

ELECTRONICS

Australia

January, 1970



40¢

Satellite telemetry antenna at Woomera (See page 3)

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volume 31, number 10

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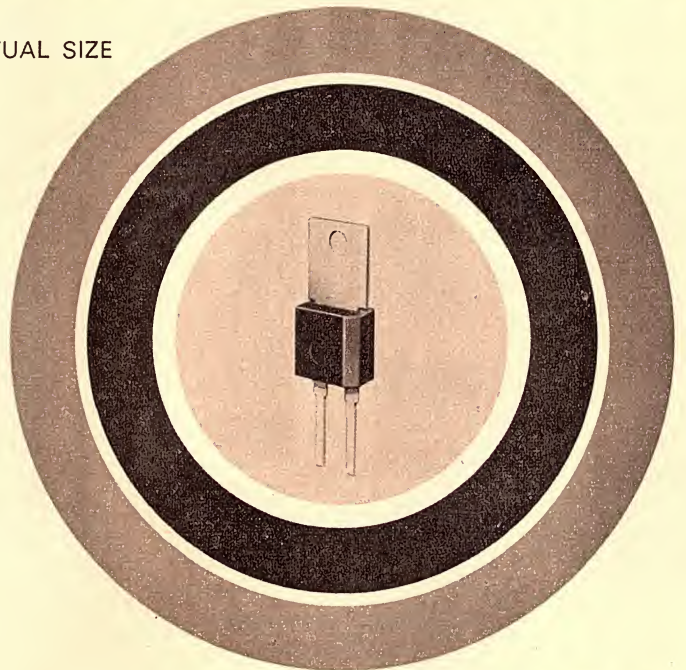
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EDITORIAL VIEWPOINT

by Neville Williams

Canned viewing . . .

During the thirties, radio was the dominant sound in Australian homes, providing entertainment that was novel, varied and accessible. But the novelty of radio gradually wore off and listeners began to seek a medium that would give them the sound they liked at the time they most wanted to listen. The need was met by long-playing discs and, today, people are likely to be as proud of their library of records as they might once have been of a library of books.

More recently, television has passed through much the same phase as did radio. Its role has changed from a compellingly novel and accessible source of entertainment to a routine part of the domestic environment. Will history be repeated? Is there a potential mass market for a more selective form of audio-visual entertainment? An audio-visual counterpart of the long-playing disc?

Many major companies seem to think that there is — a mass market which will take in, not only domestic requirements but the needs of audio-visual training, audio-visual marketing and audio-visual education in underprivileged countries. There follows immediately a question of technology: Which system holds the greatest promise?

Some companies are backing straight video recording, preferably in cassette form and played back through normal television receivers. The mode and quality of reproduction will always be limited to television practice, but the system offers the facility to erase and re-record at will.

At the other extreme is strong marketing pressure behind Super 8 sound colour film, also packaged in cassettes. It is essentially a refinement of conventional photographic techniques, but one that offers a standard of reproduction and an economy in equipment well ahead of the television-dependent approach.

In between are systems, such as that demonstrated by CBS, which are something of a marriage between electronic and photographic techniques. And, only a couple of weeks ago, RCA announced a method involving, apparently, the use of laser and holographic techniques to record audio-visual information as a surface pattern on a clear film, as a phase hologram. The exciting aspect is that copies can be produced by simply running blank stock over pressure rollers in contact with a metal film carrying a "negative" pattern.

Looking at the systems, one is moved to express the rather forlorn hope that we will end up with one or, at most, two systems — not a dozen. In saying this, however, I am not accepting as certain that any system will gain mass domestic acceptance. The fact that people can listen repeatedly to sound recordings is no guarantee that they will react in the same way to video tapes or sound films. Nor is there any guarantee that viewers will want to become involved in the routines of a film or tape library.

We shall see.

On the cover

This picture first caught our eye in a copy of "Global View," published in The Netherlands by the Philips organisation. It shows a telemetry aerial at Woomera, South Australia, photographed against a blazing red sunset. Philips is involved in the telemetry side of rockets being tested in Australia for a consortium of Western European nations. This aerial was used to track rockets in flight and to feed vital telemetry data to central receivers and recorders.

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(Electronics Aust. January 1969)

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(E.A. Nov., 1968)

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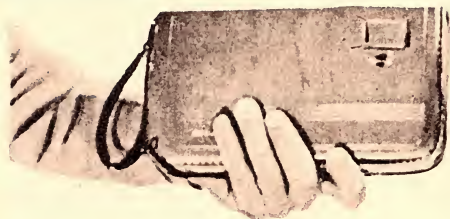
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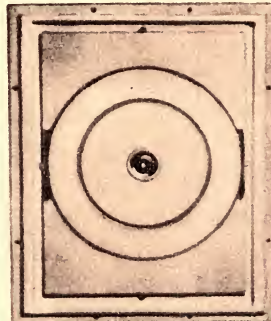
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20 watts peak
Frequency range:
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Sensitivity: 85 DB/M
for 1 watt electrical input
Input impedance: 8 ohms
Size (WxDxL): 1-7/16"
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Weight: 19 ounces

5 WATT MODEL



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Frequency range:
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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"
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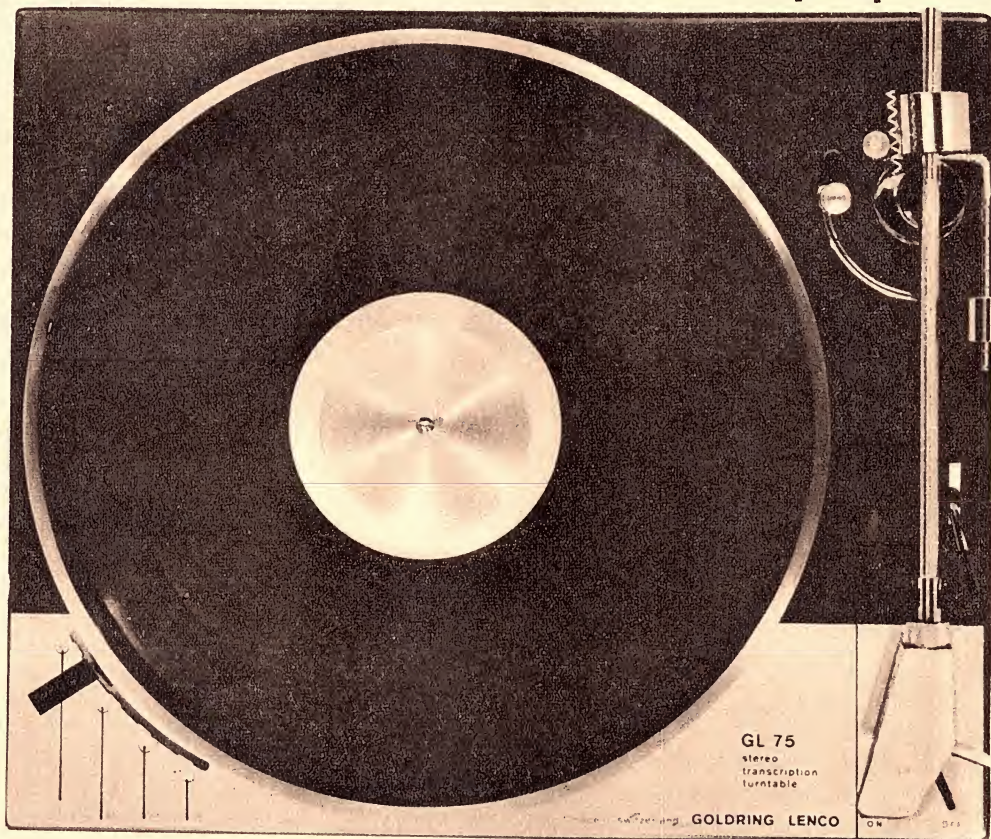


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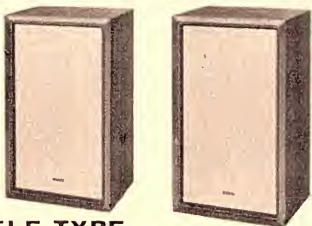
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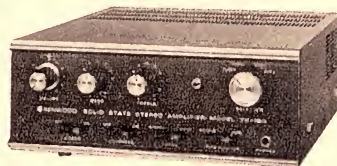
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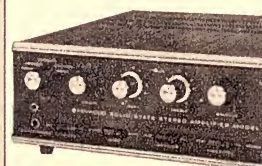
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- * Dimensions: 15" (W), 25" (H), 11 1/2" (D)



40-WATT SOLID STATE STEREO AMPLIFIER **TK-150U**

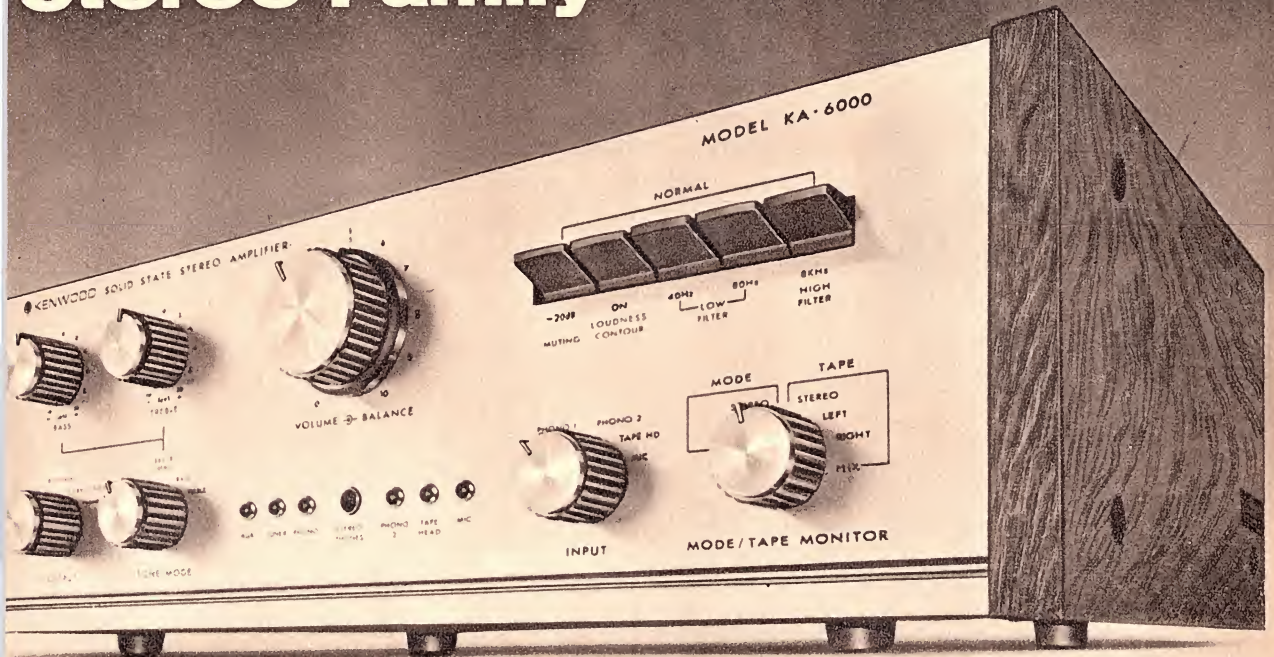
- * 5 pairs of input terminals for MAG, AUX 1, AUX 2, TAPE REC and TAPE PLAY.
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Stereo Family



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Special Features of KA-6000

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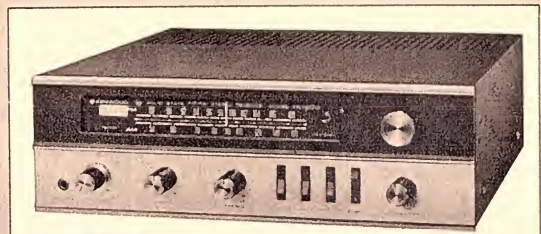
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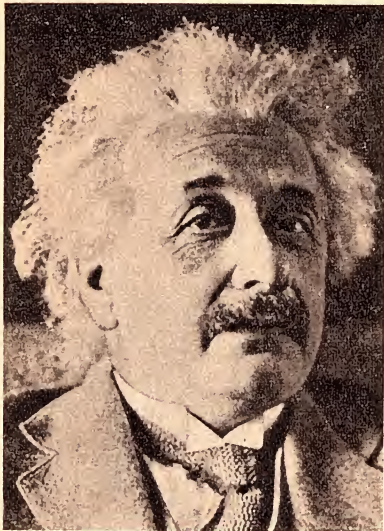
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- * Dimensions: 14 1/2" (W), 4 1/4" (H), 11 1/4" (D).

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Albert Einstein

SOME IMPLICATIONS

Although it is nearly 65 years since Albert Einstein first published his revolutionary Theory of Relativity, its implications are either unknown to or misunderstood by the vast majority of people, even those who lay claim to advanced education. While this article does not attempt to deal comprehensively with the subject, it sets out some of the basic ideas involved as well as some of the events that led Einstein to his remarkable conclusions.

by L. C. Debnam*

From the time of publication of Sir Isaac Newton's "Principia Mathematica Philosophiae Naturalis" in 1687 the laws of motion of objects have been generally well understood and predictable. The movements of objects in everyday life were found to conform as closely as could be measured to Newton's famous "laws of motion," the one observable discrepancy being the precession of the planet Mercury which was in any case an uncertain observation. As a result of these laws and observations, the principle of conservation of energy was accepted as a law of nature. Conservation of energy simply means that energy can be neither created nor destroyed, but only changed from one form to another. As an example of this, if a ball is thrown vertically upward it starts with an initial amount of energy in the form of kinetic energy (from the Greek *kineo* = to move) which is given by the expression:

$$\text{kinetic energy} = \frac{1}{2} mv^2$$

where m is the mass of the ball and v is its velocity. In moving upward against the gravitational attraction of the Earth it gains potential energy, given by the expression

$$\text{potential energy} = mgh$$

where g is the acceleration due to gravity and h is the height above the surface of the Earth.

However, in gaining potential energy the ball loses kinetic energy and, in the absence of air friction which slows it more, the total energy of the ball at any instant is the sum of the kinetic energy and potential energy at that instant. When starting its motion upward the total energy of the ball is in the form of kinetic energy and the potential energy is zero, but in gaining height the potential energy increases and the kinetic energy reduces until eventually all of the energy is in the form of potential energy and the kinetic energy is zero, thus the ball stops momentarily at the highest point of its motion.

The change from kinetic energy to potential energy is due to the force of the Earth's gravitational attraction

which causes all objects at the same position to accelerate toward the centre of the earth at the same rate. The gravitational force still acts on the ball when it is at the highest point of its motion, and as there is no opposing force to hold the ball it starts moving toward the Earth again. In moving toward the Earth the potential energy is decreased and the kinetic energy is increased until the ball reaches the point it started from and again all of the energy is in the form of kinetic energy. In a real situation the ball does not return to its starting point with the same velocity (hence kinetic energy), as some energy is transformed into heat, raising the temperature of the air and the ball due to friction against the air.

In the year 1896 however, Henri Becquerel discovered penetrating radiations emanating from uranium. These radiations were found to be of three types — positively charged particles (α -particles), negatively charged particles (β -particles) and gamma radiation (electromagnetic radiation with frequencies higher than X-rays). This posed a problem for classical physics. By the law of conservation of energy the energy of these radiated particles and electromagnetic radiation must come from somewhere as it could not be spontaneously created — but the radiations persisted without any energy being put in, a seemingly endless source of energy creation.

A clue to this energy source had appeared a few years earlier, in 1887, when two American chemists, A. A. Michelson and E. W. Morley, obtained some "wrong" results in an experiment on the determination of the velocity of the Earth through the "ether." As background to their results, consideration must be given to relative velocities as determined by Newton's Laws of Motion and practical results. If an escalator is moving at 4mph and a man walks up the escalator at 4mph an observer not on the escalator will see the man travelling at 8mph. Similarly if two motor cars on the highway are travelling in opposite directions at 60mph they approach each other at 120mph.

In the nineteenth century, scientists reasoned that as light is wave-motion it must travel through some hypothetical substance known as the "ether,"

and that the speed of light would be dependent on the speed of the ether, in the same way that the speed of a man walking up an escalator is dependent on both his speed on the escalator and the speed of the escalator itself.

The speed of the earth through the ether could thus be determined by measuring accurately the velocity of light in various directions and comparing these velocities, as light would appear to travel slower if the earth were moving in the same direction as the light than if it were moving at right angles or in the opposite direction.

The apparatus of Michelson and Morley was capable of measuring this difference in speeds to within about 0.3 per cent of the speed of light—but no differences were observed during long term experiments even though the possible error is less than the speed of the earth about the sun. Modern techniques have been used to repeat this experiment with accuracies of better than 10mph, but the same results are still obtained, i.e., the speed of light appears to be independent of the speed of motion of the observer or source. No amount of "correction" or change in the "ether" theory could account for this observation and still account for other observations which could be explained by the ether theory. The theory was therefore reluctantly abandoned—with no alternative theory available.

In 1905 Albert Einstein published his now famous Special Theory of Relativity. This theory was conceived as a result of the failure of the Michelson - Morley experiment and has far-reaching consequences. In formulating this theory Einstein made only two assumptions: 1. All inertial observers in the universe would observe the same laws of Physics. 2. All inertial observers in the universe would measure the speed of light in a vacuum to be the same.

(An "inertial observer" is an observer who is stationary or moving at a constant speed, i.e., not accelerating.) The first of these assumptions is based on reason alone, and appears to be justified as it predicts correct results. The second assumption is based on the results of the Michelson-Morley experiment.

Although the mathematics of the

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OF THE RELATIVITY THEORY

theory is beyond the scope of an article such as this, the predictions and results are readily understood even though the concepts may seem awesome. The theory was recognised immediately as it answered one important question—the origin of the radiation from uranium. This result is in the form of the equation

$$E = mc^2 \quad \dots (1)$$

where E is energy, m is mass and c is the velocity of light in a vacuum. This equation shows that mass is really a compressed form of energy and the radiation energy from uranium could occur by the conversion of a small amount of mass-energy into kinetic energy and electromagnetic radiation.

To gain some idea of the energy equivalence of mass, if one gram (about one-thirtieth of an ounce) of matter were converted wholly into electrical energy, 90 million joules of electrical energy would be available—enough to power an "all-electric" house for about 3,000 years. Such energy is only partly attained in thermonuclear explosions where efficiencies of less than 0.1 per cent on a few pounds of matter can cause vast destruction, and proof of this equation has been adequately demonstrated many times since the first such explosion in 1945.

Other results of the Special Theory of Relativity are not as well known (or as spectacular) as the mass-energy equivalence but are of at least the same importance. One of these is the "contraction of length." This means simply that if an observer stands at the side of a road and measures the length of a motor car as it passes him he would obtain a result less than if the motor car were stationary. The effect would be very small at normal speeds, and not really apparent unless the motor car were travelling at about one half the speed of light. If the length of the car when stationary relative to the observer (the "rest-length") is designated as l_0 , the length (l) when the car is travelling at a speed v relative to the observer would be given by the equation.

$$l = l_0 \sqrt{1 - \left(\frac{v}{c}\right)^2} \quad (2)$$

This effect (as with the others to be explained) is purely relative. If there were two motor cars of the same rest-length (i.e., they are both the same length when parked) and one was left parked at the side of the road while

the other drove past so fast that its length appeared to be half of its rest-length (about 0.85 of the speed of light) the driver of the moving car would see his own vehicle to be its full rest-length but would observe the stationary car to be only half-length. The theory of relativity is so named because such observations depend not on absolute speeds but on relative speeds (the "v" in equation (2) is the velocity difference between the two moving objects). The contraction of length with high relative speed occurs only in the direction of motion, and although the lengths of the cars change in the example given their heights would remain the same as they are only moving along the direction of their lengths, not up or down.

It may be seen from the contraction of length equation that as "v" approaches the speed of light (c) the expression:

$$\sqrt{1 - \left(\frac{v}{c}\right)^2}$$

approaches zero, so that if v could be made equal to c the object would have no length at all. It will be shown later however that v cannot become as great as c so the object would not disappear.

The contraction of length was not a new result obtained only by the special theory of relativity, as it had been predicted by H. A. Lorentz some years earlier when he was considering observations made on fast-moving bodies, but because he considered that v was the speed relative to the "ether" the equation did not always work; nevertheless the contraction of length is also referred to as the "Lorentz contraction."

A result which may be readily tested by experiment is the variation of mass with relative velocity. The mass increase of a body with velocity is expressed by the equation

$$m = \frac{m_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \quad (3)$$

where m is the measured mass of an object when travelling at a relative velocity v and m_0 is the rest-mass, i.e., the mass when v=0.

This result was first experimentally

proven by Bucherer in 1909 and its effects are apparent (even though the effect is small) in cathode ray tubes which use high accelerating voltages; e.g., the television picture tube where, with 16KV acceleration, electrons reach velocities of 70,000 kilometres per second—about one-fifth of the speed of light.

By equation (3) the mass of such electrons increases by about 2% and consequently larger deflection forces are required than if the mass remained constant. [This is true even though the electrons have not reached their full velocity when passing the deflection system. Their velocity when passing the deflection yoke is only about one-twentieth of the speed of light, but there is still a slight mass increase of about 0.1% at this speed.]

The situation is even more marked in the case of colour television picture tubes, with acceleration voltages of 50KV producing speeds of about one-third the speed of light; and X-ray tubes with accelerating voltages of 150KV producing electron speeds of half the speed of light.

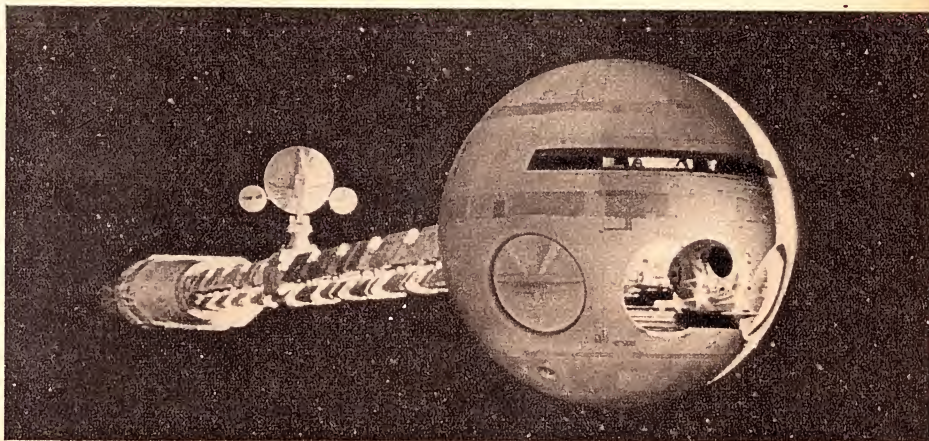
Linear accelerators have been built for nuclear research with accelerating voltages of thousands of millions of volts. With these, electrons and protons have been accelerated to speeds greater than 99% of the speed of light — with consequent mass increases of some hundreds of times being observed.

The mass increase explains why material objects cannot exceed, or even attain, the speed of light. Newton's second law of motion states that the acceleration (change of velocity) produced by a force is proportional to the mass of the object, or in symbols

$$F = ma \quad \dots (4)$$

where F is the force applied, m is the mass of the body and a is the acceleration produced. From equation (3) as the relative speed of an object approaches the speed of light its mass approaches infinity, thus larger and larger forces are required to increase its speed more, until the body is moving at the speed of light when its mass is infinite and an infinite amount of force would be required to increase its speed further. In practice this

Man is on the threshold of space travel, and when advanced space vehicles of the type envisaged here, travel at speeds which are a substantial fraction of the speed of light, highly accurate time standards, which are already available, will finally prove or disprove time dilation. (From the M.G.M. film "2001.")





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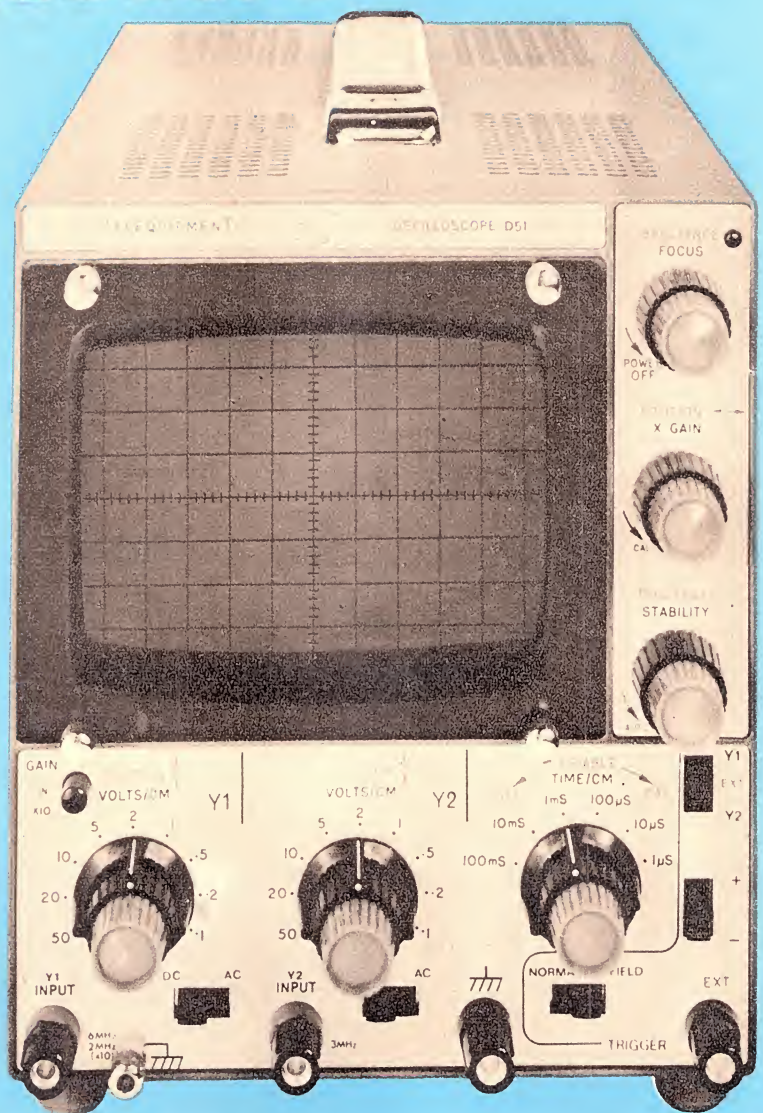
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means that no material object can quite attain the speed of light. The mass of the high speed particles mentioned earlier is measured by the forces required to deflect them from a straight path.

The "twin paradox" in space travel is occasionally revived in articles and although this is a result of the General Theory of Relativity, published by Einstein in 1915, it has its basis in the Special Theory of Relativity. This paradox concerns identical twins, one of whom remains on Earth and one who travels in a spaceship at nearly the speed of light. The twin who remains on Earth waits (and ages) twenty years for his brother to return, and when he does return he has aged only a few months. Such an effect is known as "time dilation" and is expressed by the equation

$$t = \frac{t_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \quad (5)$$

where t_0 is the time period measured by an observer and t is the time period measured on the object moving at relatively velocity v .

As may be seen from this equation, time passes more slowly for the fast moving object. Evidence for this effect is abundant, the most common example being the lifetime of π -mesons. These π -mesons are subatomic particles and are often formed in the upper atmosphere due to cosmic radiation, whence they travel toward the Earth at speeds of nearly the speed of light. When π -mesons are stationary their lifetime is approximately 0.2 nanoseconds so that at the velocity of light they would only travel about 37ft (6 metres) during their normal lifespan. However, they are often observed to travel distances of 6 miles (10KM) which means that their lifetime is approximately 4 microseconds — 200 times as long as when they are stationary. Interpreted another way, this means that time passes at only one two-hundredth of the rate for them at their high speeds than if they were stationary.

A question that is often asked in relativity concerns relative velocities and may be compared with two motor cars approaching each other. Suppose

an observer sees a spaceship approaching from his right at .75 of the speed of light and another approaching from his left at .75 of the speed of light. These will be approaching each other at relative speeds of $.75 + .75 = 1.5$ times the speed of light — yet according to the Theory of Relativity, no object can attain a relative speed greater than that of light. The fallacy in this argument is that velocities are NOT added directly. The velocity of approach (v) as measured by observers on the spaceships is given by

$$v = \frac{v_1 + v_2}{1 + \left(\frac{v_1 v_2}{c^2}\right)} \quad (6)$$

where v and v_2 are the velocities as measured by the observer watching as both approach him.

In the problem given, the spaceships would be approaching each other at only 96% of the speed of light. In the case of two motor cars approaching each other at 60mph, or even aeroplanes at 1,000mph, the expression $v_1 v_2 / c^2$ is extremely small and, as close as can be measured, equation (6) becomes $v = v_1 + v_2$, which is the equation commonly used. At 1,000mph the relativistic effect is approximately one part in 20 thousand million.

One of Einstein's initial postulates is that all inertial observers would measure the velocity of light in a vacuum to be the same. Combined with other aspects of the Theory of Relativity this has some astonishing results which are illustrated by an example. There are two spacecraft, one (A) approaching the Earth and the other (B) moving away from the Earth at speeds that are comparable with the speed of light. (The actual speeds do not matter as the result still holds.) If a radio signal is transmitted from spacecraft A an observer on A would measure its speed to be c . When this radio signal reaches the Earth, regardless of the distance away or speed of A,



("Electronic Age")

an observer on Earth would also measure the speed of the radio signal to be c . Similarly in the case of B, an observer transmitting a radio signal from B would measure its speed to be c , and its speed when it arrived at Earth would also be c . This situation may be seen to fit equation (6) by replacing one of the velocities, v_1 or v_2 , by c , the speed of a radio signal or light.

Although the speed of the radio signal as measured by an observer on the spaceship and on Earth is the same, the frequencies would not be the same because of the Doppler effect, and the information would be received in a more compressed form from the spaceship approaching the Earth than the form in which it was transmitted. Similarly the information as received on Earth from the spaceship moving away would be expanded. Such an effect may be simulated for spacecraft travelling at about one half the speed of light relative to the earth by playing a 45rpm record at 45rpm (conditions of transmission) then at 78rpm (reception from approaching spacecraft) and 33rpm (reception from receding spacecraft).

Perhaps the most unexpected result of the Special Theory of Relativity is the limitation of the speed of light on all other speeds, and its intrusion into all results. In Einstein's initial calculations, a constant speed, which he designated " c ," came into all results and it was not until late in the mathematical proofs that this constant was seen to be equal to the speed of light in a vacuum.

The speed of light in a vacuum is approximately 186,000 miles per second or 300,000 kilometres per second, but when travelling through other substances the speed is reduced. For example, in glass the speed of light is only about 124,000 miles per second or 200,000 kilometres per second. In relativity, " c " is the speed of light in a vacuum — not in material substances.

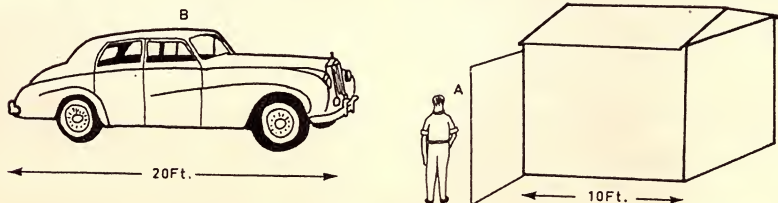
It should be pointed out in conclusion that neither the Special Theory of Relativity nor the General Theory of Relativity (which treats acceleration and gravitation) invalidated Newton's laws. Newton's laws of motion are special cases of Einstein's laws and hold as close as can be measured when relative velocities are small compared with the speed of light. Thus Newton's laws give the correct results when applied to normal situations and have the advantage that the arithmetic is much easier than that required for relativistic mechanics. ■

A Paradox of Relativity

The Special Theory of Relativity has been the source of many paradoxes, and one is given here as an example.

Consider a motor car 20 feet long and a garage 10 feet long as in the accompanying diagram. An observer "A" stands by the doors of the garage and an observer "B" drives the motor car. B drives the motor car at such a speed that A sees it to be only 10 feet long, and he thus reasons that as B drives into the garage he can close the door and the car will fit. However, the contraction of length is due to relative velocity, and B sees that his car is still 20 feet long, but the garage is only 5 feet long — and he says that the car will not fit.

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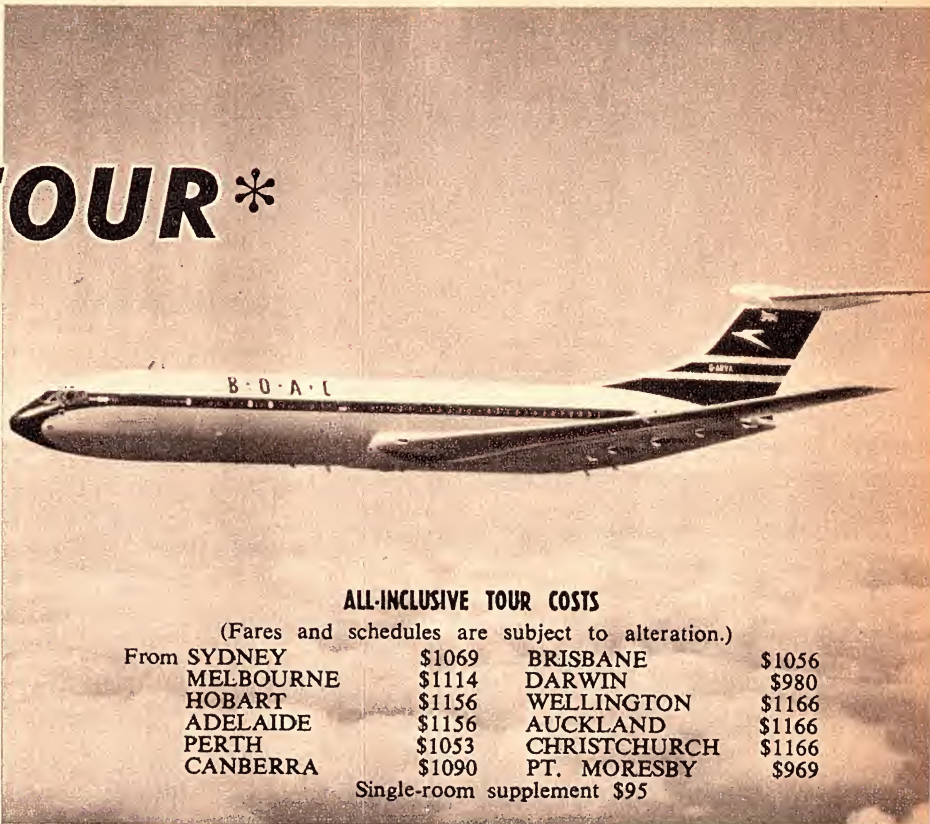
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Navigation Net Around the World

A world-wide network of VLF transmitters now taking shape will eventually cover the entire globe with a grid of radio waves to provide a single navigation system. Computers on ships and aircraft will process the VLF signals, to make navigation an entirely automatic process.

by Dr. G. A. Bailey

Very low frequency (VLF) radio transmissions of only a few tens of kilowatts of power may be received almost anywhere around the Earth. The lower "D" layer of the ionosphere behaves as an almost perfect reflector to these waves and the sea, land and ice surfaces of the earth form a second reflective shell, which traps the waves in a spherical band round the Earth. This makes it possible to consider a world-wide navigation system based on a small number of transmitters—a system that is taking shape under the name of Omega.

In 1947 the Bureau of the International Telecommunication Union, Berne, published regulations allocating the VLF frequency band of 10 to 14KHz for radio navigational purposes. Several proposals have since been put forward for navigational systems covering the whole world, one of which is Omega. It has been developed and extensively tested by the U.S. Navy Electronics Laboratory, San Diego, and the Naval Research Laboratory, Washington, D.C., with much help from other laboratories and various individuals. Many valuable measurements have been done by scientists at the Royal Aircraft Establishment, Farnborough. Recently it was decided to go ahead with developing the Omega system to cover the Earth with a VLF navigation network by the early 1970s.

The waveguide formed by the ionosphere and earth's surface is shown in figure 1. The effective height of the ionosphere "D" layer is about 70KM during the daytime, and about 90KM at night. These heights are relatively constant under most conditions. A typical electric-field pattern which is set up by a transmitter on the Earth's surface is also shown in figure 1, and this pattern moves away from the transmitter at the phase velocity of the wave. The attenuation characteristics of the earth-ionosphere waveguide is shown in figure 2 and is similar to the normal microwave waveguide characteristic. A minimum attenuation occurs at about 18KHz.

There are several ways in which radio-wave propagation at VLF can be used for navigational purposes, but in all cases it is essential that propagation characteristics can be predicted accurately and preferably be understood as well. One of the simplest navigational principles may

be understood by considering a ship which is initially in port at the same location as a VLF transmitter. The frequency of a continuously transmitted wave is precisely controlled by means of an atomic standard. The ship's receiver is equipped with a similar standard—an atomic clock—which controls an oscillator, which oscillates at the transmitter frequency. It is set up to be in phase with the transmitter. As the ship moves out from port, away from the transmitter, the received signal undergoes a phase change due to propagation over the distance between the ship and transmitter. This phase change may be determined on the ship by comparison of the received signal with the standard oscillator.

When the ship has moved a full wavelength away from the transmitter, the two signals are again in phase, i.e. a null is detectable. This process repeats in a cyclic manner as the ship continues to travel away from the transmitter. The number of nulls counted gives a direct measure of the total phase change undergone by the transmitted signal. This may be directly related to distance from the transmitter, provided the propagation characteristics of the wave are known. The transmitter can be considered as being at the centre of a family of equispaced, concentric rings of constant phase.

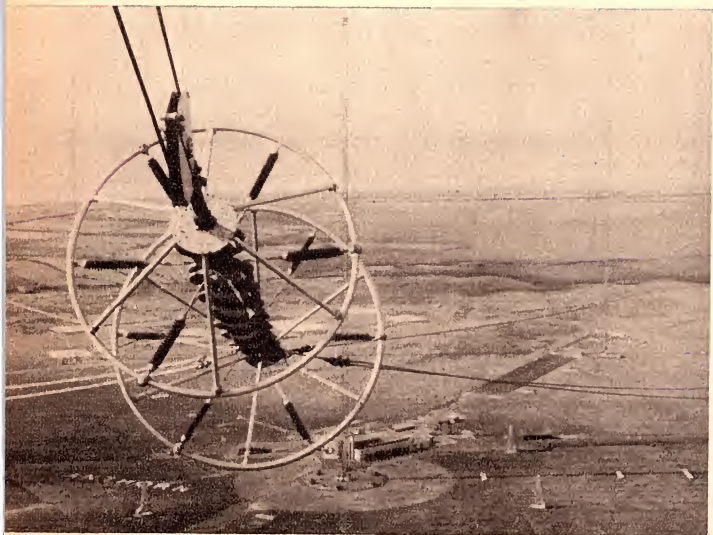
Unfortunately, this system suffers from several disadvantages. A major one is that it is essential for any craft using this form of navigation to be equipped with an atomic standard to time the phases exactly. A complete system would use several VLF transmitters positioned at optimum geographical locations on the Earth's surface. The ship's position would be determined by measuring the phase of the signals from two different transmitters using the atomic clock. Each measurement would fix the ship's position on one ring of waves from a transmitter, and the intersection of these rings would give the "fix."

A better way of doing this, one which would remove the need for an atomic clock on each ship or aircraft, would be to compare the phases of signals from two transmitters rather than measure each one. Using this technique, lines of constant phase form a hyperbolic family. A typical matrix of constant phase lines arising from three VLF transmitters A, B and C is shown in figure 3. It is, of course, necessary to identify all monitored signals and some way of identifying the signals from each transmitter must be used.

The Omega system is at present being built and will eventually consist of a network of eight VLF radio stations at various points on the Earth's surface. Although the number of stations to be used is small, world-wide coverage will result. A measure of redundancy will be built into the system, so that the system can remain operational with one or more stations temporarily out of action. (Some navigational accuracy is lost, however, with this system.) Each station will cost about £5 million (\$10.7 million). A large fraction of this will be taken up by the aerial system itself, which necessarily has to be a high structure covering many acres of land.

It is planned that each station will transmit three basic carrier frequencies of 10.2, 11.1 and 13.6KHz, and also an identifying carrier frequency, characteristic to that station. A fourth basic carrier frequency may well be used when the system is completed. No two stations will ever transmit the same frequency at the same time. Each transmitter will beam a sequence of pulses at the three basic frequencies, and one identifying frequency, for a 10-second

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The aeriels of a large VLF transmitter installation near Carlisle, in UK., erected for a NATO communications network.

period. The process will then be repeated. The basic frequencies will each be transmitted for approximately one second, and allowing about 0.2 seconds interval between pulses, six seconds will remain within the 10-second period for transmission of the identifying carrier.

Although all stations transmit the three basic carriers for about one second within any transmission sequence, the carriers are, in fact, length coded for extra identification purposes. For example, station A may transmit the following sequence: 10.2KHz for 1.2 seconds, 11.1KHz for one second, and 13.6KHz for 0.9 seconds, followed by an identifying carrier of 12.750KHz for six seconds. Station B may transmit 10.2KHz for one second, identifying carrier of 12.000KHz for six seconds, 11.1KHz for 1.1 seconds, and 13.6KHz for 0.9 seconds.

At each station, the basic frequencies are derived from a common caesium atomic standard such that although each frequency is transmitted for only about one second in every 10 seconds, these one-second pulses are phase-related and form a coherent wave. Except for the identifying carriers, all frequencies are "in phase" every 30 seconds. Although the basic frequencies are transmitted for only about one second at a time, some 10,000 cycles will be radiated in this time. This gives more than enough information for phase comparison purposes. As no two stations are ever transmitting on the same frequency at the same time, storage facilities are required at any monitoring stations, such as ships or aircraft. In this way, transmissions at 10.2KHz, from one station for example, may be "remembered" and then compared with 10.2KHz transmissions from another station at a later time.

The 10.2KHz emissions provide a form of reference in the Omega system, as this frequency is used on its own to give hyperbolic sets of constant phase lines separated by approximately 15KM (half a wavelength). It is also used together with the other basic frequencies to derive difference frequencies which correspond to hyperbolic sets of lines of separations greater than 15KM. These widely spaced hyperbolic sets are needed to remove ambiguities from the system.

For navigation using only phase comparison measurements at 10.2KHz, the navigator would have to know his position to an accuracy of better than seven kilometres, to enable him to identify, without ambiguity, the 10.2KHz constant phase lines. Clearly, this is not entirely satisfactory, so a "coarser" set of lines must be superimposed upon the 10.2KHz sets. A lower frequency is required for this. If a sub-multiple such as 10.2/3KHz (3.4KHz) is used, hyperbolic sets of lines will be produced three times more widely spaced than the 10.2KHz lines — the lines will be 45KM apart. This means that one in every three 10.2KHz lines will coincide with a 3.4KHz line. Provided the navigator can resolve a 3.4KHz line to within seven kilometres, there will be no ambiguity in interpreting the positions of the 10.2KHz lines. As VLF energy at 3.4KHz cannot be radiated very strongly from the Omega stations, the frequency is derived at the monitor by taking the difference between the two basic frequencies 13.6KHz and 10.2KHz. This procedure may also be carried out with the other basic frequencies to give even coarser hyperbolic sets.

The overall stability of VLF transmissions is so good that it is planned to use the Omega network to distribute standard time information as well as the navigational "fixes." The frequency of the stations will be so closely controlled that it will be possible to determine standard time at any point upon the earth's surface to within an accuracy of about one microsecond — providing a further aid to global navigation.

Unfortunately, VLF transmissions are not always well-behaved. If dawn or dusk conditions arise anywhere upon a propagation path, anomalous phase-change effects occur. VLF waves propagate far more easily towards the east than towards the west, due to the effect of the earth's magnetic field upon the ionosphere. This effect may sometimes mean that a craft travelling towards a transmitter receives a stronger signal from "behind" than from the transmitter direction! Propagation over certain regions, the Arctic for example, is complicated by the low conductivity of the icefields and also by unusual ionospheric conditions.

It is expected that it will be possible to take these unfortunate effects into account, either by means of charts (in the case of slow-moving craft) or by correction factors that could be automatically introduced into the receiving system as required. A system of the latter type would

(Continued on page 131)

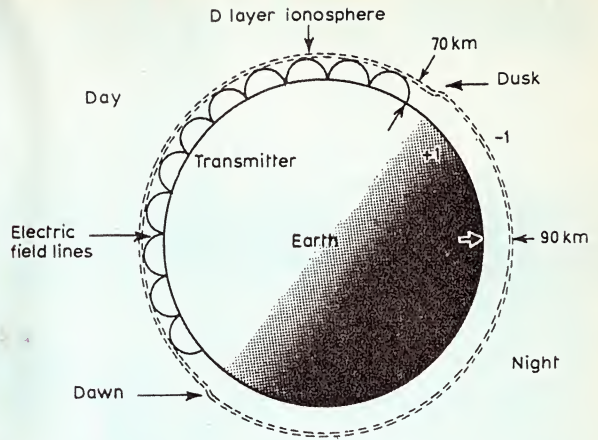


Figure 1. Diagram representing the earth-ionosphere waveguide, with an electric field pattern radiated from a VLF transmitter in daytime covering part of the propagation area.

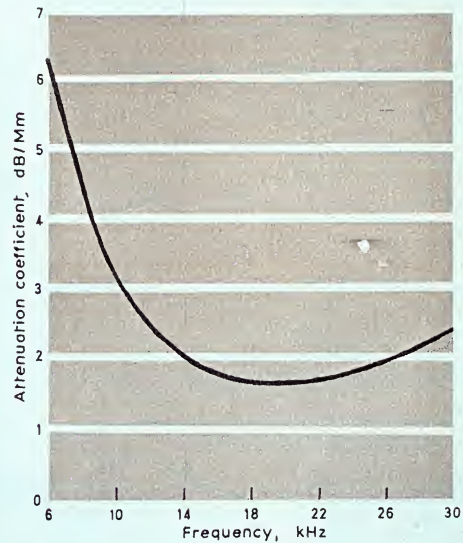


Figure 2. Graphical representation of attenuation in daylight conditions.

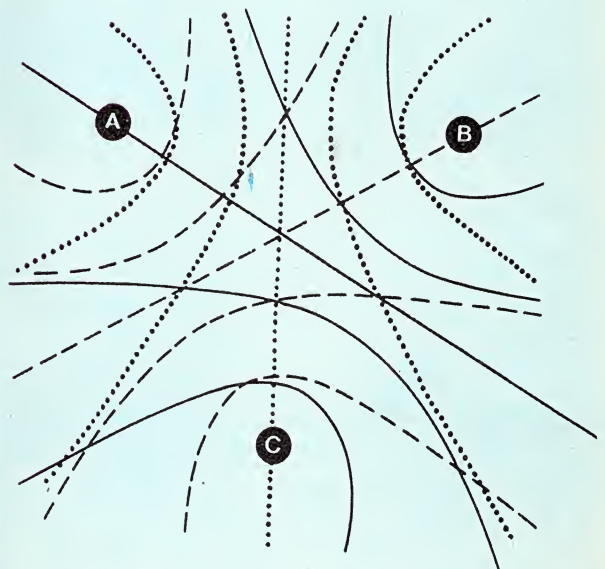


Figure 3. Showing the type of hyperbolic grid of constant-phase lines produced by three VLF transmitters, A, B and C, as used in the Omega system. For clarity, not all the phase lines are shown.

NEW POWER SOURCES

After 20 years of intensive materials research and development, the electronics industry is on the verge of new techniques which will revolutionise the generation of electricity.

By Bruce Shore



Germanium-silicon thermocouples, which convert heat to electricity.

Under the cover of such ponderous and obscure terms as magnetohydrodynamics, electrogasdynamics, photovoltaics, thermionics, thermoelectrics, and cryogenic chemistry, electronics scientists are generating significant amounts of electric power directly from hot gases, radio waves, heat, light, and such chemical reactions as occur between supercold, liquefied gases. Both government and industry are beginning to find applications for these new energy sources.

In the space program, for example, all the electricity to power the instruments and life-support equipment aboard the Apollo space capsules is provided by fuel cells. The energy is derived from electrons freed during the reaction of hydrogen with oxygen to produce water. And the electric power to run the instruments of more than 200 American space satellites — from the five-watt Vanguard to the 400-

watt Nimbus — has come from solar cells that convert sunlight directly to electricity by means of the photovoltaic effect. In addition, when the United States launched the first nuclear reactor into orbit in 1965, all power required on board was provided by a blanket of solid-state germanium-silicon thermocouples. These devices were developed by RCA to cover the reactor and convert its heat directly to a steady 500-watt supply of electricity.

The military is also using many of these new power-generation techniques. For instance, the U.S. Air Force powers a hypersonic wind tunnel at the Arnold Engineering Development Centre in Tullahoma, Tenn., with a magnetohydrodynamic generator. This produces up to 20-million watts of electric power by driving a superhot gas across a strong magnetic field.

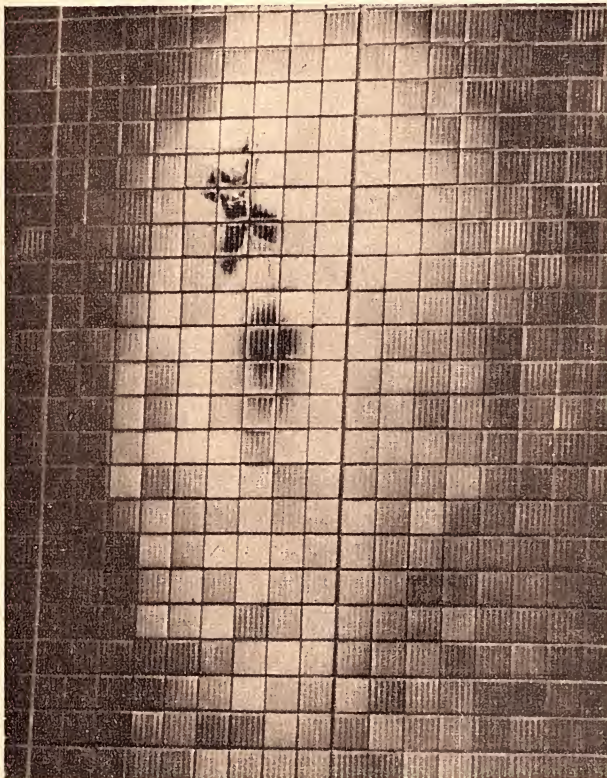
In other applications, both the General Electric and General Atomic companies are building nuclear reactors that incorporate thermionic diodes (valves) to convert heat directly into electricity. And a New Jersey firm, Gourdine Systems, Inc., has recently developed an experimental electrogasdynamic generator that employs a hot electrified gas moving in a narrow channel to generate electric power at levels of up to 120KV.

What makes all of these systems different from most conventional sources of electric power is that the actual process by which they produce current involves no moving parts. This contrasts with generators, such as are used in automobiles, and with alternators typically used in steam-generating plants and hydroelectric dams. Taken together, these two items generate about 95 per cent of the world's electric power, but both depend on the motion of a mechanical armature in a magnetic field to do so.

The reason this difference is so important is that any generator that depends on mechanical motion must inevitably suffer energy losses due to resistance and friction. As a result, the very best steam-generating plants are only about 41 per cent efficient. There are also the matters of economics and maintenance. Alternators have components rotating at high speed, and the rapidly moving parts sustain wear. This necessitates constant maintenance and expensive standby equipment for use when the machinery is out of service.

Although conventional batteries do not have moving parts, and can be highly efficient in converting chemical energy to electric current, they cannot achieve the sustained output of machinery, and they have one fatal flaw. They deteriorate in use — primary cells, for example, consume their own electrodes — thus their life is sharply limited. Further, because conventional dry cells and secondary batteries use materials such as lead or zinc, they are heavy. In space applications, the weight/power ratio is a primary consideration, so conventional batteries using heavy materials are avoided. It was just such considerations, following World War II, that led military services, and later NASA, to seek alternatives to the dynamo and the battery. What they sought were new power sources that would be self-contained, light-weight, mobile, small, long-lived, reliable, rugged, reasonably efficient and not too expensive. As if that were not enough, the military also specified that silent operation was an essential requirement.

Reprinted from RCA's "Electronic Age."



Part of a solar cell array used in one of the U.S.A.'s unmanned Lunar Orbiter missions.

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Extract from Review:

Comment from Electronics Australia (Page 119 February 1969): "frequency response checked out at plus or minus 2dB. from 30 Hz. to 20 KHz. . . a very good performance indeed."

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PRICE (Including Sales Tax) **\$39.50**

MODEL F-8L. Output 5 mV. Frequency response 5 to 35,000 Hz. Stylus: Elliptical diamond (0.2 mm x 0.8 mm). Cross talk less than -30db at 1Hz. Stylus pressure: $\frac{1}{2}$ to 2 $\frac{1}{2}$ gms. Total weight: 6.5 gms. Comment: A cartridge of truly professional standard.

PRICE (Including Sales Tax) **\$39.50**

MODEL F-8C. Frequency response: 20 to 25,000 Hz. Output 5 mV. Stylus pressure: $\frac{1}{2}$ to 1 $\frac{1}{2}$ gms. Cross talk: less than 30dB at 1 Hz. Tip mass 0.55 m.m. Stylus: Elliptical (0.2 x 0.8 mm). Comment: Performance is quite outstanding.

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AS-303. Magnificent teak/walnut speaker system with 3 speakers and 3-way crossover network. The 12in woofer with long throw voice coil provides excellent bass response; a 6 $\frac{1}{2}$ in mid-range speaker covers the middle range; a horn-type tweeter comes in at 5 kHz. Capacity is over 15 watts R.M.S. size: 25" x 14 $\frac{1}{2}$ " x 11". Comment: Extremely wide frequency range free of colouration.

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DITTON 15 measures only 2 $\frac{1}{2}$ in x 9 $\frac{1}{2}$ in x 9 $\frac{1}{2}$ in. Features an HF 1300 Mk. 11 tweeter, a new type bass drive unit and the revolutionary auxiliary bass radiator. Extracts—"Hi-Fi Sound": ". . . it was difficult to realise that so small a loud-speaker was really producing such well defined low frequency sounds. It goes without saying that the treble performance was fully up to standard of the HE 1300": "The Gramophone" — ". . . the listening tests made an excellent impression. Treble was bright and forward; the bass was clear and powerful enough to produce a good balance"; "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."

DITTON 15 (Includ. Sales Tax.) **\$94.50**

DITTON 10 measures 12in x 6 $\frac{1}{2}$ in x 8 $\frac{1}{2}$ in. Specially designed bass unit and well-known Celestion tweeter. Both 3 and 10 ohm impedances available. Was also well reviewed.

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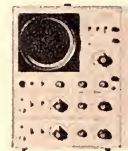
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PHILIPS

The electronics industry and others accepted the challenge. When they started, there were only three known ways to generate significant amounts of electricity: Electrostatically, electrochemically, and electrodynamically.

The electrostatic principle—storing an electric charge on an insulator and then bringing it into contact with a conductor—was recorded as having been used in a machine developed by Baron Otto von Guericke, of Magdeburg, Germany, as long ago as 1660.

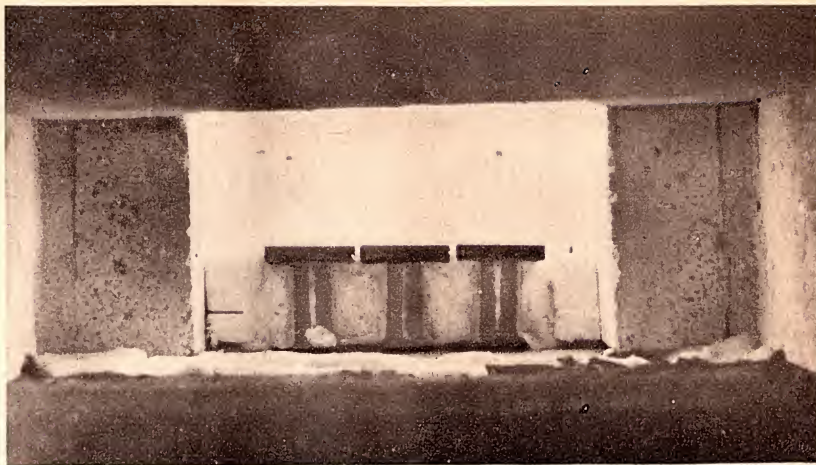
The electrochemical principle—involving chemical reactions that release excess electrons to a conductor in the course of their progress—was discovered in 1794 by Volta, in Italy, and this resulted in his invention of the chemical battery, forerunner of the primary cell.

Finally, the electrodynamic principle, which entails the mechanical motion of a conductor in a magnetic field, was first demonstrated in England by Michael Faraday in 1831, and developed by European engineers during the nineteenth century. It was used in a practical machine for the first time by Antonio Pacinotti in Italy, during the early 1860s, and eventually led to the creation of the dynamo and alternator.

