. business, to be licensed? Also can you refer me to the nearest branch of the Youth Radio Scheme. **(J.W.R., Cobram, Vic.).**

● Hand-held transceivers can be licensed for any business, sporting or hobby purpose with the provisos that the equipment must be of an approved type and, in the case of a hobby, that the hobby is not radio — i.e. transceivers so licensed cannot be used for amateur radio communications. We suggest you contact the Radio Branch of the P.M.G.'s Department in Melbourne for full licensing information. To find the nearest Youth Radio Club, contact the Victorian Division of the W.I.A. at P.O. Box 36, East Melbourne, 3002.

NEW USE FOR ADHESIVE TAPE. Recently, the tip of a speaker plug used with my tape recorder became detached and lodged itself inside the machine. Upon removing the front cover of the machine, I found the missing part wedged in a tight corner of the power supply. The gap was too small for pliers, and I had almost given up hope of retrieving the part when I spotted a roll of PVC adhesive tape. I placed a piece of the tape on the tip of the blade of a 6in screwdriver sticky side outwards, and began to fish for the missing part. Withdrawing the screwdriver after the first plunge, I found that the tape had done the trick, and the plug tip was adhering firmly to it. As the manoeuvre saved considerable dismantling, I thought it would serve as a useful tip to your readers. **(E.S., Highett, Victoria).**

● Many thanks for passing on this experience. Readers will no doubt remember it next time a screw or other small part becomes lodged in an awkward position.

Murphy's Law

Situations which occur in all branches and aspects of electronics conform to Murphy's Law. The terms in which the Law is stated vary and, indeed, it is not always credited to Murphy. This resume of the Law and its originator is adapted from a recent issue of "Telegen," the journal of the Engineering Division of the Australian Post Office:

Murphy's Basic Law states:
"If anything can go wrong, it will."

To state it in a mathematic form.
$1 + 1 = 2$
where $=$ is a mathematical symbol meaning "hardly ever."

Corollaries, as applied to telecommunications, are as follows:

● Any completed and checked drawing will neither be complete nor correct.

● Any vital instructions will be received too late.

● Quantities will always be expressed in the least usable form.

● If a project requires n components, there will be n—1 components available. The item missing will be the most important one.

● Interchangeable parts will exhibit fundamental differences.

● Handbooks will always be either (a) mislaid in the library or (b) unavailable.

● Any cable cut to length will be too short.

● A dropped tool will always land where it can do the most damage. (Also known as the Law of Selective Gravitation).

● If a circuit cannot fail, it will.

● Fail-safe circuits will always destroy those adjacent to them.

● The probability of failure is inversely proportional to the ease of repair.

● Faults occur in the heaviest unit and always at the top of the rack.

● Extension cords will always be (a) faulty or (b) missing.

● In an overall evaluation test, all errors will be cumulative.

● Items which work perfectly during development will fail during acceptance tests.

Murphy is practically unknown to most of us. He is the victim of his own law. Personnel lost his file and the Salary Section refuse to pay him. Only the Taxation Department and those of us affected by his law recognise his existence.

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Broadcasting is fascinating. Stott's offer an entirely new course that enables you to sit for the Amateur Operator's Certificate of Proficiency examinations with complete confidence. Get full details now.

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No sales representative will call

EA 270

STC 112

SOUND PROJECTORS

Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.

from $90.00

CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

$1.25 each

Post 10 cents.

REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule.
1 Lampholder. **$1.85**
Post.: N.S.W. 30c; Interstate: 40c.

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$23.00

(2 TELEPHONE SETS)

30c cartage to rail. Freight payable at nearest attended railway station.

Please note we are now able to include ½ mile of telephone cable FREE with each set of Phones.

BATTERY CHARGERS

240 volt A.C. Input.
Each battery Charger will charge either 6 or 12 volt batteries.
2 amp. without meter, **$13.75**
2 amp. with meter, **$15.75**
Post N.S.W. 70c; Interstate 95c.

MINIATURE ELECTRIC MOTORS

1½ to 3 volts D.C Ideal for model boats, cars, planes, etc. Strong torque. Only
65 cents each or 10 for $4.00.
(Post 7c).

TRANSCEIVER

(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54 megacycles F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100 K/cs: step 10 channel per meg/cycle with power supply. Leads, mike and headphones **$45**, 60c cartage to rail. Freight payable at nearest attended railway station.

TRANSCEIVER

(2-way radio) 62 set ideal small ships, Hams, etc. 1.6 to 10 megs. Crystal locked or V.F.O. controlled 5 watt output. Complete with antenna, headphones and mike **$60.** 60c cartage to rail. Freight payable at nearest attended Railway Station.

HEAD PHONES

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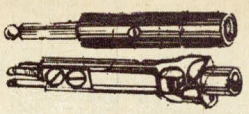
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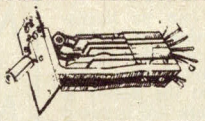
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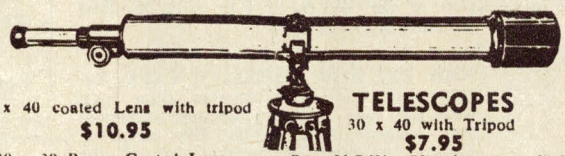
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P.M.G. 200 Ohm — 1,500 Ohm Coils, **$1.25** each.

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Ex A.M.F with Instruction Book. Complete in wooden case. Ideal for plumbers, councils for locating buried pipes, etc. Freight payable at nearest attended railway station.
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Supplies all necessary voltages to operate 522 transceiver from 240 V A.C. Complete and ready to plug in **$30.00.**

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Ex-A.B.C., consisting of low resistance 8in speaker in Acoustic Labyrinth Baffle Box, complete with 10-watt amplifier, 600 ohms plus 8dbm input, 240 volt A.C. operated.
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ANSWERS – continued

RADIO CONTROL OF MODELS: Would you please consider the following suggestions in regard to the model radio-control which one of your staff is working on?

1. Superheterodyne receiving system.
2. Plug-in matched crystals for transmitter and receiver enabling several models to operate simultaneously on different spot frequencies.
3. Continuous tone transmission for quiescent state with cessation of tone for command, thereby minimising the chance of interference.
4. Ability to change from normal pulsing system to "galloping ghost" system; that is, pulses of variable frequency with variable mark-space ratio to control both aircraft elevator and rudder on a single channel. It should be possible to use the commercial Rand LR3 GG single channel actuator.
5. (a) For normal pulsing operation a device should be used, either a micro switch or plug-in "think-box," to transmit a particular number of succesive pulses, say from 1 to 15. (b) In the receiver a decoder would then count the number of pulses and activate a particular circuit in the model.
6. Fail safe facility so that if a continuous tone is not received for, say, 15 seconds all power supplies in the model will be disconnected. **(R.A., Warners Bay, N.S.W.)**

● Thank you for the suggestions, R.A., they are quite extensive. We had planned to present a 27MHz superheterodyne receiver, simply as a means of providing the necessary radio link, leaving the control systems to the individual to suit his own particular requirements. The number of control channels which could be obtained would depend upon the transmitter and decoding circuitry following the receiver. The suggestion of continuous transmission is a good one, but it should only be necessary to transmit a continuous carrier rather than continuous modulation. We are not quite sure what you intend by suggesting plug-in crystals for multiple operation, but the receiver which we hope to decribe can be operated on several frequencies by simply changing the oscillator crystal. Similarly, we are not quite sure what you mean by normal pulsed operation but, conceivably, normal or symmetrical pulse trains for single channel operation could be a part of the "galloping ghost" system by simply arranging transmitter controls for pulse modulation having a constant frequency and a symmetrical mark-space ratio. A receiver would require separate decoding circuitry. However, a system involving this order of complexity would be rather bulky. Some of the suggestions for decoding are more applicable to separate and individual methods of decoding and control, including proportional and digital methods. There would be obvious disadvantages in a fail safe system which rendered all control circuitry inoperative, particularly in flying models. We think that a more practical fail safe system for aircraft is to arrange for the model to circle under the influence of maximum rudder in one direction in the absence of transmitted carrier. Also, there has been the suggestion that, in the absence of carrier signal, a parachute release could be triggered to safely lower the model to the ground.