Most of the initial research toward new power sources was directed along these three lines. For example, Gour-dine Systems, an electronics firm, chose the electrostatic principle and for the past several years has been developing a family of experimental electro-gasdynamic generators. These devices heat various gases to temperatures upward of 1,500°C. and then allow them to "blow" along a narrow channel through an electrical field that strips electrons from the gas atoms and sucks them into a nearby electrode. The momentum of the stripped atoms—now converted to positively charged ions—carries them beyond this field toward a negatively charged electrode. Since this second electrode is attached to the first by a wire running outside the machine, the ions recombine with their own lost electrons, thus completing the circuit. Before recombining, however, the electrons can be made to do work as they run along the wire by hooking it to a motor, light bulb, or other electrical device.

The Avco Corporation, on the other hand, is using the electrodynamic approach. Since 1954, its engineers have been building experimental magnetohydrodynamic generators that are suggestive of the Gour-dine approach in that they heat various gases to very high temperatures (about 2000°C) and blow them along a large duct. However, the gases are so hot that nearly all their atoms are broken down into constituent electrons and ions so that they form a gaseous plasma. When this plasma blows across a powerful magnetic field, set at right angles to its path, the electrons are forced up and the ions down toward electrodes protruding right into the stream. Since the electrodes are also linked by an outside wire, a current immediately flows and has the potential to do work. In effect, the Avco machine is a dynamo whose armature has been replaced by a streaming gas plasma.

Several chemically oriented companies not unexpectedly decided to try the electrochemical approach. They reasoned that, if lighter materials could be



Germanium-silicon thermocouples undergoing heat endurance tests.

used and if they could produce more free electrons while interacting, a new, high-power, lightweight battery might be developed. Further, if these chemicals consumed only each other and not their respective electrodes, a battery could be constantly replenished. The result is the fuel cell.

However, certain electronics companies, such as RCA, were not satisfied with any of these traditional approaches. They felt that, with the coming of the transistor and semiconductor technology, large amounts of electric power were no longer required to operate electronic devices and circuits. Furthermore, a hard look at the challenge given by the military services and the space agency revealed that both were primarily interested in generating power to operate control circuits, sensors, communications equipment, navigational devices and computers. Since all of these were being rapidly transistorised, they did not need big power sources.

Though electrostatics, electrochemistry and electrodynamics were the accepted ways to generate electricity, they were certainly not the only ones. Photocells that convert light to electricity, thermionic diodes and solid-state thermocouples that convert heat to electricity: all have been made and used by the electronics industry for decades. But they produce only feeble amounts of electricity—power measured in hundredths or thousandths of a watt. They obviously could not be used to power even transistor circuits unless they were greatly improved. Fortunately, the means for such improvement were at hand in the same semiconductor technology that had been used to develop the transistor.

In 1954, researchers at the Bell Telephone Laboratories demonstrated what this technology could do by developing an array of 432 semiconductor devices, which they dubbed "solar cells," as a means for producing 10 watts of electricity directly from sunlight. This array was later installed at the top of a telephone pole in a Georgia community to power the electronic amplifiers of a rural telephone line. Each cell in the array was a flat, single crystal of silicon incorporating impurities whose atoms caused a scarcity of electrons on its positive side and an excess on its negative side.

When a solar cell is exposed to light, current flows out of its n-side and into its p-side through an outside conductor

that can be attached to any electrical device to produce work.

In the light of this experience, semiconductor technology was next applied to thermocouples, initially by a firm that later became part of the Minnesota Mining and Manufacturing Company. Alloys of lead-telluride were "doped" with trace impurities and shaped to produce p-type and n-type legs, which were subsequently bonded to a copper crossbeam to form a U-shaped structure. Finally, a wire was attached to the ends of the legs.

Heat applied to the copper crossbeam of such a structure immediately drives the free electrons down to the bottom of the n-leg. This causes a chain reaction of electrons moving from the copper into the n-leg and "seated" electrons moving forward from the p-leg into the copper.

Thermoelectric arrays built from such semiconductor thermocouples now generate hundreds of watts of electricity using various heat sources, and are expected eventually to reach the 1,000-watt level.

Though thermionic diodes are not semiconductors—rather, they are vacuum tubes—they deserve mention because they, too, have been transformed into significant power producers. They work on the same principle as all vacuum tubes: heat applied to a metal electrode inside causes electrons to pop off into the surrounding vacuum. If this electrode is linked by an outside wire to a second electrode nearby, the latter will acquire a positive charge, since it is losing electrons to the first via the wire. It then will attract the electrons in the vacuum, thus completing the circuit.

Inherently rugged and capable of enduring high temperatures, thermionic diodes are particularly well suited for use in nuclear reactors and in association with radio-isotope heat sources. They have already yielded as much as 400 watts of electric power and should be able to produce 1,000 watts before long.

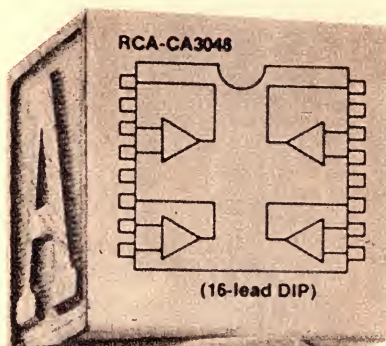
A spate of recent developments in the generation of electricity is tending to erase the artificial distinction traditionally made between electronics and the electric power industry. In the process, new and more versatile ways are being found to generate power for industrial and domestic consumers, as well as for the more exacting requirements of space research and other specialised applications. ■

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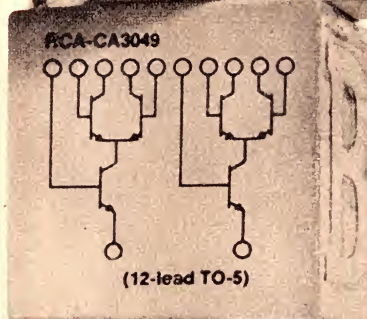


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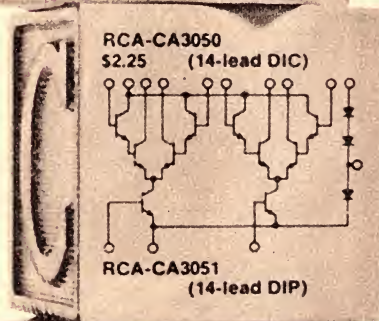
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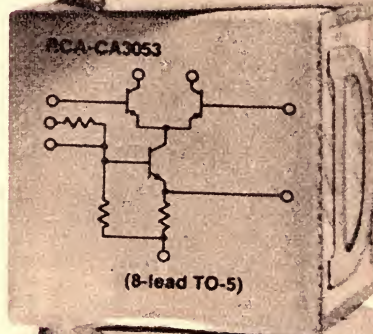
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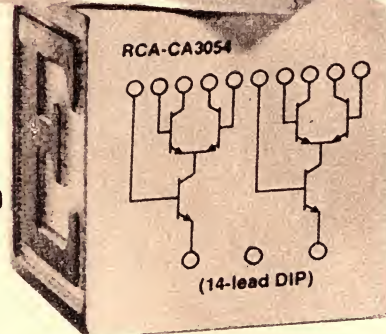
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IMPROVED ILS AERIAL

A research group at Sydney University has developed a new type of glide slope aerial for instrument landing systems which has major advantages compared with existing types. The group's work was financed by a grant from the Department of Civil Aviation.

by **W. G. Willoughby**
(D.C.A. Navigational Aids Section)

The instrument landing system glide path is a complementary facility to the localiser. Whereas the localiser defines a guidance track from the coverage point in to and along the runway centre-line, the glide path provides a fixed angle descent path in the vertical plane which allows an aircraft approaching on the localiser to descend to the runway surface (figure 1).

The localiser equipment and aerial system are sited beyond the stop end of the runway; the glide path equipment and aerial system are sited adjacent to the runway at the approach end. Since the glide path aerial must be positioned so that a landing aircraft will pass over the runway threshold at a safe height, the aerial is sited about 1000 feet inbound from the runway landing threshold in the normal system. The aerial is also offset side-ways about 570 feet from the runway centre-line so as not to be an obstruction to aircraft.

The normal glide path angle used in Australia is $2\frac{1}{2}^\circ$, although a 3° glide path is employed at some airports where obstructions on approach dictate a steeper descent angle. Generation of radio beams at such relatively low angles above the horizontal poses some difficult aerial problems at the radio frequencies involved.

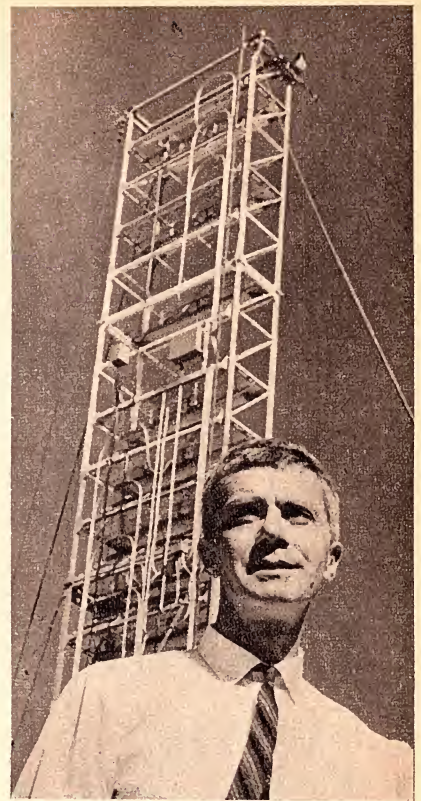
The aerial system which is in general use throughout Australia and most other countries is called the Null Reference Image System. This aerial system generates the required glide path by using a combination of directly radiated signals, and signals which are reflected from the ground surface in front of the aerial. The recombination of the two sets of signals in space forms the required pattern, provided that the ground surface behaves like a flat mirror for the radio frequency used. If the ground surface is not flat then the resulting pattern will be distorted in much the same way as one's own image is in a trick mirror in an amusement park.

The main advantage of this system is that the glide path angle is defined, to a first order, by the height of the aerials above the ground surface. It is therefore extremely stable, in keeping with the high level of safety required. The main disadvantage with this system is that a large extent (2500 to 3000 feet) of flat ground is required to obtain correct mirror-like (imaging) action. In many cases it is just not possible to provide this extent of reflecting surface, and a distorted glide path (which may be difficult to fly) results. In other cases where a high quality glide path is essential it may

cost very many thousands of dollars to provide a suitable reflecting surface.

Alternative image aerial systems have been developed in the past which do not require so much flat ground, but these all possess disadvantages (such as poor stability) which make them less attractive. Some aerial systems have been developed overseas which generate their patterns without any need for ground reflections. Unfortunately these aerials are at least 80 feet high and consequently must be sited well away from the runway, usually at a prohibitive distance. Furthermore, some signals from these aerials do strike the ground and when reflected cause distortion of the glide path.

The fact that the null reference image glide path is still preferred throughout the world highlights the



Dr. R. W. Redlich, leader of the group which developed the new ILS aerial, in front of the aerial during flight tests at Sydney Airport.

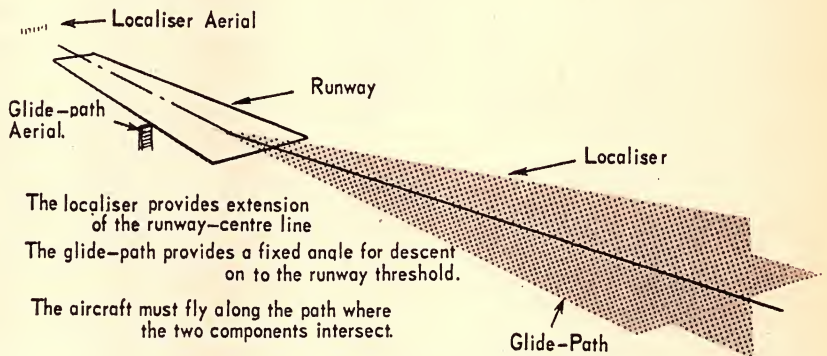
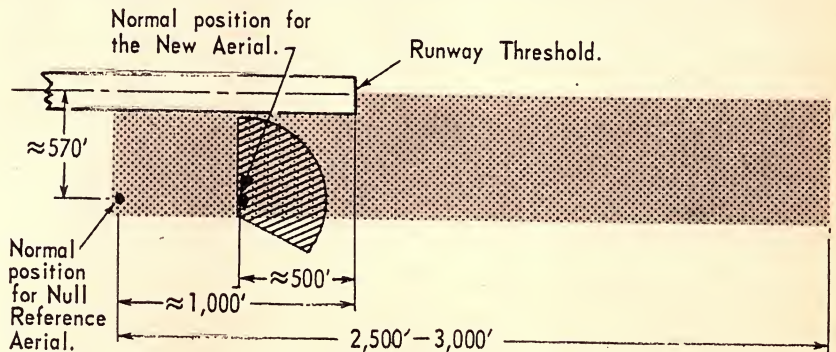


Figure 1.

ABOVE: Simplified diagram showing the principles of the instrument landing system. BELOW: The relative areas of smooth ground required for the existing glide slope aerial, and the new aerial.



Smooth flat ground required for : Null Reference Aerial .

The New Aerial. Figure 2.

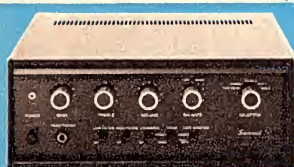
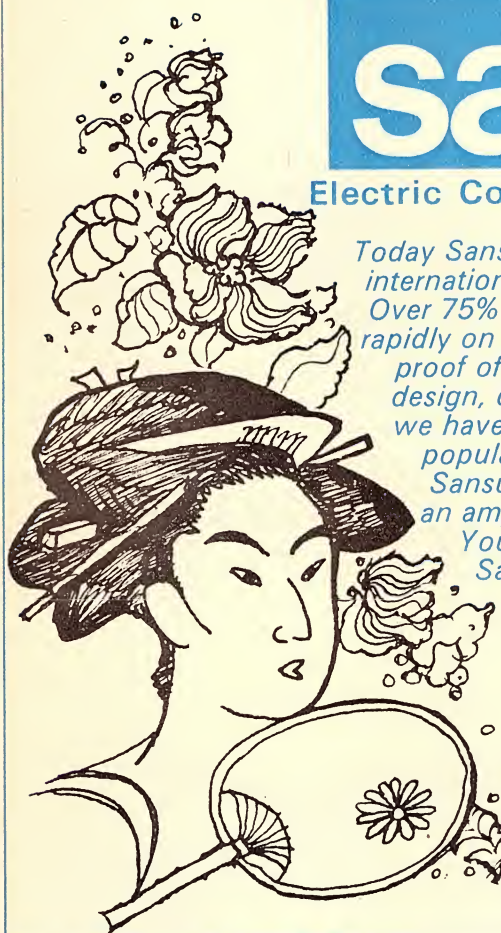
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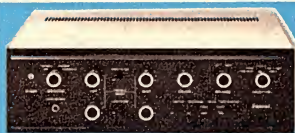
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Today Sansui is recognised as a leading international electronics manufacturer. Over 75% of Sansui's production sells rapidly on world markets — irrevocable proof of the acceptance of Sansui design, quality and reliability. Here we have illustrated just four of the popular models from the wide Sansui range. When you buy an amplifier... listen to Sansui. You'll hear the difference Sansui quality makes!



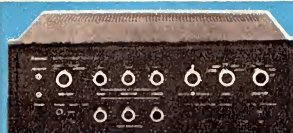
SANSUI MODEL AU-222
46 WATTS
SOLID STATE STEREO
AMPLIFIER

Using low noise silicon transistors throughout, the Model AU-222 features a frequency response of 20-30,000 Hz. ± 1 dB, and a power output of 46 watts (music power). Input sensitivity suits magnetic cartridges at 2 mV.



SANSUI MODEL AU-555
60 WATTS
SOLID STATE STEREO
AMPLIFIER

Frequency response of the Model AU-555 is 20-80,000 Hz. ± 1 dB, and input sensitivity suits magnetic cartridges at 2 mV. Total power output is 60 watts (music power). Controls offer extreme flexibility and audio quality can only be described as superb.



SANSUI MODEL AU-777A
70 WATTS
SOLID STATE STEREO
AMPLIFIER

With a frequency response of 20-100,000 Hz. ± 1 dB, at normal listening levels, the Model AU-777A offers a power output of 70 watts (music power). Input sensitivity is 2 mV, for magnetic cartridges. All-silicon transistors are used throughout. Every desirable control is incorporated.



SANSUI MODEL 300E
36 WATTS
SOLID STATE STEREO
TUNER/AMPLIFIER

With an output of 36 watts (music power) and a frequency response of 25-30,000 Hz. ± 2 dB, the Model 300E is one of the finest stereo tuner/amplifiers available. Tuners are AM/FM/SW — silicon transistors offer greater stability in both tuning and amplifier circuits.



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difficulty involved in developing a suitable alternative.

In 1965 the Department of Civil Aviation made a grant to Sydney University for the purpose of creating and supporting a Navigational Aids Research Group within the University's Electrical Engineering Department. The problem of developing an alternative glide path system was one of many which was suggested to the group. In due course the leader of the group, Dr R. Redlich, proposed a new glide path system which was called the Phase Reference Glide Path.

Dr Redlich's system uses an aerial which is only 45 feet high and does not require any ground to generate the required patterns, although about 300ft of flat ground is needed (as shown in figure 2) to redirect some unwanted signals away from the glide path.

The prototype aerial elements were constructed by the group itself, and D.C.A.'s N.S.W. Regional Workshops built the supporting tower. Initial testing of the Phase Reference Glide Path was conducted at Hoxton Park Airfield, N.S.W., by Dr Redlich and his group. Subsequent flight tests at Hoxton Park and Sydney Airport were carried out by D.C.A. aircraft under the technical direction of Dr Redlich and specialist engineers from the Department's Navigational Aids Section.

The flight tests have shown that Dr Redlich's system is capable of producing an excellent quality glide path at the Sydney 07 runway where, because of the poor site, the commissioned Null Reference Image System is necessarily displaced about 700 feet further from the runway threshold than is ideally required. This has resulted in the threshold crossing height of the radio glide path being higher than the I.C.A.O. recommended figure (50ft) causing a disparity between visual and instrument approaches. Modification of the site to achieve the recommended threshold crossing height with an acceptable quality glide path would be enormously expensive in this instance. Little modification of the site would be required to achieve the recommended threshold crossing height using Dr Redlich's glide path system.

Dr Redlich's aerial system, however, is extremely complex, and variations in antenna currents can destroy the glide path entirely. It is most important therefore that the associated monitoring system should accurately detect all changes in the aerial system to preserve the integrity of the glide path. In this regard, the Department's analogue computer is proving to be invaluable for simulation of Dr Redlich's aerial system. A simulation study of the effects of variations in antenna currents is in progress at the moment. This study will greatly assist in the development of a fully acceptable system.

Meanwhile, the Nav aids Research Group is continuing work on the glide path aerial and monitoring system at Sydney, while the Department is preparing to call tenders for a fully engineered system.

This new ILS glide path aerial system has aroused great interest around the world and should supply a much needed solution to the problem of providing ILS glide path facilities where ground conditions would have made it impracticable or uneconomical to do so. ■

Testing Rockets With Sound

A massive, towering concrete structure used for testing space vehicles and missiles by sound waves has been constructed in the U.S.A. by the Lockheed Company.

Built at a cost of \$US5-million, this building complex at the Lockheed Missiles and Space Company's headquarters at Sunnyvale, California, is the largest industrial acoustic test facility in the U.S.A. The company is one of the major suppliers of rocket vehicles for the space effort, and missiles for the armed services.

Space rockets passing through the earth's atmosphere come in for some pretty solid buffeting, and one of the main purposes of the Lockheed installation is to simulate similar conditions for testing space vehicles. Acoustic tests help determine the "flight-worthiness" of products designed to operate in hostile environments created by rocket exhausts and high speed atmospheric flight.

The intense sound waves generated for feeding to the test cells are produced by a device called an air modulator. This modulates a stream of air or gas into random pulsations, which create sound. A computer and its peripheral equipment give test engineers control over sound levels, and collect, store and analyse data from the acoustic tests.

The facility has three test cells. The largest is 44ft wide, 50ft long and 86ft high, with a sound capacity of 153 decibels (dB) above the threshold of hearing. The two smaller chambers can cope with sound levels up to 170dB. Some idea of the noise values involved may be obtained by comparison with a typical jet airliner, which generates noise which from 200ft away would register as about 122dB; while a large rocket blasting off might register up to 160dB at the same distance.

Sound levels of the order generated within the test chambers have to be isolated from the rest of the plant, and this is done by using massive concrete walls and doors.

"Each of the two big sliding concrete doors on our large test chamber weighs 600,000 pounds," said Raymond E. Dieber, acoustic test manager of Lockheed's Space Systems Division. "The doors were too heavy to have



General view of the 85ft acoustic chamber in the Lockheed testing facility, the largest of the three in the complex. The entrance is closed by double sliding concrete doors weighing over a million pounds. In the foreground is one of the horns which create sounds with levels as high as 153dB to simulate conditions such as would be experienced by spacecraft and rockets passing through the Earth's atmosphere.

built elsewhere and transported to the site, so we had them poured in place. Our developments in spacecraft, missiles and ocean systems has proved to us that tough, thorough testing can only grow in importance."

Bieber said the largest cell can accommodate vehicles and spacecraft up to 22ft in diameter and 70ft long. Vehicles up to 100ft long can be accommodated in high bay preparation areas, where they can be disassembled into sections or components for testing in the acoustic chambers.

Sound insulation of the huge concrete shells is so effective that if a battery of artillery was firing its guns within the walls of the building, passers-by would hardly be aware that anything was going on. ■

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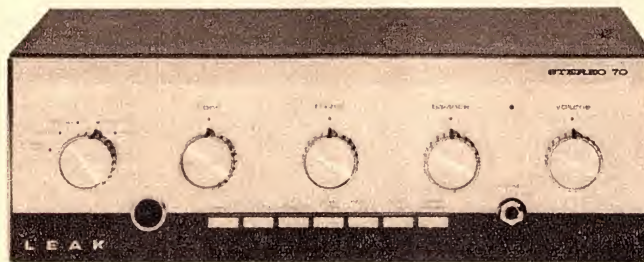
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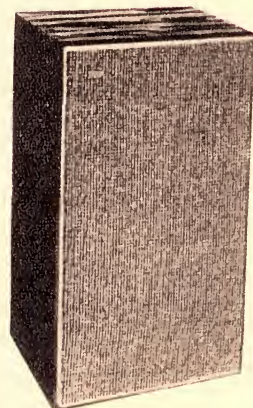
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TECHNICAL DIGEST

Anti-collision systems for aircraft demonstrated in U.S.A.

Anti-collision systems for commercial aircraft, based on an atomic clock and a computer carried in the aircraft, were demonstrated recently in the U.S.A., and may become standard equipment in U.S. airlines by 1971.

In the U.S. tests, two planes flew almost intersection paths to show how the system could warn of possible collision hazards and instruct crews on manoeuvres which would avert the possibility of a mid-air collision. The tests have generated intense interest among airline managements because there has been a steady increase in mid-air collisions, one of the most serious being a collision last September near Indianapolis in which 83 people died.

During the tests three manufacturers demonstrated anti-collision systems they have developed: The McDonnell-Douglas Corporation, Bendix Avionics, and Wilcox Electric. The tests were conducted first in two piston-engine airliners and then by one such aircraft and a twin-jet executive plane.

The basic approach used in all three systems is to use the atomic clock to time the transmission of digitally coded radio pulses from each aircraft with a high degree of precision. At present, pulses are repeated at three-second intervals, and the duration of each pulse is such that 2,000 suitably equipped planes could operate in the same area using the same system. Since the high-frequency radio waves employed are only capable of line-of-sight travel, the maximum distance any two planes would be in contact for operation of the system would be about 100 miles. For the foreseeable future, nothing like 2,000 planes could be expected to be in operation in an area of 100 miles radius, so the possibility of saturation point being reached is not considered likely at present.

Basically, this is how the system operates:

Each plane within a certain operating area would automatically be assigned to transmit a burst of radio signals during one of the 2,000 short time slots into which the three-second base period is divided.

Every three seconds, every plane in the area goes on the air in the same order at precisely the right moment.

A computer aboard each plane can then measure the precise distance between that plane and each other plane.

It can do so because it knows the time each transmission began, knows the time it arrived, and can calculate how far electronic signals travel in the elapsed time.

The second critical measurement is the rate at which any two planes may be heading towards each other. This is calculated by the apparent shift in frequency measured at the receiving plane (doppler shift). The final critical information contained in each transmission is the plane's altitude.

How is all this information used to avoid collision?

There are three important points in time when alerts and instructions are sent to the pilots. They come 42 seconds, 30 seconds and 25 seconds before the time when, if no changes are made in the planes' flight paths, they will pass closest to each other or perhaps collide.

At the 42-second point, a yellow warning is flashed on a cockpit indicator telling the pilots there is a potentially dangerous plane above or below.

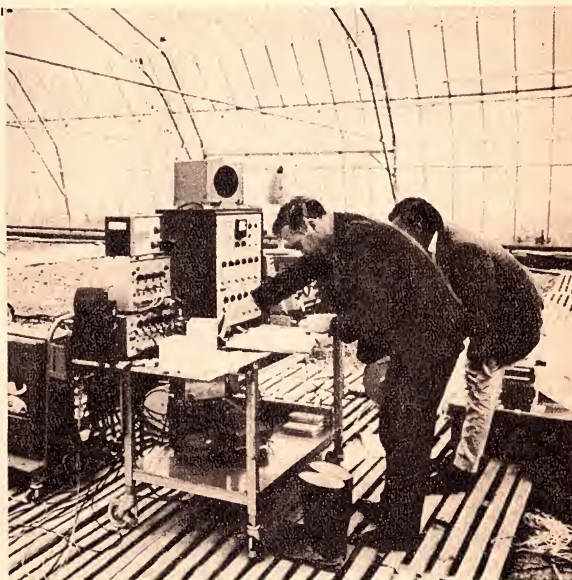
At the 30-second point, the crew is told to prepare to dive or climb. And at the 25-second point, the order is given to execute the climb or dive.

Those concerned with the tests recognise that non-airline planes have been the other aircraft in an overwhelming percentage of the collisions where commercial airliners have been involved, and that adoption of the anti-collision system by the airlines alone would be of limited value. However, they are optimistic that operators of private aircraft, especially companies operating executive planes, will soon follow the lead of the airlines, and install comparable, if less complicated and less costly, anti-collision devices.

EDITOR'S NOTE: Some aspects of the operation of the system are not fully explained. Presumably data related to aircraft height are obtained from the radio altimeter and fed to the computer for translation into a suitable code. ■

Sonic booms in a glasshouse

Ministry of Technology scientists in the U.K. are not waiting for sonic-boom problems from the supersonic Concorde to happen before tackling them. They are simulating the shock wave with explosives, mounted on poles in an adjacent field, and recording the effects on the apparatus shown in this picture. The testing ground is a huge greenhouse at the Ministry of Agriculture and Fisheries experimental station in Hampshire, England. The equipment records the shock wave and information relating to the amount of broken glass. The tests are particularly relevant



in the U.K. because of the large amount of agricultural produce grown under glass.

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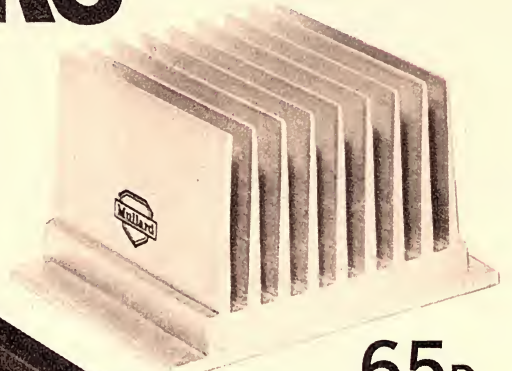
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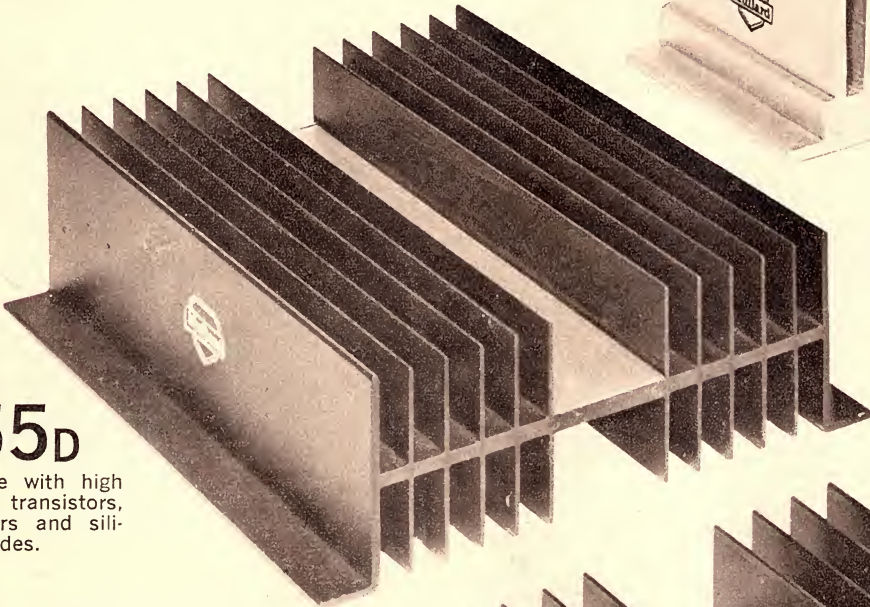
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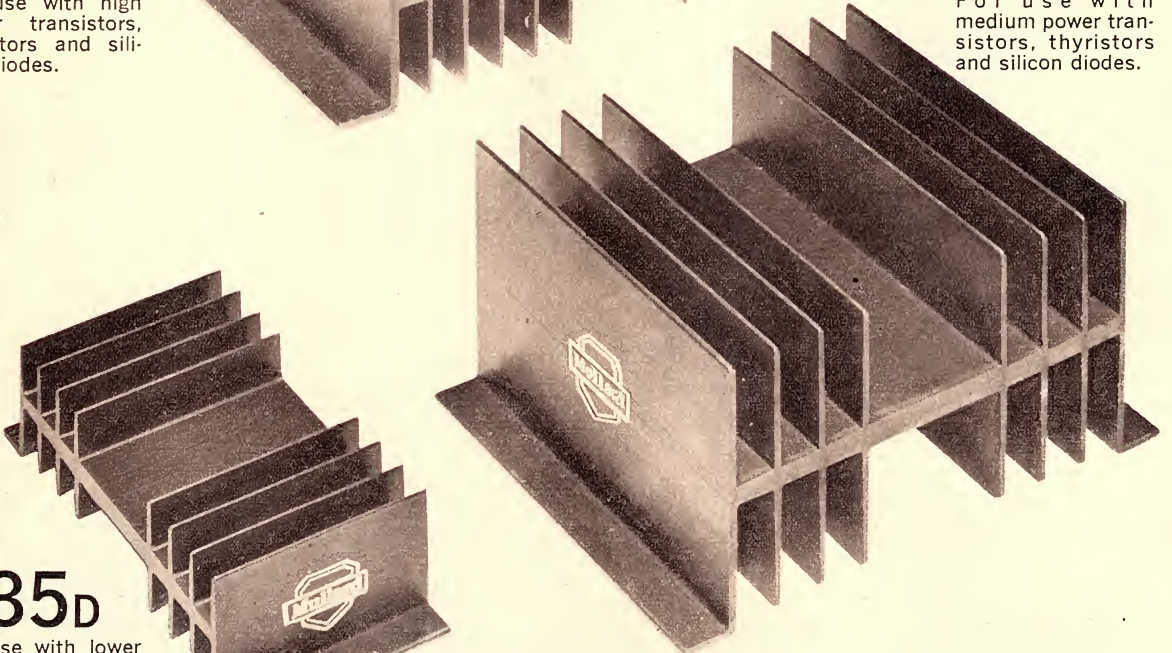


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NEW ELECTRONIC SYSTEMS FOR BERTHING BIG TANKERS

Electronic devices using doppler principles, designed to assist pilots in the docking of huge tankers, are described in this article by Dr W. P. Williams of the Marconi International Marine Co. Ltd.

In the last few years economic necessity has caused a rapid increase in the size of tankers used for carrying oil. Five years ago a 50,000 ton tanker was regarded as large. Today 200,000 tonners are typical, there are already in existence 300,000 tonners and there is no sign that the ultimate size has yet been reached. The size of these large vessels introduces a number of new handling problems, one of the most important of which is berthing them safely.

A 200,000 ton tanker is typically between 1,000 and 1,200ft in length with a draught of perhaps 70ft when fully loaded. This means that only a very few ports in the U.K. and elsewhere in the world are deep enough to take these vessels, and furthermore ports that can accommodate them allow very restricted room for manoeuvre. A second function of size is the weight of the vessel.

A fully loaded 200,000 ton tanker probably has an all up weight of 350,000 tons. The jetties against which these vessels have to berth are usually built of concrete mounted on piles sunk into the bed of the harbour, and they can withstand only a limited impact force. With small vessels these jetties would allow a wide tolerance on the range of impact speed at which the vessel could berth but with a mass of 350,000 tons the speed tolerance is very small indeed. Usually the safe impact velocity is less than 20ft per minute. The pilot therefore, has two difficult problems.

First he has to judge how the bows of a ship, possibly a thousand feet away from him, are responding to changes in engine speed and rudder movements and also he has to judge the speed at which an enormous bulk is moving in a choppy sea, usually with no reference point to guide him. Both these problems are considerably alleviated if the pilot knows the ship's velocity at any time during the berthing, and two instruments have been devised to help in this respect.

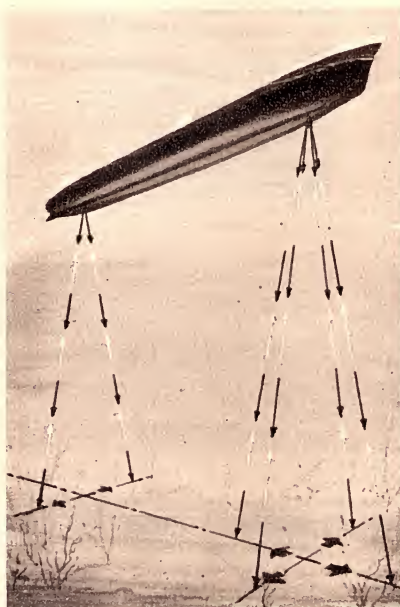
Of these the sonar doppler navigator measures the velocity of a ship over the ground in both the fore and aft, and athwartships directions. It works in a manner rather similar to the radar equipment used by aircraft, but it uses the doppler shift in a sonar beam instead of the doppler shift in a radar beam. If a single sonar beam could be transmitted from the bows of a ship and reflected from a stationary object ahead of the vessel then the doppler shift in the return signal would give a measure of the ship's forward velocity.

Unfortunately, there is usually no fixed object ahead of a ship from which to measure. The beam is therefore depressed through an angle from the horizontal so that a reflection can be

obtained from the bottom. Providing the angle through which the beam is depressed is known this gives the forward velocity of the vessel. However it is also sensitive to the vertical motion of the ship caused by pitching and rolling. This component is eliminated by having a second beam pointing in the astern direction at the same angle as the forward beam and comparing the doppler shift between the two beams.

This technique eliminates doppler shift due to vertical movement and makes the system more sensitive to a horizontal movement. By putting a further two beams in the athwartships direction, the sideways velocity of the vessel can also be measured. Adding these two velocities vectorially gives the actual speed and direction of the vessel over the ground.

If two transducer arrays are fitted (see diagram) all the components of the ship's motion can be measured and displayed. The technique is extremely accurate (better than 1 per cent) and is very sensitive to movement, being capable of measuring velocities less than 0.1 of a knot and giving an indication of movement down to 0.01 of a knot. An equipment using this technique has been developed by the Marquardt Corporation of America. On the display with which the pilot is provided, a centre digital display shows the fore and aft velocity of the vessel and the two displays on the top and bottom of the unit give the sideways velocities of the vessel at the bows and



Arrangement of beams used in the Marquardt doppler system.

stern. This is achieved by having two sets of transducers providing two sets of four beams of the type described above.

The sonar doppler equipment provides a measure of the ship's velocity over the ground on board the vessel, immediately available to the pilot at any time. However, it has one serious disadvantage in that it is expensive and has to be fitted on every vessel above a certain size.

Another approach to the problem is to use a velocity measuring device mounted on the jetty and reporting the ship's speed to the pilot by radio. Such a device, known as SAMI, has been developed by Marconi Marine in conjunction with the Royal Radar Establishment, Malvern, and the Esso Petroleum Company. This uses the doppler shift in a radar beam reflected from the vessel and it has been made possible by the use of Gunn diodes which provide a stable radar frequency source.

In this system, a device is mounted on the jetty, and is steered manually to follow the vessel as it comes up the approach channel. The readout is provided on a separate unit and the berthing master on the jetty relays the ship's velocity, as measured by the radar, to the pilot by VHF radio.

When the vessel has been manoeuvred to a position parallel to the berth and is stationary relative to the berth, two radar doppler units come into use, both of them mounted so that their beams are at 90 degrees to the jetty. These two units then measure independently the velocity of the bow and stern sections of the vessel as it is pushed into the berth by tugs. This part of the operation is probably the most crucial and this is the time when serious damage is most likely to occur.

The difficulty is that the ship is now travelling at a very low velocity sideways, and this velocity is very difficult to judge. In particular it is very difficult to determine whether the bows are moving faster or slower than the stern, in other words to judge whether the vessel is swinging. A swing of this kind can easily be caused by a strong wind and can be very dangerous. While the stern may be within a safe impact speed the bows may start to exceed this speed and at this stage there is very little time to take corrective action.

An immediate indication of the development of a swing is therefore essential. The SAMI equipment is capable of measuring speeds with an accuracy of better than 3 per cent down to velocities slower than 5 feet per minute.

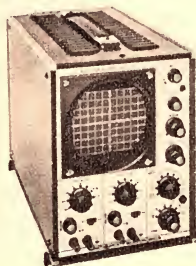
It can discriminate to an accuracy better than 1 foot per minute. This means that using the dual RF head system a swing can be immediately detected and the pilot warned to take corrective action. The equipment's range is limited to about two miles but this is generally quite adequate for most harbours. ('Electronics Weekly,' Sep. 24, 1969.)

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(Above) Advance OS25 Oscilloscope has vertical amplifier bandwidth from DC to 5 MHz with a max. sensitivity of 10 mV/cm on each channel. Time base gives sweep speeds from 1 sec/cm to 0.5 μ S/cm using switched and fine controls. Bright clear display on 5" helical PDA tube.

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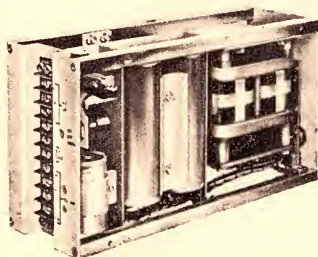
(Above) Advance TC9 Timer Counter is a 6-digit instrument capable of measuring frequencies up to 32 MHz with 0.1 Hz resolution. Freq. Measurement: 2 Hz to 32 MHz. Time Measurement: 1 μ S to 10 S in decade steps. Sensitivity: 3 position attenuator providing 10 mV, 100 mV, and 1 V RMS.

Tick for further details.



(Above) Advance TC11 & TC12 Timer Counters are designed to measure frequencies up to 15 MHz. TC11 has 4-digit display with 1 Hz resolution. TC12 has 5-digit display with 0.1 Hz resolution. Freq. Measurement: 2 Hz to 15 MHz. Time Measurements: TC11 10 μ S to 1 S, TC12 10 μ S to 10 S. Sensitivity: 10 mV, 100 mV and 1 V RMS.

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(Above) Advance PM Series Stabilised Modular Power Supplies are designed in modular form to be used as integral parts of other equipment, either singly or in multiples. Voltage Range 0-50 volts. Current capability 500 mA to 10 A. Fully transistorised, with silicon semi-conductors which permit operation up to +60°C.

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(Above) Jayem S100 Tr Multitester provides AC and DC measurements, also resistance, capacity and level. Also measures the more important parameters of transistors, both NPN and PNP types. DC 100,000 o.p.v. A 3" anti-parallax scale and sensitive 7.5 μ A meter. Shockproof suspension and full overload protection.

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(Above) Jayem JM-01 Micromegmet is designed for the rapid and accurate testing of insulation resistance such as motors, generators, power-lines, etc., and for voltage detection and continuity checks. Rated voltage is 500 V and measuring range is 0.01-100 Megohms. Fully transistorised with 1 transistor and 4 diodes. Only 6" x 3 1/8" x 1 5/8", in soft leather carrying case with 1 pr. of test leads.

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KOVO



(Right) Kovo Megmet is a portable insulation tester for measuring insulation resistance of DC and AC mains, machines and appliances. The generator is driven by 2 sets of gears, the tooth wheels being of bronze and the pinions of steel. Models Available: Megmet 500 500 V, Resistance: 50 Kohms to 50 Megs; Megmet 1000 1000 V, Resistance: 100 Kohms to 100 Megs.

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Air drying of wood depends on evaporation of moisture at or near the surface of the wood. This means that the moisture content is always higher in the centre and continued evaporation cannot proceed at a rate faster than water will diffuse outward. In order to increase this diffusion rate, woods are often heated in a dry kiln, but always slowly enough that the evaporation does not exceed the diffusion of water, so that the surface does not overdry and cause stresses which at the least cause warping and in more serious cases result in checking or splitting.

Another factor limiting the rate at which centre moisture can be heated is the wood's natural insulating properties which impede the flow of heat into the centre where it is most needed.

Drying with microwaves is carried out in a controlled temperature atmosphere so that the surface of the wood actually remains cooler than the interior, due to heat losses by convection and radiation. With the centre of the wood being the hottest part, moisture is driven out rather than being drawn out. The surface is kept moist and cooler than the interior in order to hold warpage, cracking and checking to a minimum.

The most obvious effect of the use of microwaves in the process of wood drying is the very significant reduction in the time required to reduce the moisture level in wood. Practical schedules for microwave drying reduce the time from months to days or from days to hours. In many cases the practical schedule is sufficiently short so that a continuous conveyerised process becomes practical. This can eliminate most labour associated with stacking and sticking.

Microwave heating can be used at the most optimum part of the drying cycle. In some applications it is most desirable to use microwave heating at the beginning of the drying cycle. In other applications it may be most desirable to use microwave heating for the entire drying cycle. Many applications find microwave heating most effective at the end of the drying cycle to complete the finish drying.

An example of the use of microwave drying is at the Tanoak Industries, Inc. facility at Harbor, Oregon, U.S.A., where newly felled tanoak logs are brought into the plant and cut and shaped into billets for baseball bats. These billets are immediately placed in a microwave drying cavity and reduced from nearly 100 per cent moisture content, figured on dry weight, to approximately 40 per cent

in only four hours. They are then brought to the desired final moisture content in a small, hot air kiln in three to four days.

Microwave drying schedules will vary according to the wood species. However, in general a very attractive drying schedule can be developed for almost any species.

Cost is the most important limitation to the use of microwave for drying. Cost must be balanced against possible savings in process time, process labour, product yield, improved delivery, and other related factors.

In some cases, because of the unique characteristic of microwave energy which generates heat uniformly throughout the material, it may be the only solution to a serious production problem. ("Varian Spectrum," September, 1969.)

A NEW LOOK FOR THE PRINTED WORD

For some years, the need for a form of alphabet suitable for scanning by computers, yet easily legible to man, has been apparent. Illustrated below is the form of such an alphabet designed at Britain's National Physical Laboratory.

Every engineer who has designed and built any kind of data processing machine has been faced with deciding what form data to and from the machine will take.

Many systems have been tried. Most have been coded systems, others have been plain language systems using various bastardised Roman alphabets. The most common of these alphabetical systems is the OCR system used by organisations such as banks to identify cheques.

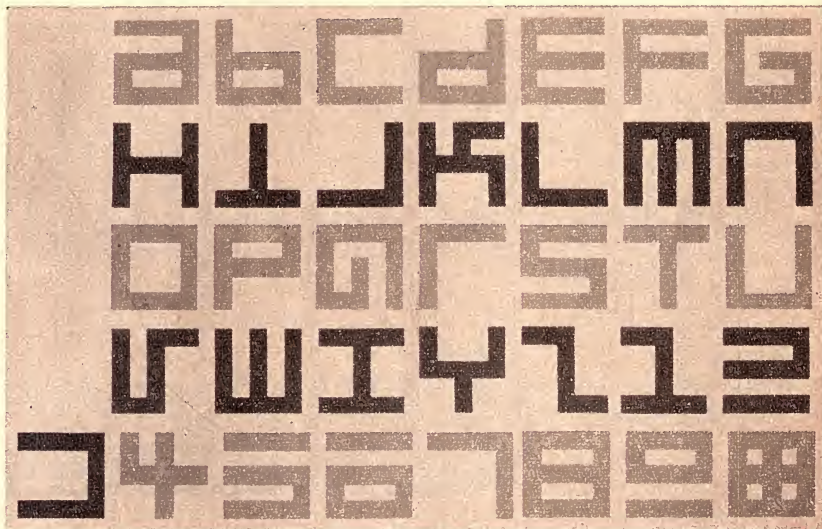
From the graphic designer's or typographer's point of view all of these systems have one common fault, that is, lack of legibility. To the layman the coded system means nothing and the alphabetical systems are so badly proportioned that rapid reading is impossible. It would seem that design engineers have either ignored this problem or have given up hope of finding a type that is pleasing and legible to man and at the same time suited to scanning by computers.

Having been made aware of this problem the London School of Printing asked Dr Chris Evans, an experimental

psychologist at the National Physical Laboratory, Teddington, to take into his department an art student, to see if someone with an art training could apply his art to scientific problems and in particular to the design of an ascetically pleasing alphabet suitable for machine use.

The student chosen was Timothy Epps and the result of his work is the Epps alphabet complete with figures, ligatures and an ampersand. All letters are of a single weight made of vertical and horizontal strokes built on a 5 x 5 grid system. Very little practice is needed before man can rapidly read this alphabet, and because it is based on a square, little effort is needed to hand-write in this style. Ideally suited for machine scanning it remains to be seen if all symbols ever used can be reduced to this simple formula. If they can, this type could well become a world standard for machine and man.

If this alphabet does become a world standard, no doubt purists will mourn the passing of the Roman alphabet as we know it. However, these purists should remember that other purists four hundred years ago mourned the passing of the handwritten manuscript when a new form of communication called letterpress printing was introduced to the world. ("Planar," June/July, 1969. Published by Fairchild Australia Pty. Ltd.)



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 watch-maker'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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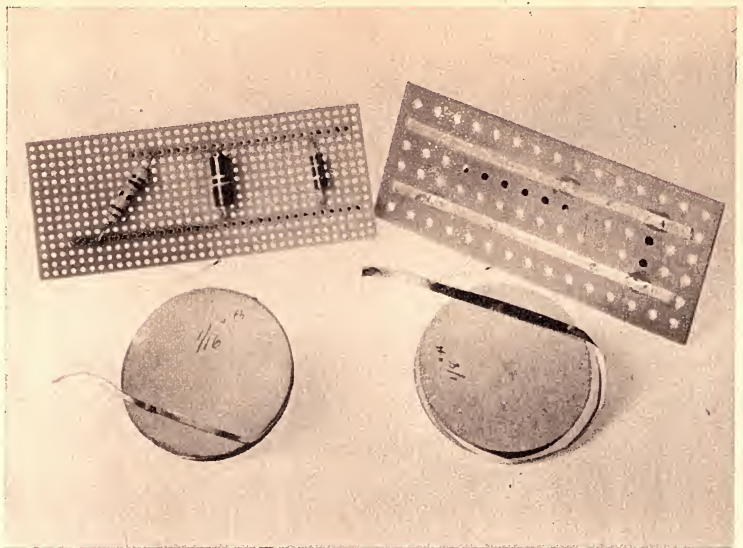
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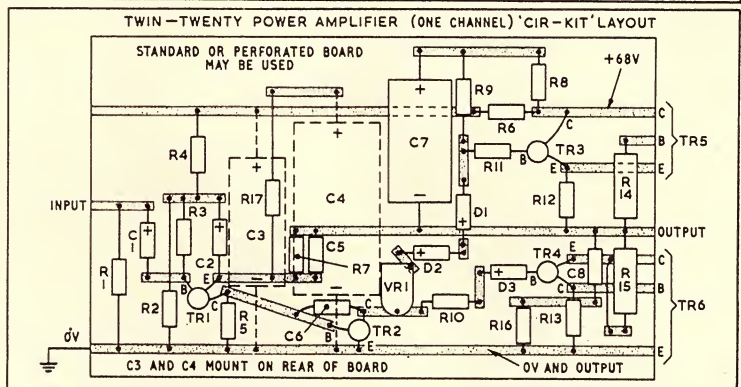
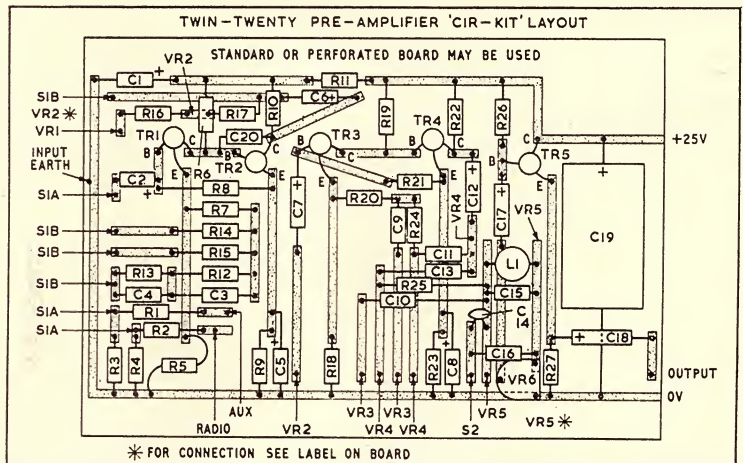
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INSTANT CIRCUITS

**A new method of making component boards
using self-adhesive copper strip.**





SCIENTIFIC AND INDUSTRIAL NEWS

Seismic exploration vessel

The first all-Australian seismic exploration vessel, the M.V. Western Endeavour, was launched at Maryborough, Queensland, recently. Designed and built in Australia, it is one of the most modern ocean exploration ships in the world, and is believed to be the first commercial vessel specifically designed to be guided by inertial navigation. The owner, Western Sea Services Pty. Ltd., is an Australian subsidiary of the Western Geophysical Division of Litton Industries, which operates a fleet of vessels for the seismic exploration of oil and gas throughout the world.

Western Endeavour's inertial navigation system is similar to those which Litton is providing for several commercial jet airliners. The system measures the forces of acceleration in all directions and translates them into electrical impulses which are fed into a computer. These impulses are an exact record of every movement of the ship, and the computer can translate them into exact positions. To provide another reference, sonar-Doppler position-finding equipment is carried. This technique measures the shift in frequency of sound pulses reflected from the seabed and translates these into distance and direction travelled. As a further check, the computer will determine the ship's position by reference to one of four orbiting navigational satellites.

The ship will use an "Aquapulse" sound source system to emit sonic waves at a depth of 40 feet below the surface. Every eight seconds, pulses are transmitted into the earth beneath the sea, are reflected from rock strata as deep as 30,000 feet, and received by the ship's 8000-foot hydrophone cable. Instruments in the shipboard laboratory sort out, measure, and record on computer tape all of the information from the sea bottom. At the same time, readings of all the navigation instruments are automatically recorded every two seconds. At the end of a survey, all the tapes will be fed into a computer centre to build up a clear picture of the rock layers making up the Australian continental shelf.

French exhibitions

The 13th International Exhibition of Electronic Components will be held from April 3 to 8, 1970, at the Porte de Versailles, Paris, France. Organised under the patronage of the Federation Nationale des Industries Electroniques, the exhibition will include more than 50 per cent foreign exhibitors. There will be no display of measuring equipment at this exhibition, as these will be the subject of a later exhibition—"MESUCORA"—to be held from May 27 to June 24, 1970.

An international conference on advanced microelectronics will be held in Paris from 6 to 10 April, 1970 in connection with the components exhibition. The purpose of the conference is to bring together the users of integrated circuits and those specialising in their design and manufacture. Papers to be presented are grouped under four broad headings: circuits; advanced technologies; advanced microelectronics in complex systems; computer assisted design. Full details of the exhibition and conference may be obtained from the Societe pour la Diffusion des Sciences et des Arts, 16 Rue de Presles, Paris 15e, France.

Isotope separator

This isotope separator has been designed to give a performance equivalent to that of machines many times its size and cost. It is a compact laboratory facility for the separation of isotopic material of very high purity. The machine uses a powerful 40cm-radius homogeneous field deflection magnet to impart a curved trajectory to electrically charged particles emitted from an ion source. Particles of different masses follow different paths, and by a suitable system of collectors can be accumulated at rates of milligrams per hour. (Lintott Engineering, Foundry Lane, Horsham, Sussex, England.)

Bio-telemetry course

Dr R. Stuart Mackay has been invited by the Australian National University and the University of New England to present an intensive course on bio-medical telemetering applications and techniques. It will be held at the Australian Academy of Science, Canberra, from February 2 to 5, 1970. The purpose of the course is to present to scientists, physicians and engineers information on the possibilities and limitations of bio-telemetry methods, and to give biologists sufficient background in electronics to enable them to select the most appropriate equipment for their needs and to recognise proper performance.

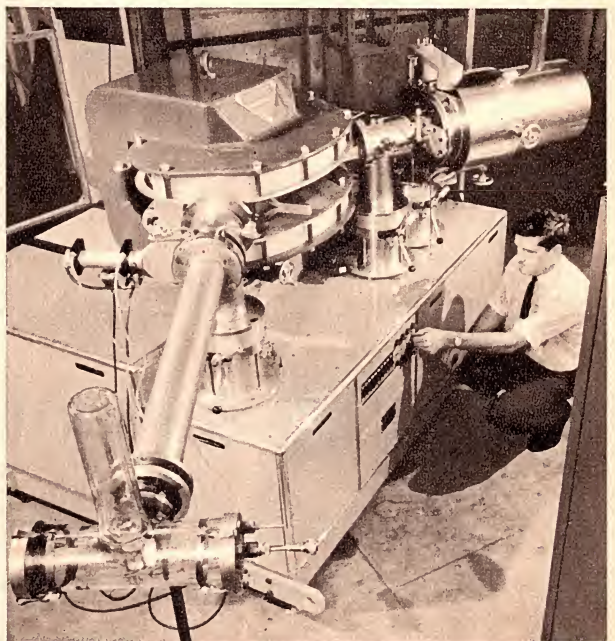
The course is based on six previous presentations by Dr Mackay in the U.S.A. and London; it is scheduled for New York later in the year. Dr Mackay is an adviser to Government and industry, and is the recipient of a number of awards. His research interests have yielded over 150 publications.

Live demonstrations and applications of equipment will be on display throughout the program. Experts will be in attendance to answer questions about methods and construction. There will be a laboratory session during which each participant will be given a set of components with which to construct a simple physiological monitoring transmitter for use with any receiver. If necessary, laboratory sessions will also be arranged for groups of participants in the evenings. Informal discussion periods will permit close consultation between participants and staff. (Department of Adult Education, Australian National University, P.O. Box 4, Canberra, A.C.T. 2600.)

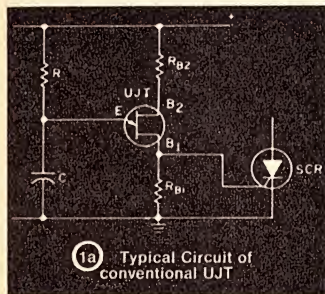
Modular RF amplifier

EMI Electronics Canada has developed a modular solid-state 100W RF amplifier. Designed to cover the frequency range from 2 to 32MHz, it is a broadband linear amplifier which can be used singly or combined in parallel for higher power outputs. The unit is compatible with transmitters used in manpack radio systems as well as those used in mobile, airborne and fixed ground stations.

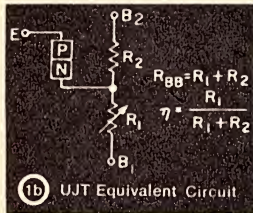
The complete amplifier is contained in a 12in x 2½in x 2in module weighing only 2½lb. Sockets for power and for RF input and output are on the front panel. The rear panel is used to dissipate heat by various methods: water or air



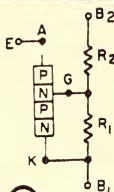
GE PROGRAMMABLE unijunction transistors (PUT) add flexibility to your UJT applications.



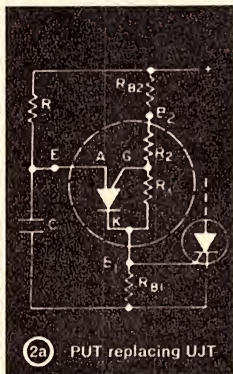
1a Typical Circuit of conventional UJT



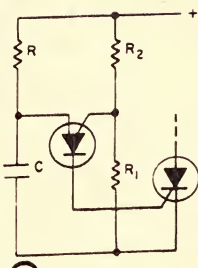
1b UJT Equivalent Circuit



2b UJT Equivalent Circuit using PUT



2a PUT replacing UJT



2c Simplified Typical Circuit

General Electric now offers a complete choice of state-of-the-art negative resistance threshold devices with the flexible programmable D13T UJT.