QUESTIONS ON PREVIOUS PROJECTS: Can the Playmaster 127 IC control unit be used with the Playmaster 113 power amplifier by using the amplifier's pilot lamp supply voltage for the control unit? Could the chassis connection of the 113 be moved and made common with the control unit. Is there likely to be a solid state version of the Playmaster 110 tape recording amplifier and a solid state recording adapter in the future? How long before the solid state communications receiver will be published as I am really looking forward to it? Is the radio control unit which you are currently designing proportional and how many channels will it be? **(C. McG., Killara, N.S.W.)**

● The Playmaster 127 control unit is not compatible with the Playmaster 113 power amplifier. A basic power amplifier appears in this issue and is intended to complement the above mentioned control unit. We do not have any definite plans to feature a solid state equivalent of the Playmaster 110 in the near future, but it is a project which we would like to present when able. A tape adapter could also form part of the same project. We have begun to publish the articles on a solid state communications receiver in this issue. The radio control unit which we plan to publish is a single channel superheterodyne transistorised receiver only. For the present, actual control systems will be left to individual readers, according to their particular requirements.

PAT ON THE BACK: I feel I should congratulate you on a truly excellent magazine. It's the most informative electronics magazine I have come across out of many. Your very interesting semiconductor series and especially your projects on the laser beam, makes it even better. I feel that it not only caters for the professional but also for the young and not-so-young amateurs. I am sure that many of your readers will agree with me in saying that "Electronics Australia" is well worth the 40c. I also found your "Basic Radio Course" most helpful, particularly when followed up with your varied and interesting projects. I feel confident in saying that "Electronics Australia" will in the future become bigger and better and even more informative. I can only see a great future for this excellent magazine. **(M.B., West Pymble, N.S.W.)**

● Please spare our blushes, M.B. We receive many letters from our readers, often with praise for some particular aspect of our magazine but rarely do we receive such a glowing testimonial. Thank you very much for showing your appreciation. We are very proud of "Electronics Australia" and will do our best to justify your confidence in us.

RADIO: Unofficial history

Eighteen-year-old Andy, employed by a Sydney radio firm, was keenly interested in the technical side and his ambition was to build a dandy little four-valver he'd seen in "Wireless Weekly." Not every family owned a radio set in the early 'thirties and his family was one which didn't.

They lived in an old 100ft ex-Sydney ferry which had been converted into a houseboat. With the engines extracted and the top deck removed, she was anchored fore and aft in a bay in Iron Cove, close enough in for a gangway, floating on 44-gallon drums, to be secured ashore.

Aside from the constant chore of fresh water carrying, wick type kerosene lamps and the problem of clothes laundering, it was a comfortable existence and worked out cheaper than living in a house, which was just as well. Old Man Depression held the world in thrall and Andy's father found it difficult to get even an occasional day's work to supplement the family dole, so every penny had to stretch further than panty hose on a circus fat lady.

The four-valver was out, so he settled for a crystal set, forgoing other pleasures to scrape together the necessary .0005 variable condenser, catswhisker detector and crystal, 3in cardboard former and DCC wire, terminals, earphones, etc. The wooden baseboard and panel were cu from timber scrounged from a local tip, neatly squared, bevelled and finally painted by a mate.

To everyone's surprise, the darned thing worked and Andy was able to lie in bed at night and listen to the new-fangled "crooner" Bing Crosby sing "Cabin in the Pines," "Please" and "The Last Roundup." Also the cricket Tests, which that year were played in England, until the "wee small hours."

The 80ft aerial was strung from one end of the ship to the other and the "earth" consisted of a heavy bolt attached to a wire and lowered over the side to the bottom of the bay.

But Andy had a problem!

He'd be enjoying a program, perhaps Bradman about to reach his double century when, with little warning, the set would cut out. He'd cuss a bit, frantically grab the catswhisker and jiggle. Not even a click would disturb the silence and no matter what he did, the set remained obstinately silent, electronically dead.

After half an hour of fiddling he'd given it away, as cranky as a camel with toothache and spent a sleepless night blessing everything from a faulty crystal to open-circuit phones.

Next day he'd have another go, prepared to pull it to pieces part by part, only to find the offender as lively as ever, with all stations coming in loud and clear!

Night and the next day's play at Lord's. Once again a critical stage, once again sudden zero signal. It was maddening!

Sometimes it would be silent when he put on the phones and, after the usual session of fiddling, prodding, phone testing and cussing, he'd give it away and try to win back his sunny disposition with a whodunit. Later, he'd try again and in would come the station as though the transmitter was just across the bay!

In desperation, Andy approached his technician mates with negative results. Oh, they were full of ideas and remedies but none worked. This went on for months until the penny finally dropped. The answer was simplicity itself.

The rising tide was lifting the earth bolt from the bottom of the bay, then dropping it back again with the ebb, acting like a switch and effectively breaking the circuit!

All that was needed to cure the trouble was an extra foot or so of earth lead. (C.D., Cromer, N.S.W.)

EDITORIAL NOTE: We wrote to C.D. and remarked that this was a good story well told, except for one thing—It should not have mattered in the slightest whether the wire was touching the bottom or not, as long as it was immersed in the salt water. C.D., however, swears that the story is absolutely true and that he witnessed the effect himself. When last heard of, he was building up a crystal set to duplicate the situation and prove to himself—if to no one else—that his memory is not all that bad.

(Readers are invited to submit contributions to "RADIO: Unofficial History" and a publication fee will be paid for those used. Stories must be humorous and they must be true. Letters must be signed and the locale of the story indicated as a mark of good faith. The Editor reserves the right to re-phrase contributions as necessary to preserve uniformity of style.

Beacon replaces Lightship . . . from page 20

The light gives a stationary intensity of 200 candelas with an optical range of 7.75 miles. The emitted sound level of the fog signal is 104.5dB at 25ft. (0dB = threshold of hearing.) Failure of either of the main navigational aids will operate the respective emergency aid, and failure of the battery supply will switch on both emergency aids.

Duplicate coders and transmitters are fitted, each with its own alarm circuits to initiate changeover to the standby unit. An alarm is telemetered back to the control station when changeover occurs. The aerial, and aerial tuning unit connected by coaxial cable to the transmitters, are located on the top of the mast. The 36ft four-piece fibreglass aerial has a top-loading capacity section located at its highest joint to increase the electrical height.

A UHF radio-control link carries 2-way data traffic on an FSK system between the buoy and its shore station. A handset for speech facilities is also included. The radio equipment is duplicated to increase reliability. A manual changeover unit is used to bring on the standby radio at the shore station, while the standby at the buoy has an automatic changeover with remote override.

The equipment is completely solid-state including the micro-wave local oscillator and transmitter output. The latter has an output of 150mW and has a range of 5 to 10 miles depending on the sea state.

The aerial has been specially developed for use on the buoy. It is omni-directional in the horizontal plane, and has a ±27° pattern in the vertical plane permitting operation consistent with buoy movement. With its enclosure, it is a separate entity using short wave-guide interconnections.

A radio beacon with an adjustable range from 5 to 70 miles can also be fitted in the buoy. The carrier frequency is controlled to within ±0.01 per cent. Maximum radiated power is about 50W and can be modulated by a tone (frequency tolerance ±2.5 per cent) to a depth of about 85 per cent. A time switch regulates the periods at which the beacon radiates a preset group of letters. The switch has an accuracy of ±2 seconds per 24 hours and is capable of being reset through the telemetry link.

The fog signal is switched on by remote control via the telemetry link. Failure to receive the regular interrogate signal from the shore station will also start the fog signal after a specific period. Shore control monitors the fog signal's operation by a microphone on the mast which feeds an audio amplifier-detector. The time constant of the amplifier output is sufficiently long for the level to remain on for longer than the blank period of a normal fog signal character.

Provision has been made for fitting a radar responder beacon (Racon) at the top of the mast. This will operate in the 9,300-9,500MHz marine radar band. It will receive all signals in the band and trigger the Racon transmitter which radiates a long pulse for every short one received. Both transmitter and receiver operate on the same frequency across the band about once every two minutes. ■

Digital Freq. Meter

(Continued from page 53)

Normally this is done by the operator, either mentally or on a slide-rule or convenient slip of paper; however, recent DFMs in the higher-price category have included computational circuitry which performs the inversion automatically. While very convenient this facility does tend to raise instrument cost significantly, so that for an economy instrument "basic" period measurement relying upon "external" inversion is generally regarded as adequate.

In some instruments, decade frequency dividers are available for signal frequency division on the period measurement ranges. This allows the gate to be opened for a period equal to 10, 100 or even 1,000 cycles of the input signal, if required. By dividing the counter reading by the appropriate multiplier (10, 100 or 1,000), the result is a "multiple period average" measurement, representing the period of the signal averaged over the number of cycles concerned.