D13T permits you to program n , R_{BB} , I_P , and I_V . . . and very simply.

By replacing the standard UJT with the D13T plus resistors R_1 and R_2 both circuits (fig. 1b & 2b) have a diode connected to a voltage divider. When this diode becomes forward biased in the UJT, R_1 becomes strongly modulated to a lower resistance value. This generates a negative resistance characteristic between the emitter E and base one, B_1 . For the D13T, resistors R_1 and R_2 control the voltage at which the diode (anode to gate) becomes forward biased. After the diode conducts, the regeneration inherent in a PNP device causes the D13T to switch on. This generates a negative resistance characteristic from anode to cathode simulating the modulation of R_1 for a conventional UJT (fig. 2b).

Resistors R_{B2} and R_{B1} (fig. 1a and 2c) are generally unnecessary when the D13T replaces a conventional UJT. Resistor R_{B1} is often used to bypass the interbase current of the UJT which would otherwise trigger the SCR. Since R_1 in the case of the D13T can be returned directly to ground there is no current to bypass at the SCR gate. Resistor R_{B2} is used for temperature compensation and for limiting the dissipation in the UJT during capacitor discharge. Since R_2 is not modulated, R_{B2} can be absorbed into it.

Applications of the programmable D13T include SCR triggers, pulse and timing circuits, oscillators, sensing circuits, and sweep circuits.

D5K has characteristics like those of standard silicon planar passivated UJT except that the currents and voltages applied to it are of opposite polarity. The choice of this polarity enables the

use of standard NPN planar passivated transistor processing techniques. This results in a unijunction having superior stability and better uniformity than any model previously available. The device also features a much tighter distribution of intrinsic-standoff ratio.

Completing GE's full-line availability are the UJT 2N489-494 (proved reliability, MIL spec version), 2N1671, and UJT 2N2646-47 (hermetic sealed device). These devices provide top performance for trigger, timer, oscillator, phase control, and variable threshold.

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or 552 Lonsdale Street
Melbourne, Victoria 3000
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or 453 Ann Street
Brisbane, Queensland 4000
Telephone 21 5207

Fibre-optics for image orthicon



At the English Electric Valve Company's works in England an argon-arc welder is used to fit a fibre-optic window to an image orthicon television camera tube. The use of a fibre-optic window instead of an ordinary glass faceplate allows direct coupling to a previous stage without the loss of light associated with a lens coupling system. A finished tube lies to the right of the welder. (English Electric Valve Co. Ltd., Chelmsford, Essex, England.)

cooling can be used for large systems, and panel or plate mounting for smaller systems. The power requirement is 24V DC at 11A per unit.

Radar landing system

A high-precision radar system for future giant aircraft is under development at Lockheed-Georgia Co., Marietta, Ga., U.S.A. The Self-contained All-weather Landing and Taxiing (SALT) system will enable surveillance of landing area traffic and aid in collision avoidance. It needs only two simple radar corner reflectors on the ground at each end of a runway to bring an aircraft to safe landing under all weather conditions. The entire active system is carried on board the aircraft, and requires no communication with the field or signals from ground-based equipment to operate.

Completely compatible with present instrument landing systems (ILS) in general use in aviation, the first application

Vehicle tracking and control system

A vehicle tracking and control system, developed by the Marconi research laboratories provides a complete and continuously updated picture of the positions of all vehicles in a fleet. It is applicable to bus companies, to police, fire and ambulance services, and to other large vehicle fleets. The system locates and identifies every vehicle throughout a network, presents this information in a simple form, and detects any variations from schedule or route. This is done automatically without any driver involvement. The system also provides voice communication between the driver and the control centre.

A passive beacon method is used to locate the vehicles. The beacons, rectangular metal plates with strips of reflective material, are mounted on lamp-posts or bus stops at regular intervals along the route. Each beacon has a different code determined by the sequence of wide and narrow reflective strips. A device fitted to each vehicle emits a pencil of light which vertically scans the beacon. The light reflected back to a detector identifies the beacon. This information is stored in a register until superseded by that of the next beacon.

The vehicle is fitted with a two-way radio with a separate telemetry channel and, in response to interrogation by central control, transmits the identity of the last beacon passed. This data is processed at the control centre by a

Myriad II computer and displayed on the screen of a cathode ray tube.

The display can be in one of two basic formats. In one, the route is represented as a pair of straight lines, one for each direction, with prominent features identified. In the case of bus control, these features might be fare stages or bus stops. Each vehicle is then continuously represented by a symbol at its current position on the route. The second method of display allows all the vehicles in a particular area, e.g. a city centre, to be shown on a map drawn electronically on the screen.

The computer can be programmed to provide a number of other facilities. It can compare the true and scheduled locations for all vehicles and, should these vary by more than a predetermined amount, superimpose a message containing all relevant details on the controller's display. The computer may additionally generate a log of "out of schedule" running, and also log the mileage covered by each vehicle. A "record and playback" facility can also be incorporated.

The mobile radio used to transmit the telemetry data can easily be switched to a speech channel to give voice communication between control and the driver. The controller can pass fresh instructions to the driver, or the driver can contact control in the event of an emergency. (The Marconi Company, Marconi House, Chelmsford, Essex, England.)

of SALT will be geared to obtaining pilot confidence in the system. According to Lockheed, it could ultimately serve as the primary landing system for all aircraft.

Goldstein memorial award

The Institution of Engineering Science, Sydney, will present annually the M. E. Goldstein Memorial Gold Medal Award to perpetuate the memory of the Institution's late honorary secretary. The prize is offered for papers which contribute to the furthering of knowledge of engineering science subjects. It is open to members and non-members, and can cover any aspect of engineering science. Judges, appointed by the council, will determine on the basis of scholarship, originality, presentation and value to engineering science, the paper most deserving of publication.

Two copies of the paper must be provided. Entries must be accompanied by photographs and diagrams. The following details must be forwarded on a separate sheet of paper: author's name; title of paper; present occupation giving name and address of employer (if any). Any paper submitted may become the property of the Institution, and the Institution may publish it as submitted or in a condensed form. Each entry must be an individual effort and not a company or sponsored article. Any company material used should be sanctioned for use by the entrant's employer.

Entries must reach the Secretary, Institution of Engineering Science, P.O. Box 14, Pymble, 2073, by March 30, 1970. Results will be announced at the next annual general meeting.

Prison communications

Telephone systems designed to provide faster and more efficient communication between prison officers have been installed at the Goulburn Training Centre and at the Bathurst and Parramatta Gaols. The largest system is at the Parramatta Gaol, where 41 extensions link the prison office staff with the guard posts and the towers in the gaol. The central control, or annunciator panel, of each system is located in the main gatehouse of the prison.

The system, designed and manufactured by Plessey Communication Systems Pty. Ltd., is operated from a desk-type console that has numbered lamps for each extension. Officers in any part of the prison can be reached by touch-dialling facilities on the console. Officers in any section of the prison can contact control immediately by a simple procedure which causes a light to show on the console's panel.

The connecting wires are buried and protected by steel pipes throughout each gaol. If an attempt is made to sabotage the system or damage any of the telephones, a warning light on the console pinpoints the area affected, and the phones of the superintendent and deputy superintendent ring continuously until answered. The telephones in the gatehouse, the superintendent's quarters and deputy superintendent's office are on an "open line system" which provides simultaneous and direct connection to all guard towers in an emergency.

IC pacemaker



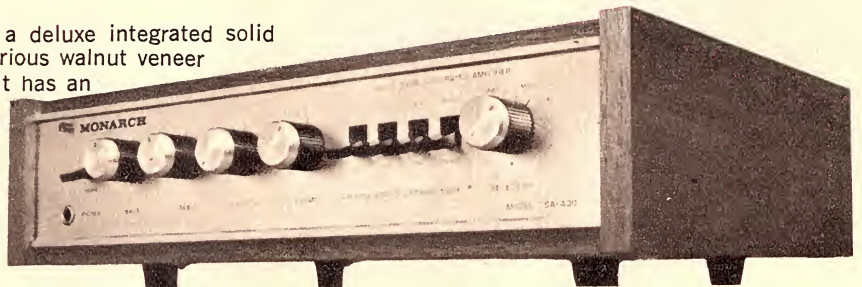
An integrated circuit cardiac pacemaker, developed by Teletronics Pty. Ltd., of Sydney, is believed to be the first based on IC technology. The IC was specially designed for Teletronics by the micro-circuit facility of A.W.A. supported by the Department of Supply. It replaces 12 components used in a conventional circuit and is mounted in a TO-5 low-profile package. Compared with earlier models, the new design is 30 per cent smaller and is at least ten times as reliable. It is powered by five inbuilt mercury cells with an estimated life of 4 to 6 years.

The IC is tested to military standards including 65 hours at 70 deg. C, severe thermal and mechanical shock, and 35,000G centrifugal forces. The completed pacemaker is immersed in a saline bath for 720 hours at 37 deg. C. The stimulating pulse of the pacemaker is of 6.5V amplitude and 0.5mS duration at a repetition rate of 70 pulses per minute. (Teletronics Pty. Ltd., 29 Gibbes Street, Chatswood, 2067.)

The pocket priced sound maker

monarch

The Monarch SA-400 is a deluxe integrated solid state stereo amplifier with luxurious walnut veneer cover. Flexible and compact, it has an ample power output of 10 Watts continuous per channel to the speakers. Includes Phono (both magnetic and ceramic), Tuner and Auxiliary Input, Tape-In and Tape-Out for tape recording, playback or monitoring.



The Monarch SA500/W amplifier — a deluxe solid state unit. Versatile and compact, it provides an

ample output of 34 watts continuous power, to the speakers. Includes Phono, Tuner and Auxiliary Input and Tape-Out for tape recording. Smoothly styled in a handsome walnut veneer cover. Careful selection of high-quality components in these amplifiers ensures



trouble-free operation in the Monarch tradition of fine quality.

MONARCH 500/W \$129 R.R.P.

FACILITIES

Front Panel: Selector—Aux; Tuner; Phono; Mono-Stereo Volume • Bass • Treble • Loudness • High Filter • Low Filter • Power • Phone Jack
Rear Panel: Input—Mag; Ceramic; Tuner; Tape; Tape Output • Speaker Terminals • AC Output • AC Fuse • Speaker Fuse

SPECIFICATIONS

Output Power: 42 Watts Total Music Power (IHF) into 8 ohms • 17½ Watts RMS each channel into 8 ohms.
Harmonic Distortion: Less than .9%
Frequency Response: 20-20,000 Hz + 1 DB
Channel Separation: Over 50 DB
Hum and Noise: Over 55 DB
Loudness: 50 Hz + 10 DB; 10,000 Hz + 4 DB
Tone Controls: Bass 50 Hz + 10 DB; —12 DB; Treble 10,000 Hz + 10 DB —12 DB
Low Filter: 50 Hz —10 DB
High Filter: 10,000 Hz —10 DB
Input Sensitivity: Mag. 3MV at 1KHZ. Tuner 150MV at 1KHZ. X'tal 150MV at 1KHZ. Aux. 150MV at 1KHZ.
Power Supply: 240 Volt A.C.
Dimensions: D — 10", W — 14½", H — 5".

MONARCH S.A.400 \$105 R.R.P.

FACILITIES

Front Panel: Selector—Aux; Tuner; X'tal; Phono • Volume • Balance • Treble • Bass • Loudness • Mode-Stereo • Mono • Tape Monitor • Power • Phone Jack • High Filter
Rear Panel: Input—Mag; X'tal; Tuner; Aux; Tape-Input; Tape-Output • Speaker Terminal • AC Output • AC Fuse • Speaker Fuses.

SPECIFICATIONS

Output Power: 28 Watts Total Music Power (IHF) into 8 ohms • 10 Watts RMS each channel into 8 ohms.
Harmonic Distortion: Less than 1%
Frequency Response: 30-20,000 Hz
Channel Separation: Over 50 DB
Hum and Noise: Over 60 DB
Loudness: 50 Hz + 10 DB; 10,000 Hz + 4 DB
Tone Control: Bass 50 Hz + 12 DB —12 DB; Treble 10,000 Hz + 12 DB —12 DB
Scratch Filter: 10,000 Hz — 10 DB
Input Sensitivity: Mag 3MV at 1KHZ. Tuner 150MV at 1KHZ. Aux 150MV at 1KHZ. X'tal 150MV at 1KHZ.
Power Supply: 240 Volt A.C.
Dimensions: D — 9½", H — 3½", W — 13½".

W.C. Wedderspoon

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Environmental laboratory

Standard Telephones and Cables Pty. Ltd. is setting up an environmental laboratory at its Liverpool plant with highly skilled staff and advanced testing equipment to prove the efficiency of semiconductor devices to exacting Defence standards. A company spokesman said that no Australian company has yet manufactured semiconductors that were type-approved to Military Standard 195-00E, and that consequently most of the components were imported. He said that to be able to manufacture them from local resources and to prove them to type-approval standard would be a significant achievement.

The laboratory, scheduled to undertake the first practical tests early this year, will have a range of equipment to embrace every test needed for the supply of type-approved semiconductors. The devices will be subjected to centrifugal and vibration tests, climatic, moisture and temperature cycling, shock and leakage, and also given tests under salt spray. The system is intended to reveal any possible defect, any potential point of breakdown, before final production proceeds.

Intruder detector

A new range of burglar and intruder detection devices using microwave transmissions, introduced in the U.K. by Shorrock Security Systems Ltd. (a subsidiary of Hawker Siddeley Dynamics) can detect intruders at distances up to 50 yards, by Doppler effect principles. The system uses a Gunn diode to produce the microwaves and is powered by a 6V torch battery. The apparatus can be linked to the police by telephone or to other alarm or bell equipment. It is claimed to significantly cut the cost of security services and at the same time give greater reliability, ease of installation and a tamper-proof nature as compared with earlier systems.

The device can be programmed to differentiate between a human intruder and accidental happenings such as falling packing cases or blowing about of leaves or paper and so prevent false alarms. Jamming devices only cause the equipment to give an alarm, and the system cannot be fooled by the wearing of special clothing. Other new products from Shorrock's

include a protection unit to give an alarm when glass is broken, and a device which can detect the sound of brickwork being drilled or hammered and then trigger an alarm. (Hawker Siddeley Dynamics, Manor Road, Hatfield, Herts., England.)

Space heat simulator

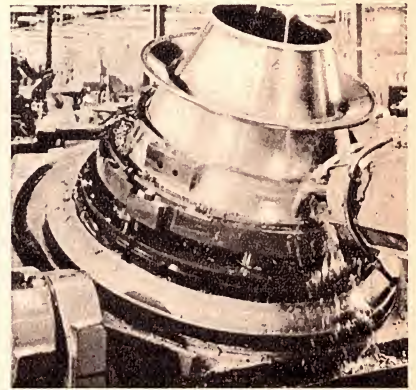
A programmed heat flux simulator in a thermal vacuum test chamber is providing scientists at Lockheed Missiles and Space Co. with data for the design of future space vehicles. The facility simulates the radiant heat transfer from the sun, earth and albedo (the reflected energy from the earth). The simulator contains an array of 1500W quartz lamps, backed by gold-plated reflectors, spaced and supported to provide the required thermal distribution and maximum flexibility for space vehicles under test. The simulator is divided into 76 zones each of which has a capacity of 15KW. The voltage to each zone is computer programmed, and controlled by a motorised variable transformer.

Automatic testing

A Culton 167 automatic component bridge has enabled Lucas Gas Turbines Ltd. to double the rate at which acceptance tests can be carried out on thin film circuits the company are developing for jet engine control circuits. The development modules will be used to measure jet pipe temperatures and turbine speeds — new applications for thin film circuits.

To carry out the tests, a module (about the size of a stamp) is placed under a microscope fitted with pivoted connecting probes. These are accurately positioned on the module to connect the circuit under test to the bridge. This instrument automatically completes the resistance measurements in less than two seconds to give a digital readout with automatically positioned decimal point. Previously, a conventional manually-operated bridge was used: this entailed up to seven separate adjustments which had to be repeated for each of 20 resistance measurements on each module. In addition to being faster, the new bridge requires no skill on the part of the operator, reduces fatigue and virtually eliminates the possibility of error through incorrect operation. (Racal Electronics Pty. Ltd., 47 Talavera Road, North Ryde, 2113.)

Machining Saturn V motor



Wickman (Aust.) Pty. Ltd. is now distributing in Australia the Milwaukee-Matic model III 5-axis machine, photographed in operation machining a complex titanium nozzle for the Minuteman second-stage motor of a Saturn V rocket. The numerically controlled machine eliminated six detail welding and X-ray operations to reduce the fabrication time from 425 hours to 180 hours. (Wickman (Aust.) Pty. Ltd., 153 Victoria Parade, Colingwood, 3066).

Radiological exhibits

Watson Victor Ltd., introduced two locally manufactured pieces of radiological equipment at the recent international radiological congress in Tokyo. The items are a floating top horizontal Bucky Table (for the examination of the most critically ill or injured patients in X-ray clinics) and a push-button controlled spot film screening device (for visual internal X-ray examination with provision for accurate spot film radiography of selected areas). This is said to be the first time that an Australian company has exhibited locally manufactured radiological equipment at an overseas exhibition. (Watson Victor Ltd., P.O. Box 100, North Ryde, 2113.)

Titanium in magnets

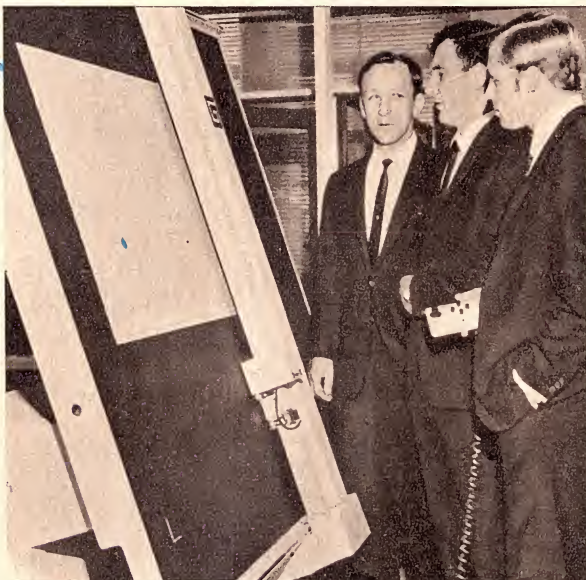
A technique to overcome the previous difficulties involved in the addition of titanium to conventional magnet alloys has been developed in the research laboratories of International Nickel Ltd., of London. The addition increases resistance to demagnetisation and also produces a good columnar structure with a consequent improvement in magnetic properties. The process, called "Magnicol," employs carefully controlled additions of carbon and sulphur in correct sequence to the molten alloy, as well as specific holding times at various stages of melting. Oxide and carbide nucleants, which would inhibit the columnar grain formation, are thus removed.

Space shuttle craft

Two leading U.S. aerospace firms have teamed to study a re-usable chemically fueled vehicle which could fly between earth and low-earth orbit. The Boeing Co., Seattle, Wash., and Lockheed Missiles and Space Co., Sunnyvale, Calif., have announced they will seek a space agency contract to study the space shuttle craft. As presently envisioned, the space shuttle would consist of a large vehicle to provide initial boost and a smaller vehicle to continue into orbit and perform space missions. Each vehicle, after completing its task, would fly back to an aircraft-like landing.

Plotting Queensland's roads

The Queensland Department of Main Roads has installed a Gerber 622 drafting system to operate in conjunction with a new \$700,000 computer complex. The system will enable the Department to speedily perform a variety of functions such as graph-plotting contours, road surveys, cross sections, and profiles of roads for use in construction. The system will assist in road safety by preparing perspective views of blind corners and other road visibility problems as experienced by motorists. The Department also hopes to use the equipment to prepare maps of traffic density in various areas to allow greater accuracy in establishing future road needs and construction programs. (Distributors Corporation Pty. Ltd., 24 Johnston St., Fitzroy, 3065.)



The drafting and display table installed at the Queensland Department of Main Roads.

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Rating: 19 watts and micro-miniature electronics
Weight: 3 ozs. and instrument work.



M64 Tip Shaft Dia: 3/16" Application: Standard tool for
Rating: 23 watts radio and television assembly
Weight: 3 1/2 ozs. and servicing.



M107 Tip Shaft Dia: 1/4" Application: Servicing in tele-
Rating: 27 watts communication centres and
Weight: 4 ozs. similar heavier tagging.

*Weight of tool only, without cord set.



M150 Tip Shaft Dia: 5/16" Application: General Purpose
Rating: 45 watts Solder Tool, sheet metal, earthing
Weight: 6 ozs. strips and other heavy duty work.
Tip incorporates unique anti-seizing ferrule

LONG LIFE TOOLS, TESTED AND PROVED IN WORLD-WIDE SERVICE.

Adcola "M" Series soldering tools are long-life precision-made tools, the result of 20 years' development to meet the particular needs of the Communications and Electronics industries throughout the world.

They are standard equipment in all Australian Armed Services, Space Tracking establishments, P.M.G.'s Department, major computer firms and numerous other organisations with the resources to carry out stringent comparative pre-selection tests on soldering equipment.

GREATER THERMAL EFFICIENCY

The advanced design reduces heat losses to a minimum and provides a work capacity in each model normally associated with conventionally designed tools of twice the rated power. Initial heat-up time (60 seconds for M70, 100 seconds for M64) and heat recovery are extremely rapid. Elements are calibrated to provide optimum tip temperatures for swift and sound soldering of terminations in each type of circuit.

DESIGNED FOR ACCURATE SOLDERING

The lightness and balance of the "M" Series tool; the flared handle, ribbed for a positive precision finger grip; the slim heater unit allowing the best possible visibility and penetration; the combination of these design features allows easy, precise manipulation and therefore better soldering.

INSTANT CONTROLLED HEAT

A constant heat tool operating at the correct soldering temperature ensures the swiftest and most efficient soldering. Poor quality soldered joints caused by too high or too low a soldering temperature are avoided. Fitted with a hook for suspension while idling, Adcola soldering tools will operate continuously without risk of overheating or loss of tip tinning. Heat sinks, idling or cut-off switches are NOT required.

EASY REMOVAL OF TIP

The tip is held firmly by a stainless steel collet, and is easily removed for cleaning and replacement and to allow quick fitting of special-purpose tips.

SAFETY FIRST

Safety was a primary consideration in the design of the "M" Series, which embodies a fully insulated element and a double-earthed helical wire outer casing to the heater unit. Every heater unit must pass an insulation test of 2,000 volts before release from the factory.

NO TRANSFORMER REQUIRED

Adcola tools conform to S.A.A. approval and test specifications and are approved in all States for mains voltage operation.

All models are available for 230-250V, 200-220V, 100-120V, 50-55V, 32V, 24V, 12V and 6V.

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I.E.E.E. president

The Institute of Electrical and Electronics Engineers in U.S.A. has announced the election of Dr John Granger as President of the I.E.E.E. for 1970. Dr Granger, who is the President of Granger Associates of Palo Alto, California, holds a B.A. in mathematics and physics from Cornell College, an M.S. in communications engineering from Harvard, and a Ph.D. in applied physics from Harvard. He is a Fellow of the I.E.E.E. and has served as a member of the board of directors, vice-president, treasurer and on many Institute boards and committees.



Time service

The Bureau International de l'Heure (B.I.H.) has announced that the fractional frequency offset from nominal of co-ordinated radio transmissions for 1970 will remain at -300×10^{-10} . The interval between seconds time signals in the Australian Post Office scale of Universal Co-ordinated Time (U.T.C.) will, therefore, continue to be $(1 + 300 \times 10^{-10})$ second. The second is defined in terms of a particular transition of the atom of caesium 133 undisturbed by external fields.

Satellite phone calls

Telephone calls between Sydney and Perth are now transmitted via the Intelsat III satellite over the Pacific. After trial calls proved satisfactory, the satellite link came into general use last November. It is believed to be the first use of a satellite for mainland calls in the world. The satellite link has relieved pressure on trunk telephone lines between Perth and the eastern States, and has increased the overall number of trunk channels by about 25 per cent.

Communications conference

A conference to be held in Melbourne from February 16 to March 11 will discuss fundamental telephone transmission requirements to facilitate world-wide telephone interconnections. The meetings are being held under the auspices of the International Consultative Committee on Telephony and Telegraphy (C.C.I.T.T.), a permanent organisation of the International Telecommunications Union (I.T.U.). The discussions will include a two-day seminar on national telephone transmission planning which will be open to all telecommunications engineers.

Satellite consortium

A new European international consortium, led by the French company Thomson-TSF, has submitted a bid to provide a European communications satellite to carry sound and television programs within Europe and Africa. The new consortium, called COMEST (Communications European Satellite Team), brings together EASAMS and GEC-Elliott Space and Weapon Systems from the U.K.; ASEA from Sweden; Dornier-System from West Germany; CGE-FIAR from Italy; Fokker-VSW from the Netherlands; and Thomson TSF from France. Also associated in this project are SABCA from Belgium; TERMA from Denmark; SENER from Spain; and Contraves from Switzerland.

The satellite system proposed by COMEST will allow the simultaneous exchange of two colour TV programs and

10 sound channels between ground terminals situated in Europe and Africa. Each station will be able to use the satellite for the transmission and reception of programs. Command and telemetry systems and an engineering service channel will also be provided.

Propellant stresses

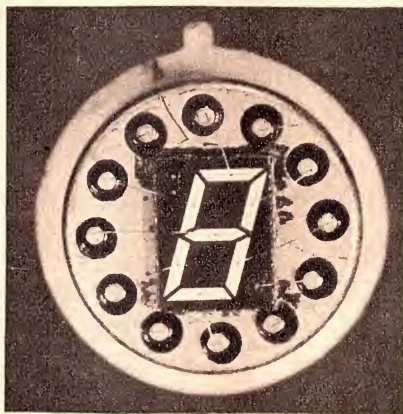
The Lockheed Propulsion Co. has received a contract from the U.S. Air Force's rocket propulsion laboratory to load the rocket motor of a simulated missile with an inert solid propellant to determine the flight stresses on the propellant. The rocket will not fly by itself, as the "fuel" is non-combustible although it looks and feels like the real thing. Instead, an aircraft will carry it over the Southern California desert. Imbedded throughout the propellant will be tiny sensors, designed for doctors to implant in humans, to pick up stresses and strains imposed throughout the propellant system as it is exposed to temperature extremes and to the vibrations and shocks of flight. Wires will transmit the data to recorders inside the missile.

Fluidics at CETIA 70

The many uses of fluidics for industry will be discussed at a symposium as part of CETIA 70 to be held in Melbourne from February 23 to 27. The principal speaker at the fluidics symposium will be Professor Ernest C. Fitch, Ph.D., Oklahoma State University, U.S.A. To support and complement the fluidics symposium, a large number of organisations will be exhibiting systems, equipment, components, etc.

Non-destructive testing will also be covered by CETIA 70. The latest equipment will be shown and a symposium will be conducted on "The Applications of Non-Destructive Testing to the Maintenance of Plant and Equipment." (The Executive Director, National CETIA Program, Box 3629, G.P.O., Sydney, 2001.)

Integral photo-diode



An integrated high-brightness photo-diode for use as numerical or character readout in a variety of electrical and electronic equipment has been introduced by Hitachi Ltd. The device uses large crystals of gallium arsenic phosphate (GaAsP), produced by the vapour-phase epitaxial process. A monolithic integrated structure, instead of a conventional hybrid structure, has been used to obtain a number of display units out of a large crystal sheet. It operates from a 1.75V supply and draws 50mA per numerical digit. An 8-segment display about the size of a drawing pin can produce the numerical figures from zero to nine and the full-stop sign in bright red. A 16-segment variation could be used where a complete alphabet is desired. (Hitachi Ltd., 8 2-chome, Ohte-machi, Chiyoda-ku, Tokyo, Japan.)

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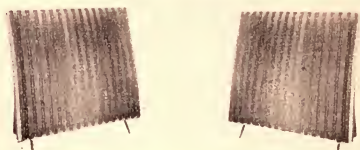
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A "DIFFERENT" METAL LOCATOR



In spite of the reservations we expressed recently concerning "treasure locators" we felt that this article was worth securing for our readers. One reason was that the author does not make extravagant claims for it, and another was that a reader in Western Australia has already built one and confirms that it will do what is claimed for it.

by Leslie Huggard*

Treasure hunters use all kinds of schemes and gimmicks in trying to find their fortune — divining rods, extra-sensory perception, ancient pirate maps, and so on. Experience has shown, however, that the most successful treasure hunters use some form of electronic metal finder.

The operation of most buried-metal locators is based on a type of heterodyning principle, with the frequency of one of a pair of interacting oscillators being changed when in close proximity to metal. One of the oscilla-

tor is metallic carrying handle. When the loop is brought near metal, the oscillator frequency changes and an audio beat note is created between the two oscillators. This audio signal can be picked up on a speaker or headset. Metal detectors operating on this principle require semi-critical tuning of one of the oscillators for best results. Their operation can often be disturbed by nearby electrical noise sources or powerful radio stations in the vicinity.

In spite of the considerable publicity that metal locators have received

two sets of coils, at right angles to each other, forming the input and output circuits for a high-gain audio amplifier. If the coils are constructed so that they are very close to being at right angles to each other, there is not enough inductive coupling between them to produce the feedback required to make the amplifier oscillate. However, if the coil set is brought close to any metal, the metal forms a coupling between them, the amplifier oscillates, and an audio signal is produced.

Because the intensity of a magnetic field falls rapidly with distance and the influence on the magnetic field produced by a metallic conductor within it decreased rapidly as the conductor gets smaller, it is very difficult to make a device that will detect small objects at

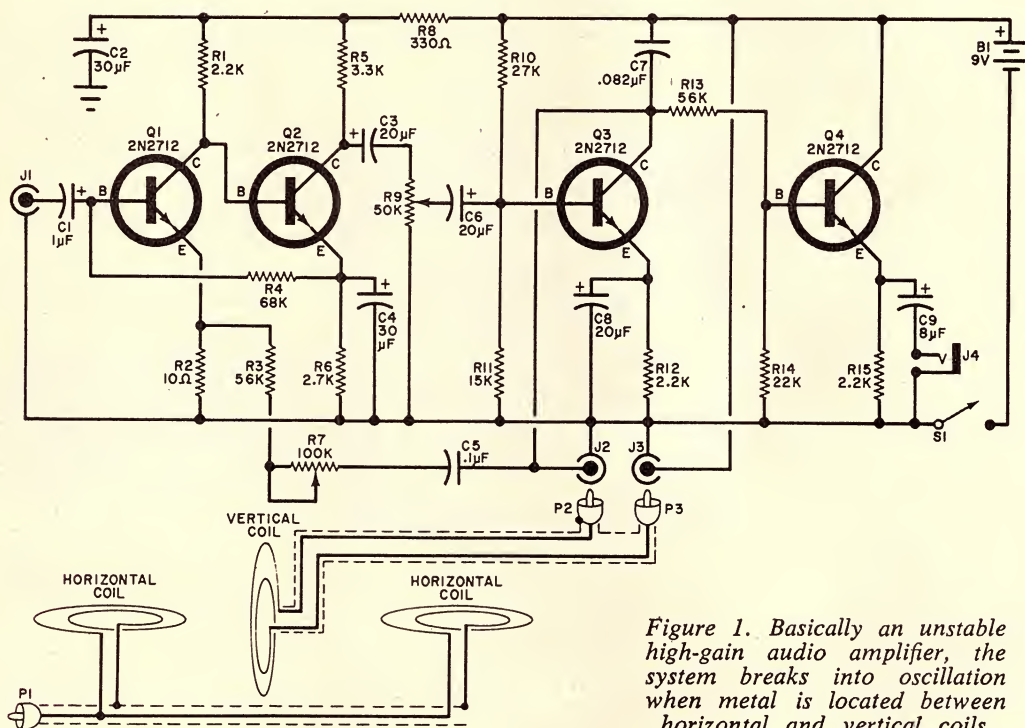


Figure 1. Basically an unstable high-gain audio amplifier, the system breaks into oscillation when metal is located between horizontal and vertical coils.

tors operates at a fixed frequency and the tuning coil of the other is usually a loop of wire at the end of a non-

* Reprinted from "Popular Electronics," February, 1969, by arrangement with the publishers, Ziff-Davis Publishing Co.

in the past few years, one type has received very little attention, being used only in high-priced commercial equipment. The locator described here is of this type; it uses an "inductance bridge" method of detection. Audio-frequency coupling is used rather than RF. The inductance bridge consists of

a distance. In the detector which uses a loop to locate the metal, varying the size of the loop can produce problems. For a given number of turns and a given amount of current in the loop, the field at a distance along the axis of the loop depends on the diameter of the loop. The greater the diameter,

the further the field extends. However, the greater the loop diameter, the larger the metal object must be to have any effect on the field. Thus, in this type of locator, it is necessary to compromise between the size of the object to be located and the distance at which it can be located.

The locator described here will detect an aluminium bottle cap or a three-inch nail at a depth of 2 inches. It is not sufficiently sensitive to detect coins smaller than a quarter, which coin will only be detected if favourably positioned and almost on the surface. Larger objects (such as a garbage-can lid) can be detected at a depth of 2½ feet. The locator is more sensitive to ferrous materials than others since iron-based metal has a greater effect on the magnetic field.

The electronic circuit is basically a high-gain audio amplifier whose gain is controlled by R9. Positive feedback is provided through R7 and C5. A tuned circuit consisting of the vertical coil and C7 is connected to the collector of Q3.

The two horizontal coils are connected to the amplifier input. Because the coil sets are at right angles to each other, coupling and feedback are at a minimum. However, there is always some slight electrical noise in an amplifier, and this is sufficient to set up a weak magnetic field around the vertical coil.

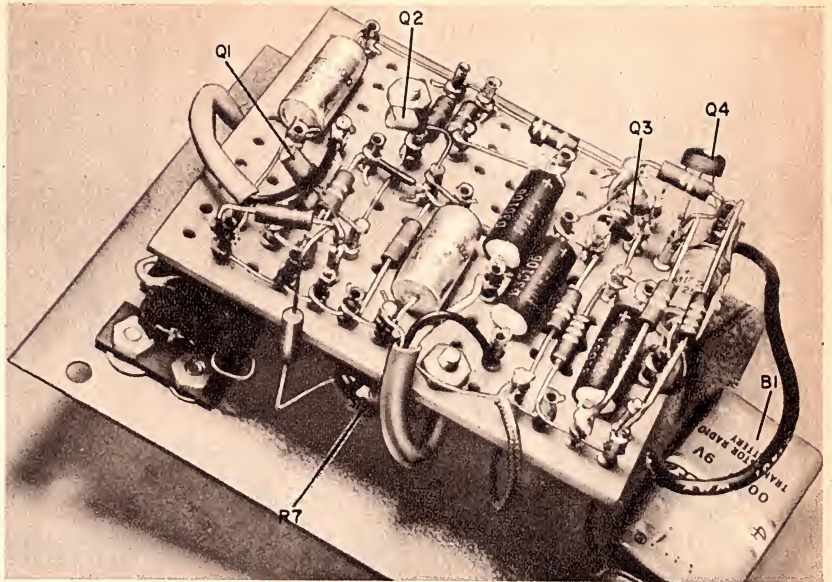
The lines of flux along the axis of the vertical coil are parallel with the planes of the horizontal coil. If a metal object comes within this field, the lines of flux are distorted so that some of them link with a horizontal coil. The coils are connected so that the signal input to the amplifier is in phase with the output of the amplifier when there is a disturbance in the magnetic flux. When this happens, the circuit breaks down with positive feedback and the output is similar to the feedback obtained between an audio amplifier speaker and a microphone. The oscillation has a frequency of about 2KHz. Unlike most RF beating systems used in metal locators, this circuit requires no tuning.

The locator consists of two principal parts: a search head which is a rigid assembly of three coils, and a control box containing the electronic circuits which energise the coils and produce the audible output signal.

The electronic circuit, shown in figure 1, can be constructed on matrix board. In laying out the components, be sure to keep the input components as far as possible from the output components to avoid unwanted feedback. The two potentiometers, R7 and R9, switch S1, search-head jacks J1, J2, and J3, along with the headphone jack, J4, can be mounted on the front panel of a small metal box. The author used a 5in x 4in x 3in aluminium enclosure.

Once the front-panel controls are mounted, connect them to the matrix board and mount the board on the front panel using insulating spacers. Use shielded leads between the three jacks and the two potentiometers. Connect the shields to the matrix board common and make sure that the board common is well bonded to the metal enclosure.

When wiring is complete, recheck



The electronics may be assembled on matrix board. Any arrangement can be used as long as the input and output circuits are as far apart as possible to prevent unwanted coupling.

the circuit for possible polarity errors in electrolytic capacitors and transistors and be sure that all resistor values

are correct. Also check the solder connections for cold solder joints or accidental shorts.

Report from E.A. reader

We were encouraged to reprint this article by the experience of a reader who has already built one. He is Mr B. Holloway, 67 Tain St., Ardross, Western Australia, 6153. Here are some comments on his version of the unit.

Initially I had some difficulty in finding equivalent transistors. In the original metal locator, four 2N2712 NPN transistors were used. A very similar transistor is the Mullard BFX13, although it is a PNP type. With a few circuit changes (reversing the polarity of the electrolytic capacitors and power supply) I successfully used them in the construction of the metal locator.

I have found the performance of my metal locator to be slightly less than that stated in the "Popular Electronics." This can be attributed to my makeshift construction of the search head. I constructed it without any possibility for adjustment (due to the difficulty in obtaining nylon screws) and the coils were wound to a standard considerably less than that suggested in the article. My locator will not detect 1 cent, 2 cent, or small silver coins.

It will detect:

- (1) Pennies at about 1-2 inches.
- (2) A small pocket knife at about 4 inches.
- (3) Bottle top at about 2 inches.
- (4) Soft drink can at about 10 inches.
- (5) Aluminium radio chassis at about 8 inches.
- (6) Bull-nosed pliers at about 5-6 inches.
- (7) Watch. The depth at which a

watch can be detected varies greatly with different watches. Some watches can be detected at 3-4 inches, while others may not be detected at all. I was able to detect a pocket watch at 6 inches.

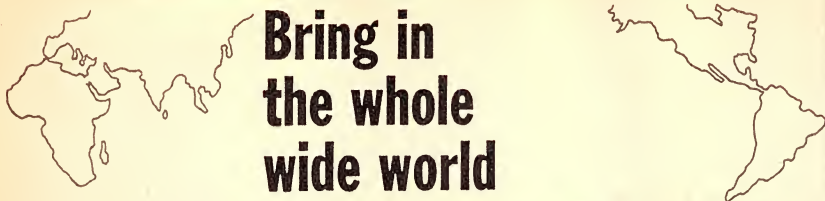
My locator performed extremely well in damp beach sand, but some misleading signals were detected on certain areas of lawn.

When the search head of the locator was brought near the household electrical wiring I received signals from a local broadcast transmitter. I can trace any household wiring due to this distinct, characteristic signal.

The performance of my locator will probably be greatly improved when I put a little more time and effort into a better search-head, but even in its present condition it is superior to many metal locators I have heard of.

The aspect of this metal locator which is most appealing is the fact that it is very inexpensive. The entire unit can be built for well under \$20.

The metals which are most effectively detected by this locator are ferrous metals and aluminium. Other metals such as gold, silver and copper are detectable to a lesser degree if they are of reasonable size (i.e. at least the size of a 20c coin). It is almost impossible to detect gold or silver rings with this detector, or probably any other detector available.



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In constructing the search head, there are three important points to remember: the assembly should be as rigid as possible, the two horizontal coils should be identical, and no metal other than the coil wire and leads should be used. This means no metal screws. All the parts making up the assembly are wood, and strong glue or wood cement should be used in fabrication.

Construct the wood head assembly as shown in figure 2. Note that nylon adjusting screws are used to tilt the horizontal coils slightly. This permits setting both horizontal coils exactly at right angles to the vertical coil. If you use care during the construction and make sure that the vertical and horizontal coils are as close to perpendicular as possible, the nylon screws will not have to be used. The horizontal coils should be made separately from the rest of the frame and not mounted until wound. All the wood parts should be given two coats of paint or varnish before winding the coils.

PARTS LIST

- 1 Metal box (see text)
- 1 9V radio battery
- 4 2N2712 (NPN) or BFX13 (PNP) transistors. See page 41 for changes to accommodate PNP types.
- 2 Phono jacks
- 2 Phono plugs
- 1 Headphone jack
- 1 Single pole, single throw switch
- Headphone (2000 ohms or greater)
- ½lb 32 B&S wire
- Matrix board, spacers, battery connector, wood for coil assembly and handle, 6 nylon screws, knobs, paint or varnish, plastic electrical tape etc.

RESISTORS

(All ¼W types)

- 1 10 ohm
- 1 330 ohm
- 3 2.2K
- 1 2.7K
- 1 3.3K
- 1 15K
- 1 22K
- 1 27K
- 2 56K
- 1 68K
- 1 50K pot
- 1 100K pot

CAPACITORS

- 2 30uF low voltage electrolytic
- 3 20uF low voltage electrolytic
- 1 8uF low voltage electrolytic
- 1 1uF low voltage electrolytic
- 1 0.1uF
- 1 .082uF

When starting to wind a coil, put a layer of plastic electrical tape around the core. Solder a length of fine multi-strand plastic-covered wire to the end of the coil wire and insulate the joint carefully with plastic electrical tape. The piece of fine wire should be long enough to make one complete turn with enough left over to make a connection outside of the coil (two or three inches). Leaving this length of the fine wire hanging free (or anchored temporarily to some other object to keep it out of the way), wind the coil with the proper number of turns. Each horizontal coil requires 470 turns of 32 B&S wire, while the single vertical coil takes 870 turns. Wind the

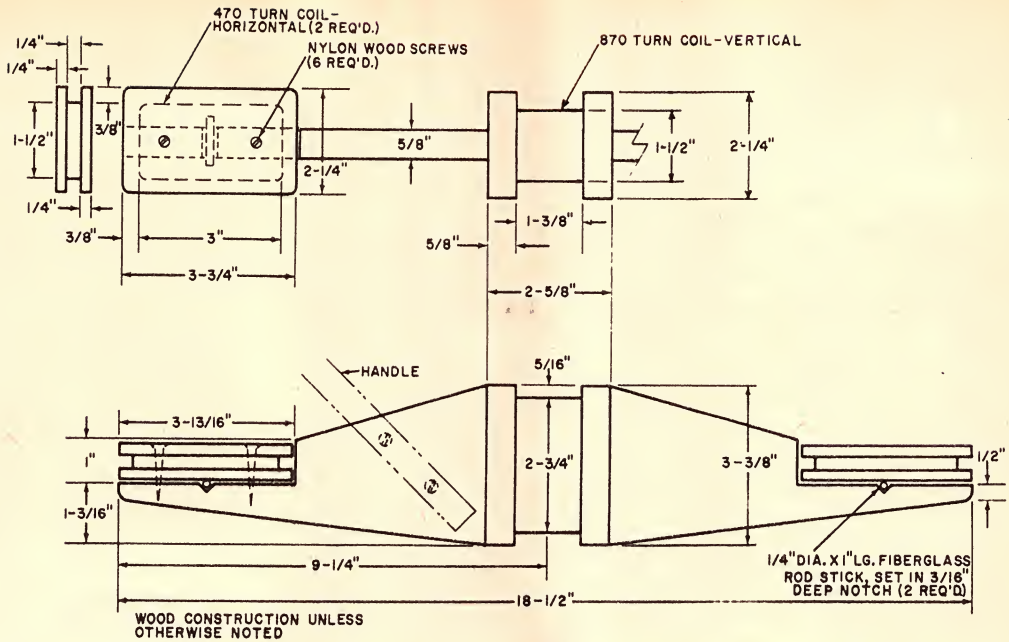


Figure 2. Except for the copper wire in the three coils, no metal is used in the search head construction. Nylon screws secure the two horizontal coils. Use a strong glue or cement for overall assembly.

coil wire as evenly and firmly as possible and avoid kinking. When the winding is finished, protect it with a couple of layers of plastic electrical tape. Be sure that you can identify each end of the coil.

Winding the horizontal coil will be easier if you drill a hole in the centre of the coil form and push a long machine screw through it. Anchor the screw at one end with a nut and clamp the screw in the chuck of a hand drill. Let an assistant operate the drill while you hold the wire and count the number of turns.

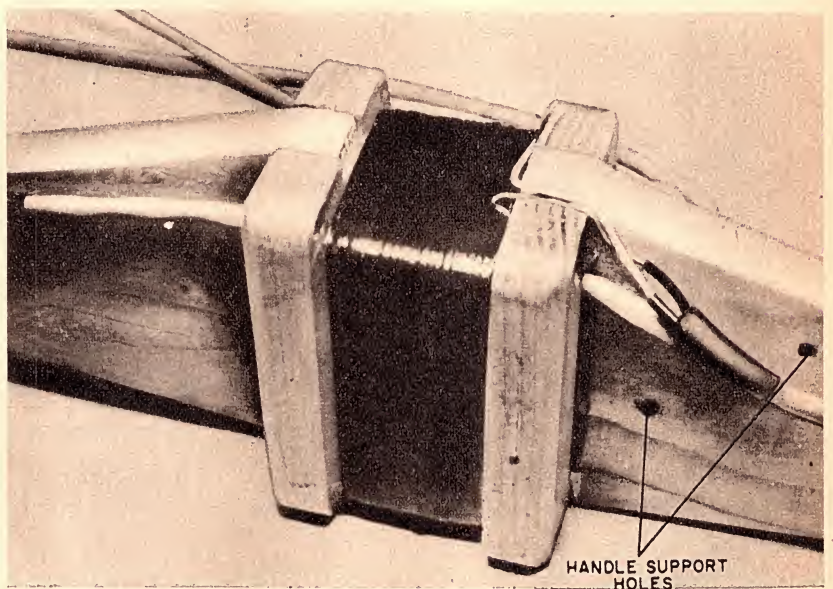
When winding the vertical coil, drill a small hole at each end of the form and push a round nail (with the head removed) in each hole. Use one nail as a pivot and put the other in the hand drill. Be sure to remove the nails and bolts after winding the coils.

Once all three coils are wound assemble them as shown in figure 2. The handle, fastened to the frame with nylon screws, can be any shape or length.

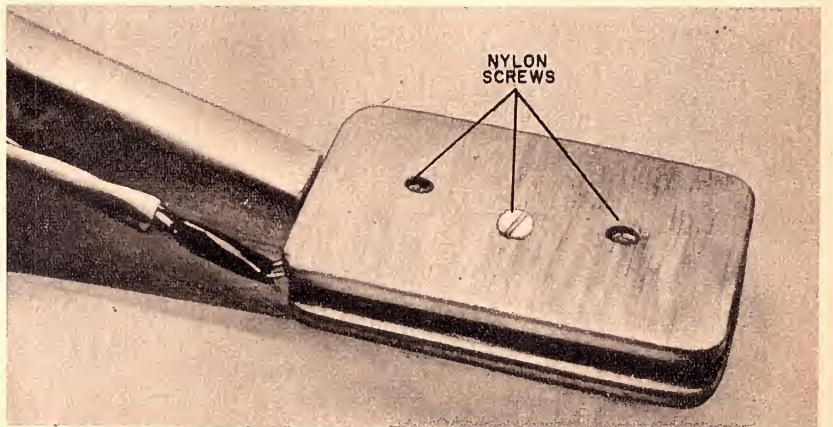
Use shielded twin-conductor cable about 6 feet long to connect the coils to the appropriate jacks on the electronic package. Connect the vertical coil as shown in figure 1. For the horizontal coils, the two wires in the cable are connected together to form one lead with the shield used as the other lead. At this time, connect only one horizontal coil to the cable.

After the complete detector has been assembled, hang the search coil assembly so that it is well clear of any metal objects (about six feet). With the headphones plugged in and the power turned on (S1), turn up gain control R9. At some point, the circuit will oscillate and a tone of about 2000Hz will be heard. Turn the gain down until the circuit just stops oscillating. Turn up the feedback control (R7) until the oscillation is just audible.

Bring a ferrous metal object (pliers, large screwdriver, etc.) near the coil



Details of the vertical coil. After winding, wrap plastic electrical tape around the coil to prevent damage and keep out moisture.



Three nylon screws are shown here because the author trimmed the mounting for a true 90-degree fit. Normally, only the two outer screws are used and the coil form rotates about a thin plastic rod.



THE MARK OF
DISTINCTION

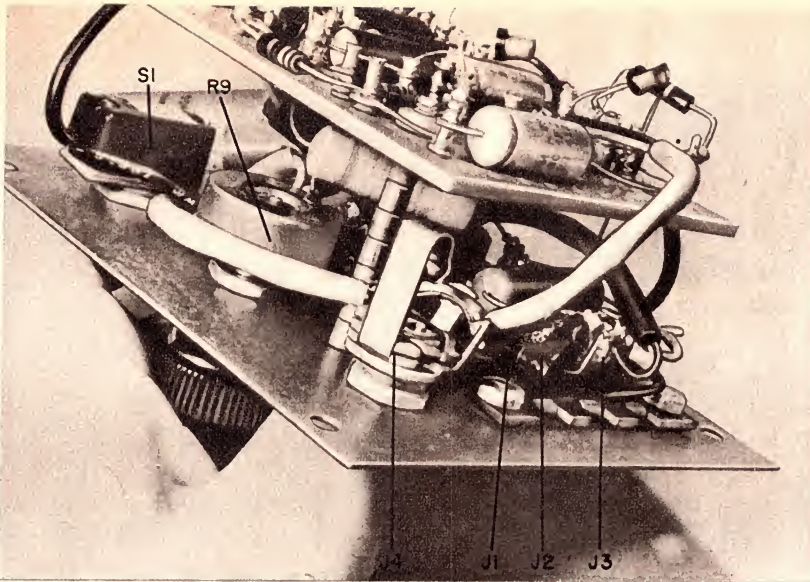
TYPE NO.	NOM. WATTS	PRIMARY IMPEDANCE (OHMS)	SECONDARY IMP. (OHMS)	MTG.	H.	W.	L.	
OPM1A	5	7000, 5000	S.E. 15, 8, 3.7, 2	W	2 1/4	x 2 1/4	x 2 1/4	MEDIUM FIDELITY 40-30000 CPS ± 2 db. () Impedance in brackets indicate screen taps available.
OPM19A	5	7000, 5000	S.E. 500, 250, 166; 100	W	2 1/4	x 2 1/4	x 2 1/4	
OPM20A	5	10000, 8000	S.E. 15, 8, 3.7, 2	W	2 1/4	x 2 1/4	x 2 1/4	
OPM2A	7	10000	P.P. 15, 8, 3.7, 2	W	2 1/4	x 2 1/4	x 2 1/4	
OPM3A	10	4000, 2500	S.E. 15, 8, 3.7, 2	VC	3 1/4	x 2 1/2	x 2 1/2	
OPM4A	10	4000, 2500	S.E. 500, 250, 166, 100	VC	3 1/4	x 2 1/2	x 2 1/2	
OPM5A	15	5000, 3000	P.P. 15, 8, 3.7, 2	VC	3 1/4	x 2 1/2	x 2 1/2	
OPM6A	15	5000, 3000	P.P. 500, 250, 166, 100	VC	3 1/4	x 2 1/2	x 2 1/2	
OPM7A	15	(10000) 8000, 7000	P.P. 15, 8, 3.7, 2	VC	3 1/4	x 2 1/2	x 3 1/4	
OPM8A	15	(10000) 8000, 7000	P.P. 500, 250, 166, 100	VC	3 1/4	x 2 1/2	x 3 1/4	
OPM10A	25	(8000) 6600	P.P. 15, 8, 3.7, 2	VC	3 1/4	x 2 1/2	x 3 1/2	
OPM9A	25	(8000) 6600	P.P. 500, 250, 166, 100	VC	3 1/4	x 2 1/2	x 3 1/2	
OPM14A	35	(8000) 6600	P.P. 15, 8, 3.7, 2	VC	4 1/4	x 3 1/4	x 3 1/4	
OPM11A	35	(8000) 6600	P.P. 500, 250, 166, 100	VC	4 1/4	x 3 1/4	x 3 1/4	
OPM13A	55	3500	P.P. 15, 8, 3.7, 2	VC	4 1/4	x 3 1/4	x 3 1/4	
OPM12A	55	3500	P.P. 500, 250, 166, 100	VC	4 1/4	x 3 1/4	x 3 1/4	
OPM21A	100	(4500)	P.P. 500, 281, 125, 31	VC	4 1/4	x 3 1/4	x 4 1/4	
OPM16A	10	500	15, 8, 3.7, 2	W	2 1/4	x 2 1/4	x 2 1/4	LINE TO VOICE COIL 40-30000 CPS ± 2 db.
OPM18A	25	500	15, 8, 3.7, 2	VC	3 1/4	x 2 1/2	x 3	
OP412	7	9000 + Screen Taps	P.P. 15, 7.5, 3.7, 2.	W	2 1/2	x 2 1/4	x 3	MULLARD STEREO PLAYMASTER UNITS
OP308/15	12	8000, 6000	P.P. 15, 3.75	VC	4 1/4	x 3 1/4	x 3 1/2	HI-FI FOR MULLARD 5-10 AMPLIFIER
OP308/8.4	12	8000, 6000	P.P. 8.4, 2.1	VC	4 1/4	x 3 1/4	x 3 1/2	
OP301/15	12	8000 + Screen Taps	P.P. 15, 3.75	VC	4 1/4	x 3 1/4	x 3 1/2	ULTRA-LINEAR
OP301/8.4	12	8000 + Screen Taps	P.P. 8.4, 2.1	VC	4 1/4	x 3 1/4	x 3 1/2	
OP312/15	25	6600 + Screen Taps	P.P. 15, 3.75	VC	5	x 4	x 3 1/2	
OP312/8.4	25	6600 + Screen Taps	P.P. 8.4, 2.1	VC	5	x 4	x 3 1/2	
OP387/15	12	8000 + Screen Taps	P.P. 15, 3.75	VC	3 1/2	x 3	x 3	For 6BQ5's (EL84's)
OP387/8.4	12	8000 + Screen Taps	P.P. 8.4, 2.1	VC	3 1/2	x 3	x 3	
OP447/15	12	8000 + Screen Taps	P.P. 15, 3.75	VC	3 1/2	x 3	x 3	For 6GW8's (ECL86's)
OP447/8.4	12	8000 + Screen Taps	P.P. 8.4, 2.1	VC	3 1/2	x 3	x 3	
OP499/500	60	4000	P.P. 500	W	2 1/2	x 4 1/2	x 3	PHILIPS 60 WATT AMPLIFIER (6CA7's) (EL34's)
OP499/15	60	4000	P.P. 15	W	2 1/2	x 4 1/2	x 3	
OP499/8.4	60	4000	P.P. 8.4	W	2 1/2	x 4 1/2	x 3	
OP541	40	3300	15, 8, 3.7	VC	4 1/4	x 3 1/4	x 3 1/4	GUITAR AMPLIFIER ELECTRONICS AUSTRALIA
OP542	60	2600	15, 8, 3.7	VC	4 1/4	x 3 1/4	x 3 1/4	
OPS10K3	5	10000	S.E. 3		HEIGHT 1-5/16			SPEAKER TRANSFORMERS
OPS7K3	5	7000	S.E. 3		WIDTH 1-1/16			
OPS5K3	5	5000	S.E. 3		LENGTH 1-1/2			
OPS10K15	5	10000	S.E. 15		MOUNTING			
OPS7K15	5	7000	S.E. 15		CENTRES 2"			
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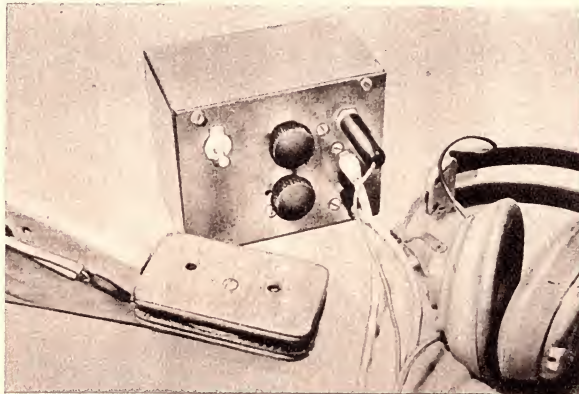
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The matrix board is mounted on four long spacers to provide room for the front-panel components. The battery is secured in a clip affixed to the panel.

The complete assembly consists of the search coil, a pair of headphones and the electronics package.



assembly about midway between the vertical coil and the horizontal coil that is hooked up. At some short distance from the coil assembly, the circuit oscillation will increase rapidly, creating a loud tone in the phones. If it does not and the faint oscillation tone disappears instead, exchange the connections to the horizontal coil and repeat the test.

Identify both leads of the horizontal coil, disconnect it, and repeat the procedure with the other horizontal coil connected. Identify these leads also and then connect both coils to the cable. After soldering the coil leads to the cable, insulate the connections with plastic tape. Then retest the entire locator head by bringing a metal object midway between the vertical coil and either of the horizontal coils. You can now experiment with various metal objects of various sizes to get the "feel" of the detector's operation.

To test for a true null angle between the vertical and horizontal coils, an external audio generator capable of delivering 2KHz is required. Unplug both vertical coil connectors and insert a 2200-ohm, 1-watt resistor between J2 and J3.

Connect the audio oscillator, set at 2KHz, to the vertical coil connectors. P2 and P3. Rotate the feedback control, R7, fully counterclockwise (maxi-

mum resistance) and set the gain control, R9, at about its midpoint. Adjust the output of the audio generator until a tone is heard in the headphones. Very carefully tip one horizontal coil about the horizontal until the tone is minimised. Fix the coil in this position using the nylon screws. Repeat the procedure with the other horizontal coil. When the tone is at a minimum, the coils should be fixed that way. When this test is complete, attach the wooden handle with two nylon screws.

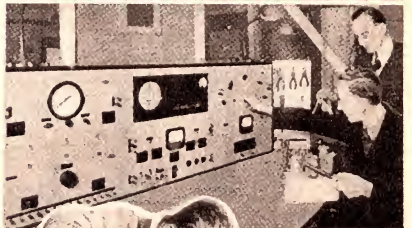
With the detector assembled, ear-phones plugged in and on the head, turn on the power. Hold the coil assembly up in the air so that it is well clear of the ground and any metal. Rotate the feedback control to full counterclockwise and turn up the gain control until oscillation is just heard. Then back it off slightly until the oscillation just stops. Adjust the feedback control until the circuit just trembles on the edge of oscillation. Now proceed with a search pattern, bringing the coil assembly down to ground level and making wide sweeping motions in arcs over the top of the ground. When a metal object is detected, the barely audible tone will suddenly increase in volume as the hidden metal reaches an area just midway between either horizontal coil and the vertical coil.

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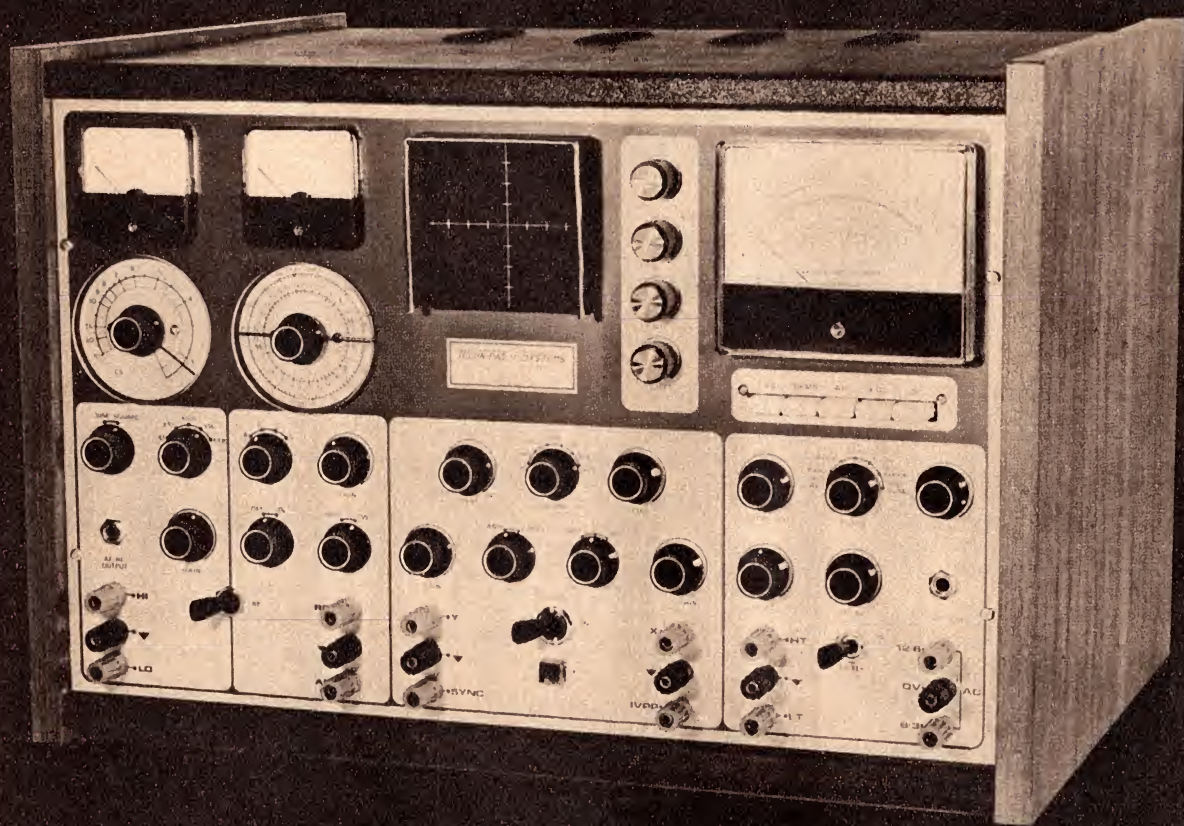
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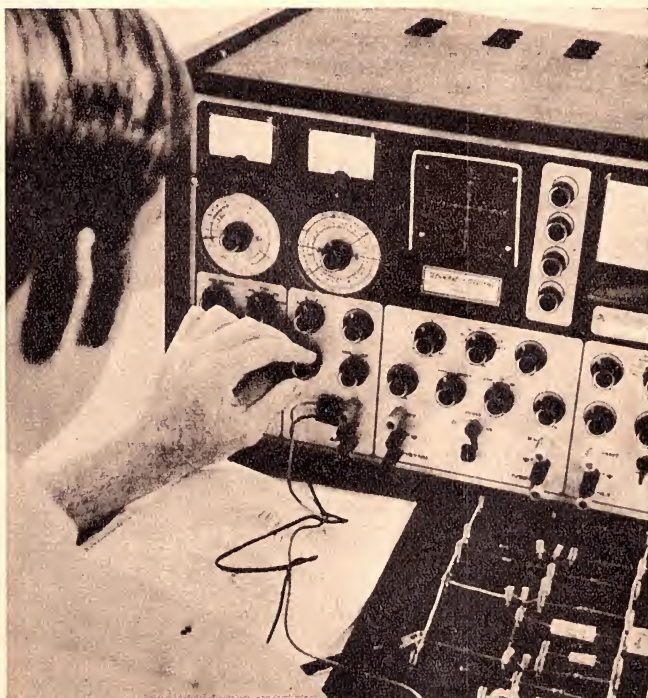
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FORUM

Auditory training of deaf children

Our "Musicolour" unit, described in the October issue last, has proved to be immensely popular for the entertainment role originally intended. As a side issue, it has raised the idea of an audio-visual device along similar lines as an aid in training deaf children to speak.

Conducted by the Editor

We reproduce below a most helpful letter from Mr J. Venn, B.Sc., C.Eng., A.F.R.Ae. S., A.F.A.I.M. Mr Venn is Chief Engineer (Trials and Documentation) of E.M.I. Electronics (Australia) Pty. Ltd.

We should explain that the letter came to hand some time ago but, because of early printing schedules and prior commitments, we were not able to reproduce it earlier, in full, as we desired to do. What follows is Mr Benn's letter, reproduced in ordinary body type and without the complication of quote marks:

Dear Sir,

I found your article on the construction of the "Musicolour" unit more than usually interesting as I have for many years, as a private individual, been interested in the design and construction of such devices. In fact, my first version was made in 1948 and used PX4 triodes controlling the current through 220 volt, 15 watt lamps, power being taken from a 400 volt DC power pack. Although reasonably effective as a musical kaleidoscope, it was even more effective as a room heater! Later versions progressed from more efficient and effective valve-operated devices, through saturated-core transformers to a power transistor-controlled unit activating ear head-lamp globes.

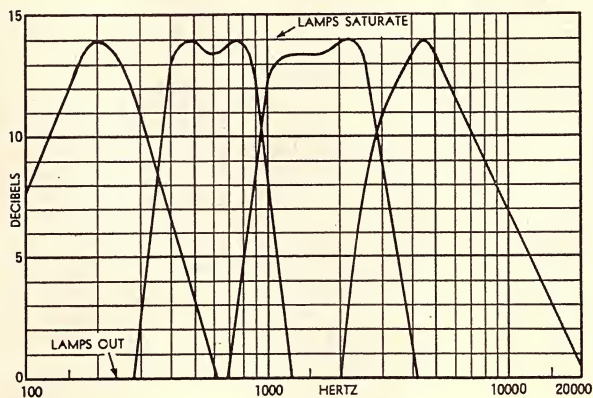
This letter, however, is more concerned with your footnote regarding the possible use of such an instrument to assist in the auditory training of deaf children. With the co-operation of this company, I was able to design a 4 channel frequency-to-light converter specifically tailored to the characteristics of speech and this unit was lent to the South Australian Oral School at Gilberton, Adelaide, to use as a teaching aid.

You and your readers might be interested in some of the technical details of the device. It is certainly worth noting that the type of filter used in your "Musicolour" is quite inadequate for the purpose of separating out characteristic speech frequencies.

In the analysis of speech by frequencies, the fundamental "voice frequency" is not particularly informative except to define the pitch and to determine whether the speaker is a man, a woman, or a child. Fortunately, therefore, for a general purpose instrument, this band, approximately 120 to 280Hz wide, can be omitted.

To permit some degree of identification of vowels, some splitting of formant frequencies is required. This can best be done by the use of two narrow-band filters centred on 200Hz and 600Hz respectively. This permits the separation of vowel sounds such as EE (as in meet) from those such as E (as in met). The formant in the first case has a frequency of approximately 300Hz and in the second case

Typical filter/output characteristic of a 4-channel auditory training device. Also indicated is the relationship between the audio response and brightness of the lamps.



a frequency of approximately 600Hz.

Identification of consonants, voiced and unvoiced, is even more difficult but two filters centred on 1.5KHz and 5KHz respectively permits some separation of the frequency components in the 1½ to 3½KHz band met in such consonants as L, H, G, P, etc., from the very high frequency components such sibilants as S, F, Z, V, etc. The lower band also isolates second formant frequencies in some vowels. The bandwidth of these filters should ideal-

ly be approximately 1½ octaves with a flat topped, steep sided, characteristic. A good enough approximation was achieved by the use of two stagger-tuned resonant circuits with a fall-off on each side of the plateau of not less than 15dB per octave.

The first version of the auditory aid used active filters but it was found that the cost was higher and the performance was not noticeably better than a considerably simpler design using what were effectively "junk box" inductors in a "tuned base/tuned collector" amplifier circuit. Some further improvement in slopes was obtained by the appropriate choice of R/C coupling and detector time constants.

Since the display unit of the device was required only to be visible to a teacher and a limited number of pupils, low voltage low power lamps were used, the brilliance of these being controlled by a "Class D" or duty cycle switching amplifier, the ratio of the on to off time of the lamps being controlled by the DC output from the channel detectors. This allowed up to 3 watts worth of lamp per channel to be controlled by transistors in the 200 milliwatt collector dissipation class, keeping the bulk and cost of the unit to a minimum. The total number of transistors used, all low cost, low power germanium types, was twenty-two.

In such devices the wide dynamic range of speech is a problem unless complex AGC circuits are used. This problem was partly overcome in our device by compression of the input signal v lamp brightness characteristic; since the variable mark space ratio of the lamp switching cycle was derived by varying the clipping level of a 50Hz sine wave, a non-linear control characteristic was obtained. Individual gain controls were also provided for each filter channel. These could be set

by the teacher to bring out the particular characteristics of the sound being taught.

The unit proved to be capable of displaying differences in vowel sounds which were difficult to identify by the usual "clues" used during auditory training. It was readily capable of differentiating multi-component sounds such as "sh" from simple sibilants like "s" and was in general capable of separating the gross characteristics of many consonants.

The attractive sequences of colours characteristic of slowly spoken words aroused the interest of the children, although in the absence of any means of freezing the display a considerable amount of concentration was required. As expected, the device by no means replaced the careful and laborious demonstrations and repetitions required to teach deaf children to speak but did prove to be a useful aid to such teaching. After approximately 12 months' use the opinion was expressed that most oral schools would find such a device useful provided "the price was right."

Unfortunately, in this area such devices fall into a rather odd category. The quantities required are not sufficient to attract the attention of those electronic equipment manufacturing companies who could produce them in quantity at a reasonable price (the device, for example, is much less complicated than a portable television set). Those companies who produce specialised one-off pieces of electronic equipment usually for teaching or medical purposes appear to operate on

such overheads and profit margins as to make the equipment prices unattractive to customers, who feel that the money would be better spent on absolutely essential equipment.

It is our feeling that devices of this nature could best be built by groups of electronic hobbyists or radio amateurs as a form of charitable project for their local school or hospital, which might be prepared to pay for the components. Individuals or groups who would like to obtain more circuit details of the device for such charitable purposes rather than commercial exploitation are welcome to write to the undersigned.

It is also worth noting that there could well exist patents applicable to the utilisation of the concepts outlined in both your article and in this letter in auditory training.

There is to our knowledge on the market at least one piece of overseas designed medical electronic equipment which displays speech characteristics in the form of a set of variable colour, variable length, discharges in gas glow tubes.

In conclusion, for those interested in the analysis of speech in the frequency domain for the purpose of designing such devices, a useful reference is "Speech Analysis, Synthesis and Perception" by J. L. Flanagan, published by Springer-Verlag; Berlin, Heidelberg and New York, 1965.

Yours Faithfully
J. VENN.

(Chief Engineer, E.M.I. Electronics (Aust.) Pty. Ltd., P.O. Box 161, Elizabeth, S.A. 5112.)

Words in place of facts

Dear Sir,

In the September issue of "Electronics Australia," in the Forum feature on page 73, the word "LEDUC" is listed as being unknown to your technical staff.

The correct term is the Righi-Leduc Effect. Stated rather simply, it is a transverse temperature gradient observed in a metal when the metal is in a magnetic field whose lines of force are perpendicular to the heat flux. The condition was jointly observed by Augusto Righi, a physicist in Italy who passed away about 1920, and Anatole Leduc, a physicist in France.

In the early part of this century, there were people in the medical field, particularly in England and the Continent, who held great hopes that a substantial number of mental and physical ills might successfully be treated by a combination of electrical shock and physiotherapy — the treatment of disease by physical remedies such as massage, exercise and diet.

They developed a fantastic number of instruments and machines reflecting a high order of craftsmanship, materials and design. They attacked the subject with a zeal that would have turned a medieval alchemist green with envy. The result was a conglomeration of electrical machines that would have made the torture chambers of the Great Tower look like a Sunday School Bible class.

In this environment, charlatans swarmed, opened a large number of clinics, devised rules and added another chapter to the book of confidence games. Unfortunately, history is continuing to repeat itself.

Where one cannot closely define the operation of equipment or the efficacy of treatment, there is a very strong objection to the exploitation of mere terms to promote its sale and use. Words like Galvanic, Faradic, Leduc, Sinusoidal and such other tongue twisters can all too easily be used to support the salesman's charming manner and help mesmerise the intended "victim!"

Speaking generally, it has been my experience that many sales personnel exhibit an enormous lack of technical knowledge of their product unless, perchance, they have been specifically recruited and trained by a large organisation. Such lack of knowledge is frequently offset by impressive sounding words, metaphors and fantastic mental gymnastics, all aimed at completing a sale without too much regard for the customer's needs or ability to pay.

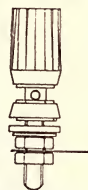
Turning to things more pleasant, "Pages From The Past" has resulted in many happy memories. Your printout of the tempered musical scale almost produced a war between the musically and technically inclined members of this family.

R.R. (San Francisco, Calif., U.S.A.)



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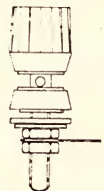
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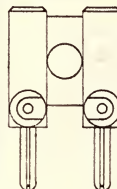
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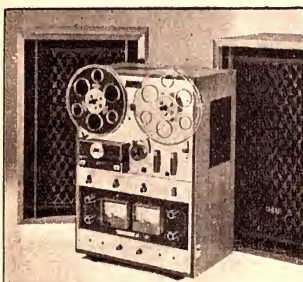
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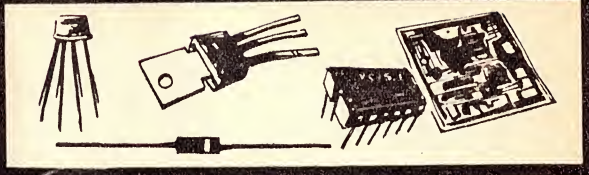
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Fundamentals of SOLID STATE



Chapter 9

by Jamieson Rowe

FET applications—parameter spread and its implications—design approaches — biasing — fixed and self bias — composite bias—audio amplifiers—configurations—DC amplifiers — RF amplifiers and oscillators — other applications.

We have seen in the last chapter that both the JFET and IGFET varieties of field-effect transistor effectively combine many of the worthwhile features of the familiar thermionic valve with the compactness, efficiency and reliability characteristic of semiconductor devices in general. It should therefore come as no surprise to find that both of these devices are of considerable value to the designer of electronic circuits and that, as a result, their applications are both numerous and rapidly growing.

It is proposed to discuss briefly in the present chapter some of the more common applications in which FET devices are found. However, before dealing with specific applications it will be worthwhile to examine some more general aspects of device usage which are associated with, and follow from, a seemingly unavoidable variation in parameter values from device to device.

It may be remembered that the behaviour of FET devices can be described in terms of three main parameters, which in the case of JFETs and depletion-type MOSFETs are the zero bias current I_{DSS} , the pinch-off voltage V_p , and the transconductance g_m . Enhancement type MOSFETs may be described by equivalent parameters.

Basically these parameters are determined by such factors as the semiconductor impurity doping levels and the effective dimensions or "geometry" of the device channel region. Because doping levels and device geometry are in practice variables, subject to inevitable variations during production, the parameters for a particular FET device type are subject to a corresponding variation about their nominal values. This type of variation in fact tends to occur in the parameters of all semiconductor devices, and is commonly known as **parameter spread**.

As a result of parameter spread, the voltage-current behaviour of the channel region of each device of a particular type of FET will tend to be different from that of every other device. Hence in practice such a device type cannot be represented by a single family of V_{DS}/I_{DS} curves as shown in figure 8.3 of last chapter. Rather, each individual device will tend to have its own family of curves, so that the device type as a whole

could really only be represented by a complete "family of curve families."

Not only is such a "family of curve families" very difficult to represent graphically, but also it presents the information on both the nominal device parameter values and their spread ranges in a particularly unwieldy form. It is for this reason that the "static drain-source characteristic" illustrated in figure 8.3 is generally found to be of little use in practical FET circuit design.

Fortunately the required information can be both presented and represented in a form far more easily interpreted and used, by means of

figure 9.1 can be drawn using information supplied by the manufacturer. Hence, by definition, any particular device of the type concerned should have a transfer curve lying somewhere between those for the upper and lower limit devices, with a majority of devices (ideally) falling close to the curve representing a nominal device.

The curves of figure 9.1 may seem to exaggerate the extent of spread variation in FET parameters, but this is not the case. Because of the narrow channel region involved in most FET devices, the parameters of these devices tend to be particularly sensitive to doping level and geometry variations. Hence the extent of spread variation in FET devices tends to be somewhat greater than for most other semiconductor devices.

As one might expect, this rather wide spread in FET parameters tends to complicate circuit design. The de-

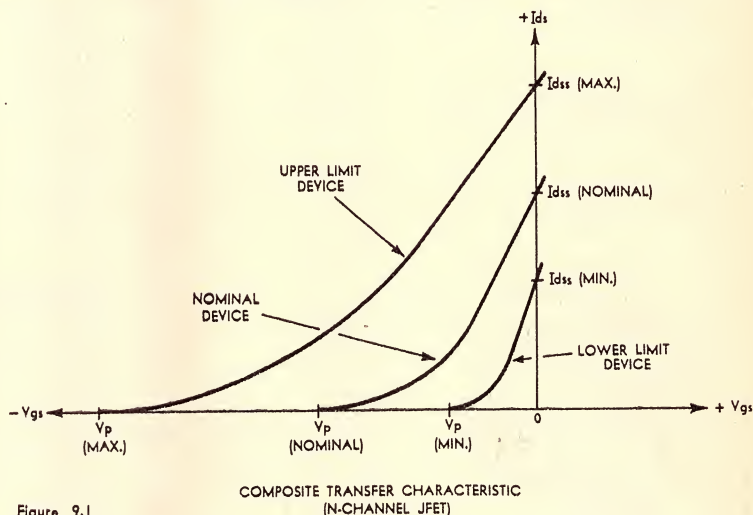


Figure 9.1

COMPOSITE TRANSFER CHARACTERISTIC (N-CHANNEL JFET)

the "static transfer characteristic" which was shown previously in figure 8.4. Being a single curve for any particular device, this characteristic quite readily lends itself to representation of the limits of parameter spread applicable for a given device type.

The way in which the static transfer characteristic is adapted to represent the behaviour of a certain FET device type is illustrated in figure 9.1. Here the curve marked "nominal device" corresponds to an average or typical device having the nominal values of I_{DSS} , V_p and g_m for the device type concerned, while the other two curves represent hypothetical "limit" devices representing the extremes of parameter spread permitted within that device type.

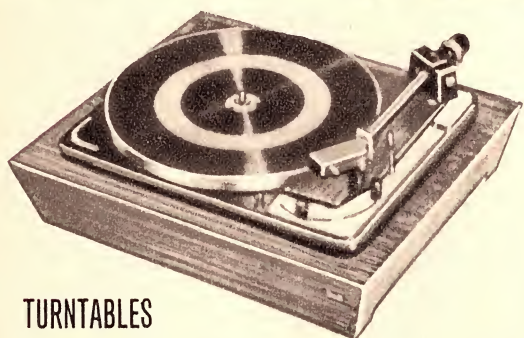
For any given FET device type, a set of curves similar to that of figure

signer must generally arrange for his circuit to be particularly tolerant of device parameter variations, because each piece of equipment concerned will contain not simply a sample from a group of virtually identical devices of the required type, but rather a sample from a distribution of devices whose behaviour varies over a significant range.

Basically this forces the designer to think primarily in terms of the upper and lower limit devices, and adopt a "worst case" design procedure. Each important aspect of circuit performance is arranged to fall within acceptable limits for both the extremes of device variation, by this means ensuring that performance will also be acceptable for all devices in between the extremes.

Naturally those aspects of circuit be-

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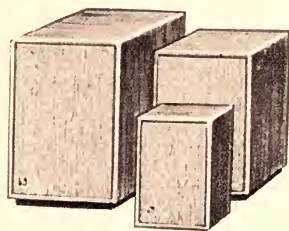


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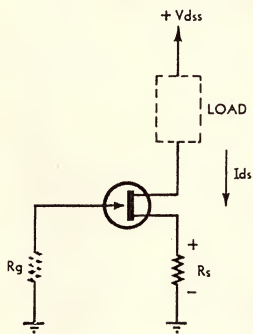
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behaviour or performance which the designer may regard as important will depend upon the type of circuit involved. In the case of audio and RF amplifiers, it is often important to keep the transconductance of the FET devices within narrow limits at the quiescent operating point, in order to maintain the circuit gain; however, in RF mixers it may be more important to maintain the drain current within a narrow range, to ensure satisfactory signal-handling performance. In the case of DC amplifiers it may be important to maintain the drain or source voltage of a stage within certain limits, to ensure correct interstage coupling conditions, whereas in switching circuits the main concern may be to ensure that all devices switch reliably between cutoff and "full on."

Probably the most common method used to bias JFETs and type A and B MOSFETs to the appropriate DC quiescent operating point in linear circuits is the "self-bias" method, which is illustrated in figure 9.2. It may be seen that this method is very similar to the cathode-bias system often used for thermionic valves. The required gate-source bias voltage is generated as a voltage drop due to the flow of drain-source current I_{ds} through a



EFFECTIVE GATE BIAS = $-(I_{ds}R_s)$
ASSUMING GATE LEAKAGE
CURRENT NEGLIGIBLE

Figure 9.2

small resistor R_s connected in series with the source electrode.

With most modern JFET devices, and certainly with all normal MOSFETs, the gate leakage current I_{gss} is sufficiently small to be negligible in all but the most critical circuitry. Hence the presence of any resistance R_g in series with the gate electrode does not provide any significant contribution to gate-source bias. As a result, the effective gate-source bias presented to a device in this type of circuit is simply given by $-(I_{ds}R_s)$.

It may be seen that this bias method involves negative feedback, because the bias applied to the device depends upon the current drawn by the device itself. This explains the meaning of the term "self-bias."

The negative feedback involved in this method of biasing helps considerably to reduce the effect of device parameter spread upon the DC operating conditions. A device near the upper limit of the parameter spread range tends to provide itself with increased bias, while a device near the lower limit tends to provide itself with less bias—in both cases moving the operating conditions closer to those for a

nominal device than would be the case if fixed bias were applied.

This "stabilising" action may be seen quite clearly if the behaviour of the self-bias system is compared with that of fixed bias using a composite transfer characteristic of the type introduced in figure 9.1. Such a characteristic has been drawn in figure 9.3 with bias lines for both fixed and self-bias.

With fixed gate-source bias, represented by the dashed line, it may be seen that the operating point of individual devices will vary widely. An upper limit device will operate at point A, drawing considerably greater drain-source current than a nominal device at point B. Conversely a lower limit device will operate at point C, with a considerably lower drain-source current. Quite apart from any embarrassment which this wide range in drain-

source current may well reduce its signal performance to an unacceptable level.

The improvement in operating point stability gained by the use of self-bias is shown by the oblique solid line passing through the origin. The slope of this line is equal to $(-1/R_s)$, representing the relationship between gate-source bias voltage and the drain-source current. The self-bias operating points for upper limit, nominal and lower limit devices are marked respectively as points D, E and F.

It may be seen that the range in I_{ds} values between points D and F is significantly less than that between points A and C, showing that self-biasing helps considerably to reduce the effects of parameter spread on quiescent drain-source current. Also it may be noted that all devices are now biased to approximately corresponding

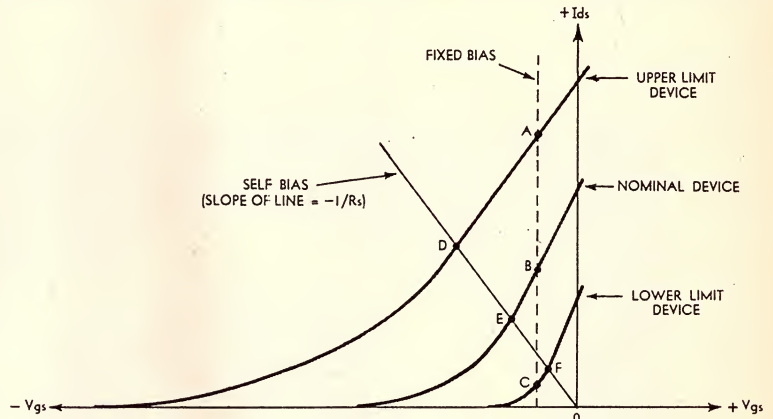


Figure 9.3

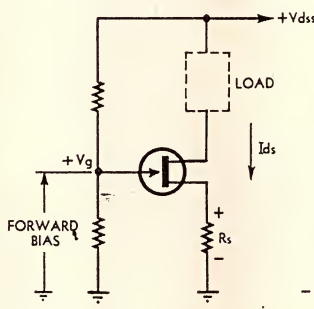
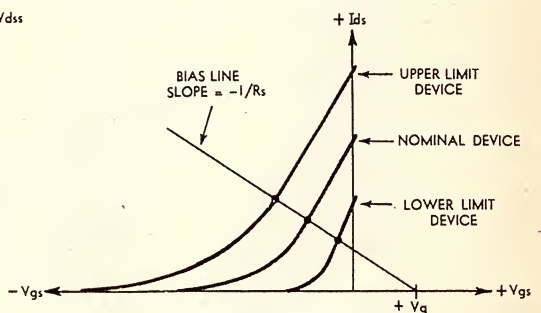


Figure 9.4

FIXED FORWARD BIAS TO PERMIT INCREASED SOURCE RESISTOR



source current may incur, there are often other problems.

In circuits wherein the drain is connected to the drain supply via a very low resistance, the high current drawn by an upper limit device under fixed bias conditions may be sufficient to cause excessive power dissipation and device damage. Alternatively, if the drain is connected to the supply via a significant resistance the voltage drop produced by the high drain current may cause the drain-gate voltage present at the device to fall below the pinch-off voltage V_p , causing such a device to operate outside the linear pinch-off or "pentode" region.

The low drain-source current drawn by a lower limit device admittedly does not produce dissipation or operating region problems. However, the working transconductance or g_m of such a device will tend to be quite low, because of its proportionally greater

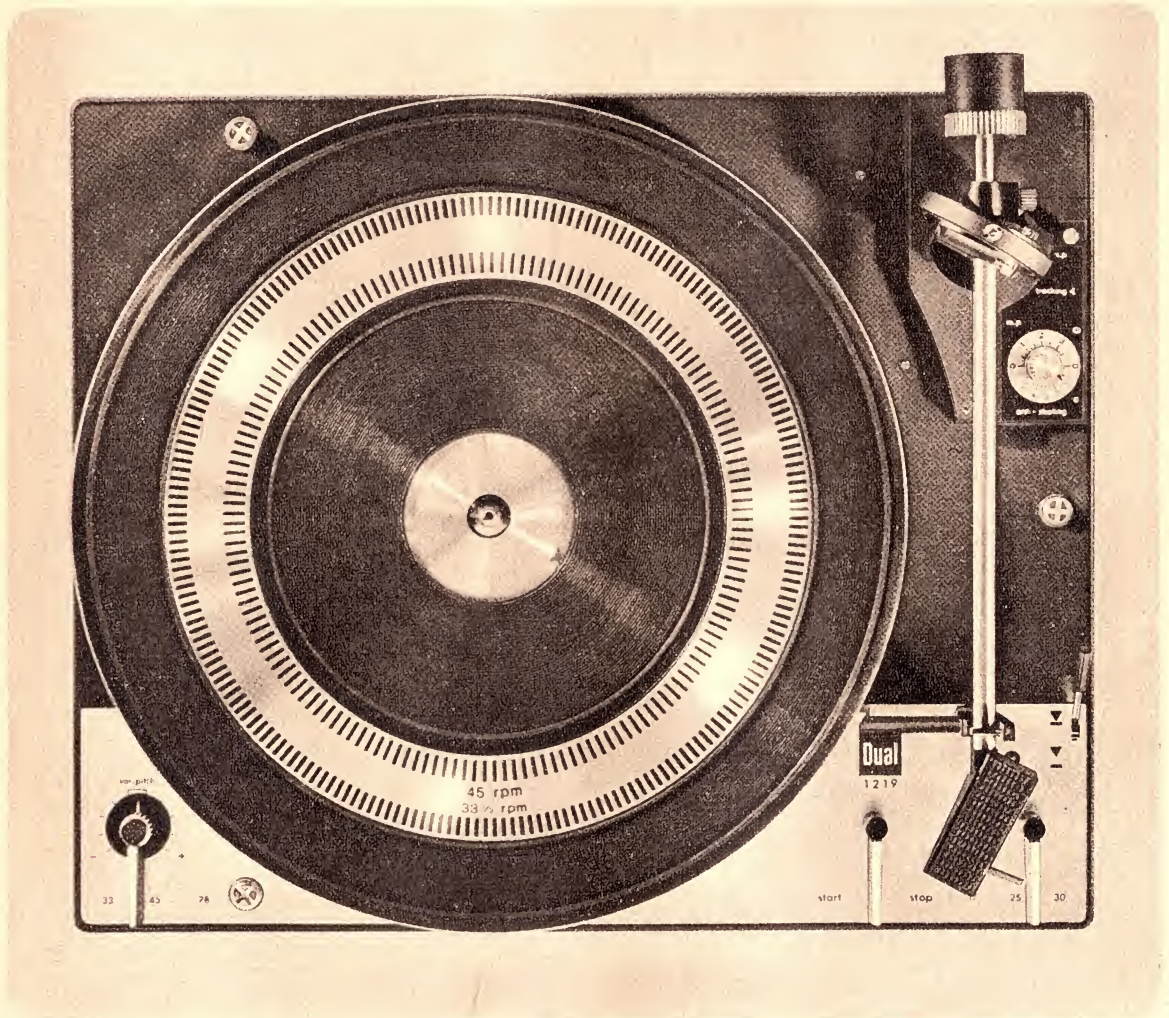
points on their transfer characteristics, which generally reduces transconductance variations to a minimum and contributes to more uniform signal-handling performance.

As may become apparent later in this chapter from the various FET device applications described, the simple self-bias method illustrated in figures 9.2 and 9.3 is widely used for FET amplifiers, mixers, oscillators and other "linear" circuits. Assuming the use of modern FET devices having parameter spreads confined within reasonable limits, the designer can generally use this method to design his circuit for satisfactory operation with all devices of the type concerned.

There are, however, cases where the simple self-bias method does not provide the required degree of operating current stabilisation. In such cases it is often possible to achieve satisfactory results using an extension of the

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method which is illustrated in figure 9.4.

Here a source resistor R_s is used as before, but in addition the gate of the device is provided with a fixed forward bias. This may be provided either by means of a resistive voltage divider from the V_{dss} supply, as shown, or alternatively by leaving the gate at ground or common potential and returning the source resistor to a suitable reverse-polarity supply line. In the case of an N-channel device as shown, the latter approach would involve the use of a second supply which provides a negative voltage with respect to ground.

As a result of the fixed forward bias, the source resistor R_s can be made larger in value than for simple self-bias. This increases the negative feed-

back action and hence gives a further improvement in operating current stabilisation. The effect may be seen from the graph in figure 9.4: the reduced slope of the bias line has further reduced the range in I_{ds} values between the operating points of upper-limit and lower-limit devices.

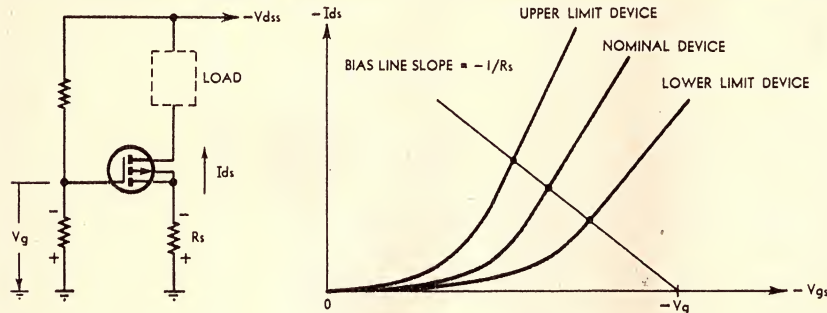


Figure 9.5
TYPE C OR ENHANCEMENT MOSFET BIASING
(P-CHANNEL DEVICE SHOWN)

Note, however, that although an improvement is gained in terms of drain-source current stability, it is actually at the cost of transconductance stability. Because of the lower slope of the bias line, devices near the upper limit of spread range are biased at proportionally lower points than those near the lower limit.

Fairly obviously the bias requirements for minimum I_{ds} variation are somewhat in conflict with those for minimum transconductance variation, so that the designer must generally select his bias conditions to favour whichever of the two is of greater importance in the application concerned. Where both are equally important it is usually necessary to arrange a "compromise" bias situation, and use selected FET devices whose parameters are confined to a sufficiently narrow spread range. Naturally this course is adopted only in critical applications, as selected devices are generally rather costly.

Because the application of forward bias to the gate of a FET tends to reduce the drain-gate bias, the designer using the bias method of figure 9.4 must be careful to ensure that all devices will operate in the pentode region with $V_{dg} > V_p$. This can sometimes pose problems, as the resistance of a load in the drain circuit tends to reduce the actual drain voltage, while the drain supply voltage V_{dss} is generally limited by device breakdown considerations.

The simple self-bias method of

figures 9.2 and 9.3 cannot be used for enhancement or type C MOSFETs, because it may be remembered that these devices are normally "off." A fixed bias component is therefore always required for such devices when used in linear circuitry. However, this requirement nevertheless permits the use of the composite bias method of figure 9.4 and, in fact, this method is that generally used with type C MOSFETs because of the wide parameter spreads encountered.

Figure 9.5 shows this biasing method as used for type C MOSFETs, together with the corresponding composite transfer characteristic and bias line. The reader may care to compare these with figure 9.4.

Having considered briefly some of

signal to the device is applied to the gate electrode, while a load resistor R_d in the drain lead develops the amplified output signal. The source resistor R_s is normally bypassed to ground as shown, to prevent signal negative feedback or "degeneration."

Typically the voltage gain which may be obtained from such a stage is rather modest compared with the corresponding valve configuration. This is both because current JFET devices have a somewhat lower transconductance, on the average, and because parameter spread and voltage breakdown limitations generally restrict the value of load resistor R_d to a relatively low value.

With JFET devices this type of stage also tends to have a rather restricted high-frequency response, due to effective magnification of the drain-gate capacitance C_{dg} by the Miller effect. For any signal at the gate of the device there is at the drain electrode an amplified replica of opposite phase, so that the total effective signal voltage across C_{dg} is $(A + 1)$ times the signal amplitude at the gate. As a result the current drawn by C_{dg} is quite high, equivalent in fact to a capacitor of value $(A + 1) \cdot C_{dg}$ connected from gate to ground.

Despite the limitations on gain and frequency response, the common source configuration is a very useful one, and is finding increasing use in

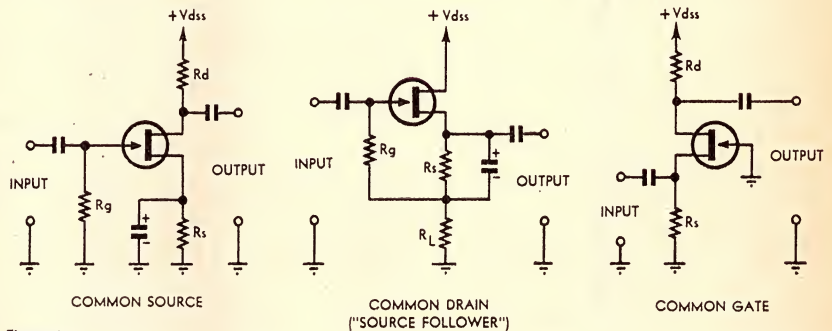


Figure 9.6

the general aspects of FET device usage, let us now turn to consider more closely some of the more common circuit applications of these devices.

Possibly the most familiar type of circuitry in which FETs are found is that of **low frequency or "audio" amplifiers**. Both the JFET and the various types of MOSFET are eminently suited for use in this type of circuitry, their unique combination of high input impedance and significant power gain making them the solid-state equivalent of the familiar thermionic valve.

As with the thermionic valve, there are three general amplifier circuit configurations in which FET devices may be used. These are known respectively as the **common source**, **common drain** and **common gate** configurations, and are illustrated in basic N-channel JFET form in figure 9.6. It may be noted that the common drain configuration is also known as the "source follower" configuration.

The common source configuration may be seen to be the FET equivalent to the familiar common cathode thermionic valve stage. Here the input

modern audio equipment. It provides useful voltage gain while offering the high input impedance characteristic of thermionic valve stages, together with a very low noise level.

The common drain or source-follower configuration is very similar to the familiar cathode follower stage, and finds corresponding circuit applications. While providing slightly less than unity voltage gain it offers appreciable current gain, and is therefore well suited for impedance transformation. Typical JFET source follower stages may present input impedances of 30M or higher shunted by a few pF, and output impedances as low as 100 ohms. Higher input impedance values again may be obtained either by means of more elaborate source-follower circuits, or by using MOSFET devices.

The common-gate configuration is probably that least used for audio amplification, although it is quite frequently used in RF circuitry as may become evident shortly. It offers voltage gain but no current gain, and hence does not take advantage of the inherently high input resistance of the device itself. The main advantage offered is high frequency response, as the grounded gate acts as a shield

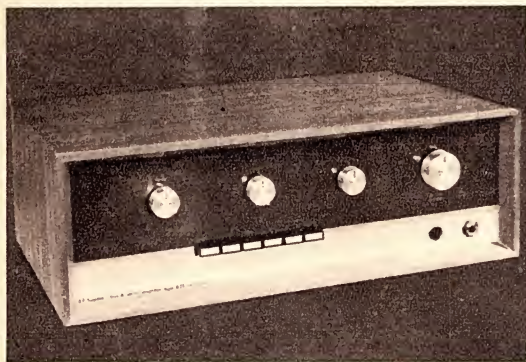
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between input and output and prevents degenerative feedback.

It should be noted that although the basic circuits shown in figure 9.6 employ N-channel JFET devices, they are equally suitable for both P-channel JFETs and the various types of MOSFET. Also although the circuits are shown with the simple self-bias system of figure 9.2, which is often quite adequate, they may also be arranged with the composite biasing system of figures 9.4 and 9.5.

DC amplifiers form a second important application of FET devices. Such

arises from the shape of the transfer characteristic, which for FET devices is significantly closer to the ideal "square law" relationship.

Examples of typical FET device RF applications are shown in figure 9.7. The circuits of (a), (b) and (c) illustrate RF amplifier configurations, shown here using various MOSFET devices, while the circuit of (d) is of a simple self-excited L-C oscillator using a JFET device.

Of the RF amplifier configurations shown in figure 9.9 (a) and (b), which are those most commonly used for

grounded and therefore act as a shield between input and output. However, this configuration has no current gain, and does not take advantage of the high input impedance of the device. It is used mainly at frequencies above the range in which stable operation may be obtained with the common emitter circuit.

Virtually all the advantages of the common-source and common-gate configurations are combined in the so-called "cascode" circuit, which is illustrated in figure 9.7(c). This is basically a combination of the two previous circuits, with the output of the common source stage untuned and connected directly to the input of the common-gate stage. It is a configuration for which the recently developed dual-gate MOSFET is particularly well suited, as may be seen, because this device is virtually two devices in one. However, the cascode circuit is also often used with single gate JFET and MOSFET device pairs.

The circuit of figure 9.7(d) illustrates a simple L-C oscillator using a JFET device. The configuration shown is that of the classical "Hartley" or tapped coil oscillator, and it may be seen that the JFET version of this oscillator is very similar to that using a thermionic triode. A "gate leak" R-C combination in the gate lead develops signal-derived bias as a result of gate current flow on signal peaks.

The MOSFET version of this and other oscillator circuits tends to be slightly more complex, as it may be remembered that MOSFETs cannot draw gate current without sustaining damage. It is generally necessary either to provide fixed bias, or to provide a diode detector circuit to generate signal-derived bias.

There are many interesting and important applications of FET devices in addition to those which have been mentioned in this chapter. These include ultra-long period timing circuits, sample and hold circuits, chopping and analog signal switching, and in circuits requiring voltage-controlled resistors and current regulating elements. Unfortunately space restrictions prevent discussion of these further applications here even in a brief and cursory manner; however, it is hoped that the foregoing will have given the reader at least a satisfying introduction to the many and varied applications of these devices.

Further information concerning both the applications discussed in the foregoing and those which it has not been possible to discuss will be found by interested readers in the references listed below.

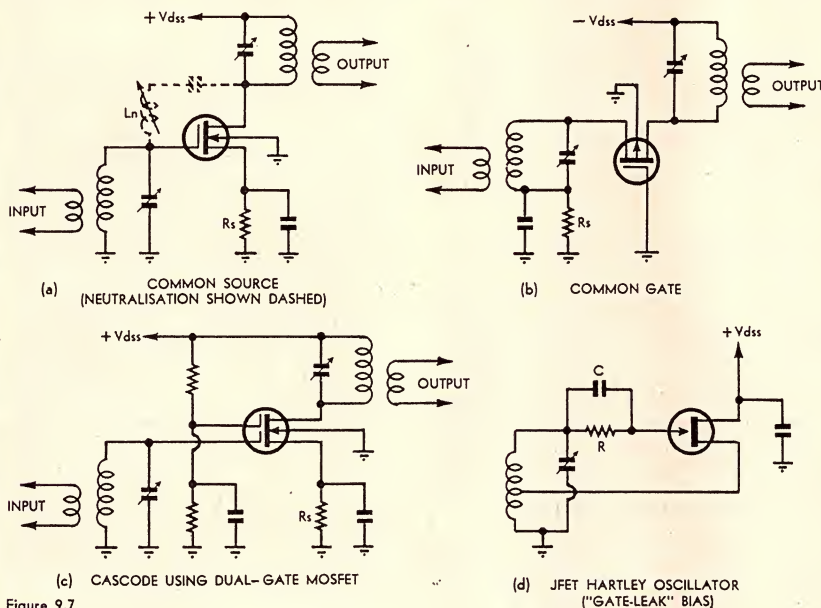


Figure 9.7

amplifiers are used in analog computers, control systems, electronic voltmeters, electrometers and other measuring instruments. FETs are quite well suited for this type of application by virtue of their high input impedance and the inherently good temperature stability of their parameters.

A common configuration used in DC amplifiers using FETs is the differential amplifier, also called the "long-tailed pair." This is a balanced circuit in which two devices are connected in basically common-source configuration, but sharing a single source impedance. The balanced nature of the circuit tends to cancel out any drift of the device parameters with aging and temperature variations, resulting in a high degree of stability. The shared source impedance may be either a resistor, for relatively non-critical applications, or alternatively another FET device connected as a constant-current load.

Another very important application of FET devices is in **RF circuitry**, where they are used as amplifiers, oscillators, mixers and frequency multipliers. JFET and particularly MOSFET devices are well suited for most RF applications by virtue of their high power gain, high input and output impedances (for low tuned circuit loading) and low internal feedback.

A further advantage of FET devices for RF amplifier and mixer applications is that they are generally capable of significantly improved cross-modulation performance compared with both thermionic valves and the more established bipolar transistors. This

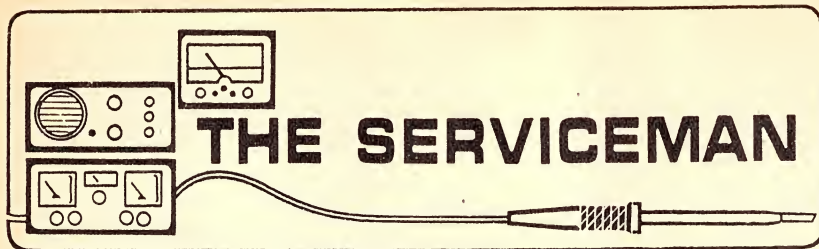
single-gate JFET and MOSFET devices, the common-source circuit generally makes best use of all the device parameters. However, with JFETs and to a lesser extent with MOSFETs, the feedback action of the internal drain-gate capacitance C_{dg} tends to make neutralisation necessary if full gain and adequate stability are to be obtained. This applies particularly at very high and ultra-high frequencies.

A common method of applying neutralisation in fixed tuned, narrow band amplifiers is by means of an inductor connected between the drain and gate electrodes of the device in series with a DC blocking capacitor, as shown. Basically the inductor produces parallel resonance with C_{dg} at the operating frequency, and thus cancels the feedback action.

The common-gate configuration of figure 9.7(b) needs no neutralisation, as the gate and substrate are both

SUGGESTED FURTHER READING

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THE SERVICEMAN

You thought you knew all the tricks!

One of the weirdest "service" stories I have encountered for a long time came my way this month, and I have elected to commence my notes with it because it has prompted some general thoughts and comments on the section of the set it concerned.

An acquaintance of mine is by way of being a part-time reconditioner of TV sets. He has a regular job—but not in any way connected with electronics—but is now approaching retiring age. As a part time activity, which he will no doubt continue after he retires, he acquires traded-in sets, usually for a quite nominal sum, reconditions them, and sells them. And, even where a set needs a new picture tube, which a good proportion do, he is still able to sell it at an attractive price and make a few dollars on the deal.

Naturally, he lands a "bomb" now and again, fit only to be stripped for spare parts, but even these are good value when considered on this basis. Among the "bombs" are those that someone has had a go at; someone who should have stuck to his motor bikes and lawn mowers!

It was one of these that forms the basis of my story. The set as he received it was working, but producing a very weak wishy-washy picture; the type of image that can only be viewed at night with the lights out. His natural reaction was to suspect the picture tube and, in a way, this was right. However, the connection between the picture tube fault and the weak picture was very indirect.

The picture tube had a heater cathode short. This usually means complete loss of picture, since the cathode is the electrode normally used to accept the video signal. One of the tricks employed in the past, to avoid buying a new picture tube, is to fit a one-to-one filament transformer to supply the picture tube heater, thereby providing a heater supply which is not connected to chassis. This allows the cathode to resume its role of a video electrode, even if now limited in terms of response to high video frequencies by the added capacitance to ground.

Presumably the character who had doctored this set knew all about this technique; at any rate, he was well clued up on TV circuitry. The only snag was he obviously did not want to incur the cost and inconvenience associated with fitting such a transformer.

So what did he do?

I could stop the story right now and leave you to guess the answer, but I'll

wager the only right answer would be from "the bloke wot done it."

His trick was to wind three turns of EHT cable around one leg of the EHT transformer and use this as a filament winding. My first reaction, on hearing the story, was to declare that it wouldn't work; that there simply would not be enough energy available to supply any useful amount of power to the picture tube filament, to say nothing of what was needed to supply the normal EHT requirements.

As it turned out, I was wrong. I was able to satisfy myself that, at least as far as this particular set was concerned, there was enough energy to perform these functions — after a fashion. More precisely, the picture tube had some heater voltage and some EHT voltage, but not enough of either to function properly. Hence the dim picture and restricted viewing conditions.

Which is not surprising. The surprising thing is that it worked at all!

Which brings me to a more serious discussion of an apparently simple part of the TV receiver, but one which can create its own share of problems. I refer to the legitimate filament loop around the EHT transformer leg, used to light the EHT rectifier.

A regular fault in this section is a breakdown between the loop and the transformer core or frame. One or two brands of sets seem to have been the

main offenders in the past, mainly, it appears, because they were designed to deliver rather more EHT than the average set. At any rate, and whatever the cause, at least one manufacturer has recognised that the problem does exist and has made available an extra insulating sleeve designed to slide over the filament loop.

Such a breakdown is not hard to diagnose and repairs would appear to be relatively simple. In an emergency, one may sometimes get the set back on the air with the aid of some plastic insulation tape, but the complete loop should be replaced at the first opportunity.

But this operation is not as simple as it may appear, because there is more than one kind of wire for this job. For the reason that it is difficult to provide less than one complete turn of wire around the transformer leg, it is also difficult to provide precisely the correct voltage to suit the EHT rectifier filament. In practice, the filament is designed to operate on something less than a typical voltage delivered by a single turn, the difference being taken care of by means a small value resistor in series with the filament loop.

At least, that was the original idea. Then someone had the bright idea that the resistance could be included in the loop by using resistance wire in place of copper wire, which was a much neater way of doing the job. The only snag was, what happens when someone unfamiliar with the technique replaces a resistance wire loop with a copper wire loop? The answer is a string of prematurely defunct EHT rectifier tubes, a situation I have encountered many times over the years.

And not the least disturbing aspect of this situation is that it can, and often does, go on for many months before someone complains that the set seems to be "hard" on EHT rectifiers. Even then, an inexperienced mechanic may dismiss the sequence as "coincidence," if for no other reason than that he can offer no satisfactory explanation.

But recognising someone else's mistake, in the light of complaints, is one thing. Not making the same mistake oneself is something else again. It is easy enough to stock both kinds of wire but less simple accurately to recognise the type of wire encountered in a damaged loop in order that one may select the correct type for replacement.

Just how does one tell the difference between tinned copper wire and resistance wire? One trick, assuming one has a couple of inches of material available, is to scrape the wire with glass paper or the blade of a knife. If it retains its "tinned" look, it will be resistance wire, whereas copper wire will be immediately recognisable. Alternatively, if it is not convenient to scrape a suitable length, snip off an end leaving a clean cut which can be viewed under a small magnifying glass.

Where a damaged loop can be stripped of insulation, it is usually possible to recognise resistance wire by the way it bends. Copper wire is fairly soft, but resistance wire is harder with a more "springy" characteristic.

Manufacturers do colour code this kind of wire, which should make things simple. Unfortunately, they do not all



The tube's gone all right! Somebody's pinched it! ("TV Times")

use the same code, which is confusing to say the least. What appears to be the most popular code is green for resistance wire and red for copper wire. However, one manufacturer uses black for resistance wire, which tends to conflict with the older situation where black was often used for copper wire, particularly in the days before resistance wire was common in this application.

By way of variety, my next story is on a completely different subject. The device was a portable tape recorder, of Japanese origin, and of a make and model which I could not recall having seen on the local market. In short, I had every reason to believe that it was one which had been brought in by someone returning from an overseas tour. Even before I opened it, I mentally registered that it might present a problem if any special parts were required.

The unit was designed to work either from internal batteries or an internal mains supply, and I gathered that it was used mainly in the latter mode. The owner's complaint was that performance was poor, very noisy, and that the function switch — a simple rotary control knob — often had to be juggled back and forth before it would work at all. I was able to confirm these symptoms with a quick check at the counter.

Some time later I set it up on the bench and took a more serious look at it. Having fiddled with the controls once again and confirmed that it was still faulty, I removed the back. And what a sight I beheld. It was the old story of a set of forgotten batteries. Whether they had simply died of old age or whether the recorder had been put away while switched on, I have no way of knowing. Suffice to say that the batteries now had their insides outside — and spread over most of the inside of the recorder.

What a mess it was. Presumably it had been left standing with the batteries at the top. The "goo" from their insides had run out through several openings in the battery compartment, down the centre of the board, and finished up on the multi-contact function switch. This latter was a "straight line" type switch, operated by a system of levers which coupled it to the control knob and converted the rotary action of the knob to the reciprocating action for the switch. And, while similar types are available on the local market, I was not very optimistic about securing an exact replacement.

Gaining access to all the places which needed attention was the next problem. Not only did I need to treat those which I could see, I also needed to be able to inspect the whole of the mechanism to ensure that that there were no hidden pockets which could cause trouble later.

The best approach seemed to be to lift out the deck. The printed wiring board was fastened to this at right angles and the slide switch was attached to the wiring board, but with a mechanical linkage to the deck. After removing what seemed to be an unusually large number of screws I was able to lift the deck clear. There were a large number of interconnecting cables between the board and the deck, and I did not fancy the task of recording

their terminations, disconnecting them, and then replacing them later. However, I soon realised, that by disconnecting only three, I would be able to lay the board flat alongside the deck. The only other requirement was to disconnect the mechanical linkage between the switch and deck.

Then I took a more detailed look at the damage. As far as the board was concerned it seemed to have come off rather better than I expected. The copper pattern did not appear to be damaged at all, mainly because the coating of flux which is normally sprayed on to these before assembly seemed to have provided very good protection. However, several components in the direct path of the goo had suffered.

The main casualties were two electrolytics. Both were single ended types supported by their pigtailed just clear of the board. There was a mass of corrosion where the two pigtailed should have been and it was evident that at least one pigtail no longer existed. When I prodded the same general area of the other one another pigtail disintegrated. Well, that was two components which would have to be replaced.

But what was really worrying me was the switch. Some of the contacts were badly corroded, and I could see little possibility of replacing it. It was salvage it or nothing. One of the problems with the goo from inside batteries is that, once it hardens, it does not respond readily to the common solvents. I tried attacking it with a toothbrush dipped in a variety of solvents, but it stubbornly refused to move. This was not so bad on the board, where one could apply some force with the blade of a screwdriver. Around the delicate switch contacts it was another matter.

Finally, I tried a weak solution of vinegar in water, reasoning that the acid content might react favourably with the alkaline contents of the batteries. Whether the resultant chemical reaction was as simple as all this I am not sure; all I know is that it worked. The white crystalline mess started to soften and fairly soon I had the switch looking reasonably clean, if somewhat patchy.

Then I began to worry about the effect of the vinegar. Might it not be just as corrosive, in its way, as was the alkaline mixture? So once again I attacked with the toothbrush, this time dipped in clean water. After giving it a pretty thorough going over in this fashion, I felt reasonably confident that the various mixtures had been removed.

It may seem strange to talk about cleaning parts of electronic equipment with water but, provided one is careful, it is an acceptable approach. The main thing to avoid is allowing water to reach components having a mechanical function, such as potentiometers, variable capacitors, sockets, and so on. Water in the working parts of these can cause trouble, even if it may be only temporary. Remember also, I am talking about solid-state equipment operating at low voltages. Valve equipment, running at several hundred volts, is quite another matter.

And if one has to use water, it is

essential to make sure that all traces of it are removed. After wiping off that which was obvious I selected a nice warm spot on top of the battery charger and left it there for several hours. Then I gave it a good spray with a moisture inhibitor, just to make sure.

Before returning the deck and board to the cabinet, I found it convenient to restore temporarily the few necessary connections to allow the unit to work, and thereby allow me to test it on the bench. As far as I could tell, it was working perfectly; no background noise, no crackles in the switch and, apparently, quite reliable. From then on it was a more or less routine job to put everything back in its place — or as routine as any of these jobs can ever be. One never does them in five minutes.

Which brings me to the main point of the story. I have deliberately described the job in some detail in order to emphasise the amount of work which this kind of fault creates; an amount of work which I am afraid the owner has to pay for. And inasmuch as this kind of trouble can fairly be described as "self-inflicted," the owner has no one but himself to blame if the bill comes as a bit of a shock. He also has no one but himself to blame if the final verdict is that the nature of the damage is such as to make repairs impractical.