Although quite a useful addition to the basic period measurement configuration, multiple period averaging calls for additional frequency divider components and thus involve further cost. It is therefore usually omitted on economy instruments, the design philosophy being that if multiple period average measurements are required they may be obtained "the long way"—by taking a series of single-period measurements, and then averaging them arithmetically. ■

Radio Control

(Continued from page 63)

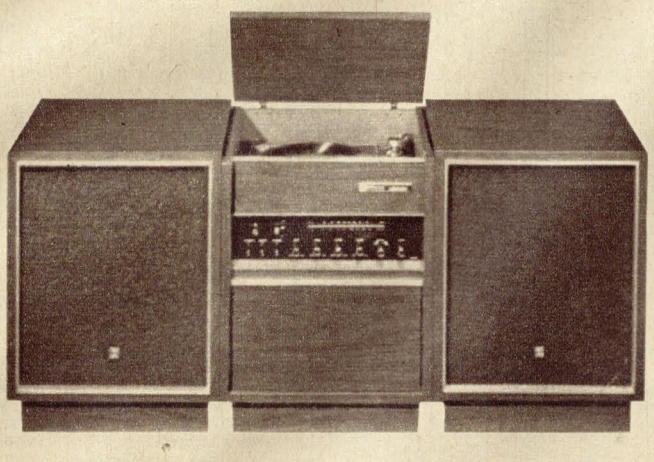
and collector of T3 will vary when a signal is received.

The voltages at the emitter and collector of the oscillator (T2) were measured with it in oscillation. If the oscillator is rendered inoperative then the voltages will be about 1.4V and 10.5V at the emitter and collector respectively. These voltages could be useful in diagnosing a faulty local oscillator in the event of the receiver not functioning properly.

However, constructors should encounter little difficulty provided sufficient care is taken in construction. And, with only one adjustment there is little room for misalignment. ■

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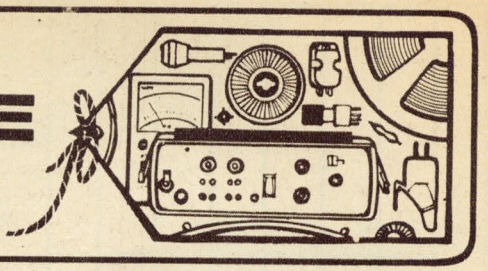
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TWO-WAY RADIO for sale. VHF-FM radio telephone equipment comprising five (5) AWA 10-watt car phone transceivers type 6F354901 and four (4) AWA 20 watt two unit transceivers type 1F352856. All units are in working order but without aerials. The equipment may be inspected by arrangement. Offers to A.F. Taylor, County Clerk, Berrima County Council, P.O. Box 98 Bowral, N.S.W., 2576. Telephone Bowral 1012.

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ANSWERS — continued

TRANSISTOR 10W AMPLIFIER: Have you described in the magazine a transistorised mono amplifier of about 10 watts output, and suitable for use with a microphone and pickup? **(A.G., East Doncaster, Vic.)**

● The only amplifier published to date in this category would be the "10-Watt Transistor Amplifier" of November-December 1959, A.G., but this project would now be rather dated. Probably your best plan would be to build a single channel version of the "10 Plus 10 Stereo Amplifier" of January 1969, and add a microphone pre-amp such as that described in the June 1967 issue.

HIGH SOUND LEVELS: I am perturbed that you did not add, in block capitals, a warning with your article on the 50-100 watt loudspeakers (January, 1970). Temporary exposure to such levels will cause temporary deafness. Continued exposure will cause permanent deafness. Having seen a youth emerge from a pop concert showing obvious signs of temporary hearing loss, I consider that such a warning should be obligatory. **(R.C., Ewey Bay, N.S.W.)**

● While we appreciate the point you make, the sound intensity from such a loudspeaker system at the listener's ears depends on the environment and the intervening distance. At close enough quarters, one could probably do damage with a much lower powered system or even with a husky pair of headphones! If there was a legal obligation to label high-powered audio equipment this way, or even if it was common practice, we would doubtless fall into line. However, your letter itself will have drawn attention to the problem.