What is the answer? Apart from looking forward to the day when all batteries will be completely incapable of leaking, I'm afraid there is nothing that can be done except to hammer home the need for care in this regard, whenever we get the opportunity.

But I fear that there will always be some who do not get the message.

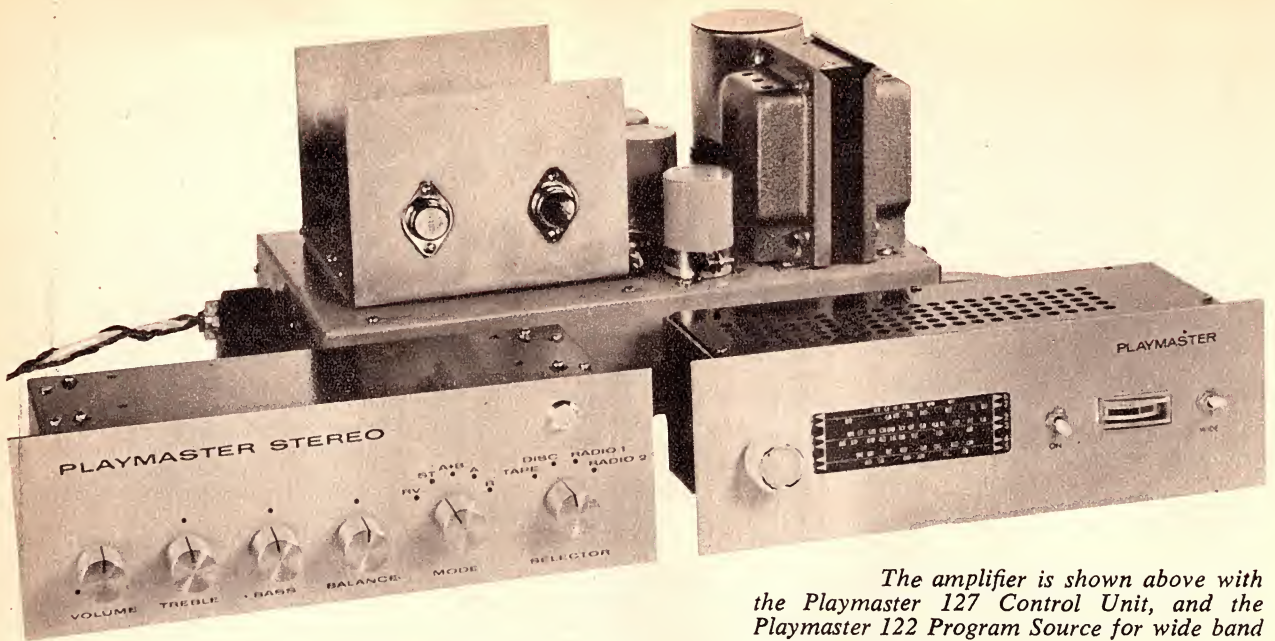
To finish off these notes, here is another story about a repair which, for want of a better term, might be described as "novel." And, while I still think the one described at the beginning of these notes qualifies for some kind of a prize, this one must run it a close second.

The story started when I answered a call to a new customer to deal with a faulty radiogram. It turned out to be a routine kind of fault which I fixed on the spot and prepared to leave. However, I asked the routine question, "Everything else all right?" glancing at the TV set as I did so.

"Well, as a matter of fact," came the reply, "the set isn't too good on Channel 10. It's sort of snowy and not nearly as good as the other channels." And without any further prompting he switched the set on to demonstrate. Apparently it was already set to Channel 10 because he simply let it warm up and then pointed to the picture. "See what I mean?"

I had to agree that it was a very poor picture for a suburban area, even though it wasn't a particularly good location. If the other channels were satisfactory, then I couldn't understand why 10 should be as bad as it was. To satisfy myself that the other channels were, in fact, as the owner described them, I reached for the channel selector knob and began checking them.

(continued on page 158)



The amplifier is shown above with the Playmaster 127 Control Unit, and the Playmaster 122 Program Source for wide band broadcast listening.

PLAYMASTER 128 STEREO AMPLIFIER

Here is a high power transistorised basic amplifier to team with the Playmaster 127 control unit. The two units as a system offer a degree of performance comparable with any commercial amplifier up to about \$400. The amplifier will deliver at least 45 watts per channel, with wide bandwidth and extremely low distortion.

By Anthony Leo

In the November, 1969 issue we described a new solid state audio control unit using a linear integrated circuit in the compensation preamplifier. Designated Playmaster 127, the control unit provided CCIR compensation for tape replay, RIAA compensation for magnetic pickups, and, a high impedance input for crystal and ceramic cartridges.

While the control unit was designed to be compatible with valve amplifiers we nevertheless intended that it would be companion to a high power transistorised basic amplifier. Such an amplifier is the subject of this article.

Until now, the transistorised stereo amplifiers of either "unit" or "basic" style have all provided an output of around 10 watts or less, and in the main they have used germanium power transistors. In using germanium transistors, with their limited voltage ratings, either out of necessity or the convenience of ready availability, the power capability of these amplifiers has been fundamentally restricted.

An amplifier of 10 watts maximum output may be more than adequate when used with the larger and more efficient loudspeaker systems, commonly using a 12-inch bass reproducer in either a vented reflex or sealed enclosure. But 10 watts may be only marginally adequate for some of the modern compact enclosures which are becoming increasingly popular. A good example of a compact style enclosure

is our own Playmaster Point Four speaker system.

Although larger enclosures can produce a wider range of bass with only modest drive power, their bulk, often

around nine cubic feet, is somewhat difficult to place unobtrusively in a typical lounge room. And the problem becomes more acute when there are two enclosures in a stereo system.

SPECIFICATIONS

OUTPUT POWER: At the point of clipping from a single channel measured at 1KHz. 64 watts into 4 ohms. 45 watts into 8 ohms. 25 watts into 16 ohms.

POWER BANDWIDTH: Measured with respect to 64 watts at 1KHz, -3dB at 10Hz and 50KHz. Measured with respect to 45 watts at 1KHz, -3dB at 8Hz and 60KHz. Measured with respect to 25 watts at 1KHz, -3dB at 5Hz and 70KHz.

FREQUENCY RESPONSE: Measured with respect to 1 watt at 1KHz. 4 ohm load, -3dB at 20Hz and 55KHz. 8 ohm load, -3dB at 12Hz and 65KHz. 16 ohm load, -3dB at 8Hz and 150KHz.

DISTORTION: Total harmonic distortion together with residual hum and noise. 4 ohm load; 55 watts -0.5 per cent, 1 watt -0.1 per cent. 8 ohm load; 40 watts -0.25 per cent, 1 watt 0.07 per cent. 16 ohm load; 20 watts -0.1 per cent, 1 watt -0.05 per cent.

DAMPING FACTOR: Approximate output impedance is 0.28 ohms representing a damping factor of 56.

SENSITIVITY: The amplifier has a voltage gain of 100 for all load impedances yielding sensitivities of 160mV for 64 watts into 4 ohms, 190mV for 45 watts into 8 ohms, and 200mV for 25 watts into 16 ohms.

NOISE: Noise measured with respect to maximum power in each case. 4 ohm load; -76dB open circuit input, -85dB short circuit input. 8 ohm load; -78dB open circuit input, -90dB short circuit input. 16 ohm load; -80dB open circuit input, -95dB short circuit input.

CHANNEL SEPARATION: Separation at 40 watts up to 10KHz better than 65dB.

Hence the compact enclosures are rapidly gaining popularity.

Since we seldom get something for nothing, the disadvantage of a compact enclosure is reduced loudspeaker sensitivity coupled with a need for bass boost to provide adequate bass reproduction. This means that a greater power is needed to give a particular loudness level. Thus, a power amplifier must have greater power output in order to provide a reasonable dynamic range without risking amplifier overload.

For the reasons stated, and in answer to the many requests from readers, we are presenting a stereo amplifier with substantially greater power capability than those described in the past. The basic amplifier which we are presenting can deliver up to 64 watts into a 4 ohm load, 45 watts into an 8 ohm load, and 25 watts into a 16 ohm load; powers which are consistent with current commercial trends.

Logically, the general performance of a basic amplifier must complement that of its control unit. Overall system performance will only be as good as the least of these two links in a chain. In addition to the performance requirement, the cost had to be kept down to a reasonable level to compete with commercial products.

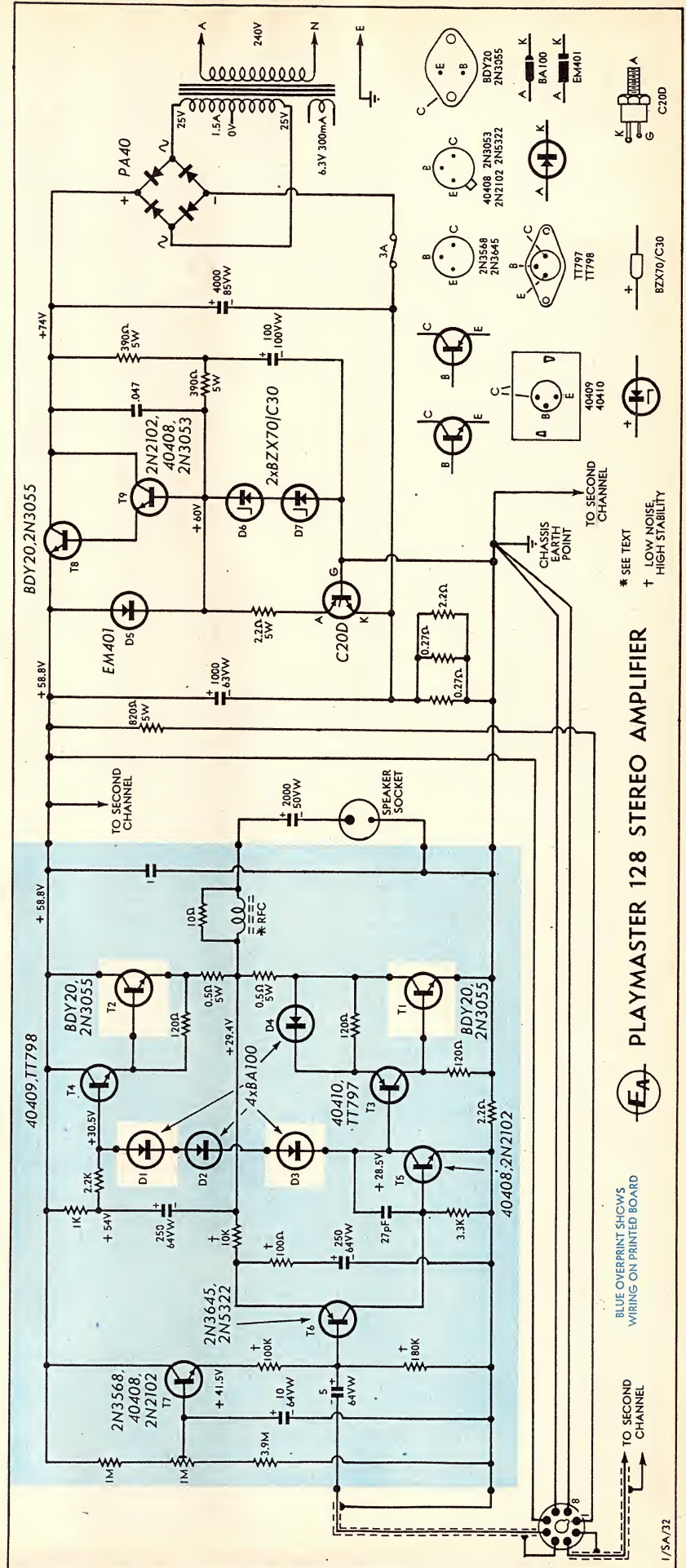
We commenced the amplifier design with the output stage, electing to use class-B as being the most economical mode of operation for a high power amplifier. However, there are essentially two class-B power amplifier configurations in common use in medium and high fidelity applications, one using output and/or driver transformers, the other being completely transformerless.

In the initial stages of circuit development we considered using a transformer-driven, transformerless-output stage, the same approach as used in the Playmaster 125 guitar amplifier. This method has the advantage that the power amplifier is virtually divided in two by the driver transformer, forming a driver amplifier and an output stage.

By using a driver transformer, only the output transistors need have the high voltage ratings necessary in generating high output power. Transistors in the driver amplifier may be lower voltage devices isolated in terms of DC from the output stage and therefore protected in the event of a breakdown in the output stage.

On the other hand, a driver transformer often imposes unavoidable performance limitations which, although perfectly acceptable in a guitar or public address amplifier, are not always acceptable in a high fidelity power amplifier. As a major component in an amplifier, a driver transformer having intrinsic performance limitations—low frequency power handling ability, premature high frequency roll-off, etc.—

The amplifier circuit diagram with a blue overprint showing those components which are mounted on the printed wiring boards. Note the various connections to one chassis earth point in the diagram.



PLAYMASTER 128 STEREO AMPLIFIER

BLUE OVERPRINT SHOWS WIRING ON PRINTED BOARD

* SEE TEXT
† LOW NOISE HIGH STABILITY

will significantly limit overall amplifier performance.

While it would be normal to use a transformer of the highest quality in a high fidelity amplifier, other limitations can still adversely effect performance. It is customary in amplifier design to apply negative feedback to obtain the required overall performance. As a general rule, the improvement in performance is proportional to the amount of feedback, although this is not a linear function. Initial application markedly improves performance but, following the law of diminishing returns, additional feedback has less effect up to a point where further increase has little worthwhile effect.

However, use of a driver transformer could cause normally negative feedback to undergo sufficient phase rotation as to cause instability, and such instability would almost certainly occur before the maximum useful amount of feedback could be applied.

Thus, in an amplifier using transformers, feedback must be restricted by the designer to ensure that the amplifier will be stable under all operating conditions. This will usually result in second order performance in respect of distortion and frequency response.

For all these reasons we decided to design a completely transformerless DC coupled amplifier. But, in so doing we had to carefully consider the problems of transistor protection in a DC coupled amplifier and its ability to withstand overload and short circuit load conditions. A further important requirement, which we believe we have satisfied, is that the amplifier can be easily reproduced in all aspects of construction and performance by readers with only limited facilities.

To satisfy the requirements of high output power and inherent reliability we used silicon transistors, with adequate voltage ratings in the output and driver stages of the amplifier, the whole being operated from a regulated power supply. The regulated power supply facilitated provision of adequate overload and short-circuit protection,

One of the criticisms often levelled at class B transistor amplifiers is that, while low distortion figures can be obtained at high power levels, the harmonic distortion percentage rises sharply at normal listening levels. Similarly, there has been much debate on the low level performance of the class B amplifier compared with that of a class A amplifier.

It is not our intention to further that debate; suffice it to say that the low level distortion performance which we have been able to achieve in a class B design compares more than favourably with any class A amplifier both in terms of measured figures and subjective listening. The greatly improved distortion performance, compared with some class B amplifiers, has been obtained by a rather different approach to the problem.

As readers are probably aware, a class B amplifier has two output transistors, each conducting over alternate half-cycles of a signal waveform. But, as transistors are neither ideal nor perfectly matched devices, there will be some distortion introduced at the cross-over point where one transistor stops conducting and the other begins. The resulting distortion is termed

cross-over distortion and is illustrated in figure 1.

Previously the accepted method of reducing cross-over distortion has been to bias each transistor for a collector current of up to about 100mA in the quiescent or steady state condition. In this way the output transistors tend to operate in a class A mode for small amplitude signals with each transistor conducting over both half-cycles of the waveform. As signal amplitude increases the transistors become progressively cut off during the alternate half cycles.

To some extent, the forward bias applied to the output transistors is only relieving the symptoms of cross-over distortion without attacking the underlying problem. The problem is essentially non-linearity of amplification by the complementary halves of the amplifier due to mismatch, caused in part by the way the complementary compounded transistors are contrived.

To better understand the operation of a complementary pair, let us again refer to figure 1. The elementary diagram shows a complementary class-B output stage consisting of one NPN

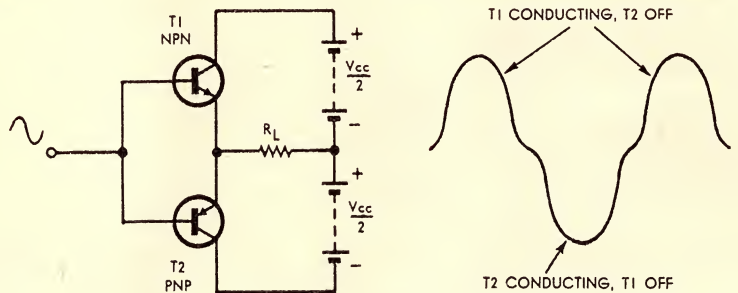


Figure 1

A basic complementary symmetry class B output stage is shown above, together with a waveform showing the type of distortion which can occur.

Compounded PNP and NPN transistor equivalents are shown at right. These complementary compounds are fabricated using high power NPN transistors with lower power PNP and NPN types.

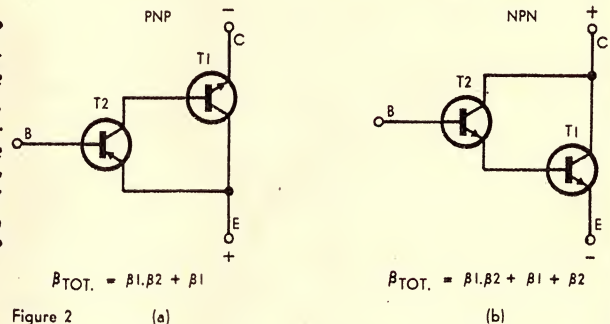


Figure 2 (a)

(b)

PARTS LIST

- 1 Set of metalwork.
- 2 Printed wiring boards, 70/a1.
- 1 Power transformer, 50V CT at 1.5A.
- 2 Radio frequency chokes, see text.

SEMICONDUCTORS

- 5 NPN power transistors, type BDY 20 or 2N3055.
- 2 NPN transistors, type 40409 or TT798.
- 2 PNP transistors, type 40410 or TT797.
- 2 NPN transistors, type 40408 or 2N2102.
- 2 NPN transistors, type 2N3568, 40408 or 2N2102.
- 1 NPN transistor, type 2N3053, 40408 or 2N2102.
- 2 PNP transistors, type 2N3645 or 2N5322.
- 1 Thyristor, type C20D.
- 2 Zener diodes, type BZX70/C30.
- 1 Silicon diode, type EM401.
- 8 Silicon diodes, type BA100.
- 1 Bridge rectifier, type PA40.

RESISTORS 1/2-watt 5 per cent

- 2 3.9M, 2 x 1M, 2 x 180K, 2 x

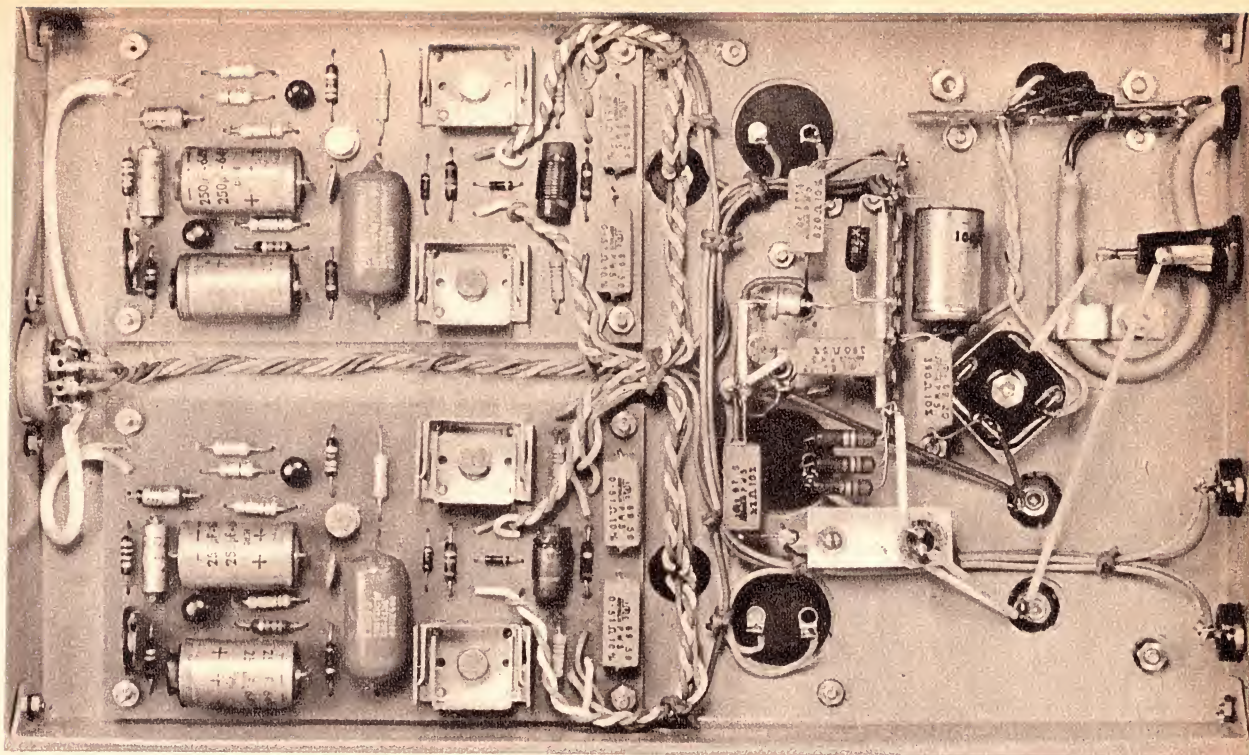
- 100K, 2 x 10K, 2 x 3.3K, 2 x 2.2K, 2 x 1K, 1 x 820ohm 5 watt, 2 x 390 ohm 5 watt, 6 x 120 ohm, 2 x 100 ohm, 2 x 10 ohm, 3 x 2.2 ohm, 1 x 2.2 ohm 5 watt, 4 x 0.5 ohm 5 watt, 2 x 0.27 ohm, 2 x 1M linear printed wiring board mounting tab pots.

CAPACITORS

- 1 4000uF 85VW electrolytic.
- 2 2000uF 50VW electrolytics.
- 1 1000uF 63VW electrolytic.
- 4 250uF 64VW electrolytics.
- 1 100uF 100VW electrolytic.
- 2 10uF 64VW electrolytics.
- 2 5uF 64VW electrolytics.
- 2 1uF plastic.
- 1 .047uF plastic.
- 2 27pF ceramic.

MISCELLANEOUS

- 1 Fuse holder and 3A fuse.
- 1 Mains cable and plug.
- 1 Octal chassis mounting socket.
- 2 Polarised speaker sockets.
- 4 Miniature 3-lug tag strips.
- Hookup wire, shielded cable, nuts and bolts, solder, etc.



An underside view of the amplifier chassis, giving a clear indication of the positions of the wiring boards and other major components. Note the method of mounting the thyristor on an aluminium bracket held off by an insulated spacer (lower right).

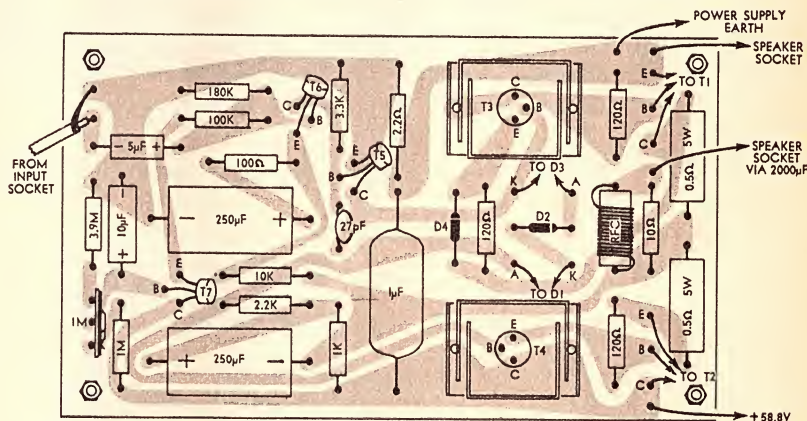
transistor and one PNP transistor. On the positive half-cycle of the input waveform T1 conducts and T2 is cut off. On the alternate negative half cycle T2 conducts and T1 is cut off. No phase inversion of input signal is required in a complementary stage.

Thus a complementary pair of transistors can form the basis of a transformerless power amplifier. Among the larger complementary power transistors are those used in the 10 Plus 10 stereo amplifier (November 1968), which have voltage ratings around 30V and dissipation ratings of about 4 watts. Unfortunately it is difficult to make PNP transistors with power ratings in excess of the figures given, thereby limiting the power available from a complementary configuration using moderately priced transistors.

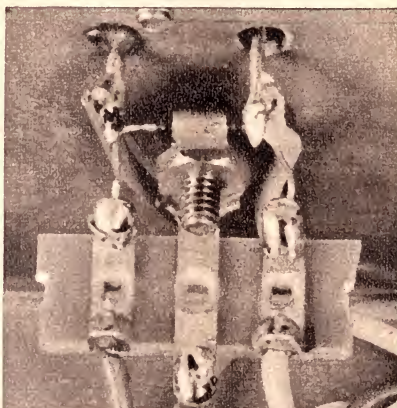
A solution is to electrically fabricate a high power PNP transistor by compounding a low power PNP transistor with a high power NPN transistor as shown in figure 2a. The two compounded transistors can be regarded as a single PNP transistor with emitter, base, and collector as shown.

In a similar way a high power NPN complement can be fabricated using two NPN transistors connected in a Darlington compound shown in figure 2b. In both cases the effective current gain (beta) of the fabricated transistors is approximately equal to the product of the individual current gains. More accurate expressions for effective beta are given in figure 2.

However, having now fabricated high power complementary pairs it is necessary to examine how these can best be used in a circuit configuration to produce an amplifier with very low distortion. While the only way to treat distortion arising from inherent transistor non-linearities is by the use of feedback, much can be done to improve the matching of the complementary pairs in the overall configuration with-



A diagram showing the component positions on the printed wiring boards. Note the polarity of the diodes both on the board and remotely positioned on the transistor heat sinks.

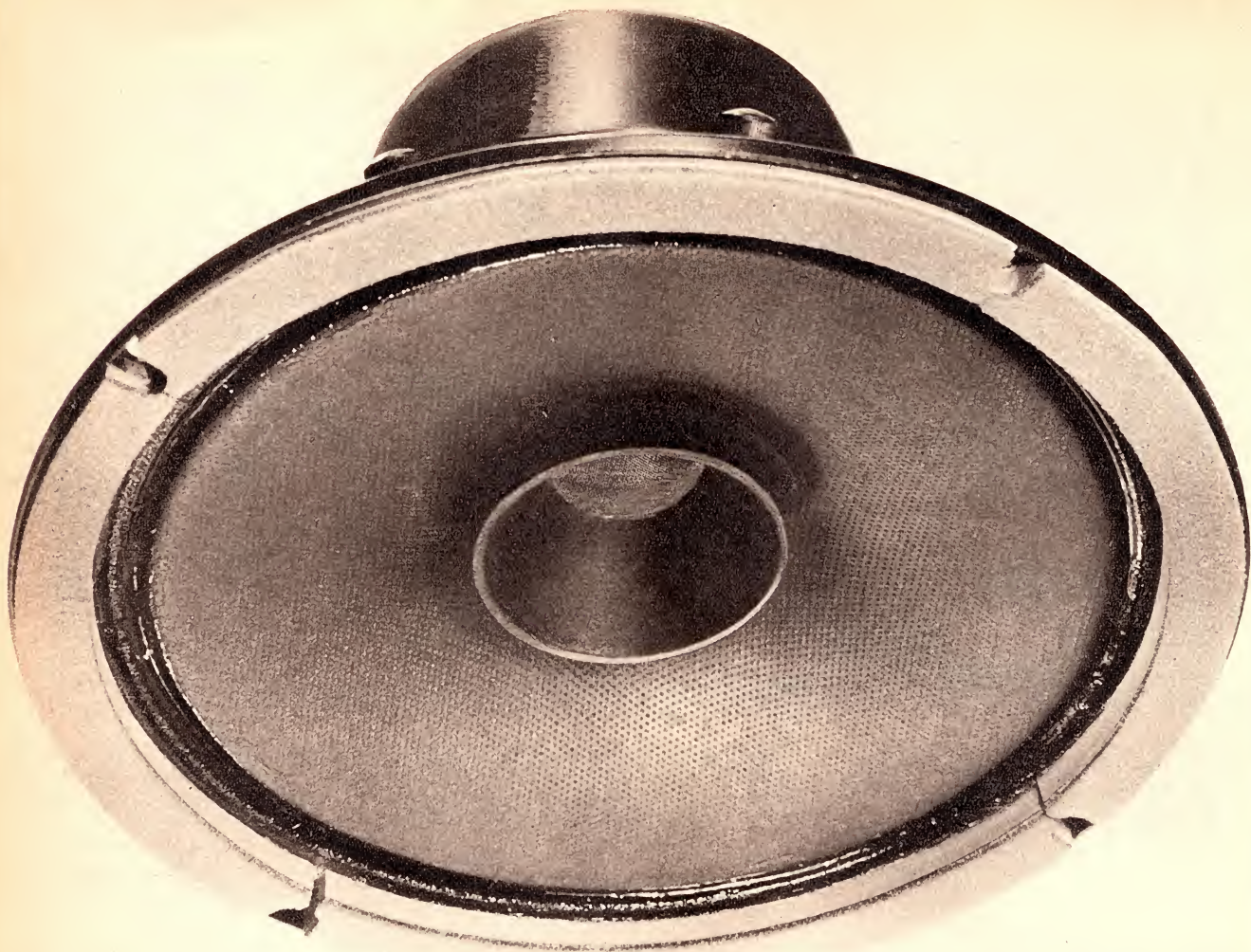


The method of mounting the thermal compensation diodes and termination of their leads to a tag strip.

out resorting to large quiescent currents.

This has been demonstrated by P. J. Baxandall in a contribution published in the September, 1969 issue of Wireless World (Letters to the Editor, p. 416). And the output stage of our amplifier, shown in the circuit diagram, follows substantially the techniques demonstrated by Baxandall.

In the main circuit diagram the fabricated PNP transistor consists of transistors T1 and T3 while the fabricated NPN transistor consists of transistors T2 and T4. The major contribution by Baxandall to preserve symmetry in the quasi-complementary output stage is the addition of a diode and a resistor connected from the collector of T1 to the emitter of T3. This simulates the effect of T2's base-emitter diode, which is shunted



ILLUSTRATED ACTUAL SIZE

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by a resistor, in the upper complementing compound.

Local negative feedback in the quasi-complementary pair, developed across 0.5 ohm resistors, together with the inherent symmetry, assists in reducing the overall harmonic distortion to about 0.05 per cent, measured at one watt into 16 ohms, rising to 0.1 per cent at 20 watts. However, the distortion figures may vary slightly from unit to unit, depending upon the transistors used.

Quiescent current in the power transistors T1 and T2 is set by a voltage across three silicon diodes (D1, D2 and D3) connected in series between the bases of T3 and T4. Two of these diodes are also used for thermal stabilisation of quiescent current by arranging for them to be thermally connected to the power transistors. It is most important to mount the diodes in good contact with the transistors, in the manner to be described, so that there will be adequate protection for all four transistors in the complementary output stage when the amplifier is operated at high power levels in high ambient temperatures.

When the power transistors become warm, due to high ambient temperatures, high power operation, or both, their quiescent current tends to rise. But the voltage across the three diodes, which will be at about the same temperature as the transistors, will tend to decrease, thereby reducing the bias current in the output transistors.

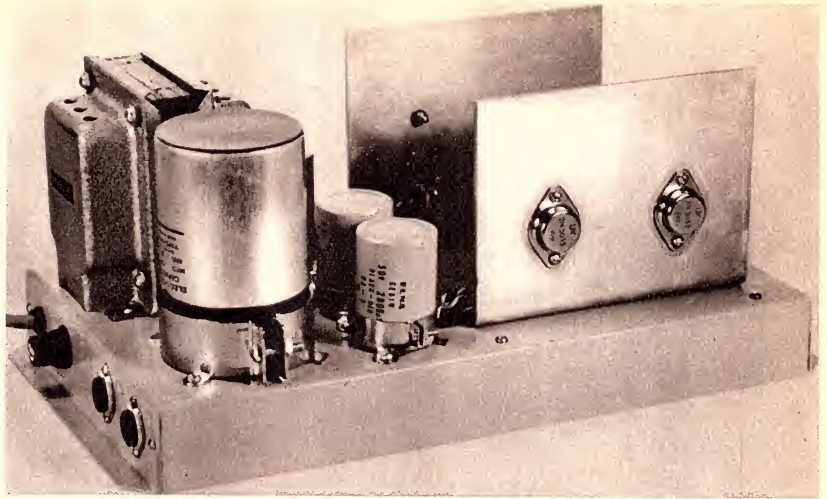
The previous stage, involving T5, operates class-A and delivers a drive signal to the output stage. The load consists of two resistors, 2.2K and 1K, and is bootstrapped via a 250uF electrolytic connected back to the output point. Bootstrapping T5's load enables the amplifier to have a peak-to-peak output voltage swing almost equal to the full supply voltage.

Another transistor, T6, is connected in cascade with T5 and provides further voltage amplification. A 10K resistor is connected in series with the emitter of T6 and is connected back to the amplifier's output point, the junction of the two 0.5-ohm 5W resistors.

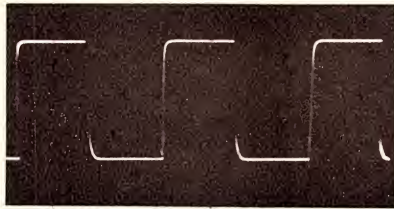
The 10K resistor provides a very large DC feedback from the output point to the emitter of T6. By the feedback mechanism, the voltage at the output will be approximately the same as the voltage at the base of T6. Thus the DC operating point of the output stage can be set by setting the bias voltage of T6.

The 10K resistor also provides an AC feedback path and is used in setting the amplifier's overall voltage gain. Voltage gain is determined by the ratio of the 10K resistor and a 100-ohm resistor connected to the negative rail via another 250uF electrolytic. For the values shown, the gain is approximately 100 times, but this could be adjusted by altering the value of the 100-ohm resistor.

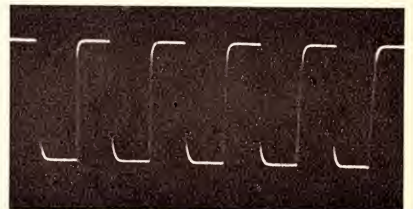
At this point, the whole amplifier may be thought of as a power amplifier consisting of two separate sections, the first section being the quasi-complementary output stage (T1, T2, T3 and T4), having unity voltage gain and very high current gain, and the second being a voltage amplifier consisting of transistors T5 and T6, the combina-



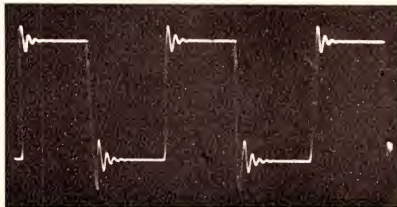
A photograph of the amplifier showing the placement of major components above the chassis. Note that the 4000uF electrolytic adjacent to the power transformer has been mounted upside down and insulated from the chassis.



Amplifier square wave response at 5KHz measured at a power level of 40 watts with an 8 ohm resistive load. Note the absence of ringing.



A very wide power bandwidth is indicated by this square wave response at 10KHz, again with only minor rounding of the leading edge.



Good amplifier stability is indicated by only slight ringing with 0.47uF placed directly across the 8 ohm load. The power level is approximately 40 watts.



Excellent low frequency power response is indicated by the above square wave response measured at 100Hz with a power level of 40 watts.

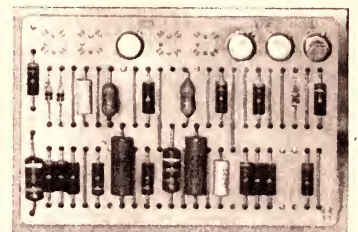
tion of a current amplifier and a voltage amplifier being a power amplifier.

Voltage at the base of T6 is set by a high-impedance voltage divider which forms an emitter load for T7. The transistor T7 is a dynamic filter, used to reduce hum and cross-talk between channels. A 1M potentiometer in the base voltage divider for T7 allows fine adjustment of the voltage at the output point.

Voltage at the output point should be adjusted so that the amplifier clips symmetrically when overloaded. The adjustment can be made by viewing the output at the point of overload on an oscilloscope, or, alternatively, the voltage can be adjusted to half-supply voltage using a voltmeter. Either way, the adjustment allows the amplifier to deliver maximum power up to point of overload.

There will be a considerable lag between the actual adjustments of the potentiometer setting and changes in

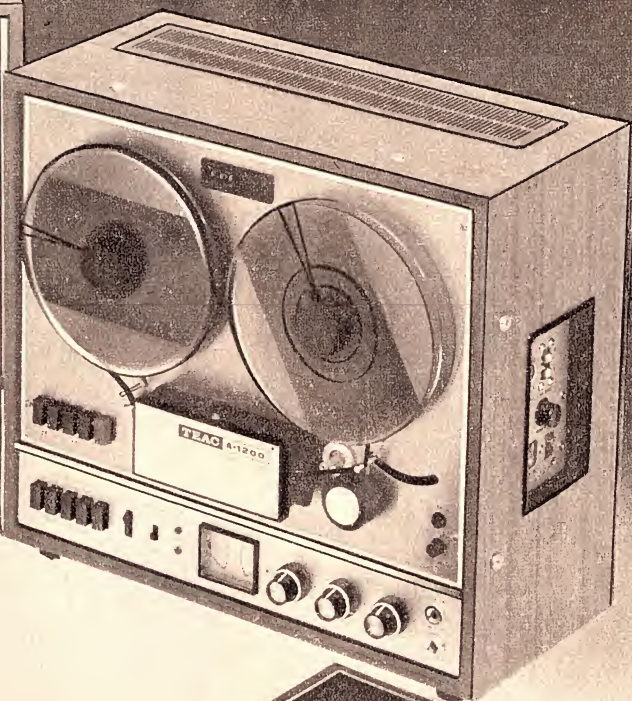
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voltage at the output point. This is due to the long time constant associated with the 10uF capacitor in the dynamic filter.

As is shown in the circuit diagram, the speaker is connected to the output point via a 2000uF coupling electrolytic and a radio frequency choke (RFC). The RFC and associated 10-ohm damping resistor are used to maintain an adequate margin of stability with capacitive loads, as might be encountered with some cross-over networks. A 27pF capacitor is connected between collector and base of T5, as a further stability measure.

Each RFC consists of 12 turns of 22 SWG wire on a 1/2in long ferrite former. The ferrite formers are cut from a standard 10 millimeter diameter (approximately 3/8in) ferrite aerial rod. The ferrite is brittle and some care is necessary when parting the rod. A groove should be filed around the circumference of the rod where it is to be parted and then, holding it between two pieces of wood in the jaws of a vice, it may be cleanly broken.

Both amplifier channels are supplied from a transistor regulated supply which incorporates overload protection circuitry. Transistors T8 and T9 comprise a Darlington compound series regulator operating from a reference voltage derived from two 30-volt zener diodes connected in series (D6 and D7).

The overload circuitry employs a thyristor, which is connected across the reference zener diodes. When an overload or short-circuit occurs, a current sensing resistor causes the thyristor to conduct and remove the reference voltage, so bringing the supply voltage to zero. The current sensing resistor consists of three parallel wire-wound 1-watt resistors, two 0.27-ohm resistors and one 2.2-ohm resistor.

When the voltage from the series regulator is brought to zero, it is also necessary to discharge the 1,000uF electrolytic capacitor across the supply output, otherwise a residual charge on the capacitor could destroy the output transistors. This is accomplished by discharging the electrolytic through the thyristor via an EM401 silicon diode (D5) connected between T9 base and T8 emitter.

Normally, the diode is reversed biased by the base-emitter voltage of the T8-T9 Darlington compound and no current flows through it. However, when the base of T9 is shorted to the negative rail by the thyristor, the reverse bias is removed and the electrolytic capacitor is able to discharge through it. A 2.2-ohm 5-watt resistor in the discharge path limits the current surge through the diode and thyristor.

The sensing resistors shown set the output from the prototype amplifier at 64 watts total, delivered by either channel or as 32 watts from each. This limit was set after considering the transformer limitation of 1.5A continuous secondary current. At 64 watts, the secondary current is approximately 2A, which is quite acceptable for intermittent or program material. We suggest that readers also set this limit. If a more suitable power transformer was available, total output power from the amplifier could be increased to a full 64 watts per channel.

The value of the 2.2-ohm resistor may have to be adjusted in some cases

to compensate for variation in thyristor gate-firing voltage. The exact value can be set by monitoring the transformer secondary current. The overload power could be reduced from 64 watts by increasing the value of padding resistor.

The maximum power delivered by the amplifier will depend on the load impedance, which may be any value from 4 ohms upwards. With a 4 ohm load each channel is capable of delivering 64 watts at the point of clipping when operated singly.

With a load of 8 ohms, each channel will deliver 45 watts at the point of clipping when operated singly or again, 32 watts with simultaneous operation. With a 16 ohm load, each channel will deliver a maximum power of 25 watts per channel operated either singly or simultaneously.

While this means that, with 8 and

4 ohm loads, the amplifier will cut off with both channels simultaneously delivering less than their single channel continuous power capability, on program material the output from each channel can approach the maximum. However, under normal conditions such output power would rarely be required.

When planning the prototype amplifier we aimed at relatively simple metalwork and, most importantly, a familiar style of construction. While we have used printed wiring boards for the amplifiers, being obviously the easiest method of construction, the remainder of the wiring is mounted under a dish chassis in a conventional way.

The printed wiring boards are mounted under the chassis as shown in the accompanying photograph. Leads from the wiring boards are laced into

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Tone Controls:

Base minus-plus 20 db at 20 Hz.

Treble minus-plus 20 db at 20,000 Hz.

Medium Sound Range:

Plus 6 db at 7,000 Hz.

Tone Filters:

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Balance Control:

Plus 8 db minus 12 db.

Dimensions:
410 x 250 x 82 mm.

Weight:

7.2 KG.

Power Output:

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4 ohm.

2 x 70 W music power.

4 ohm.

Distortion:

At 1000 Hz less than 0.2%.

Power Band Width:

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Minimum Impedance: 4 ohm.

Output Impedance:

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Signal to Noise Ratio:

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a form and taken through grommets holes in the chassis. The wiring form allows the boards to be hinged to a vertical position to provide access to their underside.

Large components, such as the power transformer, can-mounting electrolytic capacitors, and the heat sink for the output transistors, are mounted on top of the chassis. The heat sink is in the form of a "U" bracket made from 10 gauge aluminium. It should be available with the rest of the metal work.

Construction would be best started by mounting all the large components on the chassis. The 4000uF electrolytic must have its can insulated from the chassis. This is very necessary for the correct operation of the overload protection circuitry.

This capacitor is normally supplied with a ring of fibre insulation inside the mounting bracket and the end of the can opposite the terminals is also insulated. The capacitor is intended to sit on the insulated end with the terminals on top. However, it is more convenient to wire as we have mounted it.

As a precaution, we cut an additional insulating washer from cardboard and fitted this between the capacitor and the chassis. It would be possible to mount the capacitor clear of the chassis, inside its mounting ring-clamp.

Two of the other three small can-mounting electrolytic capacitors, those coupling to the load, must also be insulated from the chassis. However, all three capacitors are fitted with a plastic sleeve, so isolating their cans from the chassis.

The series regulator transistor T8 is mounted on the chassis between two of the smaller electrolytics. It is mounted in the normal way using mica washer, silicone grease and insulating bushes.

The thyristor is mounted on a small piece of aluminium which is insulated from the chassis by an insulating spacer. Note that the thyristor case must be insulated from the chassis. Connection to the anode terminal is by a solder lug placed under the screw which secures the aluminium bracket to the insulating spacer.

The power supply wiring should be undertaken next, with considerable care being taken to ensure correct wiring. Its operation should be checked by measuring appropriate voltages shown on the circuit diagram.

The printed wiring boards may be assembled next. Be particularly careful when connecting the power transistors to ensure that their emitter and base pins are not confused. Also, it is most important to have the thermal compensation diodes wired with correct polarity, otherwise transistor damage could result. Make sure that the diodes of the left hand channel are in fact attached to the transistors of the left hand channel and similarly for the right.

As is shown in a close-up photograph of the heat-sink, the silicon compensation diodes are mounted in small clips fashioned from solder lugs. For the prototype, the solder lugs forming the diode clips were curved around

the shank of a twist drill of appropriate diameter. The solder lugs should not be bent around the glass encapsulation of a diode as it is very fragile, and even when fitting the diodes in their clips care should be taken to avoid damaging the glass envelopes.

The diode clips, together with a 3-lug miniature tag strip, are mounted on the inner side of the heat-sink bracket under the transistor mounting nuts. Two lugs on the tag strip are used to terminate the diode pigtailed and the connecting wires from the wiring board, while the centre mounting lug of the tag strip is used to make connection to the power transistor's collector.

To further improve contact, silicone grease may be used when mounting the diodes in their clips. However, every effort should be made to ensure that the diodes fit well in the clips, without being damaged.

The earth wiring in the amplifier is fairly straightforward. The points to note are these: Each speaker earth lead is taken to the printed wiring board earth. A single earth lead from each printed wiring board is connected to the main chassis earth point.

The negative side of the 4000uF and 1000uF electrolytics in the power supply are connected in series with the current sensing resistors, which then connect to the main chassis earth point. The negative ends of the 100uF capacitor and the zener diodes are also connected to the main chassis earth point. It is important to make all these connections to the chassis at only one point.

The shield braid in the input leads is taken to the control unit socket and ultimately connected to the earthing system of the control unit. A single earth lead comes from the control unit via pin 7 on the socket.

A supply for a 24V pilot lamp in the control unit is also provided via pins 1 and 8 on the socket. The completed power amplifier is compatible

Notes & Errata

3-PLUS-3 STEREO AMPLIFIER (August 1968): The parts list on page 55 specifies 2 x 470 ohms, in error. It should be 2 x 180 ohms, as on the circuit diagram.

SOLID STATE GUITAR AMPLIFIER (July 1969): A resistor in the parts list on page 85 was shown as 200 ohms, it should be 220 ohms. In the wiring diagram on page 93 a 1.5K resistor connected directly to the collector of T5 should be 820 ohms. Also, the -18.5V connection and the adjacent "driver transformer" connection should be transposed, so that the transformer connection is common with the 9V connection and -18.5V goes to the negative end of the 200uF and 2500uF electrolytics.

LOW FREQUENCY CONVERTER (March, 1969). Winding details for the toroidal transformers, T1 and T2. T1, prim. 40 turns, sec. 40 turns centre tapped. T2, prim. 20 turns, sec. 10 turns. ■

with the control unit described in November, the two being simply connected together via the octal plug and socket provided.

When the amplifier construction and wiring are completed it can be switched on. Ideally, for greatest safety, the amplifier should be turned on using a "Variac" to gradually increase the supply voltage while at the same time monitoring the various voltages to ensure correct operation. However, not many constructors would have access to a "Variac."

As an alternative, one half of the transformer secondary winding could be used to provide a low voltage for initial checking of the amplifier boards. The bridge rectifier should be connected between one side of the secondary winding and the centre tap. Correct operation of the amplifier boards can be determined by measuring the voltage at the junction of the two 0.5 ohm 5 watt resistors. This voltage should be approximately equal to half the supply voltage. The latter should be around 36V. Note that all voltages on the circuit are measured with respect to the chassis.

With correct amplifier operation established, the bridge rectifier can be reconnected across both halves of the transformer secondary. And so with the control unit connected you are ready to enjoy a really high performance amplifier system. ■

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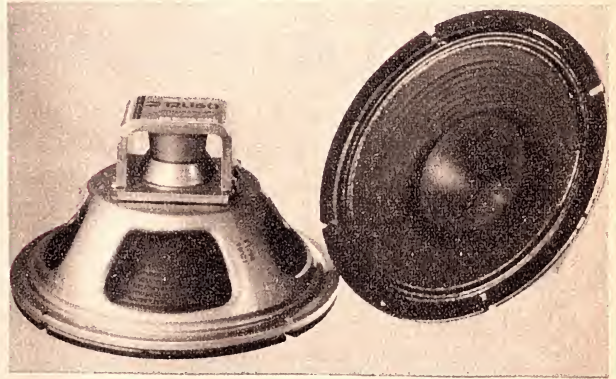
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Loudspeaker systems intended for use with electronic musical instruments must be capable of handling very high orders of power for long periods of time. The new 12U50 loudspeaker, just announced by Plessey Rola Pty. Ltd., carries a 50W RMS rating over the full frequency range.



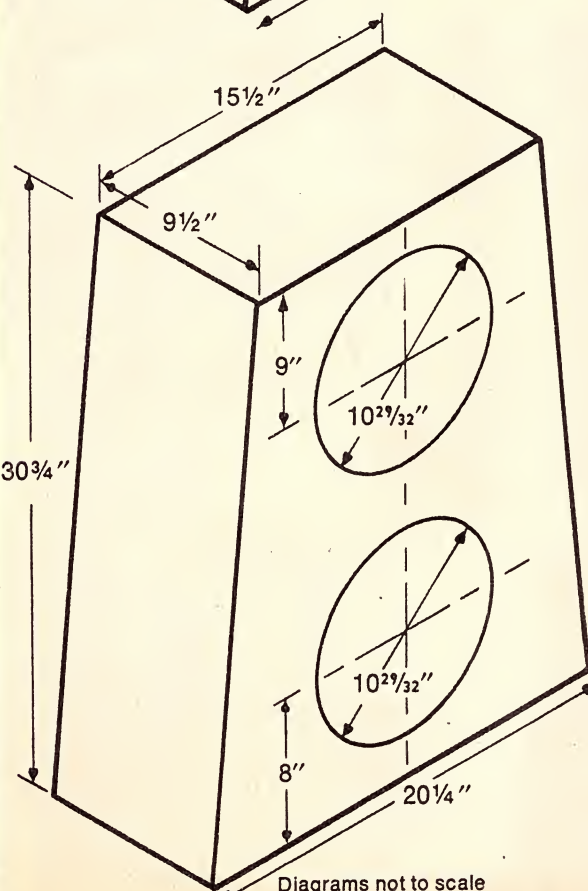
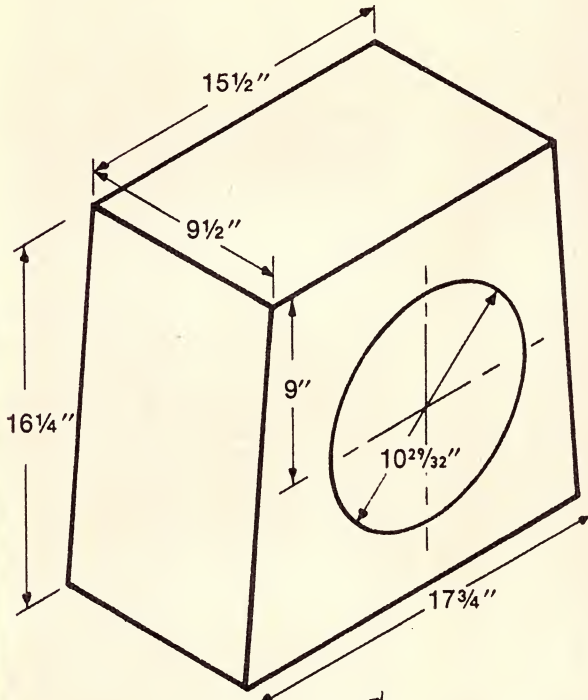
The 12U50, as pictured above, does not supersede the existing 12UEG model but is a distinct addition to the Rola range, more highly priced and carrying higher power ratings.

It is described by the makers as a medium compliance, long throw loudspeaker, developed for high power handling under rigorous conditions, as for electric guitar applications.

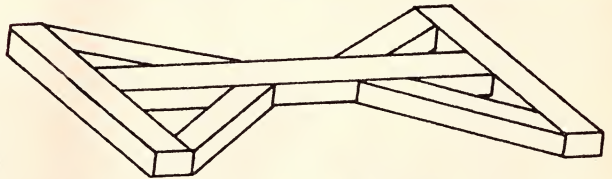
The free-air resonance of the cone system is quoted as 45Hz, with a nominal response on an infinite baffle extending from 35Hz to 6.5KHz. The bass characteristics under practical conditions depend, however, on the nature of the enclosure, a small enclosure tending to raise the fundamental resonance of the cone system and, with it, the frequency region over which bass roll-off occurs.

For those requiring a harder, more percussive sound, model 12U50X is available, as pictured, with a tweeter cone. Power rating and other characteristics are the same as for the 12U50, but the tweeter cone extends the response up towards the supersonic region.

Both versions use a high mass, fully felted cone, with



Diagrams not to scale



special rim treatment to permit and withstand large linear excursions. For the same reason, the magnet and dust collar have been redesigned and the chassis itself modified. The voice coil has been wound on an aluminium former, epoxy coated, to ensure maximum adhesion, freedom from warp and high thermal conductivity. The modifications have involved a slight loss in sensitivity compared with the 12UEG (about 2dB) but the manufacturers believe that this is an acceptable price to pay for an ability to cope with much more onerous conditions.

As with any loudspeaker intended for use under rigorous conditions, proper baffling arrangements are essential. Rola recommend that the loudspeaker be used in a stout, fully sealed enclosure, lined with Insulwool, carpet felt or some similar material. The enclosure should be built from particle board or plywood not less than 3/4-inch thick and braced if there is any sign of panel resonance.

For a single 12U50 or 12U50X an enclosure could typically have internal dimensions of about 16 x 16 x 10-inches, giving an internal volume of 2560 cubic inches. For two such loudspeakers in a common enclosure, typical dimensions would be 30 x 20 x 10 inches, giving a volume of 6000 cubic inches.

Illustrated are two enclosure outlines suggested by Rola for enclosures approximating the foregoing dimensions. In each case the sides are slanted to get away from a purely rectangular appearance. The boxes can be stood on either the wider or the narrower end, whichever best suits the arrangement on stage.

It is envisaged that, in some circumstances, a smaller enclosure for a 50-watt channel could be inverted on top

(Continued on page 158)



A READER BUILT IT

A solid state darkroom timer

This timer uses a basic timing circuit which, while simple, has a number of attractive features. Even if the reader is not interested in the darkroom application, there are many others where such a simple, reliable timing circuit would be very useful.

Believing that the more photographs I take now the more fond memories I will have in my inevitable old age, I make a point of using my cameras profusely to record the events of my life and of those near me. The result, of course, is a mounting collection of, to me, priceless negatives, all of which need to be evaluated, and the significant ones enlarged.

result was an electronic enlarger timer which for several years now has proved its sterling worth. And, it can be constructed with a minimum of effort and a modicum of money.

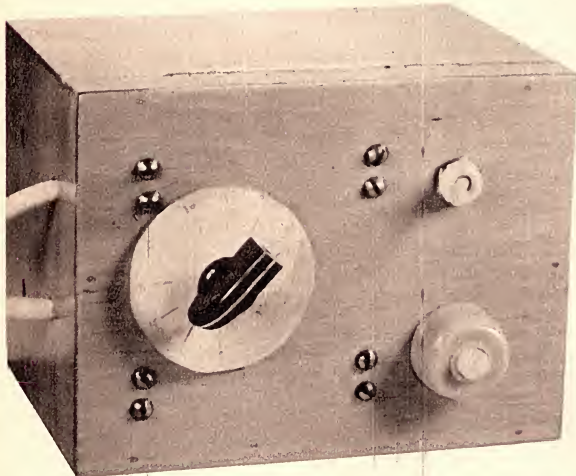
The circuit functions as follows: Initially, the 400uF timing capacitor is completely discharged by reason of the 100 ohm resistor connected across it via a set of normally closed contacts

on the relay. Unlike many timing circuits, which function on the basis of the time taken for a charged capacitor to discharge through certain value of resistance, this circuit functions in the reverse mode, i.e., the time taken for a discharged capacitor to charge through a certain value of resistance.

The timing cycle is initiated by operating the press button. This connects the collector of the transistor to the power supply via the relay coil and, at the same time, applies forward bias to the base by reason of the charging current through the timing capacitor and its associated 2.5K pot. As a result, current flows through the emitter/collector junction, through the relay coil, and the relay pulls in.

When the relay pulls in it operates a set of changeover contacts (in addition to the main contacts controlling the lamp). The changeover set removes the 100 ohm resistor from across the capacitor and completes a parallel circuit across the push button, thus maintaining this circuit after the push button is released.

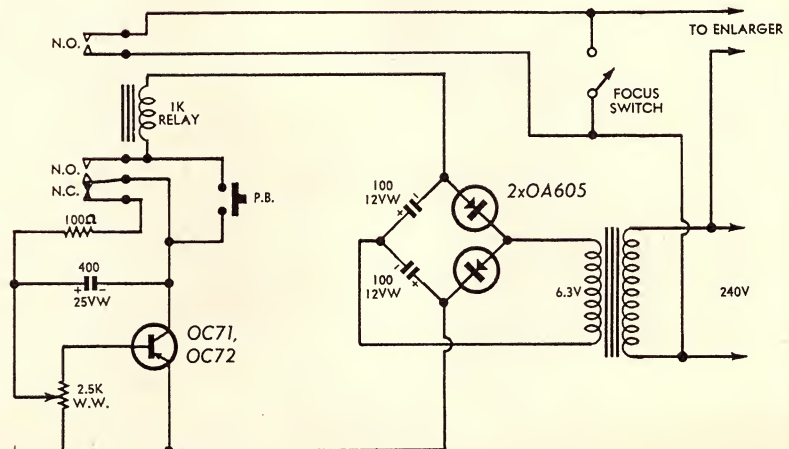
The timing capacitor continues to charge via the 2.5K potentiometer and the base/emitter junction of the transistor. It is this base current which constitutes the forward bias for the transistor and allows current to flow in the collector circuit. As the charge on the capacitor increases the rate of current flow decreases, eventually reaching a point where it no longer permits sufficient collector current flow to hold in the relay. The relay then drops out and the timing cycle



The author's unit was constructed in a wooden filing card case, but the more conventional metal box could be used if preferred.

After the printing exposure time is determined—a story in itself—there is still the matter of switching the enlarger light off, after the indicated length of time. I began this chore as most people probably do; with a switch in one hand, and my eyes glued to the second hand of my watch. But the concentration required reduced the process of making prints to at best an uninteresting evening, and at worst a discouraging frustration. There were occasions when I postponed making prints because I had had enough of watching the second hand making its revolutions. Obviously, a timing device for the enlarger was an urgent necessity.

I had heard that electronic timers were commonly used in this role so I repaired to the Public Library, where an hour or two spent in research produced the necessary information. The



The timing function is based on the time taken to charge the 400uF capacitor via the selected portion of the 2.5K pot.

is completed. At the same time the relay changeover contact set connects the 100 ohm resistor across the capacitor, completely discharging it in anticipation of another cycle.

A feature of the circuit is a linearising function associated with the capacitor charging cycle. This comes about as follows: At the commencement of the cycle the charging rate of the capacitor tends to be high which, in turn, produces a high value of forward bias and high value of collector current, possibly up to saturation of the transistor and limited only by the resistance of the relay coil.

However, this high value of current through the relay coil results in a maximum voltage across the relay coil and minimum voltage across the capacitor. Thus the high rate of charge tends to be offset by a lower charging voltage. As the capacitor acquires more charge its rate of charge decreases, forward bias decreases, collector current decreases, and the voltage applied to the capacitor increases, thus tending to maintain a constant rate of charge.

This linearising function is important in a timing circuit. Without it the rate of charge tends to slow down as the capacitor charges, eventually reaching a value where current flow is decreasing so slowly that it is difficult for the sensing mechanism to determine the precise point at which the cycle should be terminated. Unless a linearising circuit is used, this

can only be avoided by using very large values of capacitance operated over only the beginning of their charging (or discharging) cycle.

Although the circuit shows a mains power supply, the timer could be operated from a small 12V battery. However, the effect of falling battery voltage would have to be allowed for.

Also shown on the circuit is a "Focusing Switch." This, as its name implies, is to provide light while setting up and focusing, but may also be used for very long exposures outside the range of the timer.

The value of the capacitor determines the range of the times available. The capacitor shown in the circuit is of 400uF. This size, in the unit I have constructed, produces a range of from one second to 47 seconds. Since most of my enlarging exposures vary between 10 and 20 seconds, this range is more than adequate.

However, you may alter it to fit your own requirements. If one second to about 35 seconds is more in your line, use 300uF. If you require a range of one second to about one minute, use 500uF.

If any unusual time interval outside the capacity of the timer is required, such as the occasions when you produce 24" x 20" prints, it may be necessary to resort to the wrist watch and the focusing switch of the timer. Alternatively, one may produce longer

times by repeating a selected time as many times as may be necessary.

The timer can be built into any suitable receptacle measuring internally about 6in x 5in x 5in, or thereabouts. The unit I constructed is housed in a timber box intended for holding 6in x 4in index cards. Such boxes are available from stationery shops at a reasonable cost. The layout is not critical and the constructor can suit his own requirements.

The relay is a standard Post office type 3000, with contacts capable of switching 3 amps at 240 volts. As a 150 watt enlarger lamp draws only 0.6 amp, the contacts are ample for this use. It is advisable to house the relay in a plastic cover, to protect the contacts against dust, and from coming into contact with the wiring of the unit. Such relays and housings are readily available.

The timer is especially useful when a quantity of identical prints is required from the one negative. Some amateur photographers make their own Christmas cards, in batches of a hundred or so. All one does is to push the button for each print. The timer does the rest. It is even possible to place the unit on the floor, and to press the button, perhaps inelegantly, with a big toe. Both hands are then free for inserting and removing paper from the easel. The prints can be developed and fixed all in a batch, thereby saving much time.

(Submitted by Mr K. W. Gray, 95 The Bulwark, Castlecrag, N.S.W.)

More on C.D. ignition

A lot of interest seems to have been aroused by the articles on capacitor discharge ignition in the September and November issues. Here is a story of one reader who built his own version of the unit described in the September "Reader Built It" section.

I built-up the ignition system described in your "Reader Built It" columns of the September issue, but used a different high voltage circuit. My car is a Peugeot 403 and has negative earth ignition. The system built was that described for negative earth in the article. Having had previous experience in building a transistor DC/DC inverter, to supply plate voltage to my valve type car radio, I considered that the same inverter would be suitable also to supply the necessary 300 volts to the discharge capacitor.

The new ignition system has been in use in my car now for about five weeks and has been entirely satisfactory. I have not made any fuel consumption checks, but two facts have been evident. These are that the car pulls better on hills and the engine shows much increased power at higher revolutions. I used to consider that valve bounce was limiting power at high revolutions, but I have found power rising as far as I care to increase revs. and, in fact, have refrained from going well past the earlier peak revs. only from concern for the machine.

Getting back to the circuit, the

transistor DC/DC inverter used was one originally suggested by Mullard. The heart of the circuit is the ferrite pot cored transformer used. I did not fancy winding a large number of turns on a ring core, and while the pot core is more expensive, it makes it reasonably easy to wind the coils required.

For a voltage of 300 on the 1uF discharge capacitor, I wound the following windings on the No. DT2180 former supplied with the FX2242 Mullard pot core:—

Secondary winding: 330 turns 32 22 B&S wire.

Primary winding: 14 plus 14 turns 22 B&S wire.

Feedback winding: 18 plus 18 turns 30 B&S bifilar wound.

The windings should be in the order set out. All wire enamelled.

The biggest problem with a DC/DC inverter of this type is the 6000Hz note which is emitted by the transformer. This also appears in the battery supply leads which would cause it to appear in the car radio speaker.

I found that sponge rubber or sponge plastic sheet shaped to form a chamber around the transformer muted the

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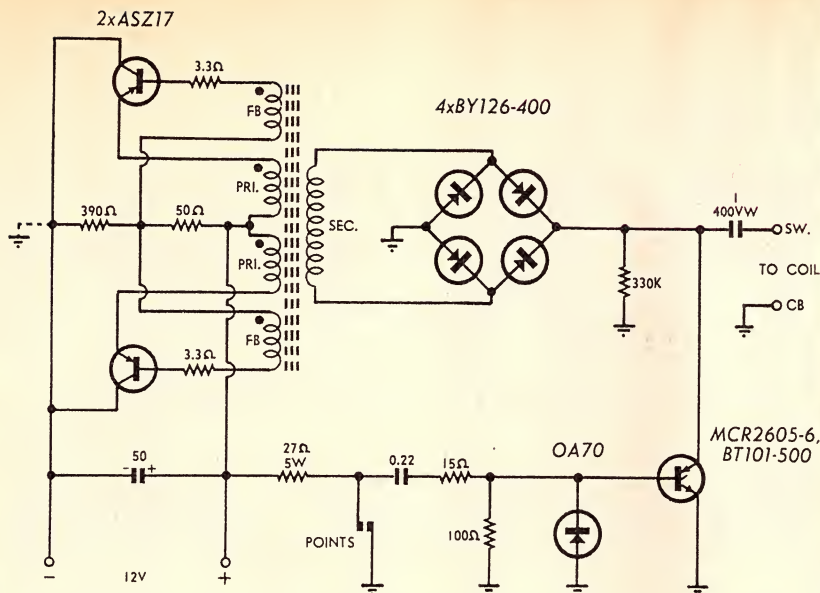
MELBOURNE
67 9161

BRISBANE
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ADELAIDE
72 2366

PERTH
28 6400

LAUNCESTON
2 1804



The circuit is similar to that described in the September issue, the main variation being in the design of the inverter.

mechanical sound. The chamber was made up by using contact glue.

The sound from the car radio was removed by connecting an iron core choke, suitably by-passed, in the battery lead to the inverter. It was placed in the same shielded case as the ignition supply circuit. The choke was made by using the core from an old speaker transformer of reasonable dimensions and winding on as many turns of 19 B&S enamelled wire as would fit in the core window.

I have found that ignition as generated by the condenser discharge ignition system is greater than that generated by the normal type of ignition but the interference is not excessive in the car radio, and, in fact, will not be noticed in normal listening situations.

Total cost of parts was about \$20.

Submitted by: Mr W. A. McArthur, 56 Balaclava Road, Eastwood. N.S.W., 2126.

Door stop makes "third hand"

How often have you wished you had three hands when soldering small components, particularly for experimental mockups? Here are details for a simple but effective "third hand" which can be made in a few minutes.

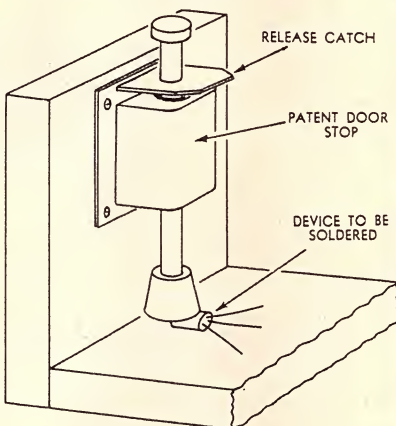
Heart of the unit is a spring loaded door stop, normally mounted on the bottom of a door and operated by the foot. The main feature of these devices is that they lock automatically at any position they are set, retain whatever pressure was applied to set them, yet can be released instantly.

The complete unit consists of a wooden baseboard and upright, making an "L" shape assembly. The writer used a scrap of 7/8in timber (1in dressed) cut to give a base 4in x 6in and an upright 4in x 5in.

The doorstop is mounted on the upright section and the component to be held placed on the base beneath it. Gentle pressure on the plunger will clamp the component in place. The rubber foot will adapt itself to most irregular shapes and also minimise any chance of damage to delicate components.

One of the main advantages of the clamp is the speed with which it can be set or released; simply a moment's pressure in each case, and a lot quicker than if using a vice or other screw type clamp.

In some cases it may be more convenient if the unit is turned through 90 degrees so that the upright becomes the base, and vice versa.



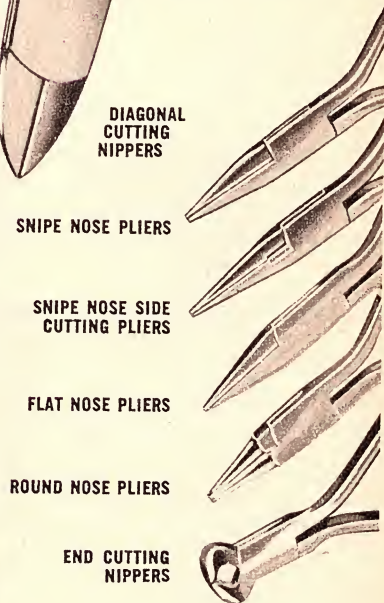
General layout of the door stop type "third hand."

(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.)

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Matching Speaker : SW-120

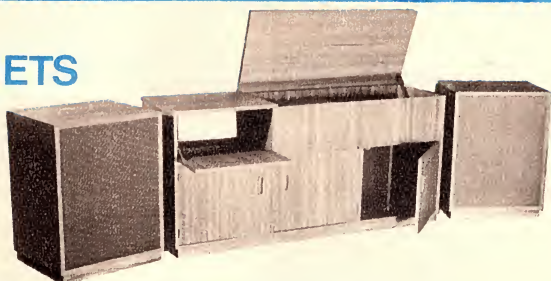


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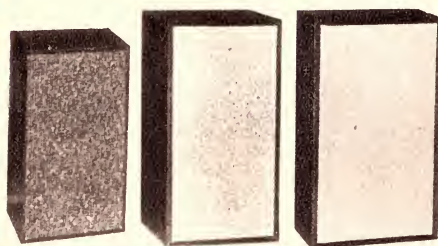
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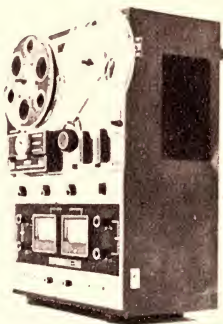
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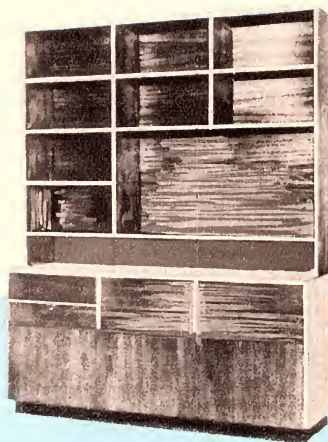
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This completely new communications receiver should appeal to a wide variety of readers. Combining maximum economy with a high performance, its features include high stability with tunable IF, excellent IF skirt selectivity and provision for AM, CW and SSB reception. And it's all solid-state!

PART ONE

By Ian Pogson

There is no doubt that the concept of a solid-state full coverage communications receiver has excited the imagination of many readers—our mailbag tells us that! Unfortunately, while we understand their enthusiasm, we suspect that many do not appreciate the problems involved. While solid-state devices are quite remarkable in terms of efficiency, reliability, compactness, and so on, they demand a price for these advantages.

This price is the need for much more critical and careful circuit design. Solid-state devices are not nearly as tolerant as valves in many applications; "front end" design, to name just one, must face up to problems of cross modulation, overload, and so on, of a very much greater magnitude than in the valve counterpart. And, while they can undoubtedly be solved, the solution will invariably involve more critical circuit design, greater complexity and, probably, higher cost. This last factor may, in some cases, force us to accept some order of compromise.

We find it all the more gratifying therefore, that we have been able to produce a design which, while offering all the obvious advantages of a solid-state receiver, is also one in which the more critical aspects have been successfully tackled. In short, it does not ask too high a price for the advantages of solid-state operation.

We make no claim that it is the ultimate. Like any other design, it is a compromise; but a compromise which we think will appeal to a large number of readers.

The amount of information to be presented for a project like this is quite

large; far too large to cover in one article. It will require at least two, and probably three articles to tell the full story. This article includes the circuit, parts list, and general views of the layout. This will enable interested readers to assess the value of the design for their requirements, place their orders for metal work and other hardware, and even do some of the assembly work. Coil data, panel wiring diagrams, and similar detailed information will appear in subsequent issues.

As a first step to the design of this receiver we listed those factors which needed to be considered, together with some suggested orders of performance. The list went something like this:

1. Constant coverage from 0.5 to 30MHz.
2. Best possible bandspread.
3. Ability to resolve effectively, AM, CW and SSB signals.
4. Good sensitivity and signal-to-noise ratio.
5. High stability and reasonable dial setting accuracy.
6. Selectivity: Preferably adjustable, to suit reception of AM, CW and SSB.
7. Minimum of spurious responses and cross-modulation, consistent with economy.
8. Signal strength meter.
9. AGC system suitable for use on AM, CW and SSB.
10. Noise combating device, suitable for use on AM, CW and SSB.

We can elaborate on these items as follows:

The order of bandspread will of necessity be a compromise between that which may be considered desir-

able, and the cost. Where a spread of 1MHz per dial sweep may be considered as most desirable, the cost would be prohibitive. A good compromise appears to be 3MHz per dial sweep. With a smooth dial movement and a reasonable ratio, this amount of bandspread can be quite satisfactory for most purposes. The limiting factor would be the ability to readily tune CW and SSB signals.

To be able to resolve AM, CW, and SSB signals, we need both an AM detector and a product detector, together with a BFO. These can be provided without much difficulty.

To get good sensitivity and signal-to-noise ratio, design of the RF amplifier and mixer stages must be carefully considered. An economical RF amplifier stage can be designed around the now readily available junction FET. This can be followed by a low noise mixer, such as a double-balanced, or "ring" type.

For high stability we should go to a tunable IF system, following a crystal-locked front end. Indeed, the tunable IF system is necessary to realise a constant band spread. With a crystal-locked front end, the stability of the receiver is virtually that of the VFO associated with the tunable IF, at least as far as AM reception is concerned. For CW and SSB, the stability of the BFO must also be considered. This will require a crystal-controlled BFO or one of equivalent stability.

The dial setting accuracy is a function of the overall stability of the receiver oscillators, together with the mechanical quality of the dial movement and the clarity of the dial scale.

Two degrees of selectivity may be obtained in a number of ways. The wider one may be achieved by using conventional IF transformers, suitably coupled and of sufficient number to achieve a satisfactory skirt selectivity. The narrower bandwidth can be obtain-

ed with a mechanical filter, or perhaps a pair of crystal lattice filters in cascade. However, while these systems are very good, they can be bulky and expensive. A satisfactory alternative for both conditions can be achieved with ceramic resonators, which are small and relatively inexpensive.

Keeping spurious responses to a minimum can be a demanding assignment. To keep cost down, a minimum of shielding and filtering between relevant circuits is desirable. By taking certain precautions we have established that spurious responses can be kept to a minimum. Those which persist usually do not interfere with the wanted signal anyway. This compromise appears to be a small price which we must be prepared to pay.

There are no special problems in fitting a signal strength meter. A bridge circuit can be used to achieve a forward reading system.

Techniques whereby AGC may be generated to suit all modes of reception are now well established. The main problem is to keep the BFO injection (into the product detector) from getting back into the AGC system and so reducing the sensitivity of the receiver. With suitable design, a satisfactory solution can be provided.

A most difficult requirement is to provide a satisfactory noise silencer, suitable for all three modes of reception. There are a number of detector noise limiters which can be used on AM reception. Performance is limited, however, by the selectivity of the IF strip. With a high degree of selectivity, ringing occurs and the limiter effectiveness is seriously reduced. In any case, this type of device cannot be used for CW and SSB. An alternative is a positive and negative peak clipper in the audio circuits immediately following the detector system. At best, this is only of token effectiveness and could not be considered.

Possibly the most effective method of silencing, short of using a separate "blanking" receiver, is the Lamb noise silencer principle. Even this is normally anything but simple and it may seem strange that we would consider such a device for this receiver. However, we have evolved a design which does not use an excessive number of parts, and we have adopted it.

The accompanying block diagram illustrates the receiver which we have designed to meet the specifications laid down earlier. An RF stage, with switch positions, covers from 0.5 to 30MHz, in five ranges. This is followed by a balanced mixer. A crystal oscillator, followed by an amplifier-multiplier, provides a high stability injection signal for the mixer.

The tunable IF covers the range from 3 to 6MHz. This is followed by another balanced mixer similar to the first. Injection for the mixer is from a VFO, tuning the range, 3.455 to 6.455-MHz, so giving a second IF of 455-KHz. As there is no gain in the balanced mixer, there is an amplifier immediately following it.

The Lamb noise silencer depends to a large extent for its success on being placed ahead of any highly selective circuits. The normal place is immediately after the mixer circuit but before the selective circuits of the 455KHz IF strip. The silencer consists of a balanced gate, noise amplifier, noise rectifier and pulse amplifier.

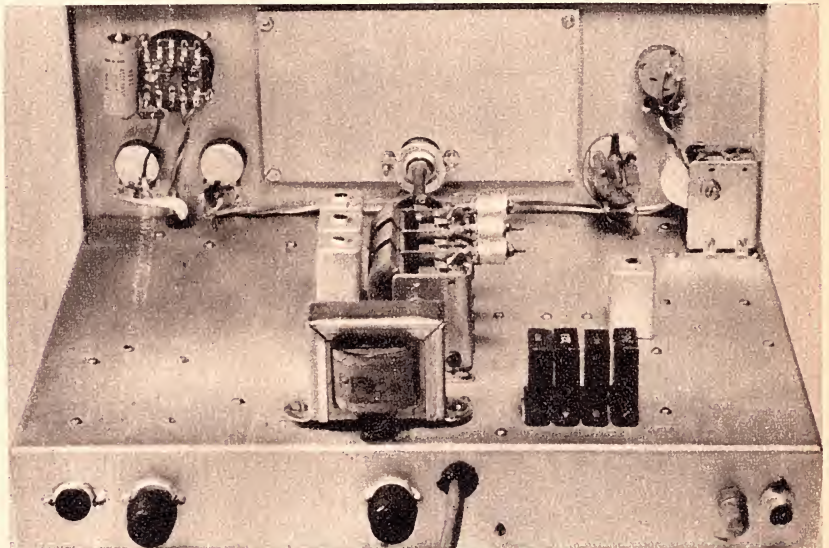
After the silencer, ceramic filters are

switched as required to determine the overall selectivity. Two bandwidths are available; 5KHz for AM reception and 2.5KHz for CW and SSB reception.

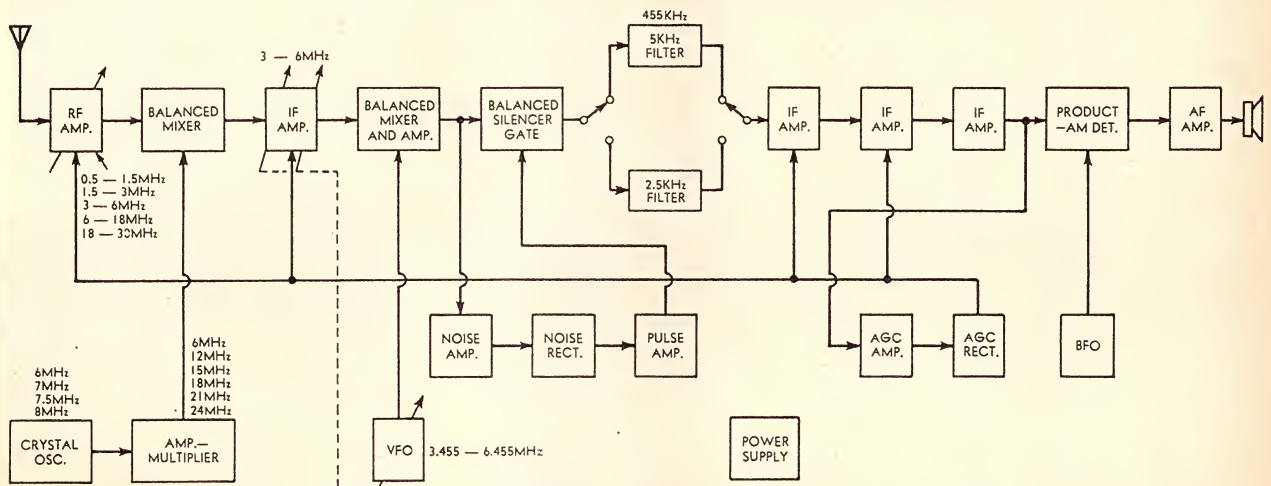
After the bandwidth selection filters, are three IF amplifiers. The output of the third IF amplifier feeds a combined AM and CW-SSB detector. For the latter two modes a ceramic controlled BFO supplies the injection. The output of the detector feeds a three-stage audio amplifier, capable of two or more watts of audio, into a speaker of 8 to 15 ohms.

A split from the output of the last IF amplifier is diverted to an AGC amplifier, followed by a rectifier and selectable time constant circuits. The AGC voltage is used to control the gain of the RF amplifier, the tunable IF amplifier and the first and second 455KHz IF amplifiers.

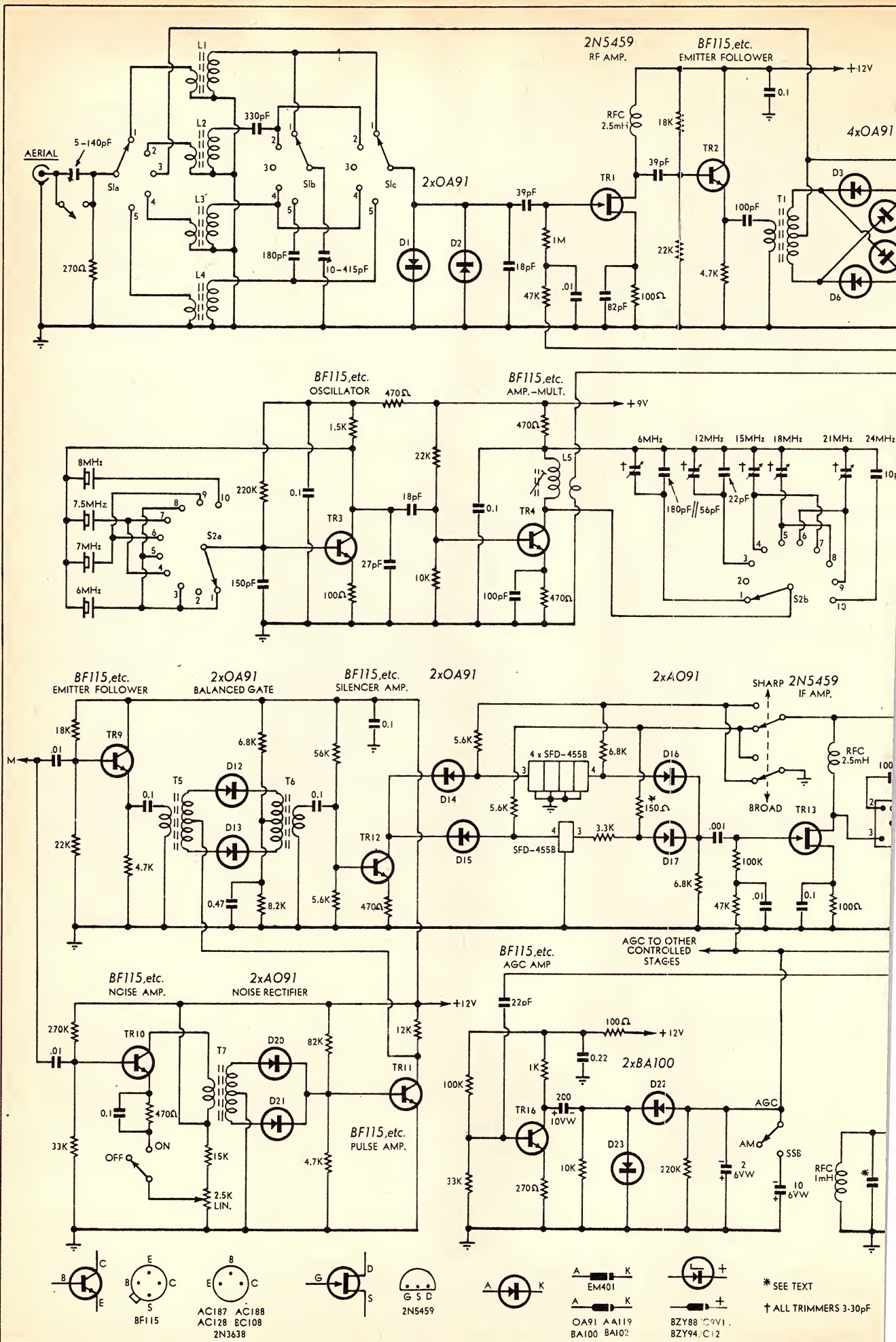
The power supply provides about 17 volts unregulated for the audio amplifier. From the 17 volts, a shunt regulator delivers a substantially constant 12 volts for the rest of the receiver, except the oscillators. The 12 volt

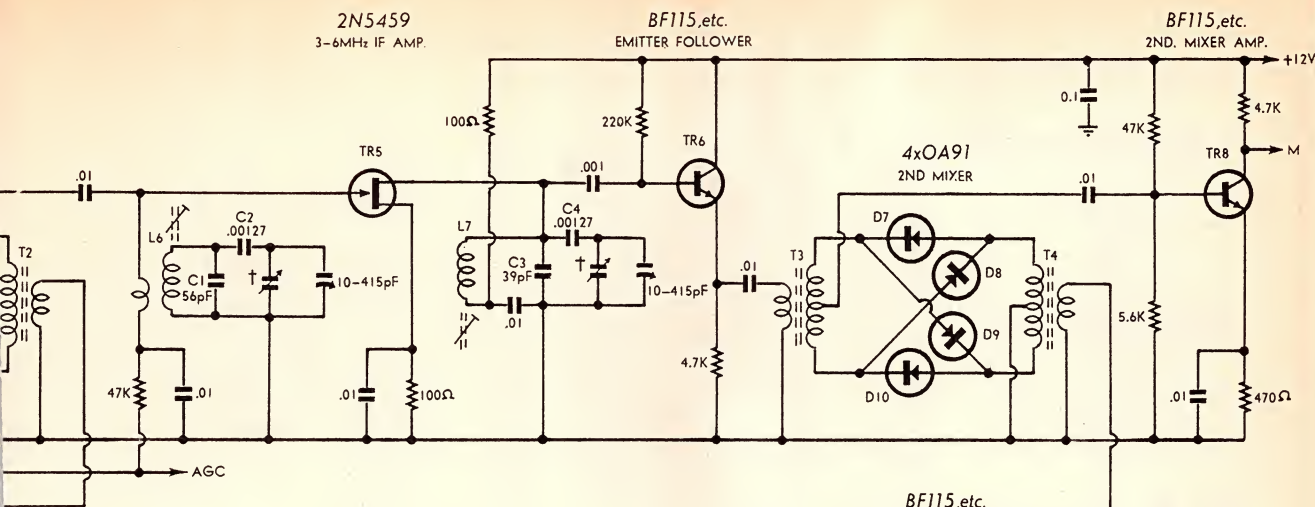


This rear picture indicates rather dramatically how components have shrunk. The usual IF transformers in the square cans have been replaced by very small ceramic resonators, placed under the chassis. Note also the dial mechanical details.



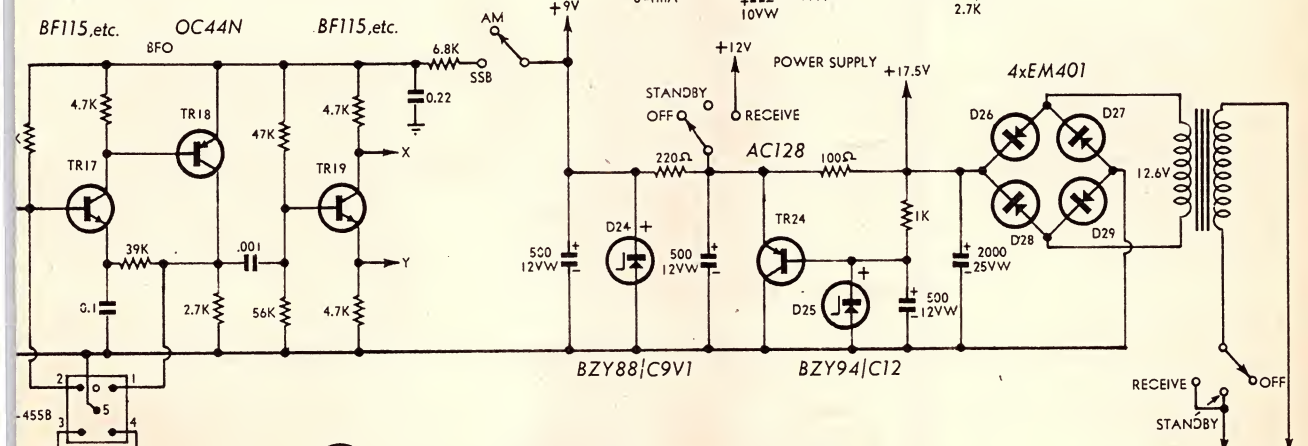
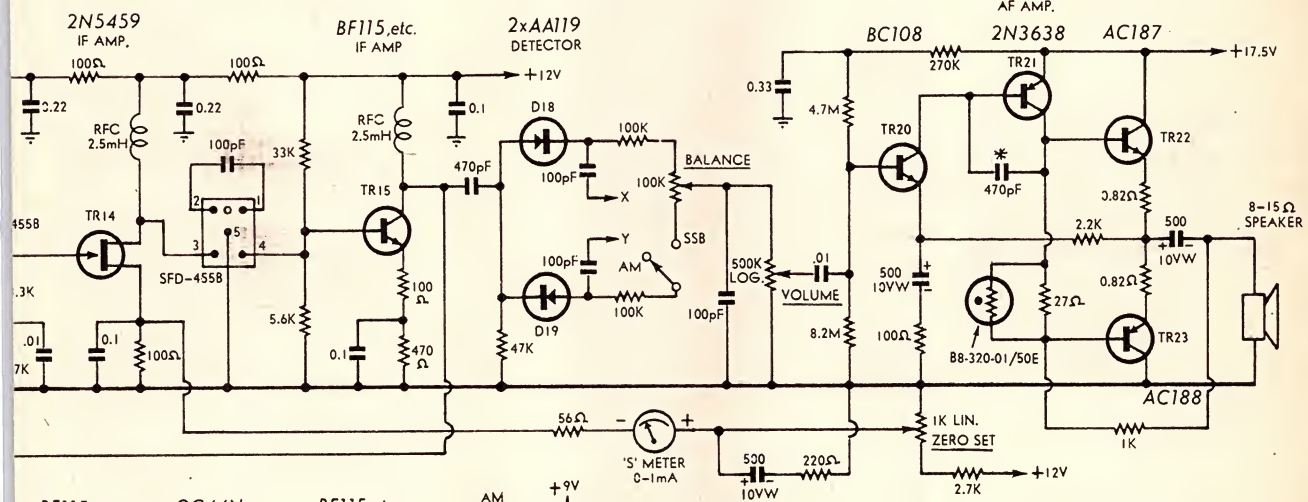
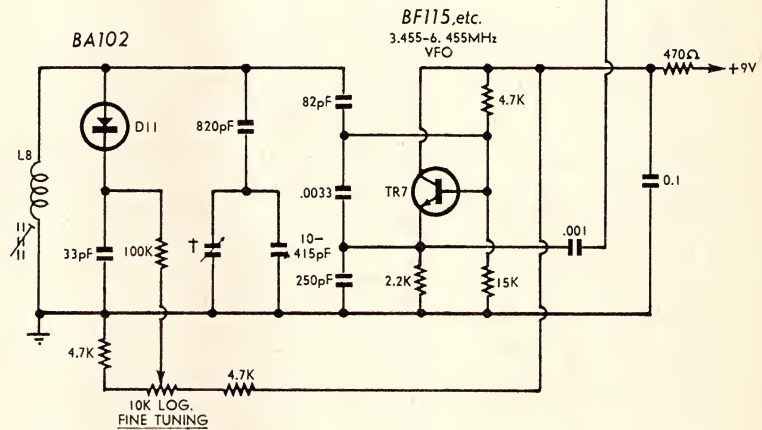
The block diagram of the complete receiver is explained in detail in the text and helps to simplify the main circuit diagram. All frequencies are given, which helps to show, at a glance, the relationships between them.





SWITCH POSITIONS:-

- S1 : 1 : 0.5-1.5MHz
 2 : 1.5-3MHz
 3 : 3-6MHz
 4 : 6-18MHz
 5 : 18-30MHz
- S2 : 1 : 0.5-3MHz
 2 : 3-6MHz (STRAIGHT THROUGH)
 3 : 6-9MHz
 4 : 9-12MHz
 5 : 12-15MHz
 6 : 15-18MHz
 7 : 18-21MHz
 8 : 21-24MHz
 9 : 24-27MHz
 10 : 27-30MHz



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PARTS LIST

- | | | | |
|---|--|--|--|
| 1 Chassis 13-7/8in x 9-7/8in x 2in (with partition) | | | |
| 1 Front panel 14-1/8in x 7in x 1/2in | | | |
| 1 Metal cabinet 14 1/2in x 7 1/2in x 10 1/2in. | | | |
| 4 Rubber feet for cabinet | | | |
| 1 Dual ratio dial movement (Jabel type 4511DRF) | | | |
| 1 Meter 1mA FSD | | | |
| 1 Indicator lamp 14V type BFB-6G (Rodan). | | | |
| 1 Toggle switch, DPDT type S-2022 (NKK) | | | |
| 1 Toggle switch, 4-pole, 3-position type S-2043 (NKK) | | | |
| 1 Rotary Switch, 1 wafer, 2-pole 3-position | | | |
| 1 Rotary switch, 2 wafers, 2-pole 5-position | | | |
| 1 Rotary switch, 2 wafers, 1-pole 10 position. | | | |
| 1 Knob, large, for dial | | | |
| 3 Knobs for switches | | | |
| 5 Knobs for potentiometers, etc. | | | |
| 1 Power transformer, 2 x 6.3V. 1A. (PF1728), 2 x 12.6V. 0.5A (PF2565), or similar | | | |
| 1 Crystal 6MHz | | | |
| 1 Crystal 7MHz | | | |
| 1 Crystal 7.5 or 15MHz | | | |
| 1 Crystal 8MHz | | | |
| 4 Sockets to suit crystals | | | |
| 1 2-pin miniature speaker socket | | | |
| 1 4-pin miniature speaker socket | | | |
| 1 5-pin miniature speaker socket | | | |
| 1 2 1/2in x 1/2in dia. steel or brass rod | | | |
| 1 3 1/2in x 1/2in dia. steel or brass rod | | | |
| 1 1/2in dia. shaft extension. | | | |
| 1 1/2in coupling | | | |
| 1 Coaxial socket | | | |
| 1 Aerial terminal | | | |
| 1 Miniature tag board, 5 prs. | | | |
| 1 Miniature tag board, 7 prs. | | | |
| 4 Miniature tag boards, 10 prs. | | | |
| 2 Miniature tag boards, 11 prs. | | | |
| 2 Miniature tag boards, 13 prs. | | | |
| 1 Miniature tag board, 17 prs. | | | |
| 1 Miniature tag board, 22 prs. | | | |
| 1 2-tag strip | | | |
| 1 3-tag strip | | | |
| 1 4-tag strip | | | |
| 2 10-tag strips, two mtg. feet | | | |
| 1 Printed board, 69/F10 | | | |
| 6 Rubber grommets | | | |
| 6 1/2in dia. x 1/2in brass spacers, tapped 1/8th Whitworth | | | |
| 1 1/2in flexible coupling | | | |
| 1 1/2in bush | | | |
| 2 1/2in dia. x 1/2in brass spacers, tapped 1/8in Whitworth. | | | |
| 2 1/2in dia. x 1/2in brass spacers, 1/8 in. clearance hole. | | | |
| 4 2.5mH RF chokes | | | |
| 1 1mH RF choke | | | |
| 4 Ferrite toroidal formers, Q2 material, Ducon type F4040/2. | | | |
| 7 Ferrite balun transformer cores. Ducon type F684, Q2 material, or Neosid type 1050/1/F14. | | | |
| 3 Neosid coil formers, 7.6mm x 2 1/2in, with top ring, slug and can | | | |
| 1 Neosid coil former, 7.6mm x 1 1/2in, with slug and can | | | |
| 8 Murata ceramic resonators, type SFD-455B | | | |
| Shield mounting panels for IF strip, noise silencer and tunable IF. Hookup wire, screws, nuts, solder, power flex and plug, solder lugs, etc. | | | |
-
- | | | | |
|---------------------------------|--|---|------|
| TRANSISTORS | | | |
| 4 | 2N5459 (Motorola) | | |
| 14 | BF115, BF184, SE3001, etc. | | |
| 1 | 2N3638, BC178, OC44N, OC170, etc. (BFO). | | |
| 1 | 2N3638, BC178 (audio amp.) | | |
| 1 | BC108 | | |
| 1 | AC187 } matched pair | | |
| 1 | AC188 } with heat sinks | | |
| 1 | AC128 with heat sink | | |
| DIODES | | | |
| 4 | EM101, BY126/100 | | |
| 1 | BZY94/C12 zener | | |
| 1 | BZY88/C9V1 zener | | |
| 18 | OA91 | | |
| 2 | AA119 | | |
| 1 | BA102 | | |
| 2 | BA100 | | |
| RESISTORS (all 1/2 watt) | | | |
| 2 | 0.82 ohm | 2 | 10K |
| 1 | 27 ohms | 1 | 12K |
| 1 | 56 ohms | 2 | 15K |
| 11 | 100 ohms | 2 | 18K |
| 2 | 220 ohms | 3 | 22K |
| 2 | 270 ohms | 3 | 33K |
| 8 | 470 ohms | 1 | 39K |
| 3 | 1K | 5 | 47K |
| 1 | 1.5K | 2 | 56K |
| 2 | 2.2K | 1 | 82K |
| 2 | 2.7K | 6 | 100K |
| 1 | 3.3K | 3 | 220K |
| 12 | 4.7K | 2 | 270K |
| 5 | 5.6K | 1 | 1M |
| 3 | 6.8K | 1 | 4.7M |
| 1 | 8.2K | 1 | 8.2M |
| 1 | 1K linear tab pot | | |
| 1 | 2.5K linear pot with switch | | |
| 1 | 10K log pot | | |
| 1 | 100K linear tab pot | | |
| 1 | 500K log pot | | |
| 1 | Thermistor, type B8-320-01/50E | | |
| CAPACITORS | | | |
| 1 | 10pF NPO ceramic | | |
| 2 | 18pF NPO ceramic | | |
| 2 | 22pF NPO ceramic | | |
| 1 | 27pF NPO ceramic | | |
| 1 | 33pF NPO ceramic | | |
| 2 | 39pF NPO ceramic | | |
| 2 | 56pF NPO ceramic | | |
| 2 | 82pF NPO ceramic or polystyrene | | |
| 8 | 100pF polystyrene | | |
| 2 | 150pF polystyrene | | |
| 3 | 180pF polystyrene | | |
| 2 | 270pF polystyrene | | |
| 1 | 330pF polystyrene | | |
| 2 | 470pF polystyrene | | |
| 1 | 820pF polystyrene | | |
| 7 | .001uF polystyrene | | |
| 1 | .0033uF polystyrene | | |
| 5 | .01uF polystyrene | | |
| 8 | .01uF 25V. ceramic | | |
| 13 | 0.1uF 25V ceramic | | |
| 5 | 0.22uF 25V ceramic | | |
| 1 | 0.33uF 25V ceramic or polyester | | |
| 1 | 0.47uF 25V ceramic or tantalum | | |
| 1 | 2uF 6VW electrolytic or tantalum | | |
| 1 | 10uF 6VW electrolytic or tantalum | | |
| 1 | 200uF 10VW electrolytics | | |
| 3 | 500uF 10VW electrolytics | | |
| 3 | 500uF 12VW electrolytics | | |
| 1 | 2000uF 25VW electrolytic. | | |
| 8 | 3-30pF Philips trimmers | | |
| 1 | 5-140pF or 5-100pF miniature variable. | | |
| 1 | 10-415pF variable, 3-gang | | |
| 1 | 10-415pf variable, single. | | |

supply is reduced to 9 volts by a zener diode. This provides a very stable supply for the oscillators.

From the broad outline of the design as covered by the block diagram we can turn to the circuit diagram for a more detailed description. At the aerial input is a small variable capacitor in series with the aerial. In the prototype, this capacitor is variable from 140 to about 5pF and is used as an effective aerial attenuator. Four coils L1 to L4, are used to cover the ranges 0.5-1.5MHz, 1.5-3MHz, 6-18MHz and 18-30MHz. This leaves a gap of 3-6MHz, which is the range of the tunable IF. As part of the economy, the front end is not used for this range, the aerial input being switched directly into the first tuned circuit of the tunable IF. The coils L1 to L4 are wound on ferrite toroid formers. This gives compact coils of high Q, which permits using only one tuned circuit in the RF amplifier stage.

Across the input of the 2N5459 junction FET is a pair of germanium diodes, one in each direction. These are to protect the junction FET. They could be considered as optional where the receiver is not likely to be operated very close to a transmitter. The gate of the FET is connected to the AGC system and the drain is broad-banded by using a 2.5mH RF choke for its load. As a high to low impedance transformation is necessary to couple from the RF amplifier drain to the mixer, an emitter-follower is used.

The mixer, as previously mentioned, is a double balanced or ring type. Although it has no gain it is an excellent mixer, easy to get going, and it contributes substantially to spurious response reduction and good signal-to-noise ratio. The four diodes used in the prototype are type OA91. The purist may like to pay a little extra and fit a matched quad of OA91s.

Inspection of component values in the circuits thus far will show that they favour the higher frequencies. All interstage coupling capacitors, and the source resistor by-pass capacitor, are small values. Beginning with the aerial attenuator, which has a maximum capacitance of 140pF, this is followed by two capacitors of 39pF each, with the coupling from the emitter-follower to the mixer, via 100pF. In addition, the 2.5mH RF choke as the RF amplifier load has reduced reactance at low frequencies, and so contributes to the overall effect.

There are two reasons for this. Firstly, there is a natural tendency for RF amplifier gain to fall as the frequency is increased and this approach has a levelling effect. The second reason is perhaps peculiar to this design. As mentioned earlier, we used only one tuned circuit in the RF amplifier. Although the circuits are of quite high Q, there is not sufficient discrimination to prevent strong local broadcast stations from breaking through in some circumstances. By reducing the RF amplifier gain at these frequencies this problem is minimised.

The crystal oscillator/multiplier frequencies are substantially as suggested by Murphy and Gurr (Amateur Radio, January, 1969) although the execution of the system is somewhat different. By a careful selection of crystals, combined with the tunable IF of 3-6MHz, only four inexpensive

crystals are required to cover the full range of the receiver.

The crystal oscillator, multiplier and mixer circuits are similar to those used by the writer in the SSB transmitter described about January, 1967, with changes to suit this particular application.

Injection frequencies required for the mixer are, 6MHz, 12MHz, 15MHz, 18MHz, 21MHz and 24MHz. The 6, 12 and 18MHz can be obtained from a crystal on 6MHz, multiplying by 2 or 3 as required. The 15MHz may be obtained from a fundamental unit on 15MHz, or a 7.5MHz crystal may be used and multiplied by 2. As we had the latter frequency on hand, this is what we used. The 21MHz is economically derived from a 7MHz unit, multiplying by 3. Finally, 24MHz is obtained from an 8MHz unit, multiplied by 3.

Up to the 15-18MHz range, injection to the mixer is on the high side of the incoming signal. For the ranges 18-30MHz injection is on the low side of the signal.

It would be difficult to arrive at a more economical design than this arrangement.

The crystal oscillator is a straightforward Pierce type, with provision for switching the various crystals. The output of the oscillator is fed into the amplifier/multiplier, the collector circuit of which is tuned to the frequency of the signal to be injected into the mixer. The arrangement used is an economical one, requiring only one transformer. The secondary winding is tuned to each wanted frequency by switching an appropriate capacitor across it. These are adjustable capacitors with the exception of the highest frequency one (24MHz), which is a fixed value of 10pF. The slug in the coil is used, initially, to tune this combination to resonance.

Use of a single winding demands that it be low in inductance so that it will tune to the highest frequency. To tune it to the lower frequencies it is necessary to shunt it with increasingly larger capacitance. This leads to a reduction in dynamic impedance at the low frequencies which is just what is wanted. The result is to keep the injection level, into the mixer, more or less constant regardless of frequency. The switch for the shunting capacitors is ganged with that for the crystals.

A further advantage in using a single transformer is that it avoids the necessity for another switching function.

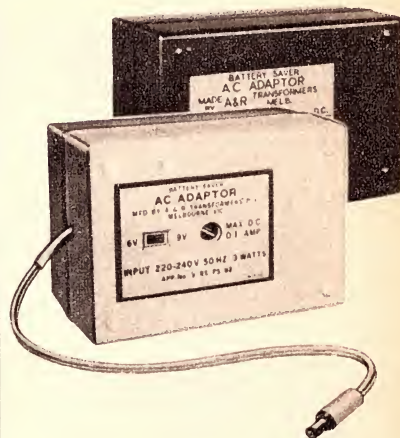
In spite of the reduction in dynamic impedance of the multiplier-tuned circuit, the gain reduction was not enough at the lower frequencies. It was reduced to the wanted level by using a small coupling capacitor (18pF) between the oscillator and the amplifier/multiplier, and a small by-pass capacitor (100pF) across the 470 ohms amplifier/multiplier emitter resistor.

This "front end" which we have just described, in addition to being suitable as part of a complete receiver, could form the basis of a converter which could be used in a number of applications. Variations could be made in the crystal frequencies, the RF amplifier tuned circuits and the tunable IF, to

(Continued on page 158)

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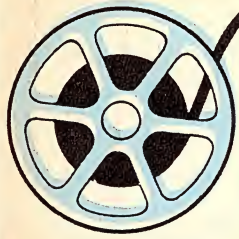
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AUDIO TOPICS



The Albert Hall acoustics problem solved

The acoustics problem in London's Royal Albert Hall, which has plagued generations of concert goers, has been solved at last. This and other "case histories" discussed in this article, indicate the widely divergent problems which come within the activities of acoustic engineers.

The science of acoustics, although generally associated with the design of concert halls, embraces acoustics and noise control in all its aspects. Examples of the acoustical consultant's work are to be found in hotels, offices and apartments, on industrial sites, and in ships and aircraft. The consultant may also have to advise and give expert evidence in legal actions concerning noise nuisance. Except for standard sound transmission tests between adjoining buildings, no two projects are the same.

In the case of concert halls the problem is often not one of designing a new hall but of correcting the faults in an existing one. The Royal Albert Hall is a good example of this type of project. This internationally famous hall, the home of the equally famous B.B.C. Promenade Concerts, was completed in 1871. It is oval in plan and has a domed roof rising at the centre to a height of about 144ft above the arena floor. Complaints were received concerning a very bad echo at the

1871 opening ceremony, the Prince of Wales' opening address being heard twice over in many parts of the auditorium. In addition to the echo, the hall was extremely reverberant and was, in fact, suitable only for the performance of major choral works.

Some improvement was later achieved by suspending a canvas valerium in the dome, and a corrugated aluminium lining, installed soon after the 1939-45 war, reduced a serious "flutter" echo noticeable in the centre of the arena immediately below the dome, but in both cases the major echoes still persisted.

This was the situation when the author's company, Acoustical Investigation and Research Organisation Ltd., was requested to investigate the problem and to devise a financially and aesthetically feasible solution. The first few months of the research program were taken up by attendance at concerts and other functions in the hall. The author and an assistant moved from seat to seat, noting the loudness

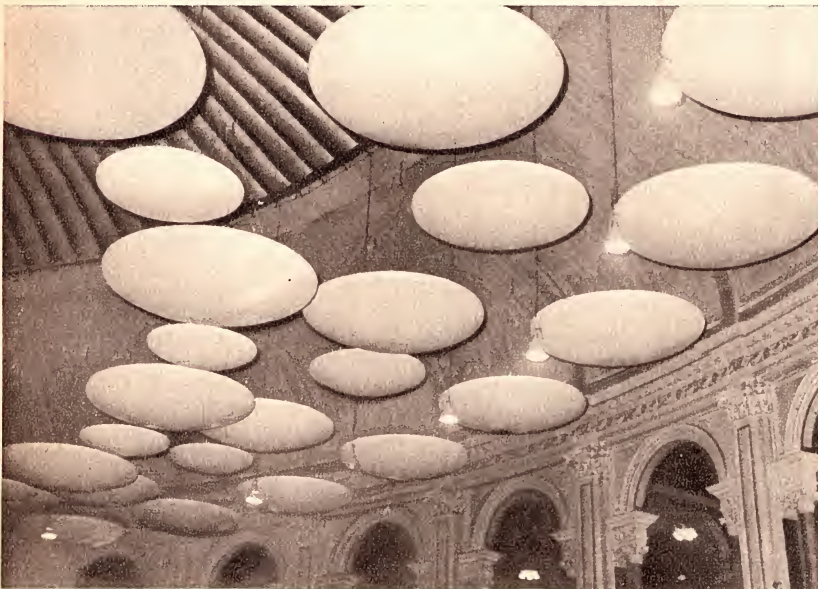
and quality of the sound and the presence or absence of echoes. At the end of this period "acoustic contours" were plotted on a seating plan of the hall and objective tests begun to determine the sources of the echoes.

Once a seating area with a pronounced echo had been selected, a microphone was set up at this point. The instrument was fitted with a parabolic reflector to render it directional and the reflector was equipped with accurately aligned sights to enable the observer to note the direction of maximum echo. The microphone was connected to a sound level meter, to which could be coupled a tape recorder and a pair of earphones. A loudspeaker on the stage was connected to a second recorder fitted with a continuous tape loop on which a broad-frequency band transient sound (that is, a loud bang) had been prerecorded. By playing this tape and metering and recording the sounds received by the microphone, apparent sources of echoes could gradually be located. Subsequent analysis of the tapes obtained via the microphone and sound level meter enabled the time delay between direct and reflected sounds to be determined.

The principal echoes, it was discovered, occurred at the curved edges of the dome rather than at the centre as had been assumed previously. It was further discovered that even with a full audience of about 5,500 people the hall was too reverberant, reverberation time being generally in the region of 3 seconds. From the reverberation time measured in the presence of a full audience and the volume of the hall (about 130,000 cu. yds.), was calculated the amount of absorption needed to reduce the reverberation time to about 2.4 seconds (considered the optimum for a hall of this size).

Results indicated that it would be necessary to introduce about 1200 sq. yds. of 2in thick mineral wool or glass fibre into the hall to achieve the required reduction. This posed a problem since all the surfaces to which this material might be affixed were either heavily ornamented or inaccessible. Another difficulty was to discover how to interfere with the path of the sound waves responsible for the echoes.

Finally, over 130 glass reinforced plastic diffusers, looking like "flying saucers" viewed from beneath, were hung by cables from suspension points in the dome. The saucers varied in diameter between about 6ft and 12ft, with a chord of about 18in. They were suspended in a random pattern in a shallow catenary, the central saucer being about 65ft above the arena and the outer ones about 5.5ft higher to



Some of the 130 diffusers which, suspended from the ceiling, have cured the famous echo in the Royal Albert Hall, London.

avoid cutting off the view of people in the gallery and in order to create a reflective plane, convex on the underside.

Thus the entire plane of the saucers was convex, each saucer itself being also convex. The concave tops of the saucers were covered with a 2in thick layer of glass fibres, faced with a thin layer of plastic film to limit sound absorption at high frequencies. The installation provided the necessary echo path interference, absorption and diffusion without disturbing the intricate surface decorations in the hall, and eliminated the 98-year-old echo problem, improved clarity at the rear of the hall and satisfactorily reduced the reverberation time.

In complete contrast to this project were the problems associated with the construction of several gas reforming plants in residential areas. These plants are designed to reform naphtha or natural gas to town gas for distribution in areas in which the gas consuming appliances have not yet been converted to suit the higher calorific value of natural gas.

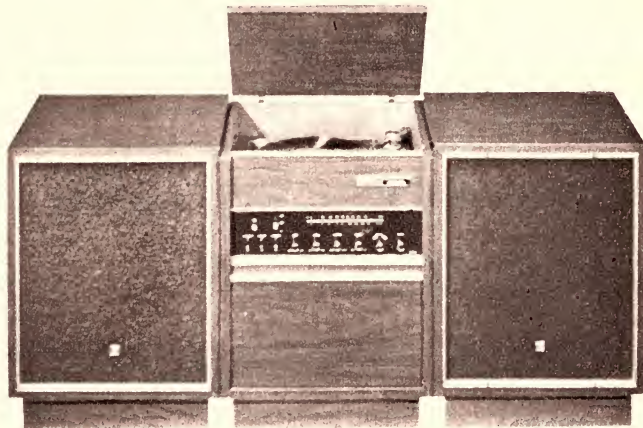
As in the case of the concert hall, the first task was to determine the nature and extent of the problems to be solved. Fortunately several similar plants were already in operation and detailed surveys to provide noise level data and to identify the various noise sources could be carried out. To provide a design criterion, the background noise level at night around the houses nearest to the proposed installation sites was measured.

It was discovered that the principal noise source in a gas reforming plant was the passage of high pressure gas through pressure reducing valves and through relief valves for venting waste gas and steam to atmosphere. These produced an intense, high pitched noise. Since the proposed new installations were to handle much larger volumes of gas than existing plants providing the research data, a method had to be determined for predicting the valve noise level from the gas throughput and other parameters. The South Eastern Gas Board offered the use of test facilities at one of its existing reforming plants, where a test rig was constructed to vary the airflow through a pressure reducing valve to atmosphere and to measure resulting noise spectra. The rig incorporated a tail-pipe so that, by advancing along the pipe a section lined with sound absorptive materials, the point at which the noise was generated could be determined.

Results demonstrated that any effective valve silencers would have to be inserted some distance downstream of the valves. Further tests revealed that a considerable level of noise was radiated from the pipework between valve and silencer. This problem could be overcome by insulating the pipe externally with 2in-thick mineral wool faced with an outer casing of 3/4in thick aluminium. It was also found that the exhaust velocity had to be limited to about 85ft/sec. to avoid jet noise at the exhaust. With the information obtained on the valve noise levels, distances from the nearest houses, the direction of the prevailing winds and the night time background noise level, the necessary silencer and insulation measures could be specified.