RF WATTMETER: I am submitting for publication in your "Reader Built It" section the circuit of an RF Wattmeter. I found the circuit in another magazine which I received for Christmas. **(B.G., Bardon, Qld.)**

● The fact that you did not design the device yourself would not disqualify it from our "Reader Built It" section. However, it is not clear from your letter whether you actually built it and found it lived up to any claims made for it. As the title suggests, the section is intended primarily for practical items which readers have constructed. Actually, the title "wattmeter" is rather grandiose, when applied to such a simple device. To be sure, the LDR/meter combintion will give a reading related to the brightness of the lamp excited by the transmitter, but the arbitrary nature of the coupling to the transmitter and the rather arbitrary impedance of the lamp itself would de-rate the device from a "meter" to a mere "indicator." ■

NOTES AND ERRATA

EA240 COMMUNICATIONS RECEIVER (January, 1970). Circuit diagram, connection from lug 2 of S1c should go to the L2 side of the 330pF capacitor.

METAL LOCATOR (November, 1969): The 9V supply rail, shown as +9V, should be reversed and made −9V.

READER BUILT IT. More On C.D. Ignition. Winding details should read:—Secondary winding: 330 turns 32 B&S wire. ■

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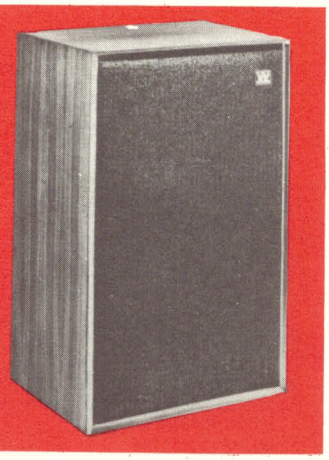


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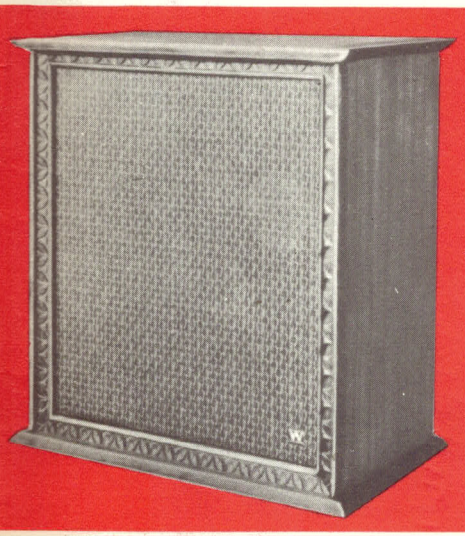
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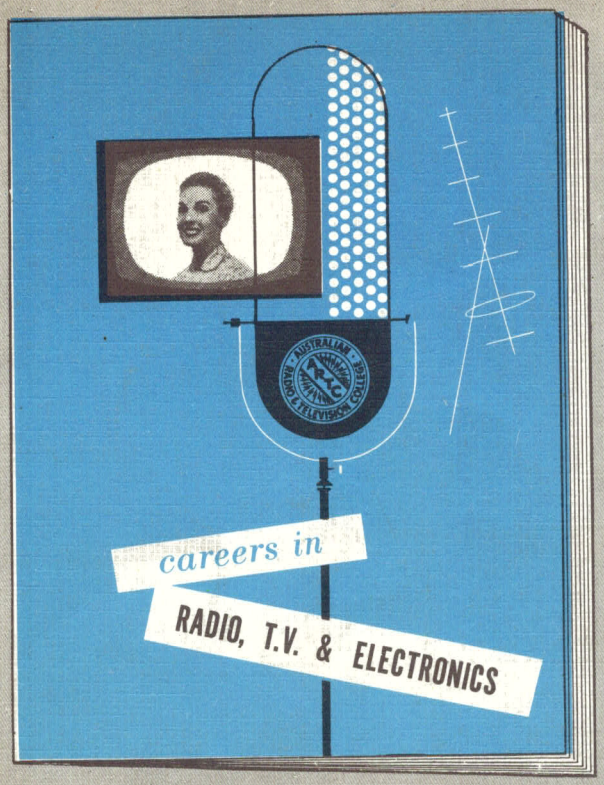
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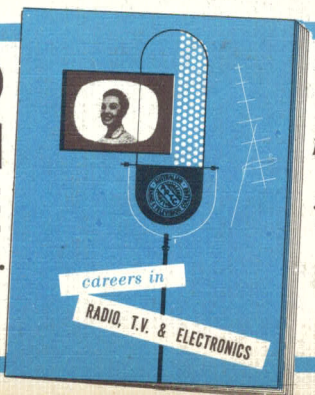
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