(Continued on page 158)

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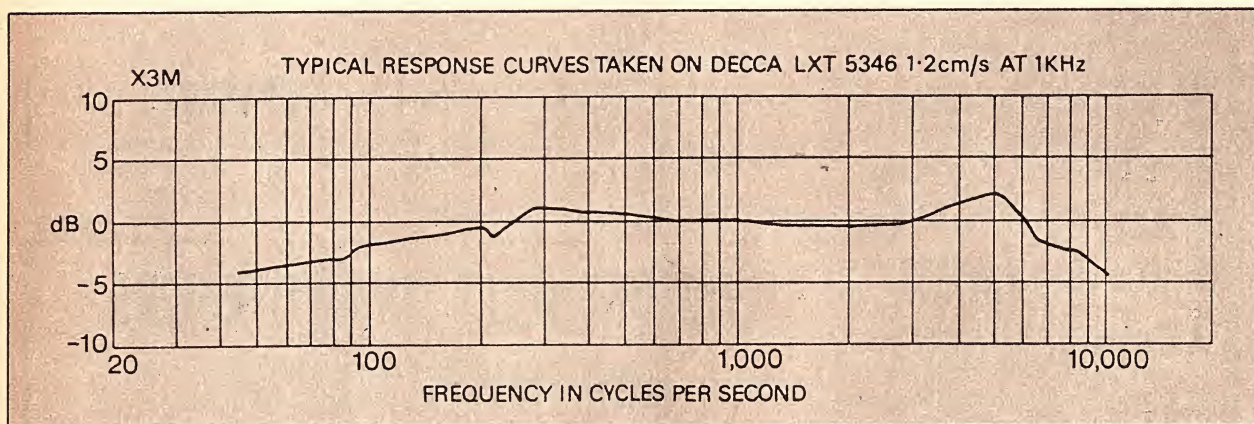
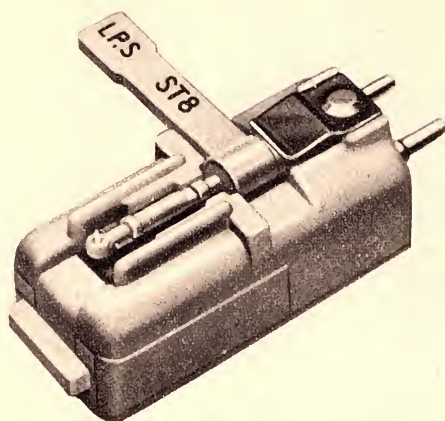
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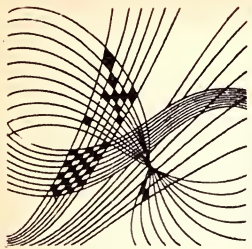
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CLASSICAL RECORDINGS

Reviewed by Paul Frolich

GRIEG: Concerto in A minor, op. 16.
LISZT: Concerto No. 1 in E flat, Van Cliburn, piano; The Philadelphia Orchestra; conductor Eugene Ormandy. RCA stereo LSC 3065.

One of the first of RCA's issues after the Philadelphia Orchestra's return to the Victor stable, this disc is wholly characteristic of what, I am told, the company and the orchestra aim at: the constant renewal of items in the standard repertoire, featuring the latest crop of virtuosi and the latest recording techniques. Van Cliburn is not, of course, a newcomer: he has been on the international circuits for at least eight years and his repertoire is quite extensive even though he usually concentrates on the most popular virtuoso concerti. In this respect, the current disc is quite representative of his work as, of course, it is of the orchestra's most frequent offerings.

It would indeed be hypocritical were I to pretend to a liking for the Grieg concerto; I have, alas, heard it far too often to retain much respect for it as a piece of music. With the assistance of Hollywood and Tin Pan Alley, this has become the pot-boiler of all times, which fact in no way denies its qualities as a fine display piece for pianists. Van Cliburn plays it exceedingly well and I doubt that there are genuinely preferable performances.

The Liszt concerto is in a somewhat different category; it is far more difficult technically, and of more, substantial musical content. It, as well as the Grieg concerto, has been brilliantly recorded on many occasions, but I am ready to believe that the present performance is one of the best yet. In any case, the playing of all concerned is quite excellent and the recorded sound, full, rich and true, very much to my liking.

★ ★ ★

VIVALDI: "Il Pastor Fido" — Six Sonatas, opus 13, for flute and harpsichord. Jean-Pierre Rampal, flute; Robert Veyron-Lacroix, harpsichord. Record Society stereo No. S 6317.

In recent years, we have come to know so large a quantity of Vivaldi's music that we have tended to identify the composer, generally, with all that was most accomplished and elaborate in the Italian baroque; and it must be recognised that this was the effect Vivaldi had on his contemporaries and followers. Yet, it is far from the complete picture, and this rather surprising disc may go some way towards demolishing such bias and prejudice. For this reason alone, if it had nothing else to commend it, the record would be a very welcome one.

These six sonatas were originally

scored for bagpipe, viol, flute, oboe and violin, with continuo and, as the author of the annotations very properly suggests, they would be better described as "Diversions" since they certainly are not what we usually think of as "sonatas." These pieces are indeed a far cry from the highly formalised sonatas popular in Vivaldi's time and they are equally remote from the scope of the "suite" of dances which also took a specific and rigid form.

What is so remarkable about these pieces is that they allow the composer to exhibit the utmost freedom from all current conventions; even more remarkable is the immensely varied, highly original and wholly diverting musical content. In these arrangements at any rate (the author has not been named but may well prove to be Rampal himself), I would class the works as being on a level with the Cassations, Serenades and other entertainments written by Mozart for his noble patrons half a century later.

Up to the present, we have been conscious of Vivaldi as a writer of concerti in the first place, with vocal and chamber music being of much lesser importance. Here, we meet the composer as a highly skilled purveyor of occasional music and light entertainment, made valuable only by virtue of the author's undoubted genius. The sonatas vary in length from four to six movements, they are highly inventive and I found them wholly delightful.

The disc is more than commonly enjoyable thanks to the simply marvellous playing of both soloists; in fact, I doubt that Rampal has ever been heard to greater advantage. The recorded sound is quite excellent, clean and crisp and I am satisfied that this record will give enormous pleasure to listeners without in the least straining their intellectual capacity.

★ ★ ★

SULLIVAN: "Irish" Symphony in E minor; Overture "Di Ballo." Royal Liverpool Philharmonic Orchestra; conductor Charles Groves. HMV stereo ASD 2435.

Although I cannot claim more than a nodding acquaintance with that great body of entertaining material known as "G & S," I had been made aware of Sir Arthur Sullivan's outspoken claim to being a leading composer of the nineteenth century. It was a claim, I should add, that I acknowledged without in the least believing in its justice.

Sullivan's big E minor symphony was written in 1863 when the composer was but a youngster, though a celebrated one, and it proves a not wholly unsuitable vehicle for a more balanced assessment of his undoubted gifts. (In

fairness, it must be mentioned that the title "Irish" was bestowed on the work by its publisher, in 1915; Sullivan's salesmanship was less devious!) One thing that stands out very clearly is that, even so early in his career, Sullivan was a true master of orchestration and had thoroughly learned everything his German teachers could teach him.

Just as evident as Sullivan's technical mastery is his great dependence on Mendelssohn, in almost every department of composition. On the other hand, what appear at first to be borrowings from Brahms and Schubert are not what they seem; the Schubert work apparently plagiarised was lost at this time and not rediscovered until much later, the Brahms piece had not yet been written and it may be that it was Brahms who borrowed from Sullivan — who can tell?

There are some other characteristics of Sullivan's music which, by our standards of today, are deplorable; but standards are governed by fashions and the things to be deplored were often not only accepted, but often expected, in their day: lapses into utter bathos, appalling banalities and brass passages barely worthy of a suburban Salvation Army band, not of a symphony orchestra, of professional musicians.

Some of the things I've said may sound nasty; therefore, I hasten to state that I enjoyed this symphony very much indeed, even if parts are in rather poor taste (a shudder never hurt anyone yet!) The performance, though it is not a brilliant one, is highly competent, intelligently conducted and quite excellently recorded — as a matter of fact the recorded sound is decidedly superior to what it is given to reproduce.

The Overture, delightfully fresh and danceable (as, incidentally, I found much of the symphony to be) is also quite excellently played and recorded and proves a very suitable filler for this memorable disc.

★ ★ ★

MENDELSSOHN: Piano Concerto No. 1, G minor, op. 25.

SCHUMANN: Piano Concerto, A minor, op. 54. Rudolf Serkin, piano; The Philadelphia Orchestra; conductor Eugene Ormandy. CBS stereo SBR 235328.

This disc is a bit of a puzzle; unless I am very mistaken, this Australian CBS issue consists of parts of two of U.S. Columbia's Serkin recordings. He played both Mendelssohn piano concerti for CBS and the resulting disc was released early in 1966; he also recorded the Schumann concerto, coupled with other Schumann works, for issue in 1965. I can find no evidence that Serkin ever did these works again and must conclude that CBS are now, belatedly, issuing some of their older titles with, probably, the benefit of re-processing at certain technical stages.

What is at least as strange is that Serkin, one of the oldest of the surviving musical giants of the thirties, should have become so expert an interpreter of the romantic repertoire. Serkin's early fame rested almost wholly on chamber music — duos, trios and quartets — and a limited specialisation on the music of Schumann. Recordings of recent years included some surprisingly insensitive Mozart performances and it is only

now that his real leanings are becoming clear.

Serkin's reading of the Mendelssohn concerto is certainly one of the finest I have ever heard; in fact, it is the only first-rate recording of the work since a 1956 version played by Peter Katin and the performance is vastly superior on just about every point, record quality apart. I have absolutely no criticism of Serkin; as far as the orchestra is concerned, they sound rather noisier and brassier than I think either right or desirable and the sound is certainly very big; but it is also silky and highly polished and never less than agreeable.

The Schumann concerto is a rather different matter since, here, Serkin has to contend with rather formidable competition. Among others, Richter, Gulda, Anda, Arrau and Katchen have given us first-rate recorded versions and Serkin is, by comparison with them, disadvantaged by the orchestral accompaniment. Rudolf Serkin was and remains a great artist and his intimate knowledge of Schumann's score is acknowledged, but this does not mean he necessarily has a better understanding of the composer than others of lesser experience.

Serkin's view of the concerto is extravagant, exhibitionist; his version of romanticism is wholly unlyrical, full of grand flourishes. The piano tone produced by him is never out of proper proportion, but his tempi, his pauses tend to exaggerate. Most importantly, the sound of the orchestra is simply too rich in its gaudiness and I can only blame Ormandy for the excessive gloss. The recorded orchestral sound is, of course, gorgeous and the playing of the orchestra is marvellous; but a certain reticence, which I believe belongs to Schumann's music, will not be found here.

★ ★ ★

BEETHOVEN: Piano Sonatas No. 21, C major, op. 53 ("Waldstein" and No. 31, A flat major, op. 110. Daniel Barenboim. HMV Stereo HQS 1181.

Both as a conductor and as a pianist, Barenboim has always impressed me as a man of exceptional good taste, great refinement and little sympathy with coarseness. If I am less than happy with these performances, it is precisely because of the artist's above qualities.

By the time he wrote opus 110, Beethoven's music bordered on the spiritual and Barenboim's approach is not wholly unwelcome. There is, perhaps, some lack of involvement with the problems of daily life, some lack of urgency in the outer movements. Against this, the sheer beauty of the Arioso is utterly right and all one could hope for from an artist twice Barenboim's age.

It is in the "Waldstein" that Barenboim seems to me to fail completely. This music definitely calls for a degree of tempestuousity and however great the beauty and refinement of Barenboim's playing, they cannot compensate for the apparent lack of temperament. There is, in fact, too much of refinement, too little of hankering after Madame Kraus' erratically personal interpretation of this music. I certainly prefer the understanding of Beethoven shown by such artists as Solomon and Backhaus.

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approach, special mention must be made of two aspects: one is the delicacy of his touch, his ability to caress the last finesse out of his keyboard; the other is the quality of the recorded sound which makes this one of the best piano recordings I've yet heard.

★ ★ ★

MOZART: Clarinet Concerto A major, K.622. Alfred Prinz, clarinet; Flute & Harp Concerto C major, K.299. Werner Tripp, flute; Hubert Jelinek, harp; Vienna Philharmonic Orchestra; conductor Karl Munchinger. Decca Ace of Diamonds stereo SDDA 155.

This is a re-issue of a well-regarded 1964 release and even though both works make frequent appearances, this low-price issue is bound to attract interest. As regards the clarinet concerto, no one would deny that there are other, far more exciting performances on the disc — as those by de Peyer, Lancelot and Walton. None of these, however, are really superior in accompaniment or the basic sound quality. Prinz is, by this performance, highly competent, able and conscientious; he is not a great and spectacular virtuoso, but he does play the score accurately and well. What matters more than his virtuosity is the marvellous support he receives from Munchinger, from flawless orchestral playing and from the strong Mozartean tradition which inspires everyone concerned in this performance.

The flute and harp concerto, little known until recent years, has been recorded on several occasions now and there are at least two truly first-rate versions: that played by Rampal, Laskine and the Paillard Orchestra (World Record); and the H.M.V. performance by Elaine Shaffer, Marilyn Costello and the Philharmonia conducted by Menuhin; this 1964 issue is, as far as I know, now deleted. The Decca here re-issued is not, I think, in quite the same class as either of the above.

The soloists play the music faithfully and well, but without a great deal of imagination and the performance lacks the sparkle that can transform this work into something very delightful. This apart, the work really comes off very well and Munchinger once again acquits himself well. The performances are stylish throughout and, allowing for the age of the recording, the sound is very acceptable and the stereo good.

★ ★ ★

BRAHMS: Sonatas for cello and piano in E minor, op. 38 and F major, op. 99, Jacqueline du Pre and Daniel Barenboim. Record Society stereo No. 6318.

Brahms' cello sonatas are far from routine fare and recent years have witnessed but few fine recordings of these works; the best, so far, is probably the set recorded for DGG by Fournier and Firkusny. In their own way, the performers on this latest release are just as good, their performances as valid as those on the German disc. Fournier, as is his wont, concentrated on classical purity of line and he was accurately, but rather discreetly partnered by an unusually reticent Firkusny who, with increasing maturity, controls his flights of fancy far more rigorously than he used to.

Miss du Pre belongs to another generation and her playing is utterly

unlike Fournier's. As usual in her interpretations, there is a certain degree of preoccupation with detail. Her concentration is rewarded with a lush and always beautiful string tone, free of nasality; whatever might be lost in the way of a grand overall design is made up for by flashes of uncanny insight. Her partner, now her husband, always a little wayward when given his romantic head, fits her approach surprisingly well.

The outstanding characteristic of this performance is that it is truly great duo work, wonderful musicianship resulting in one of the most rewarding performances of any of Brahms' music for a long, long time. There are moments when the very flexibility of the players threatens to make the whole edifice collapse, but it never quite happens and careful listening proves that all the risks they take are carefully calculated ones. Despite the great spontaneity of this performance compared to the DGG one, there is a discipline in it, albeit a new kind of discipline. The recorded sound is as beautiful as is the playing of this gifted pair and the disc is highly recommended.

★ ★ ★

WAGNER: Great Scenes from "Götterdämmerung." Helen Traubel, soprano; Lauritz Melchior, tenor; N.B.C. Symphony Orchestra; conductor Arturo Toscanini. RCA Victrola, mono only VIC 1369.

Although I have never been a Wagner fan, I shall always recall Wagner performances conducted by Toscanini as the most exciting events of my opera-listening career. Toscanini in

rehearsal, on the rostrum, even in broadcasts and, later, on records, spread an air of excitement which is reserved for truly great musical events.

The scenes from "Götterdämmerung" — Daybreak, the duet between Brunnhilde and Siegfried, Siegfried's Rhine Journey and Brunnhilde's Immolation—are well enough known and I won't claim that they are necessarily the best of Wagner, but they are probably the best choice for a summing-up of the "Ring" cycle and the music brought out all the best and most autocratic in the Maestro.

The excerpts heard here come from two 1941 performances in New York's Carnegie Hall, one being a broadcast, the other a recording session. Despite the age of the recordings, the sound is remarkably fine and free of distortion and I do not think the lack of stereo will seriously trouble anyone who is basically interested in these historic performances.

It is, of course, not only Toscanini that makes these recordings historically important. Melchior was one of the greatest and most successful of Wagnerian tenors, a true "Heldentenor," and this recording does full justice to his beautiful and powerful voice and to his great artistry even if, regrettably, it leaves us without his powerful stage presence.

Helen Traubel, the Met's celebrated Wagnerian soprano, has not fared particularly well on some recent re-issues and I am happy to report that, on this disc, she emerges more successfully. I never heard her on stage and cannot tell whether a recording such as this

one does her full justice; I do not think that she can, at any time, have been a serious rival for Flagstad and her Brunnhilde sounds less convincing than Nilsson's, dramatically.

At all events, this is an important disc for others than just Wagner fans and one of the best yet of the Toscanini re-issues.

★ ★ ★

STRAUSS: Don Quixote, op.35. Vienna Philharmonic Orchestra; conductor Lorin Maazel. Decca stereo SXL 6367.

It really seems rather odd that, after musicians and music writers have been denigrating Strauss and his orchestral "tone-poems" for years, these are the very pieces that continue to be played with great regularity, suggesting that there is a steady public demand and support for them. In addition, these works are excellent "conductor's music" and it is not surprising that several of the younger and more flamboyant conductors frequently turn to these scores.

While many of Strauss' large orchestral works have shown this trend, "Don Quixote," this great set of "Fantastic Variations" has remained relatively neglected and is far less well known. This score calls for a solo viola and solo cello at a virtuoso level and is not as obviously an orchestral bravura piece as some of the other symphonic poems.

Strauss, on this occasion, adhered to a tightly constructed program and the musical episodes are wholly based on Cervantes' great novel. The two

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solo parts are played by Emanuel Brabec, a veteran Viennese cellist and erstwhile friend of Strauss and violist Josef Staar, whom I had not previously heard; both of them play beautifully, devotedly and with great effect. The rest of the score is complex and highly accomplished, difficult to play and indeed a pleasure to hear once again.

The performance by the Vienna Philharmonic, on this disc, is truly masterful and one of Maazel's greatest achievements. He is an ambitious conductor and has steadily improved over recent years, gradually placing himself firmly in the forefront of Europe's conductors. The recorded sound is very brilliant, stereo excellent and the disc one of the best to come from Decca recently. The set can be confidently recommended as a valuable addition to the Strauss repertoire and the best recorded version of this interesting work currently on issue.

★ ★ ★

NICOLAI GEDDA: Popular Arias from *L'Africaine*, *Aida*, *Un Ballo in Maschera*, *La Boheme*, *Eugene Onegin*, *Faust*, *La Gioconda*, *Manon Lescaut*, *Tosca*, *Turandot*; with the Royal Opera House Orchestra, Covent Garden, conducted by Giuseppe Patane. H.M.V. stereo OASD 2445.

It looks like standard popular arias from the usual repertoire and I approached this disc with some reluctance. Luckily, I was wrong; many of the arias are indeed the same old war-horses, but even they sound quite interesting when they get the Gedda treatment. The beautiful voice is wholly expected, of course, but Gedda always sings with dramatic conviction... In Gedda's recital, "E lucevan le stelle" becomes much more than a famous aria — we really hear Calvarodossi's cry from the heart.

What pleased me even more was the discovery that, despite the record's title, not all the arias are popular favourites. Some of them in fact are quite un-hackneyed. Lenski's great aria from "Eugene Onegin" is certainly not everyday fare and I have rarely heard Tchaikovsky better sung, even by Russian tenors. Similarly, the two arias from "Masked Ball" are outside the standard repertoire and Gedda does this fine music full justice.

Apart from the tenor's very fine singing and his excellent dramatic characterisations, especial mention must be made of the orchestral playing which is several cuts above what one usually expects on such a recital disc. Patane's direction is never less than competent and, in places, quite brilliant. As well, the recording is uncommonly well made and H.M.V. have enclosed a leaflet with the full texts of the arias.

It is perhaps not the accepted thing to be following the texts in a recital of arias, but it now seems to me that other manufacturers might do well to follow the lead given by E.M.I. However well-known a popular aria may be, few of us own a library of libretti and I doubt that many listeners are familiar with the verbal content of their favourites. I found that the music becomes much more meaningful with this little aid. For this, and the quality of the recording, full marks to E.M.I.; for a wonderful recital, top marks to Mr Gedda!



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Devotional recordings

ONE HUNDRED AND TWO STRINGS, Volume Two, conducted by Ralph Carmichael. Stereo, Sacred LPS-74051. (From Sacred Productions Aust., 181 Clarence Street, Sydney, and other capitals).

Interest: Singing strings — devotional.

Performance: Easy on the ear.

Quality: Excellent.

Stereo: Normal.

In his jacket notes, Ralph Carmichael reminds us that his "One Hundred and Two Strings, Vol. 1" was woven around old titles and a sweeping rubato style. By contrast, this new album is devoted entirely to comparatively recent devotional songs composed by Carmichael himself. They will be well enough known to young people who frequent weekend Gospel rallies, though it is safe to say that they will seldom have been heard in the lush string settings, as here. However, the sound should equally please those to whom the titles are unfamiliar and, helpfully, the words are printed on the jacket: He's Everything To Me—For By Grace—Love Is Surrender—I Looked Into His Face—Reach Out For Jesus—All My Life—Beyond All Time—For Ever and Ever—Precious The Moments—A Quiet Place.

A very pleasant record, well recorded and playing for about 30 minutes. (W.N.W.)

★ ★ ★
MUSIC FOR HOLY WEEK. The Ambrosian Singers, conducted by John McCarthy. His Master's Voice (E.M.I.) stereo OASD 7551.

Interest: Catholic Liturgy.

Performance: Professional.

Quality: Clean sound, but non-reverberant acoustic.

Stereo: Normal.

The title of this disc should be "Liturgical Music of the Catholic Church for Holy Week, 15th and Early 16th Centuries," for this more precisely is what it contains. The composers are from Italy, England, Spain, Portugal and Bohemia, all very known in the field of Church music. The music is arranged in liturgical sequence, as follows: Palm Sunday. Antiphons "Hosanna Filio David" (Plain-song); "Pueri Hebraeorum Portantes (Palestrina); and "Pueri Hebraeorum Vestimenta" (Victoria) — Maundy Thursday. Responsory for Tenebrae "In Monte Oliveti" (Gesualdo) — Good Friday. Lamentiones (Byrd); "Tenebrai Facta Sunt" (Victoria); Responsory "Jesum Traditit" (Gesualdo); Responsory "Caligaverunt Oculi Mei" (Victoria); Antiphon "Improperia" (Palestrina); Antiphon "Crux Fidelis"

(King John IV of Portugal)—Easter Saturday. Responsory "O Vos Omnes" (Richard Deering); Responsory "Ecce Quomodo" (Jacob Handl) — Easter Sunday. Gradual and Alleluia "Haec Dies" (Byrd).

Space does not permit a discussion of each item, but particularly interesting are Gesualdo's "Jesum Traditit," one of the acknowledged masterpieces of its type, which has some very moving passages; and the two pieces by English composer William Byrd—the "Lamentiones" is tautly tragic, while his "Haec Dies" for Easter Sunday is a joyful outburst which provides a welcome relief from the predominantly gloomy atmosphere of the disc as a whole. In fact, this point deserves comment. As Easter is, with Christmas, one of the two great Feasts of the Church calendar, one would have expected rather more of the joyful feelings associated with the Resurrection, rather than the almost total preoccupation with the sorrows of Lent.

The performance of the Ambrosian Singers does not call for much comment. They are a very experienced group in this kind of antiphonal and modal music, and perform as competently as one would expect. The recording itself is slightly disappointing. The sound is as clean as one would wish, but the acoustic is non-reverberant, and the tone of the singers sounds on the thin side. This could be because of the small numbers employed. As far as I could judge, each part is taken only by one singer, so that numbers vary from four to six.

Instrumental, Vocal and Humour . . .

THE PINES OF ROME: THE FOUNTAINS OF ROME. (Respighi). The Philharmonia Orchestra conducted by Rafael Fruhbeck de Burgos. Decca (E.M.I.) stereo TWO 239.

Interest: Roman pictures.

Performance: See review.

Quality: Excellent.

Stereo: Wide and smooth.

I know it is fashionable to sneer at these pieces as pretty picture postcards, but I have always had a taste for colourful postcard views and I find considerable pleasure in listening to these musical equivalents. Not that the description is entirely justified, anyway. There is some fine music, beautiful themes and certainly masterly orchestration in this music. The last movement of the "Pines" suite, representing the slow approach and triumphant procession of Roman legions in

The absence of an organ accompaniment may also be felt by some. (H.A.T.)

★ ★ ★

OUR GREAT SAVIOUR. The John Lundberg Male Choir. Stereo, Word WST-8453-LP. (From Sacred Productions Aust., 181 Clarence Street, Sydney and other capitals).

Interest: Male choir.

Performance: Notable vocal musicianship.

Quality: Excellent.

Stereo: Normal spread.

John Lundberg, conductor of this excellent male choir, was himself first tenor for many years of The Old Fashioned Revival Hour Quartet, featured on a world-wide network of radio station. In the meantime, however, he has pursued an academic career, specialising in vocal music. He is currently Minister of Music at the famed Los Angeles Church of the Open Door.

The arrangements in the album, by John Lundberg, emphasise his preference for three-part harmony, as being more appropriate than four-part harmony for the limited compass of male voices.

Most of the hymns are well known: O Could I Speak—The Beauty Of The Earth—Dear Lord And Father Of Mankind — The God Of Abraham Praise — Our Great Saviour — The Spacious Firmament — The Lord Is Risen Indeed—Break Thou The Bread Of Life — How Firm A Foundation—Jerusalem The Golden — Glorious Things Of Thee Are Spoken — Now The Day Is Over.

Completely without instrumental accompaniment or interlude, the performance is sincere, sensitive and one that could be given by vocalists no less dedicated to their music than the conductor himself. It is an album that I would readily recommend to all interested in choral Gospel work but it would also be an excellent addition to the library of anyone interested in Gospel music generally.

Technically, the sound quality of this wholly imported album is excellent but there is a slight surface "prickle," audible mainly between tracks. Don't let this deter you, however. (W.N.W.)

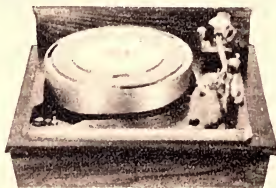
a misty dawn setting, is entirely satisfying, both musically and emotionally. The "Fountains" suite also has many fine moments.

This performance lays great emphasis on the more romantic aspects of the music, but tends to underplay the climaxes. As such, it will possibly not satisfy those accustomed to performances by the American orchestras, whose conductors tend to the opposite. Those who have no preconceived ideas about the music should find little to complain about. I regard the present Philharmonia Orchestra as one of the world's best and they are particularly good in the more lush and romantic section. However, if you really want to hear how the climaxes should sound, you must go to the Toscanini performances on RCA discs. Incidentally, this disc has a generous fill, in the form of two of Stravinsky's lighthearted pieces:

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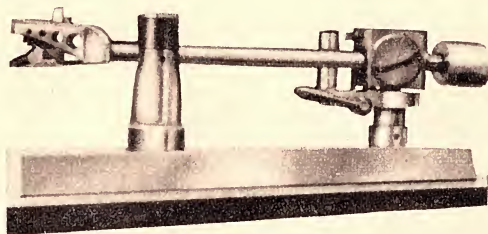
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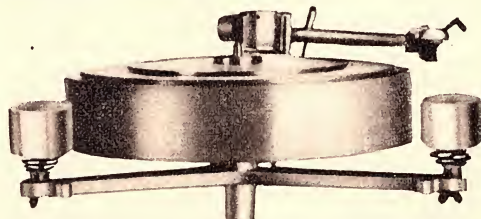
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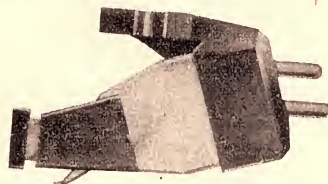
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Fireworks, and Circus Polka. Neither is very significant, but worth having as novelty items. (H.A.T.)

★ ★ ★
MOZART'S GREATEST HITS. Various artists and orchestras. C.B.S. stereo SBR235329.

Interest: Popular Mozart.
 Performance: High standard.
 Quality: Very good
 Stereo: Normal spread.

As an introduction to the music of Mozart, this disc could hardly be improved upon. The pieces are all from those which exercise an immediate appeal. In fact, I should say that every one of these pieces is among those which awakened my interest in Mozart in my early youth. The opening piece is the Andante from the Piano Concerto No. 21, which has recently become popular because of the use of its theme in the film "Elvira Madigan." The longest work is "Eine Kleine Nachtmusik" played in full by the Philadelphia Orchestra under Ormandy (and played in much too matter-of-fact fashion for my taste). Piano music is represented by the first movement from the charming little Sonata in C ("Sonata Facile") played by Glen Gould, and the "Turkish March" movement from the Sonata in A, played by Philippe Entremont. Other works are Overture to "Marriage of Figaro"—Menuet from "Don Giovanni" and Menuet from Divertimento in D. A pleasing selection, performed by leading artists and orchestras. (H.A.T.)



★ ★ ★
BEETHOVEN'S GREATEST HITS. Various artists and orchestras. C.B.S. stereo SBR235333.
 Interest: Beethoven sampler.
 Performance: Very competent.
 Quality: Very good.
 Stereo: Normal.

The second side of this disc is taken up entirely by the last movement of the choral movement of the Ninth Symphony, a somewhat strange choice for a disc aimed at those with an awakening interest in the classics. When I myself first heard this work, at a time when my knowledge of the classic literature was limited, I could make little of it, and it was several years before I could appreciate it. The rest of the program is appropriate enough. The disc starts with the first movement of the Fifth Symphony, which has introduced countless listeners to Beethoven. Also included are the

first movement of the "Moonlight" Sonata (Philippe Entremont), piano), Minuet in G, Bagatelle "Für Elise," and Turkish March from "Ruins of Athens." The orchestras are the Philadelphia under Ormandy, the New York Philharmonic with Bernstein, and the choir is the Mormon Tabernacle. With such eminent performers, intending purchasers need have no doubts about the performances. (H.A.T.)

★ ★ ★
SWITCHED ON CLASSICS. Japanese artists and orchestra conducted by Takatoshi Naito. King Records (Festival). Stereo SFL-933,276. Available in mono.

Interest: Swung classics.
 Performance: Tastefully executed.
 Quality: High standard.
 Stereo: Well spread.

Allowing for the difference between a full orchestra and a piano, bass and drums trio, there is a similarity of style between the "modern interpretations" given on this disc by a Japanese group and those of the Jacques Loussier "Play Bach" group. The material consists of well-known classics, presented in something like a modern progressive jazz style, but maintaining the feel of the original melody throughout. As with the French group, the execution is entirely tasteful and restrained. The arrangements are skilfully done and the performers are of excellent standard. I agree with the sleeve note, that this is "a thoroughly enjoyable L.P."


The original classics upon which the material is based include: Autumn from "The Four Seasons" (Vivaldi)—Piano Concerto No. 2 (Rachmaninoff)—Ma Mere L'Oye (Ravel)—Dance of the Blessed Spirits from "Orpheus" (Gluck)—Violin Concerto (Sibelius)—Adagio (Albinoni)—Clair de Lune (Debussy). The recording, by King Records, Japan, is of excellent quality. (H.A.T.)

★ ★ ★
CLASSICS FOR CHILDREN. Stories with music. Stories narrated by Art Gilmore and Don Wilson. Music played by The Continental Symphony Orchestra. Encore (E.M.I.) mono only. Two discs, Vol. 1 ENC 9525, Vol. 2 ENC 9526.


Interest: For young children.
 Performance: Adequate.
 Quality: Satisfactory.

The idea here is to interest young children in classical music by dressing up each excerpt with a story—the jam around the pill technique. Volume 1 has excerpts from Carmen (Bizet)—The Seasons (Glazunov)—Love for Three Oranges (Prokofiev)—Peer Gynt (Grieg). Volume 2 has: Lieutenant Kije (Prokofiev)—Sleeping Beauty, Swan Lake and Nutcracker Suite Tchaikowsky)—Les Sylphides (Chopin)—Invitation to the Dance (Weber)—The Three Cornered Hat (Falla). The excerpts in each case are quite short.

In assessing records of this type, the intentions of the manufacturers must be considered: I quote: "Classics for Children offers the best loved classical music, recorded by the finest musicians—and woven into the music is a simple story to intrigue the child, assuring attention and enjoyment. There is just enough story to hold interest. The music is not 'adapted' for children, or performed by small groups, but comes

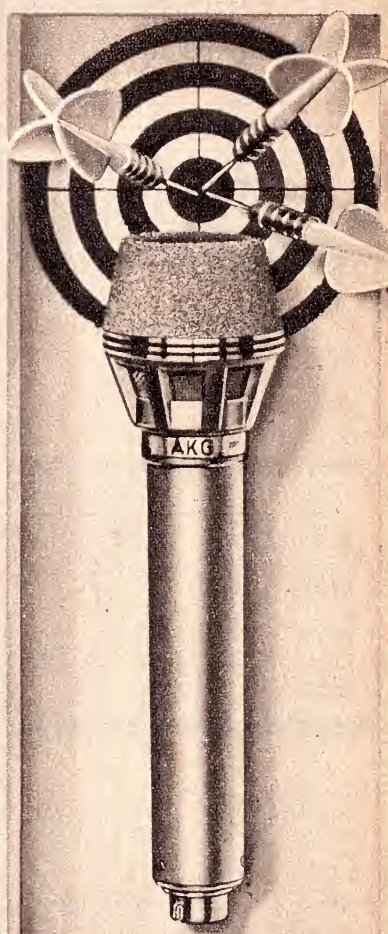


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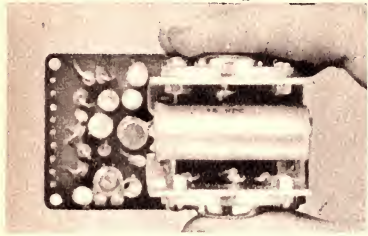


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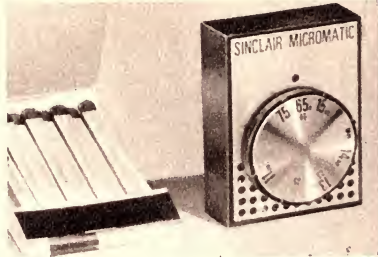


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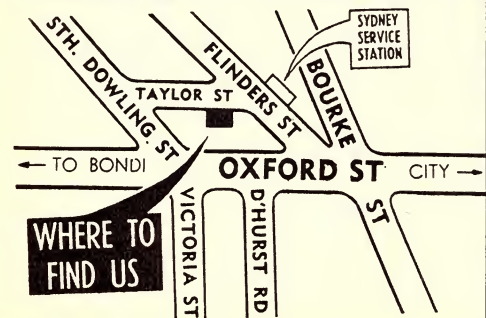
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to the child in its original full beauty of sound, exactly . . ." The idea is sound enough, but in my opinion does not work out as intended.

Leaving aside such quibbles as to whether the Continental Symphony Orchestra can be classified as the "finest musicians," I have my doubts about the abilities of children to discern the music when it is kept at a very low level while a loud voice keeps up a constant patter of storytelling. Not once is the music given a chance to speak for itself, and as a musical appreciation material I rate these discs on the low side. As a collection of simple stories the discs may have some entertainment value for young children up to about 10 years old, but most children would, I believe, prefer some of the established stories from the children's repertoire. (H.A.T.)

FESTIVAL OF SPANISH OVERTURES. The Madrid Symphony Orchestra conducted by Pablo Sorozabal. C.B.S. Stereo SBR 235321.

Interest: Spanish light music.
Performance: Adequate.
Quality: Good standard.
Stereo: Normal.

What the operetta is to the Viennese, the zarzuela is to the Spaniard — that is, a kind of lighthearted musical play, usually of the "boy, meets girl" type, with virtue always triumphing at the end. Each zarzuela had an overture, containing a summary of the main tunes, and it is a collection of these overtures which are presented here. The music is essentially Spanish, having the unmistakable Andalusian character, often featuring flamenco rhythms and castanets. As one who has always been attracted to Spanish music, I found this collection entirely enchanting. Why record companies, with their hunger for new material, have neglected this source of delightful music is quite unaccountable, and makes this issue doubly welcome.

The overtures here are by the foremost zarzuela composers; R. Chapi ("La Revoltosa" and "El Tambor de Granaderos") — J. Gimenez ("El Baile de Luis Alonso" and "La Boda de Luis Alonso") — T. Bregon ("La Verbena de la Paloma" and "La Dolores") — F. Chueca ("Agua, Azucarillas y Aguardiente") — Caballero ("Gigantes y Cabezudos"). If you favour the Andalusian style of music, you cannot fail to enjoy this disc. The orchestra is by no means in the same class as the leading ones, but are well able to give a good account of themselves in this lighthearted material. The recording quality is adequate. (H.A.T.)

STRING SPECTACULAR. Tamae Koh (harpichord) and the Symphonic Stereo Strings, conducted by Hiroshi Ishimaru. King Records (Festival) stereo SFL-933,480.

Interest: Singing strings.
Performance: Excellent.
Quality: Excellent.
Stereo: Well spread.

A performance of currently popular songs, in the "singing strings" type of performance — but excellently done, and very listenable indeed. The selection comprises: Yesterday — A Whiter Shade of Pale — The Last Waltz — I Love Paris — Scarborough

OLIVER — "Excellent buy"

THE WORLD OF OLIVER! Original cast recording from the New Theatre, London. Decca (E.M.I.). Stereo SPA 30.

Interest: Popular show tunes.
Performance: One of the best.
Quality: Excellent.
Stereo: Well spread.

This version of the popular musical "Oliver" has the original London cast, and I am told by E.M.I. that it has been a consistently good seller ever since its first introduction. Now that it has been re-issued on the Decca \$2.50 label, it should have even more attractions. The cast has Keith Hamshere

as Oliver sounding suitably thin voiced and weak in the early numbers, but more lively later on; Ron Moody, giving a very good characterisation as Fagin; Danny Sewell, as a ferocious Bill Sykes; Paul Whitsun-Jones as the Beadle, and Hope Jackman as Mrs Corney the Matron, both oozing hypocrisy; Martin Horsey as the Artful Dodger; Georgia Brown as Nancy. All parts are played very competently, although the vocal achievements of some of the players are hardly their outstanding feature. The full list of the shows songs is presented. The technical excellence of the disc makes it an excellent buy at the price. (H.A.T.)

Fair — Fascination — Strangers in the Night — Shenandoah — Love is Blue — Moon River — Greensleeves — More. If this selection appeals, the disc can be safely recommended, as the performance cannot be faulted, and the arrangements are appealing and tasteful. The recording, by King Records, Japan, is of excellent quality. (H.A.T.)

SONGS FROM HEIDI. Original soundtrack album, arranged and conducted by Camarata. Mono, Disneyland DQ-1327. (Released through E.M.I. Australia).

Interest: Music from the film.
Performance: To usual Disneyland standard.
Quality: See below.

As with many — perhaps most — soundtrack albums, this one will mean most to those who have seen and enjoyed the film, and who will quite automatically fit the scenes to the sound. Particularly will this be the case with side 2, where much of the instrumental and choral sound has apparently been taken on location in Switzerland, under conditions somewhat less than optimum in the technical sense.

By contrast, the songs on side 1 have a sparkling, studio quality and, perhaps wisely, have been grouped together: I Am Wearing A Rainbow — I'm Thankful — The Places That I Love — Mrs Rottenmeier's Rules — Off To The Hottentots You'll Go — Heidi.

For those who did not see the film, the jacket carries a brief but helpful synopsis of this essentially children's story but I imagine that the people most likely to buy the album will not need the storyline. (W.N.W.)

HELLO, DOLLY! The music from the film with Barbra Streisand. 20th Century Fox Records (Festival), stereo.

Interest: Mainly Streisand.
Performance: Successful on disc.
Quality: Very good.
Stereo: Effective.

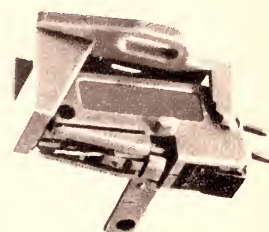
One of the most popular shows of the 1960s, "Hello, Dolly!" will almost certainly be one of the big cinema hits, since it has the enchanting Barbra Streisand in the title role, regardless of any other merits it may have. And we may be sure that the sets will be lavishly mounted and the costumes will be gorgeous. However, these are attributes which cannot be presented on a gramophone record. Here, we are left with the songs from the show, and it is on this alone that the disc must be judged. I can say categorically that the disc is quite able to stand in its own right as entertainment. Miss Streisand is as delightful as ever, and receives high quality support from the remainder of the cast and the orchestra. Normally, I find film sound track music one big yawn, but not this one. All the show tunes are there; I am sure it is not necessary for me to list them. (H.A.T.)

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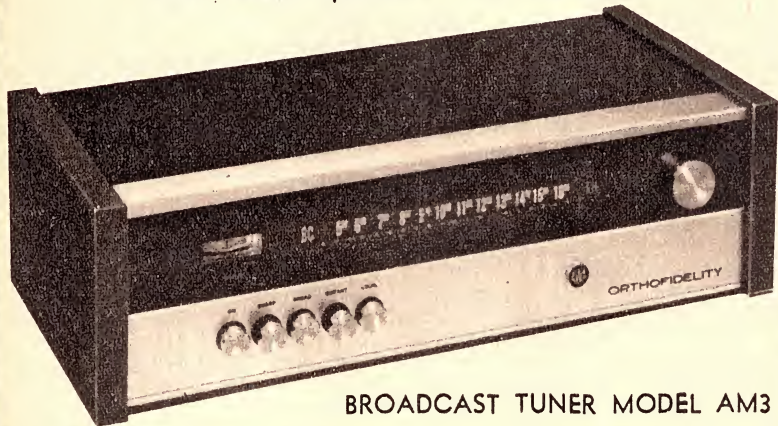
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BLUE MATTER — Savoy Brown
Decca (EMI) Stereo SKLA 4994.
Interest: English blues band.
Performance: Excellent L.P.
Quality: Well recorded.
Stereo: Adds little.

This new Savoy Brown L.P., their second to be released in Australia, is quite superb. Indeed, on the strength of these tracks, Savoy Brown is a much under-rated blues group on the scene today.

The first side was recorded in the studios and Chris Youldens singing dominates each of the five tracks. Particularly good are two Youlden originals, "Tolling Bells" and "She's Got A Ring In His Nose." But Youlden receives very sympathetic and accomplished backings from the rest of the group, particularly Bob Hall on piano and Kim Simmonds on lead guitar.

The three tracks on the second side were recorded "live" — and very well — at the Leicester College of Education last December. Unfortunately, Chris Youlden was absent through illness but Lonesome Dave, the second guitarist, took over the vocals with great success. The Muddy Waters composition "Louisiana Blues" is the outstanding track on this side.

But the whole L.P. is very successful and can be recommended to all readers with an interest in contemporary English blues. (T.F.C.)

★ ★ ★
UPTIGHT—Booker T and the M.G.'s
Stax Records (Festival) Stereo
SKL 933174 (also in mono).
Interest: Film sound-track.
Performance: Enjoyable L.P.
Quality: Very well recorded.
Stereo: Normal separation.

This album contains the sound-track music which Booker T. Jones wrote for Jules Dassin's film, "Uptight." As with the majority of sound-track recordings, this album clearly suffers out-of-context from the film. But it is, nevertheless, a thoroughly enjoyable L.P.

Booker T and the M.G.s are perhaps the most accomplished and successful recording and session group on the scene today. Their musicianship is of a very high order and, in addition, Booker T. Jones himself demonstrates a very considerable talent for composition.

Already one track, "Time is Tight" has become a smash hit for the quartet all over the world and, as soon as the film is released in Australia, this recommended LP should become very popular. (T.F.C.)

★ ★ ★
HOTCHA-MA-CHA-CHA! Harry Roy and his Band. Music for Pleasure
MFP-A8082, mono only.
Interest: Mainly mid-1930s.
Performance: Nostalgic.
Quality: Well remastered.

The 1930s in England, as in America, were the golden years of the great Swing/Dance bands, with great names like Geraldo, Ambrose, Lew Stone, Roy Fox and Harry Roy dominating the field in the U.K. Their bands were generally resident at leading hotels and restaurants in London but they also undertook national and international tours, playing for ballroom dancers and theatre audiences. The quality of the musicianship and arrangements was, in the main, very high and these orches-

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Katchen — "delightful"

ENCORES. Julius Katchen, piano.
World Record Club stereo S/4558.

Interest: Piano miniatures.
Performance: Delightful.
Quality: Very good.
Stereo: Not significant.

Most music lovers will know by now that the brilliant American pianist Julius Katchen died last year at the age of 43 — a tragic loss to the world of music. World Record Club is releasing his complete recording of Brahms' piano works next year, so this disc of pleasing trifles may be regarded almost as a curtain raiser. As the title suggests, none of the pieces is very substantial, but they are all pieces of merit. Jesu, Joy of Man's Desiring (Bach, arr. Myra Hess) — Rhapsody No. 2 in G minor (Brahms) — Adagio Cantabile from "Pathetique" Sonata (Beethoven) — Hungarian Rhapsody No. 12 (Liszt) — On Wings of Song (Mendelssohn, arr. Liszt) — First Movement, Sonata in C major (Mozart) — Rondo, Capriccioso (Mendelssohn) — Polonaise in A flat (Chopin) — Fantaisie Impromptu (Chopin) — (Claire de Lune (Debussy) — Ritual Fire Dance (Falla). Beautifully played, and well recorded, this disc should give great pleasure to those who appreciate this lighter kind of piano fare. (H.A.T.)

tras provided a valuable training-ground for many of the leading British musicians in the postwar years.

This album contains 12 tracks by the Harry Roy Band, most of which were recorded in 1933-34. No personnel is given but the band certainly featured the famous duo pianists Ivor Moreton and Dave Kaye, together with a very fine trumpet soloist. The tracks include most of Roy's big successes of the 1930s, like "Bugle Call Rag," "Casa Loma Stomp," "Canadian Capers," "Tiger Rag" and "Roy Rag."

The music on this L.P. may sound dated and corny to younger readers but, for collectors of 1930s swing and dance music, it represents exceptional value at \$1.99. (T.F.C.)

★ ★ ★
MISTER LE ROY PLAYS THE WURLITZER STEREO ORGAN.
Stereo, Disques Vogue (Festival) SVL933,454.

Interest: Versatile electronic organ.
Performance: Excellent theatre style.
Quality: Rather boomy.
Stereo: No doubt about it.

The Wurlitzer stereo organ has a wide selection of voices and effects and Mister Le Roy has selected a program that gives him the opportunity to demonstrate them and, incidentally, his own considerable abilities at the keyboard. His style is very much that of a traditional theatre organist. The program, occupying about 32 minutes, includes: Toy Trumpet — Paradise — Waves Of The Danube — Solveig's Song — Jalousie — In A Monastery Garden — In A Persian Market — Solitude — Fairy On The Clock — Espana — March Of The Aegipans — Tritsch-Tratsch Polka.

How does this electric Wurlitzer compare with its acoustic ancestors? Well, it's available, it costs but a fraction

of the price, it needs little maintenance, and it has a few sounds of its own that reminds one of the Moog Synthesiser. But, while it can also simulate traditional Wurlitzer voicings, the listener will never be in any doubt that he is listening to loudspeakers, echo and sustain — not pipes in an auditorium.

However, as electronic organ recordings go, it rates quite well and holds a good deal of interest in the technical sense. (W.N.W.)

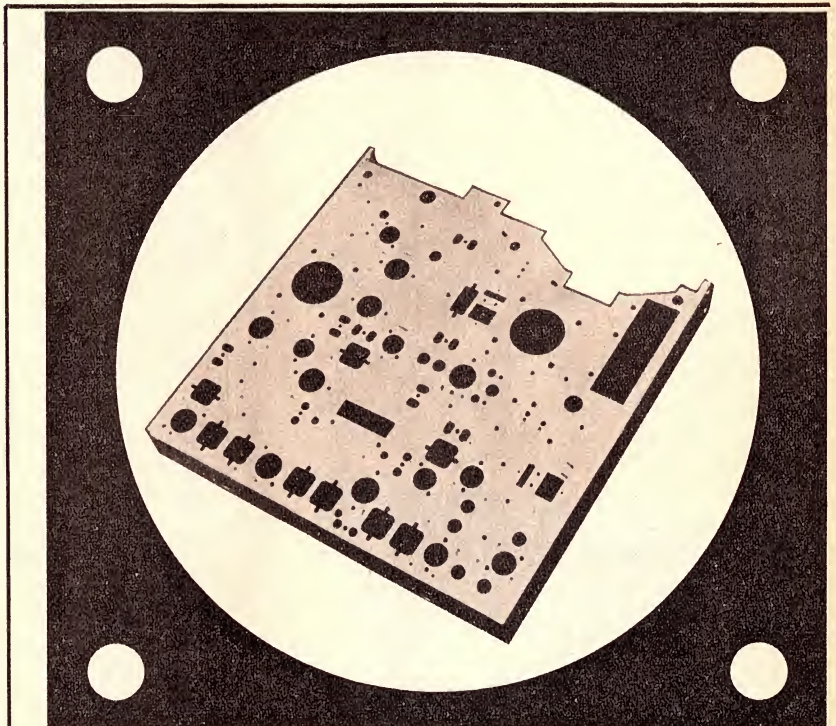
★ ★ ★
DANCING HAMMOND. Bobby As-tor. Universal Record Club stereo U-1009.

Interest: Hammond for dancing.
Performance: Should appeal.
Quality: Good.
Stereo: Unusual features.

There are plenty of records of Hammond organs; there are plenty of records for dancing. This disc will

obviously appeal mainly to those who combine these enthusiasms, although I should point out that it also has considerable listener appeal. Bobby Hammond has a sophisticated style which relies on careful and sparing choice of stops to avoid thickening of the sound. He also achieves some unusual effects, notably a "Waa Waa" sound in one track.

The sleeve note tells us that his organ has specially designed electronic circuitry which divides the range of the Hammond into five distinct channels. This is arranged to place the bass sounds on the left, and the treble on the right, with the others arranged in between in frequency order. In some tracks, the channels are arranged differently for special effects. I doubt whether the average listener is going to care very much about this aspect of the disc, but they will certainly appreciate the skill of the performer, and the tunes are good too: I Left My



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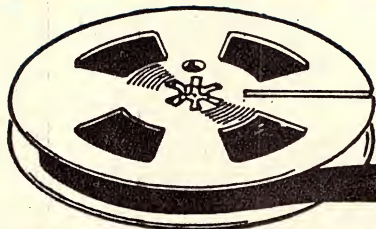
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★ ★ ★
WILBUR KENTWELL AT THE CONN THEATRE ORGAN.
 Stereo, RCA Camden CAMS-145.

Interest: Kentwell on the Conn.
 Performance: Capable.
 Quality: Normal.
 Stereo: Modest.

Through the years, Wilbur Kentwell, a school-time friend of this reviewer, has made many recordings, mainly using Hammonds. In this, his first album for RCA, he uses the Conn theatre model; the recording itself was made in the studios of TVQ Channel 0 in Brisbane, the TV station of which he is currently musical director.

Although Wilbur ranges pretty freely through the voices and the percussion facilities of the Conn theatre model, he makes no special attempt to produce a theatre pipe sound. In fact, for most of the time the sound is deliberately and unmistakably electronic. And whether it's the organ or the new situation I'm not sure but, to my ear, the performance suffered somewhat from excessive modulation of the "expression" pedal.

Be that as it may, the numbers will have their own appeal: Donkey Serenade — Somewhere My Love — Theme from Exodus — Fascination — Dream A Little Dream Of Me — Almost Like

English blues

BLUES ANYTIME VOLUME 3. Immediate (EMI) Mono IMLP 019.

Interest: Mainly for serious collectors.
 Performance: Important collection.
 Quality: Rough in parts.

Volume 3 of Immediate's Blues Anytime Series is, I think, the most important to date.

These recordings were made informally and, in parts, the music is experimental and lacking in polish. But for the serious collector of English blues, this represents an important musical documentation.

The outstanding track on the LP is Little Walter's "Someday Baby" by the late Cyril Davies and his All Stars, but the tracks on the first side also feature three magnificent guitarists in Jeff Beck, Jimmy Page and Eric Clapton. The finest of the British blues pianists, Nicky Hopkins, also plays superbly on all six tracks on this side.

The remaining five tracks on the LP are slightly inferior, apart from a fascinating duet between Clapton and Page. Three tracks feature the Santa Barbara Machine Head, a rough and raw blues group led by organist Jon Lord of "Deep Purple" fame. But there is still more than enough important material on the album to make it a recommended purchase for all collectors of early English blues. (T.F.C.)

Being In Love—Jealousy—Hello Dolly —If Ever I Would Leave You—Seventy-Six Trombones.

An album that is most likely to appeal for dining-cum-relaxation. (W.N.W.)

★ ★ ★
MOCKINGBIRD—Inez and Charlie Foxx. United Artists (Festival) Stereo SUAL 933,293 (also in mono).

Interest: 12 reissue tracks.
 Performance: Dated and dull.
 Quality: Flat sound.
 Stereo: Adds little.

Two or three years ago, it would have been inconceivable that an Australian record company would consider the issue of this album. To that extent, things have improved considerably with regard to local pop releases.

Inez and Charlie Foxx were at the height of their popularity in America (and Britain) in the mid-1960s with their 1963 hit single "Mockingbird," the title track of this album. Most of the tracks on the album are, in fact, reissues of their American singles and they include "Sittin' Here," "Ask Me," "Broken Hearted Fool," "Hurt By Love" and "Down By The Seashore."

Their music is on the raw side, rather unsophisticated Rhythm and Blues, and it now sounds dated. Neither Inez nor Charlie Foxx are particularly convincing or compelling singers on record but, by all accounts, they are very exciting on stage. The backings, too, on these tracks are thin and dull.

These recordings, all but two of which were written by Charlie Foxx.

undoubtedly have their place in the history of R and B but it is hard to see this L.P. causing much interest on the contemporary scene. (T.F.C.)

★ ★ ★
THE TONY TOUCH. Tony Mottola, guitar, with orchestra. Project Three (Festival) stereo SPJL-933-521. Available in mono.

Interest: Swinging guitar.
 Performance: Expert.
 Quality: Excellent.
 Stereo: Well spread.

The release of this latest disc from Tony Mottola provides an opportunity to compare his style of a few years ago, as demonstrated in "Roman Guitar" reviewed overleaf, with his present-day performances. I should say the modern style is more sophisticated, not quite so relaxed and using more elaborate harmonies, while the finger work is more slick. In other words, he has developed as one would expect into a more mature musician. I think the final decision as to whether you buy this disc or any of the many others he has made in recent years will depend on your reaction to the choice of material. The selection here comprises: Help Yourself — Georgia On My Mind — Can't Take My Eyes Off You — Cry Me a River — I'll Never Fall in Love Again — Goin' Out of My Head — This Guy's in Love With You — Those Were the Days — Dream a Little Dream of Me — Lush and Lovely — Come Prima — Do You Know the Way to San Jose?

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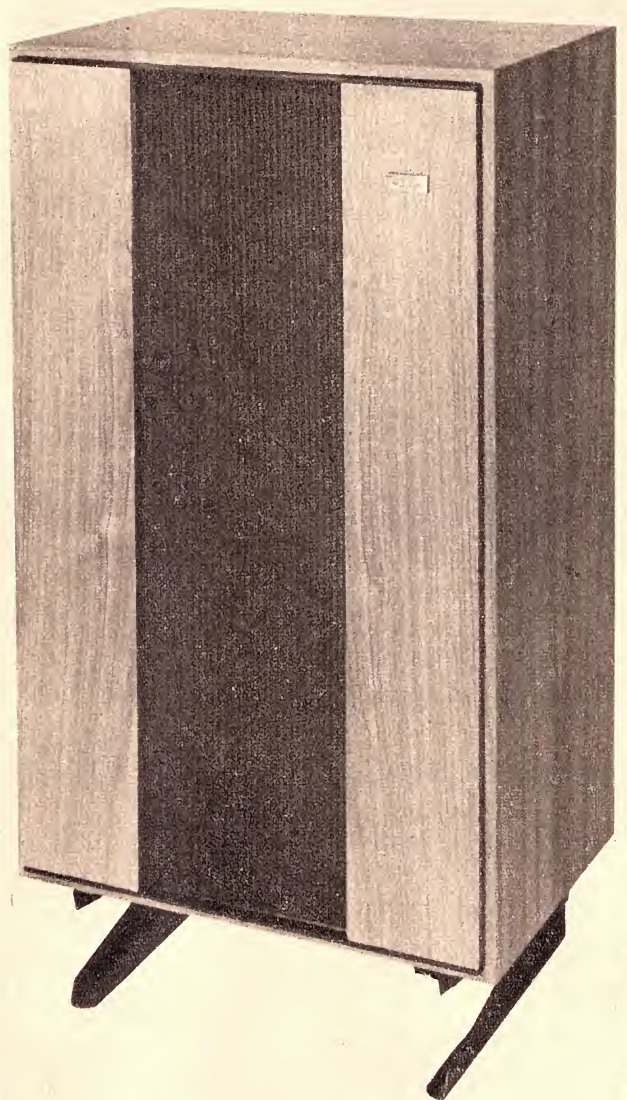
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ROMAN GUITAR. Tony Mottola, guitar, with orchestra. Stateside (E.M.I.) stereo SOSL 10056.

Interest: Italian melodies.

Performance: One of the best.

Quality: Excellent.

Stereo: Good spread and balance.

"Roman Guitar" was originally released four or five years ago under the Command label when the company belonged to Enoch Light. It is one of Tony Mottola's most successful discs and I am glad that E.M.I. have decided to re-issue it on the Stateside label, now that they have taken over the Australian distributorship of the Command catalogue. Mottola is of Italian parentage, and uses his swinging guitar to very good effect in this selection of Italian melodies, both traditional and modern: Roman Guitar — La Strada — Anna — Arrivederci Roma — Sorrento — Violetta — Volare — Italian Serenade — Neapolitan Tarantella — Non Dimenticar — Woodpecker Song — Na Voce. The Enoch Light touch is plainly discernible in the high standard of performance and fine arrangements. A most enjoyable disc which I have no hesitation in recommending. (H.A.T.)

RAW BLUES—Johnnie Taylor. Stax Records (Festival) Stereo SKL-933,281 (also in mono).

Interest: Young blues singer.

Performance: Well worth hearing.

Quality: First-rate recording.

Stereo: Well balanced.

Johnnie Taylor is a new name to me and, so far as I know, these are his first recordings to have been released on the Australian market. Judging by the brief sleeve-note, this 32-year-old blues singer from Arkansas has already achieved a fair measure of success in America.

His singing style can be loosely compared with blues/gospel/soul singers like Ray Charles and Sam Cooke. However, his voice lacks that indefinable greatness which sustains interest over two sides on an L.P. In addition, the majority of the eleven songs on the album are slow and a bit on the dull side. The anonymous backings, on the other hand, are crisply arranged and well played.

Blues and soul collectors should make a point of at least hearing this L.P. With better material, Johnnie Taylor could well become a major force on the scene today. (T.F.C.)

Popular Jazz

THE BEGINNING—Duke Ellington and His Orchestra Calendar (Festival) Jazz Heritage Series, Stereo SR66-9637 (also in mono).

Interest: Early Ellington (1926-28)
Performance: Important years for his music.

Quality: Poorly transferred.

Stereo: Electronically re-mastered.

Interest: Early Ellington.

The tracks on the first side of this bargain-priced reissue were recorded during Ellington's residency at the Kentucky Club; and the second side during the band's very successful years at the Cotton Club.

Nine of the 14 Vocalion and Brunswick tracks on the L.P. are Ellington compositions and, of these, only "Black and Tan Fantasy," "East St. Louis Toodle-oo" and "Black Beauty" have really survived the years. But almost all the tracks, including "Birmingham Breakdown," "Yellow Dog Blues" and "Jubilee Stomp" are valuable and rewarding in a period when Ellington was showing rather more concern for structure and texture in his writing. Nevertheless, at this early stage the emphasis was still directed mainly to the great soloists in the Orchestra like Miley, Nanton, Hodges and Bigard.

At the Calendar price of \$2.95, this album can only be warmly recommended to all serious collectors of Ellington. (T.F.C.)

★ ★ ★

MONK'S BLUES. Thelonius Monk. CBS stereo SBP 233686.

Interest: With Oliver Nelson.

Performance: Unsuccessful.

Quality: Good bright recording.

Stereo: Well balanced.

It would, I think, be generally agreed that Monk's recent Quartet albums for Columbia have become rather tired. Long-time producer, Teo Macero, is well aware of this and on this Hollywood-recorded L.P., he has teamed Monk with the Oliver Nelson Orches-

tra. Unfortunately, the partnership is never really successful, due mainly to the unimaginative and unduly heavy textures of Nelson's writing.

Monk has not recorded with a big band on many occasions but Nelson should have been guided by Hall Overton's arrangements for Monk's 10-piece band at his famous 1959 New York Town Hall Concert. As it is, Monk is virtually a piano soloist in front of an unsympathetic studio orchestra and this misses the subtleties of Monk's compositions and playing.

All but two of the tracks ("Consecutive Seconds" and "Just A Glance at Love" by Teo Macero) were written by Monk and he is, of course, the main soloist. Indeed, Monk plays very well on all 9 tracks. The personnel of the Nelson Orchestra is not listed, but Monk's tenorist, Charlie Rouse, is certainly featured on "Brilliant Corners," "Consecutive Seconds," "Monk's Point," "Trinkle Tinkle" and "Straight No Chaser." The only other soloist of substance is a trumpeter on "Rootie Tootie" and "Monk's Point."

The 45 minutes of this album must, I suggest, be regarded as a brave but unsuccessful attempt to lift Thelonius Monk out of the recording rut into which he has slipped. (T.F.C.)

★ ★ ★

SESSION FOR SIX/ EASY DOES IT.

Benny Goodman, Capitol (E.M.I.) Encore series mono ENC 9508.

Interest: Small groups, mainly 1947.

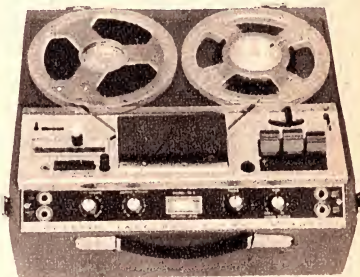
Performance: Excellent.

Quality: Very well recorded.

These Benny Goodman small group tracks were recorded at a time when he was experiencing a schizophrenic, love-hate relationship with bop, the new revolutionary jazz which was emerging with the work of musicians like Charlie Parker, Bud Powell and Thelonius Monk. On some of the tracks, notably "Small Hotel," "How High the Moon" and "Blue Lou" (fea-

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turing the great tenor player Wardell Gray), traces of bop creep into the playing of Goodman and his musicians. But the majority of these tracks could easily have been recorded in the 1930s.

Goodman, himself, is in splendid form throughout the album and he receives strong and sympathetic support from people like Red Norvo, Mel Powell, Al Hendrickson, Jess Stacy and Jimmy Rowles. The groups range in size from trio to octet and the tracks include standards like "Nagasaki," "Varsity Drag," "I Can't Get Started," "Sweet Georgia Brown" and "That's A Plenty." The sleeve note contains a very useful personnel table for the various small groups but no recording dates are given. In fact 14 of the 16 tracks were recorded between February and December, 1947, while "Blue Lou" and "There's A Small Hotel" were recorded in April, 1949.

With a playing time of 47 minutes and the budget-price of \$2.50, this L.P. should be a very attractive purchase for Goodman enthusiasts. (T.F.C.)

★ ★ ★

SON OF A PREACHER MAN. Nancy Wilson. Capitol (EMI) stereo ST-234.

Interest: Contemporary vocals.
Performance: Excellent.
Quality: Superbly recorded.
Stereo: Well balanced.

Nancy Wilson is one of the most talented of the contemporary popular singers. Her voice has true quality—flawless intonation, distinctive style and great warmth and feeling. This latest album by Miss Wilson is one of her most successful, due partly to the strength of the material and partly to the excellence of the arrangements, the majority of which were done by the jazz pianist and writer, Jimmy Jones.

The album includes Jim Webb's "By the Time I Get to Phoenix" (a beautiful, sensitive performance); the recent Dusty Springfield hit, "Son Of A Preacher Man"; Roger Miller's "Husbands And Wives"; and two Bobby Russell compositions, "Little Green Apples" and the lesser-known "I Made You This Way." Nancy Wilson's ver-

satility is further demonstrated by her bluesy treatment of Richard M. Jones' traditional jazz standard "Trouble In Mind."

This L.P., which plays for 33½ minutes, can safely be recommended to all admirers of this very talented artist. (T.F.C.)

★ ★ ★

THE BLUES AND ALL THAT JAZZ (1937-47). Calendar (Festival) Jazz Heritage Series. Stereo SR66-9656 (also in mono).

Interest: Both vocals and backings.
Performance: Generally very good.
Quality: Well remastered.
Stereo: Rechannelled for "stereo."

Side one of this recommended album contains eight tracks by female blues singers recorded between October, 1937, and April, 1940, when the small band Jazz scene in America was relatively stagnant and depressed. Rosetta Howard, Trixie Smith and Blue Lu Barker have two tracks and Rosetta Crawford and Georgia White one each.

In the tradition of the 1920s, the backings tend to be at least as interesting as the vocals. On "Rosetta Blues," for example, Rosetta Howard is accompanied by the magnificent Harlem Hamfats and some of the other great musicians include Henry Allen, Barney Bigard, Tommy Ladnier, Sidney Bechet and Teddy Bunn.

Vocally, the second side is a bit inferior with two poor tracks by Johnny Temple and two rather disappointing vocals by Peetie Wheatstraw. But to compensate for this, Joe Turner is featured with Willie The Lion Smith on "Doggin' the Dogs" and with a superb Art Tatum band (including Joe Thomas and Ed Hall) on "Last Goodbye Blues." Even on the inferior tracks on this side, there are some magnificent accompaniments by Sam Price, Jonah Jones, Sid Catlett, Henry Allen and Buster Bailey.

This L.P. was released in Australia only a year ago at the normal Festival price of \$5.75. Even with two or three relatively dull tracks, it still represents excellent value (particularly for the backings) at the Calendar price of \$2.95 (T.F.C.)

Miles Davis — "recommended"

GREATEST HITS. Miles Davis. CBS stereo SBP 233685.

Interest: Reissues 1956-65.
Performance: Recommended.
Quality: Mixed, particularly with "live" session.
Stereo: Normal balance.

Collectors of Miles Davis, the most significant trumpeter of the past 20 years, will be familiar with the tracks on this collection. The earliest recording is "Round Midnight" from September, 1956, when John Coltrane worked in the Quintet. "Someday My Prince Will Come" was recorded in March, 1961 (and is from the album of that title) and this also features John Coltrane as well as Hank Mobley, a very underrated tenor player. From the same year, "So What" is taken from Davis' magnificent Carnegie Hall Concert with the Gil Evans Orchestra and this is one of the best tracks on the album. Two 1963 recordings are included — "Seven Steps

to Heaven," the title track of a rather disappointing album, and the excellent "Walkin'" from the "Live In Europe" L.P.

Two tracks from Miles Davis' 1964 album "My Funny Valentine" have been selected for this collection — the title track and "All Blues," both of which are among Davis' finest recordings in recent years. The L.P. is completed by "ESP" from the 1965 album of the same name.

It is interesting to hear 8 tracks by the Miles Davis Quintet spanning a ten-year period, during which the modal influence in his playing gradually became dominant. Although there is not a weak track on this L.P. the inclusion of tracks, for example, from "Porgy and Bess" and "Kind of Blue" albums would have rounded out this collection.

The playing-time of 52½ minutes should be an added attraction to readers who are looking for a representative Miles Davis album. (T.F.C.)

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- 65. Simple proximity alarm unit.
- 66. Pipe and wiring locator.
- 67. Electronic metronome.
- 68. Monophonic organ.
- 68A. Keyless organ.
- 68B. Theremin.
- 68C. Laser unit.
- 68D. Color organ.

BATTERY CHARGERS

- 69. Universal unit.
- 70. 1 amp unit.

REGULATED POWER SUPPLIES

- 71. Transistor. 9v.
 - 72. Transistor, fully protected supply.
 - 73. 1966 H.T. unit.
 - 74. 1968 lab. type. D-30v. supply
 - 74A Simple Pwr. supply.
- VOLTAGE, CURRENT CONTROL UNITS**
- 75. Vari-watt unit.
 - 76. Vari-tach. motor speed control.
 - 77. 2KW auto-light dimmer.
 - 78. 4KW auto. light dimmer.
 - 79. Model train control unit.

- 80. Model train control unit with simulated inertia.
- 81. Above-hi-power.
- 82. No. 81 with simulated inertia.

TACHOMETER UNITS

- 83. 6 or 12v Std.
- 84. 6 or 12v Mullard.
- 85. 6 or 12v with dwell angle.
- 86. Tachometer and dwell angle unit for service stations.

TRANSISTOR IGNITION

- 87. Ro-Fo. 6 or 12v.
- 88. Hi-Fire 6 or 12v. (transformer).

POWER CONVERTERS

- 89. D.C.—D.C. 60w.
- 90. D.C.—D.C. 40w.
- 91. D.C.—D.C. 40w. 12v—input.
- 92. D.C.—D.C. 70w 12v—input.
- 93. D.C.—D.C. 100w 12v—input.
- 94. D.C.—D.C. 140w. 24v—input.
- 95. D.C.—D.C. 225w. 24v—input.

HIGH FIDELITY AMPLIFIERS
MONO UNITS

- 96. Hi-Fi 3.
- 97. Mullard 3.3.
- 98. Mullard 5-10.
- 99. Mullard 5-10 transistor.
- 100. Transistor 20w.
- 101. Transistor 60w.

STEREO UNITS

- 102. Mullard 2-2.
 - 103. Mullard (v) 3-3.
 - 104. Mullard (t) 5-5.
 - 105. Mullard (t) 5-5.
 - 106. Mullard (v) 10-10.
 - 107. Mullard (t) 10-10.
 - 108. Philips Twin 10.
 - 109. S.T.C. 10-10.
 - 110. Wireless world transistor 20-20.
 - 111. Hi-Fi 60-60.
 - 112. Playmaster 2-2.
 - 113. Playmaster 3 plus 3.
 - 114. Playmaster unit 3.
 - 115. Playmaster unit 4.
 - 116. Playmaster 10 plus 10
 - 117. Playmaster 101.
 - 118. Playmaster (t) 105.
 - 119. Playmaster (t) 113.
 - 120. Playmaster (t) 115.
 - 121. Playmaster (v) 118.
- P.A. UNITS**
- 122. 10 watt std.

- 123. 25 watt std.
- 124. 35 watt std.
- 125. 30 watt (t).
- 126. 100 watt std.
- 127. stereo P.A.

GUITAR UNITS

- 128. 10 watt std.
- 129. 25 watt std.
- 130. 35 watt std.
- 131. 50 watt std.
- 132. 70 watt (t).
- 133. Playmaster 102.
- 134. Playmaster 103.
- 135. Playmaster 40w. 118.
- 136. Playmaster 60w 117.
- 137. Guitar fuzz box.
- 138. Guitar Waa-Waa.
- 139. Reverb unit.
- 140. Guitar preamp.
- 140A. Guitar 50w Solid State P/M 125.

STEREOGRAMS

- 141. Playmaster 108.
- 142. Playmaster 106.
- 143. Playmaster 107.
- 143a Playmaster 124.

CONTROL UNITS

- 144. Playmaster No. 9.
- 145. Playmaster No. 10.
- 146. Playmaster No. 104.
- 147. Playmaster No. 112.
- 148. Playmaster No. 120.
- 149. Mullard 2v.
- 150. Mullard 3v.
- 151. Philips Miniwatt.
- 152. P/M 127.

PREAMP UNITS

- 153. Transistor—Mono.
- 154. Transistor—Stereo.
- 155. Transistor—Silicon mono.
- 156. Transistor F.E.T. mono.
- 157. Transistor dyn. mic. mono.
- 158. Above-Stereo.
- 159. Playmaster 115 F.E.T. Stereo.
- 160. Playmaster 118 mag.
- 161. Sound projector.

MIXER UNITS

- 162. Trans. 4 ch. (1966).
- 163. Trans—4 ch. (1967).
- 164. Valve—4 ch.

TUNER UNITS

- 165. Playmaster u/style.
- 166. Playmaster No. 11.
- 167. Playmaster No. 114.
- 168. Playmaster No. 122.
- 169. Playmaster No. 123.
- 170. Philips Miniwatt.
- 180. Trans.—Long range.

TAPE UNITS

- 181. Trans. Preamp.
- 182. Playmaster 110 (M).
- 182. Playmaster 110 (S).
- 183. Power Unit 110.
- 184. Adaptor 110.
- 185. Playmaster 119 Adaptor.
- 186. Transistor V.O.X.
- 187. Tape Actuated relay.
- 188. Mullard Trans Tape Amp.

RECEIVERS

- 189. Fremodyne 4.
- 190. Fremodyne 4 R.F. Sockt only.
- 191. Synchrodyne.
- 192. Communications RX.
- 193. Delphat RX.
- 194. 3 Band Double Change S/het RX.
- 195. Explorer VHF Transistor RX.
- 196. Interceptor 5 Semi-Comm. RX.
- 197. 1967 All-Wave 2
- 198. 1967 All-Wave 3
- 199. 1967 All-Wave 5
- 200. 1967 All-Wave 6
- 201. 1967 All-Wave 7
- 202. Transporta 7
- 203. Transistor 3 Band.
- 204. 3 Band 2V RX.
- 205. 3 Band 3V RX.
- 206. Interstate 8
- 207. Versatile Mantel Set.
- 208. All-Wave Transistor 3
- 209. A.B.C. 3
- 210. 1968 F.E.T. 3
- 210a. I/C TRF Rx.
- 210b. R.F. Preamp.
- 210c. "Q" Multiplier.

TRANSMITTERS

- 211. 144 MHZ 50W. Linear Final.
 - 212. 144 MHZ 20W.
 - 213. 144 MHZ 75W.
 - 214. 144 MHZ 18W.
 - 215. 144 MHz S.S.B.
 - 216. 3 Band A.M.
 - 217. Basic 3 Band.
 - 218. 5 Band. S.S.B.
 - 219. 1967 S.S.B.
- CONVERTERS**
- 220. 50 MHz.
 - 221. 144. MHz.
 - 222. 50 and 144 MHz Crystal Locked.
 - 223. 1965 S/W.
 - 224. 1965 S/W 2 Band.
 - 225. 1968 3 Band.
 - 226. Basic S/W.
- V.F.O. UNITS**
- 227. Remote Unit.
 - 228. 7, 8 and 9 H.F. and V.H.F.
 - 229. All transistor.

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232 FLINDERS LANE, MELBOURNE, VICTORIA 3000

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Public Address Units — Geiger Counters — Metal Locators — Decade Boxes — Mixers — Battery Chargers — Oscillators — Bridges — Parts Supplied for Projects in Electronics (Aust.), Wireless World, Practical Wireless, Electronics World, Electronics Illustrated, Practical Electronics, etc.

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**P/M
124
Stereogram**



1968 Solid State. V.T.V.M.
ELECTRONICS (Aust.), Dec., 1968.

BATTERY CHARGER 1A
ELECTRONICS (Aust.), Feb., 1966



**PLAYMASTER 116 and 117
and 125 GUITAR AMP.**

Electronics Australia
June 1967 — 40 watt
July — 1967 60 watt
July 1969 — 50 watt

3-BAND SHORT-WAVE CONVERTER
ELECTRONICS (Aust.), May, 1966.

LAB QUALITY

Regulated Power Supply (0-30v)
ELECTRONICS (Aust.), Sep-
tember, 1968.

1966 R/C Bridge
May, 1966.



**PUBLIC ADDRESS and
GUITAR AMPLIFIERS**
10, 25, 50 and 100 watt
units



3-BAND DOUBLE-CHANGE RECEIVER
ELECTRONICS (Aust.), April, 1966.

1966 3In CRO
ELECTRONICS (Aust.), May, 1966.



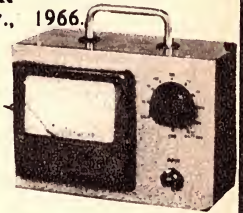
**P/M127
CONTROL
UNIT
NOV., 1969.**

FOUR-CHANNEL AUDIO MIXER
ELECTRONICS (Aust.) Feb., 1966 & 1967

3-BAND 3-RECEIVER
ELECTRONICS (Aust.), Nov., 1966.

**TRANSISTOR MILLIVOLT
METER**

Electronics (Aust.),
May, 1968.



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— STYL II — CARTRIDGES — RECORDING TAPE — PROBES — INSTRUMENTS
— POTENTIOMETERS — CRYSTALS — FERRITE BEADS — CORES — BALUNS
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PRINTED CIRCUIT BOARDS — COPPER WINDING WIRE — ETC. — ETC. —

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232 FLINDERS LANE, MELBOURNE, VICTORIA 3000

AUSTRALIAN BROADCAST STATIONS

MEDIUM-WAVE STATIONS

Frequency KHz	Call	Location	Power Watts	Frequency KHz	Call	Location	Power Watts	Frequency KHz	Call	Location	Power Watts
530	2KM	Kempsey	d 2K	910	4QB	Maryborough	dn 10K	1340	2LF	Young	2K
	3UL	Warragul	d 2K		4QO	Eidsvoll	n 10K	1350	3GL	Geelong	2K
	4KZ	Innisfail-Tully	d 2K	920	2XL	Cooma	2K ¹		4GY	Gympie	2K
	6DL	Dalwallinu	n 10K		4VL	Charleville	2K ¹	1360	2NX	Bolwarra	2K
540	4QL	Longreach	n 10K		6NA	Narrogin	2K	1370	2LT	Lithgow	500
	7SD	Scottsdale	d 2K	930	3UZ	Melbourne	d 2K		4LM	Mount Isa	2K
550	2CR	Orange	n 50K		4CD	Gladstone ²	n 2K		5SE	Mount Gambier ³	500
560	2ML	Murwillumbah	n 200	940	4QY	Cairns	n 2K	1380	2GN	Goulburn	2K
	4AM	Atherton	d 2K		7ZR	Hobart	dn 10K		4MK	Mackay	2K
	6WA	Wagin	n 50K	950	2UE	Sydney	5K	1390	4BH	Brisbane	d 2K
	7BU	Burnie	2K ¹		3BO	Bendigo	2K	1400	2PK	Parkes	2K
580	3WV	Horsham	n 50K	960	4AY	Ayr ⁴	2K	1410	2KO	Newcastle	2K
590	4QR	Brisbane	n 50K		6TZ	Bunbury	2K	1420	3XY	Melbourne	5K
600	4AT	Atherton	n 4K ²	970	5DN	Adelaide	2K	1430	2WL	Wollongong	2K
	6NM	Northam	n 200	980	6KG	Kalgoorlie	2K	1440	2MW	Murwillumbah	2K
	6PH	Port Hedland	n 2K	990	2GZ	Orange	2K		3CV	Maryborough	2K
	7ZL	Hobart	n 10K	1000	3HA	Hamilton	2K	1450	2MG	Mudgee	d 2K
610	2FC	Sydney	n 50K		4RO	Rockhampton	2K		5AU	Port Augusta	d 2K
620	3AR	Melbourne	n 50K		6R0	Perth	2K	1460	2NM	Muswellbrook	2K ¹
630	4QN	Townsville	n 50K	1010	4CA	Cairns	2K		5MU	Murray Bridge	2K ¹
	7QN	Queenstown	n 400		4IP	Ipswich	2K	1470	3MA	Mildura	2K
640	5CK	Port Pirie	n 10K		6GE	Geraldton	2K	1480	2BE	Bega	2K ¹
650	2NU	Tamworth	n 10K		7EX	Launceston	2K		4ZR	Roma	2K ¹
	6AL	Albany	n 400	1020	2KY	Sydney	5K	1490	2AY	Albury	2K
	8DR	Darwin	n 2K	1030	3DB	Melbourne	5K	1500	2BS	Bathurst	d 2K
660	2BH	Broken Hill	200	1040	2UH	Muswellbrook	dn 1K		3AK	Melbourne	d 5K
	6GF	Kalgoorlie	n 2K		5PI	Crystal Brook	2K	1510	2NA	Newcastle	n 10K
670	2CO	Albury	n 10K	1050	2CA	Canberra	2K	1520	2QN	Deniliquin	2K
	6BE	Broome	n 50	1060	4SB	Kingaroy	2K	1530	2VM	Moree	2K ¹
	8KN	Katherine	n 50	1070	2RG	Griffith	2K ¹		5LN	Port Lincoln	n 200
680	2KP	Kempsey	n 10K		6WB	Katanning	2K		8AL	Alice Springs	n 200
	6BS	Busselton	n 2K	1080	2MO	Gunnedah	2K ¹	1540	2CN	Canberra	n 2K
	8TC	Tennant Creek	n 50		4MI	Mount Isa	n 200	1550	4QD	Emerald	n 50K
690	4KQ	Brisbane	2K		6IX	Perth	2K	1560	2RE	Taree	2K
	5—	Ceduna-Streaky Bay ²	dn 2K	1090	7HT	Hobart	2K	1570	2CP	Cooma	n 50
	6WF	Perth ³	n 50K		3LK	Lubeck	2K		2LG	Lithgow	n 200
700	2NR	Grafton	n 50K	1100	4LG	Longreach	2K		3WL	Warrnambool	n 200
710	4QW	St. George	dn 10K		6MD	Merredin	2K		4GM	Gympie	n 200
	7NT	Launceston	dn 10K		7LA	Launceston	2K	1580	2WN	Wollongong	n 2K
720	2TR	Taree	n 200	1110	2UW	Sydney	5K ¹		5MG	Mount Gambier	n 200
	4QA	Mackay	n 2K	1120	4BC	Brisbane	2K		5WM	Woomera	n 50
	7QT	Queenstown	500	1130	2AD	Armidale	d 2K	1590	4SO	Southport	n 200
730	5CL	Adelaide	n 50K		3CS	Colac	d 2K		5MV	Renmark	n 2K
740	2BL	Sydney	n 50K		6CI	Collie	2K	1600	3NE	Wangaratta	2K ¹
750	4QS	Toowoomba	n 10K	1140	2HD	Newcastle	2K				
760	2AN	Armidale	n 50	1150	2WG	Wagga	2K				
	2NB	Broken Hill	n 1K	1160	4MB	Maryborough	2K				
770	3LO	Melbourne	n 50K		5PA	Penola	dn 10K				
780	2KA	Katoomba	2K	1170	2CH	Sydney	5K				
	4TO	Townsville	2K	1180	3KZ	Melbourne	5K				
	6WA	Albany	2K	1190	2NZ	Inverell	2K				
790	4QG	Brisbane	n 10K	1200	4GG	Gold Coast	d 2K				
800	5RM	Renmark	2K		5KA	Adelaide	2K				
810	2BA	Bega	n 10K	1210	2GF	Grafton ⁴	2K				
	6WN	Perth	n 10K		3YB	Warrnambool	2K				
	9RB	Rabaul	n 2K		6KY	Perth	2K				
820	2GL	Glenn Innes	n 10K	1220	4AK	Oakey	2K				
830	3GI	Sale	n 10K		5EP	Port Lincoln ²	d 2K				
	6GN	Geraldton	n 2K	1230	2NC	Newcastle	n 10K				
840	4RK	Rockhampton	n 10K		3TR	Sale ⁴	2K				
	6ED	Esperance	n 1K	1240	8DN	Darwin	2K				
850	2CY	Canberra	n 10K	1250	2DU	Dubbo	2K				
	6CA	Carnarvon	n 200		9PA	Port Moresby	n 2K				
860	4GR	Toowoomba	2K	1260	3SR	Shepparton	2K				
	6AM	Northam	2K	1270	2SM	Sydney	5K				
	7HO	Hobart	2K	1280	3AW	Melbourne	5K				
870	2GB	Sydney	5K	1290	2TM	Tamworth	2K				
	6DB	Derby	n 2K	1300	4BK	Brisbane	2K				
880	4WK	Warwick	2K ¹	1310	5AD	Adelaide	2K				
	6PR	Perth	2K	1320	3BA	Ballarat	2K				
890	5AN	Adelaide	n 50K		4NA	Nambour	d 2K				
900	2LM	Lismore	2K	1330	3SH	Swan Hill	2K				
	6BY	Bridgetown	2K		4BU	Bundaberg	2K				
	7AD	Devonport	2K ¹								

All call signs commence with a number which indicates the state or territory in which the station is located, the numbers being allocated:

- 2 N.S.W. (including A.C.T.)
- 3 Victoria.
- 4 Queensland.
- 5 South Australia.
- 6 Western Australia.
- 7 Tasmania.
- 8 Northern Territory.
- 9 Territory of Papua and New Guinea.

d Uses directional aerial.
n National Broadcasting Service.
¹ Operates at night or during specified periods on reduced (usually half) power.
² Projected station.
³ Frequency to be changed to 720KHz in February, 1970.
⁴ Directional aerial to be installed.
⁵ Directional aerial to be installed and power increased to 2K.W.
A National Broadcasting station is to be established in the Bourke-Cobar-Brewarrina area of N.S.W. The frequency and power are not yet determined.

SHORT-WAVE STATIONS

The Australian Broadcasting Commission has short-wave broadcast stations located in several States and in Papua/New Guinea to provide a service to distant sparsely populated areas of the Commonwealth and Territories. The frequencies on which they transmit are varied as necessary to obtain optimum results.

The short-wave service transmits programs obtained as follows: VLI takes N.S.W. regional programs; VLG takes Vic. regional programs and relays Radio Australia; VLH relays 3AR and VLR relays 3LO; VLM and VLQ take Qld. regional programs; VLW takes W. Aust. regional programs; VLK and VLT relay 9PA.

Call	Location	Power Watts
VLG	Melbourne	10K
VLH	Melbourne	10K
VLI	Sydney	2K
VLK	Port Moresby	10K
VLM	Brisbane	10K
VLQ	Brisbane	10K
VLR	Melbourne	10K
VLT	Port Moresby	10K
VLW	Perth (two services on two frequencies)	10K and 50K

Radio Australia

Transmitters for the overseas service of Radio Australia are located at Shepparton, Vic. (4 x 100KW, 2 x 50KW and 1 x 10KW), Lyndhurst, Vic. (2 x 10KW), and Darwin, N.T. (3 x 250KW). These stations are capable of operating on various frequencies and aerials as required to give best reception in the selected areas. In common with all international broadcasting stations, Radio Australia has no assigned frequencies, but is allocated certain frequencies for use during definite periods.

TERRITORIES

Papua/New Guinea

In addition to its services on medium-wave (9PA and 9RB) and on short-wave (VLK and VLT), the Australian Broadcasting Commission relays the programs of 9RB over the following station:

Frequency KHz	Call	Location	Power Watts
5985	VH9RA	Rabaul	

The Department of Information and Extension Services for the Territory also provides a number of short-wave stations, as follows:

Frequency KHz	Call	Location	Power Watts
2410	9CG	Goroka	250
2450	9CH	Mount Hagen	250
3235	8AS	Samarai	250
3245	8BK	Kerema	250
3305	8BD	Daru	10K
3322.5	9BA	Kieta	2K
3335	9CD	Wewak	10K
3385	9BR	Rabaul	10K

Norfolk Island

A local service is provided by the Norfolk Island Administration under the technical direction of the Department of Civil Aviation.

Frequency KHz	Call	Location	Power Watts
1570	VL2NI	Kingston	50

Lord Howe Island

The Department of Civil Aviation provides a service to inform residents of the arrival times of aircraft and shipping. Broadcasts are made one hour before the scheduled arrival time.

Frequency KHz	Call	Location	Power Watts
640		Lord Howe Is.	50

PERFECT MATES



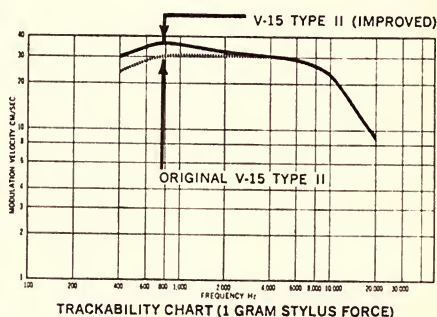
SHURE

V-15 TYPE II (IMPROVED) \$87.50
SUPER TRACKABILITY PHONO CARTRIDGE

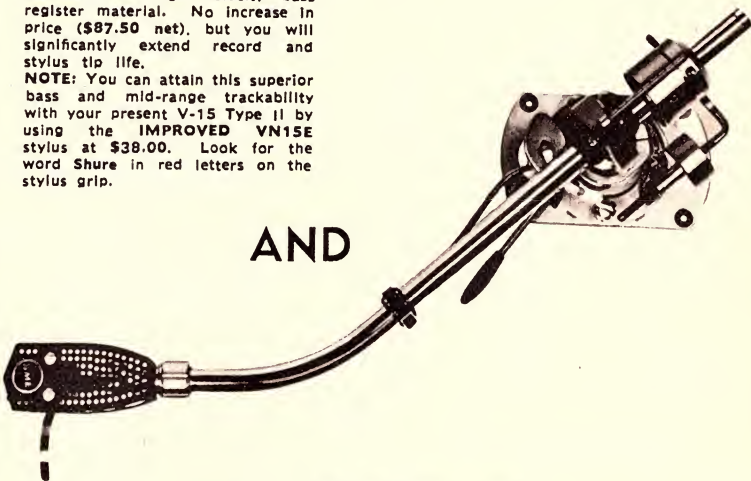
HIGHER TRACKABILITY IN THE "BACKBONE" REGION OF MUSIC

The grand structure of orchestral music relies heavily upon tympani, tuba, contrabass, bassoon, bass drum, and other low register instruments to form the solid foundation upon which the harmonies and melodic lines are built. Unfortunately it is exceedingly difficult to track these passages when they are cut at high velocities. Even the Shure V-15 Type II, the world's highest trackability cartridge, required raising the tracking force when playing recordings containing this type of program material. We took this as a challenge and have prevailed. The top line of the graph at right shows the increased bass and mid-range trackability of the IMPROVED V-15 Type II. Practically speaking, it means you can reduce 1 1/4 gram tracking force to 1 gram, or 1 gram force to 3/4 gram for records with high velocity bass register material. No increase in price (\$87.50 net), but you will significantly extend record and stylus tip life.

NOTE: You can attain this superior bass and mid-range trackability with your present V-15 Type II by using the IMPROVED VN15E stylus at \$38.00. Look for the word Shure in red letters on the stylus grip.



AND



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... the best pick-up arm in the world

SHURE S.M.E. Precision Pick-up Arms offer all these features: ● Choice of arms length Model 3009 (9") or Model 3012 (12") for still lower tracking error—of special importance with elliptical styli ● Low inertia ● High precision ball races and knife-edge bearings for minimum pivot friction ● Linear offset chosen for lowest distortion ● Automatic slow-descent with hydraulic control ● Bias adjuster calibrated for tracking force ● Exact overrind adjustment with alignment protractor ● Precise tracking force from 1/4-5 grams applied without a gauge ● Shielded output socket ● Low capacity 4' connecting cable with quality plugs ● Lightweight shell ● Camera finish in satin-chrome, gunblack and anodised alloy.

Contact your local HI-FI dealer or any of the following for more information:
N.S.W.: Audio Engineers, 342 Kent Street, Sydney.
QLAND: Ron Jones Pty. Ltd., 7-9 Merton Road, Wolloongabba, Brisbane.
VICTORIA: Audio Engineers (Vic.), 2A Hill Street, Thornbury, 44-3295.
W.A.: Athol M. Hill Pty. Ltd., 613-15 Wellington Street, Perth.
* Recommended Resale Price.

AUSTRALIAN TELEVISION STATIONS

Area	Call	Channel Polarity	Area	Call	Channel Polarity	Area	Call	Channel Polarity
A.C.T.						Western Australia		
Canberra	ABC CTC	3-V 7-V	Mary Kathleen Miles	AB-1	—	Perth	ABW TVW STW	2-H 7-H 9-H
New South Wales			Morven	AB-1	—	Bunbury	BTW ABSW	3-H 5-H
Sydney	ABN ATN TCN TEN	2-H 7-H 9-H 10-H	Mount Isa	ABIQ ¹	6-H	Carnamah	AB-1	—
Bega-Cooma	ABSN	8-V	Richmond	AB-1	—	Carnarvon	AB-1	—
Broken Hill	ABLN	2-V	Rockhampton	ABRQ RTQ	3-H 7-H	Cent. Agricultural	ABCW	4-H
Cent. Tablelands	BKN ABCN CBN	7-V 1-V 8-V	Roma	AB-1	—	Dampier	AB-1	—
Cent. W. Slopes	ABQN CWN	5-V 6-V	St. George	AB-1	—	Esperance	AB-1	—
Grafton-Kempsey	ABDN NRN	2-H 11-H	Southern Downs	ABSQ SDQ	1-H 4-H	Geraldton	ABGW	6-H
Illawarra	WIN ABWN	4-H 5A-H	Springsure	AB-1	—	Kalgoorlie	ABKW	6-H
Manning River	ABTN ECN	1-V 8-V	Townsville	ABTQ TNQ	3-H 7-H	Mingenew	AB-1	—
Mungindi	AB-1	—	Wide Bay	ABWQ	6-V	Moorra	AB-1	—
Murrumbidgee	ABGN MTN	7-H 9-H	Winton	WBQ AB-1	8-V —	Norseman	AB-1	—
Newcastle-Hunter	NBN ABHN	3-H 5-H	South Australia			Port Hedland	AB-1	—
Richmond-Tweed	ABRN RTN	6-H 8-H	Adelaide	ABS ADS NWS SAS	2-H 7-H 9-H 10-H	S. Agricultural	ABAW GSW	2-V 9-V
S.W. Slopes and E. Riverina	ABMN RVN ABUN NEN	0-H 2-H 7-H 9-H	Ceduna	AB-1	—	S. Cross-Bullfinch	AB-1	—
Upper Namoi			Central East	ABRS ²	3-V	Three Springs	AB-1	—
Victoria			South East	ABGS SES	1-H 8-H	Tasmania		
Melbourne	ATV ABV HSV GTV	0-H 2-H 7-H 9-H	Spencer Gulf N.	ABNS GTS	1-V 4-V	Hobart	ABT TVT	2-H 6-H
Ballarat	ABRV BTV	3-H 6-H	Woomera	AB-1	—	King Island	AB-1	—
Bendigo	ABEV BCV	1-V 8-V				N.E. Tasmania	ABNT TNT	3-H 9-H
Goulburn Valley	ABGV GMV	3-V 6-V				Northern Territory		
Latrobe Valley	ABLV GLV	4-H 10-H				Darwin	ABD ¹	6-H
Mildura	ABMV STV	4-H 8-H				Alice Springs	AB-1	—
Murray Valley	ABSV	2-V						
Upper Murray	ABAV AMV	1-H 4-H						
Queensland								
Brisbane	TVO ABQ BTQ OTQ AB-1	0-H 2-H 7-H 9-H —						
Alpha	AB-1	—						
Augathella	AB-1	—						
Barcaldine	AB-1	—						
Blackall	AB-1	—						
Cairns	ABNQ ³ FNQ ³	9-H 10-H						
Charleville	AB-1	—						
Clermont	AB-1	—						
Cloncurry	AB-1	—						
Connamulla	AB-1	—						
Darling Downs	ABDQ DDQ	3-H 10-H						
Dirranbandi	AB-1	—						
Emerald	AB-1	—						
Goondiwindi	AB-1	—						
Hughenden	AB-1	—						
Julia Creek	AB-1	—						
Longreach	AB-1	—						
Mackay	ABMQ MVQ	4-H 6-H						

For notes, see after "Translator Stations."

TRANSLATOR STATIONS

Area	Parent Station	Channel/ Polarity	Area	Parent Station	Channel/ Polarity
New South Wales			Victoria		
Armidale	NEN-9 ABUN-7	1-H 4-H	Alexandra	ABGV-3 GMV-6	5-H 10-H
Batemans Bay-Moruya	ABWN-5A ¹ WIN-4 WIN-4 ¹ ABRN-6 RTN-8	9-H 11-H 6-V 3-V 5-V	Eildon (via Alexandra)	ABGV-3 GMV-6 ABGV-3 ² AMV-4 ¹ BTV-6 ¹ ABRV-3 ¹	1-H 3-H 2-H 9-H 7-V 9-V
Bega			Orbost	ABLV-4 ABRV-3	2-V 4-H
Bonalbo			Portland	BTV-6 BCV-8	11-H 11-V
Bourke-Brewarrina	ABQN-5 ¹ ABQN-5 ¹ CWN-6 ¹	4-H 2-V 10-V	Swan Hill		
Cobar	ABSN-8 ¹ CTC-7 ABUN-7	0-M 10-V 0-H	Warnambool-Port Fairy	ABRV-3 BTV-6	2-V 9-V
Cooma	NEN-9 ABC-3 CTC-7	3-H 0-V 10-V	Queensland		
Glen Innes	ABCN-1 CBN-8	0-V 10-V	Blackwater	RTQ-7	10-H
Goulburn	ABRN-6 RTN-8	3-V 5-V	Bowen	TNQ-7 ¹ ABTQ-3 ¹	1-H 5-H
Kandos-Rylstone	ABCN-1 CBN-8	0-V 10-V	Cardstone Village	TNQ-7 ⁴	5-V
Kyogle	ABRN-6 RTN-8	3-V 5-V	Cracow	RTQ-7	5-H
Lithgow	ABCN-1 CBN-8	5-V 6-V	Gympie	WBQ-8 ¹ ABWQ-6	1-V 4-V
Mudgee	(Mod—1MHz) CWN-6 ABQN-5 RTN-8 ABQN-5 ¹	9-V 11-V 5-H 3-V	Monto	ABWQ-6	1-V
Murwillumbah			North Townsville	WBQ-8 ¹ TNQ-7	5-V 9-H
Nyngan				ABTQ-3	10-H
Snowy Mountains (Khancoban)					
Upper Hunter					
Walcha					

Area	Parent Station	Channel/ Polarity
South Australia		
Bordertown	ABS-2 ¹	2-V
Cowell	ABNS-1 ¹	6-V
	GTS-4 ¹	8-V
Keith	ABS-2 ¹	4-V
Port Lincoln (via Cowell)	ABNS-1 ¹	3-H
	GTS-4 ¹	-H ²
Western Australia		
Kambalda	ABKW-6 ¹	5-V
Tasmania		
Gowrie Park	TNT-9	1-H
	ABNT-3	11-H
Maydena	TVT-6	8-H
Queenstown-Zeehan	ABT-2	4-H
	TVT-6	8-H
Rosebery-Renison Bell (via Queenstown)	ABT-2	1-H
	TVT-6	10-H
St. Marys-Fingal Valley	ABNT-3	1-V
	TNT-9	11-V
Savage River-Luina (via Waratah)	ABNT-3 ¹	4-H
	TNT-9	7-H
Smithton (via Stanley)	ABNT-3 ¹	8-V
	TNT-9 ¹	11-V
South Launceston	ABNT-3	1-H
	TNT-9	11-H
Stanley	ABNT-3	1-V
	TNT-9	6-V
Strahan (via Queenstown)	TVT-6 ¹	3-H
	ABT-2	10-H
Swansea-Bicheno	TVT-6	8- H-Swansea V-Bicheno
Taroona	TVT-6	8-H
Waratah	ABNT-3 ¹	2-H
	TNT-9	10-H

All stations with a call sign commencing with AB belong to the National Television Service provided by the Australian Broadcasting Commission. All others are privately owned commercial television stations operated under licences granted by the Postmaster-General.

The polarity of the aerial is indicated by the initial letters:

H—Horizontal.

V—Vertical.

M—Mixed horizontal and vertical (for the projected national translator station at Cooma to enable viewers to obtain best reception in the most economical manner).

¹ Projected station.

² Not yet determined.

³ Temporary station. The new installation at Bellenden Ker should be ready for use by the end of 1971.

⁴ Temporary station. Its operation will be reviewed after the Cairns full-power station opens.

Frequencies

Channel	Frequency MHz	Channel	Frequency MHz
0	45-52	5A	137-144
1	56-63	6	174-181
2	63-70	7	181-188
3	85-92	8	188-195
4	94-101	9	195-202
5	101-108	10	208-215
		11	215-222

ORYX SOLDER SUCKER



A new device introduced by Oryx, this de-soldering tool makes it easy to remove excess solder from circuit boards, from plated-through holes, and from terminals, etc. Consisting of a miniature Oryx iron to melt the solder, and an attached suction bulb and a reservoir for the removed solder, the unit is small and light enough to be used easily with one hand. It has its own built-in stand, so it can simply be put down on the bench between operations. Operating on very low voltage for greatest safety, it requires only 18 watts at 6, 12 or 24 volts AC or DC, or 25 watts at 12 or 24 volts AC or DC. Highly efficient and precision-made throughout, the unit is extremely effective for use on the

production line, by servicemen, by test technicians, and in prototype and breadboarding activities. The solder reservoir is stainless steel, easily cleaned; the suction tip is heavily chrome plated so that solder will not adhere. The unit Model SS-18-6V is furnished complete with an Oryx 18 watt, 6 volt miniature soldering iron, ready for operation from a suitable 6 volt transformer or other 6 volt source. For higher temperature operation, the 6 volt iron may be removed, and any of the following Oryx models used in its place — Model 12-6, 12 or 24 volt AC or DC, or an Oryx 25 watt, 12 or 24 volt AC or DC, both used in conjunction with an Oryx de-soldering adaptor.

For further particulars please contact your nearest distributor:



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153 Sturt Street, South Melbourne.
Cnr. Ingham Rd. & Echlin St., Townsville.
Homecrafts, Tas P/Ltd. 199 Collins St., Hobart.

NEW ZEALAND RADIO, TELEVISION

TELEVISION STATIONS

Location	Call	Channel	Location	Call	Channel	Location	Call	Channel
Wellington			Auckland			Dunedin		
Mt. Kaukau	WNTV	1	Waiatarua	AKTV	2	Highcliff.	DNTV	2
Repeater Stations			Repeater Stations			Repeater Stations		
Dawson Falls	WNTV	9	Hikurangi	AKTV	3	Hedgehope	DNTV	1
Mangatarata	WNTV	2	Horokaka	AKTV	5	Kuriwao	DNTV	5
Mt. Egmont	WNTV	6	Manawahe	AKTV	6			
Mt. Erin	WNTV	6	Maungataniwha	AKTV	6			
Opunake	WNTV	5	Te Aroha	AKTV	1			
Otahoua	WNTV	7						
Pukeiti	WNTV	7						
Takaka Hill	WNTV	4	Christchurch					
Titirangi	WNTV	5	Sugar Loaf	CHTV	3			
Tautara	WNTV	4	Repeater Station					
Whakapunake	WNTV	1	Mt. Studholme	CHTV	4			
Wharite	WNTV	4						

Frequencies

Channel	Frequency MHz	Channel	Frequency MHz
1	44-51	6	188-195
2	54-61	7	195-202
3	61-68	8	202-209
4	174-181	9	209-216
5	181-188		

MEDIUM-WAVE B'CAST STATIONS

Frequency KHz	Call	Location	Power Watts	Frequency KHz	Call	Location	Power Watts
570	2YA	Wellington	100K	1160	3ZC	Timaru	c 2K
630	2YZ	Napier	20K	1180	2YW	Gisborne	2K
640	4YW	Alexandria	2K	1200	2ZW	Wanganui	c 2K
660	2YC	Wellington	60K	1220	1ZE	Kaikohē	c 2K
690	3YA	Christchurch	20K	1250	1ZM	Auckland	c 2K
720	4YZ	Invercargill	20K	1280	2ZC	Napier	c 2K
750	3ZA	Greymouth	c 2K	1310	1ZH	Hamilton	c 2K
760	1YA	Auckland	20K	1340	2ZN	Nelson	c 2K
780	4YA	Dunedin	20K	1350	1ZC	Rotorua	c 2K
800	2YB	Wellington	20K	1370	2ZP	New Plymouth	c 2K
820	4ZA	Invercargill	c 10K	1390	1ZT	Turangi	c 100
830	1YX	Whangarei	2K	1400	3ZM	Christchurch	c 2K
840	2ZD	Masterton	c 2K	1420	1ZO	Tokoroa	c 2K
860	1YZ	Rotorua	10K	1430	4XD	Dunedin	250
880	1YC	Auckland	10K	1440	1ZK	Kaitaia	c 2K
900	4YC	Dunedin	10K	1460	3YW	Westport	2K
920	3YZ	Greymouth	10K	1480	—	Radio Hauraki*	c 2K
940	2ZA	Palmerston North	c 2K	1500	1ZA	Taupo	c 2K
960	3YC	Christchurch	10K	1520	1ZU	Taumarunui	c 1K
970	1ZN	Whangarei	c 2K	1540	2ZE	Blenheim	c 1K
980	2ZB	Wellington	c 20K	1560	2ZH	Hawera	c 1K
1000	1ZD	Tauranga	c 10K				
1040	4ZB	Dunedin	c 10K				
1060	2ZG	Gisborne	c 2K				
1070	1ZB	Auckland	c 10K				
1100	3ZB	Christchurch	c 10K				
1130	2ZM	Wellington	c 2K				
1140	1YW	Hamilton	2K				

c Commercial advertising stations.

* Radio Hauraki operates on board M.V. Tiri, moored in Colville Channel in international waters off the coast of Auckland.

All stations, except 4XD and Radio Hauraki, are operated by the New Zealand Broadcasting Corporation.

S-W SERVICE

Radio New Zealand is a short-wave division of the New Zealand Broadcasting Corporation and operates two 7½KW transmitters located at Titahi Bay, Wellington.

During the day the programs are relayed from the Home Service — the National program on week days and part of 2ZB program on Sunday. Transmissions are on the air from 1700 to 0545GMT beamed to the Pacific Islands, and from 2000GMT with a service to Australia. Radio New Zealand has its own special program for the Pacific 0600-0845GMT and to Australia 0900-1145GMT. The monthly DX program, "Arthur Cushen's DX World," is broadcast on the first Wednesday of each month at 0645 and 1030GMT and repeated the following Saturday at 2315GMT.

The present schedule is:

GMT	Call	KHz
	To Pacific Islands	
1700-1945	ZL23	9755
	ZL3	11780
2000-2400	ZL21	15110
0015-0545	ZL4	15280
0600-0845	ZL2	9540
	ZL3	11780
	To Australia	
2000-0545	ZL5	17770
0900-1145	ZL18	9520
	ZL19	11830
	To Antarctica (Sundays only)	
0815-0845	ZL18	9520

Overseas Stations List

"Electronics Australia" does not publish, nor do we have available lists of overseas stations, frequencies, broadcast times, etc. The only information of this type is compiled by our DX correspondent, Mr Art Cushen, and published monthly in the "Listening Around the World" pages.

For general information on short-wave and other stations, reference can be made to the "World Radio Handbook," available through most large technical book sellers.

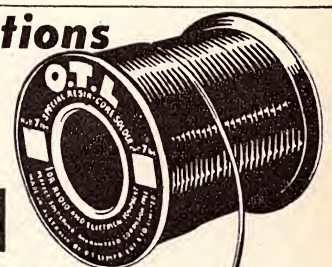
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BEOCORD 1500 DELUXE

An excellent quality tape deck with semi-professional specification which will record 2-track and playback 2 and 4-track. Speeds: 1 7/8", 3 3/4" and 7 1/2". Wow and Flutter: less than 0.07% rms at 7 1/2", 0.11% at 3 3/4", 0.18% at 1 7/8". Inputs: low impedance: 47 K ohm - 3 mV/1000 Hz; high impedance: 100 K ohm - 100 mV/1000 Hz. Mic: 47 K ohm - 1.6 mV/1000 Hz. Outputs: line: 0.6V \pm 4 db - 10 K ohm (adjustable); radio 0.6V \pm 4 db - 22 Kohm. Professional slack absorber arms are fitted to prevent jerky starts. Automatic stop functions at end of tape and also in case tape breaks. Finish: matt black with chrome plated controls. Frequency response: 7 1/2": 30 - 20,000 Hz, 3 3/4": 30 - 16,000 Hz, 1 7/8": 50 - 8,000 Hz.

BEOCORD 1800

Similar to the above but with mixing facilities and better frequency response. Inputs: mic. balanced; 35 mV/1000 Hz. Radio and record player: low impedance: 47 K ohm - 2.5 mV/1000 Hz; high impedance: 100 K ohm - 50 mV - 1000 Hz; line: 47 K ohm - 250 mV/1000 Hz. Outputs: radio 1.25 V - 25 K ohm, line: 1.25 V - 75 Kohm, headphones. Frequency response: 7 1/2" 20-20,000 Hz (\pm 2 dB 30-18,000), 3 3/4" 20-15,000 (\pm 2 dB 30-13,000 Hz), 1 7/8" 30-7,500 Hz (\pm 2 dB 40-6,000 Hz). Mechanical specifications are as for 1500 deluxe model.

POWER AMPLIFIERS

A range of power amplifiers by Dynaco is available in either kit form or assembled. These are top quality products and will satisfy the most fastidious audiophile.

DYNACO STEREO 35

An outstanding example of quality and performance in the low to medium power output class. 2 x 17.5 watts rms designed for smooth response, low distortion and stability. Frequency response: +0, -1 dB 8 Hz - 34 kHz! Harmonic distortion: (at 17.1 watt output) less than 1% 23 Hz-18 kHz.

DYNACO STEREO 70

A conservatively rated dual 35 watts rms amplifier with unsurpassed listening qualities. Frequency response is \pm 0.5 dB from 10 Hz to 40 kHz. At power outputs up to 10 watts distortion is unmeasurably low and at 1000 Hz it can be driven to 43 watts (each channel!) before it becomes appreciable. Hum level is 90 dB below 10 watts. IM distortion less than 1% at 35 watts per channel. Can be switched to mono amplifier providing a superb 85 watts (according to Hirsch-Houck lab.)

DYNACO STEREO 120

A splendid, top performing solid state unit, furnishing high, very clean power at all output impedance ratings; its distortion for the most part is literally unmeasurable. The 2 x 60 watts rms delivered are probably the best you have ever heard and no matter what speaker system you are using the Dynaco 120 will drive it. With its extremely high stability it is one of the very best

Hi-Fi amplifiers on the market, truly another 'amplifier great'; it must be heard to be believed.

DYNACO STEREO 80

Not available yet, but coming soon will be this superb addition to the Dynaco range; compact but handsome enough to display, this fully solid state unit will deliver 2 x 40 watts continuous (at 8 ohms) with less than 0.5% HD from 20-20,000 Hz. The new patented Dynaco automatic protection circuit is fitted, a device which will prevent damage to your amplifier when accidentally shortening the speaker outputs. We cannot describe the sound produced by this amplifier, its smoothness and clarity, its crispness and lack of colouration, we want you to be the judge-but we are confident you will like it just as much as we do.

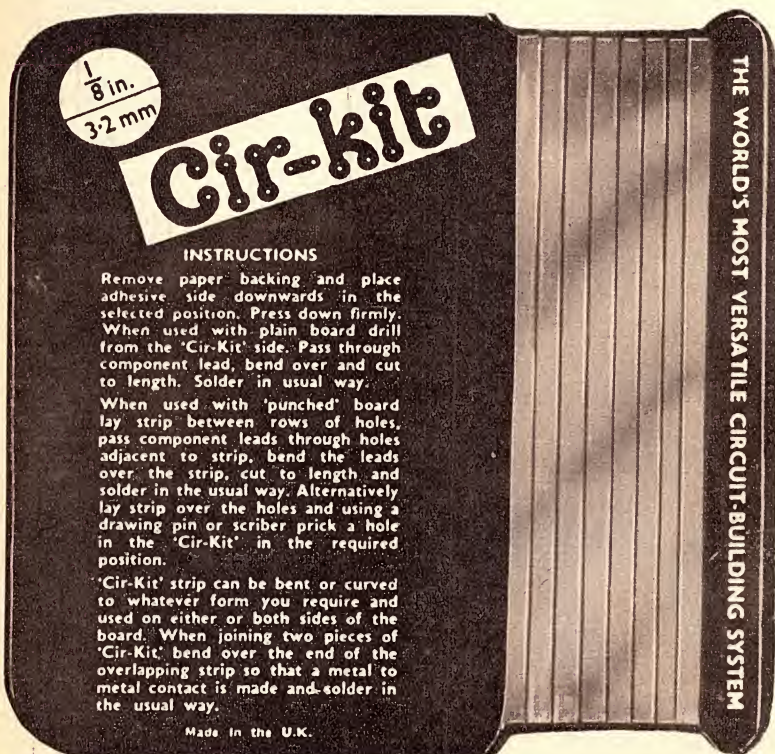
SPEAKERS

The speaker systems listed below have been selected for their excellence in sound, they vary in size from bookshelf to floor units and also in output and price. Common to all, however, is the high quality; a listening test will prove that to you.

Peerless 2-20 kits	Beovox 2400 systems
2-40 kits	Beovox 3000 systems
4-50 kits	Beovox 4000 systems
3-25 kits	Beovox 5000 systems
Dynaco A-25 systems	

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TRADE REVIEWS AND RELEASES

Stanton cartridges perform well

Stanton Magnetics, Incorporated is an American manufacturer of high quality magnetic cartridges, which are relatively new to the Australian market. Leroya Industries Pty. Ltd., the Australian distributors, recently submitted for review three cartridges in the Stanton line.

Two of the cartridges submitted were from the Stanton 500 range, the 500A and 500E. The 500 range have the following specifications:

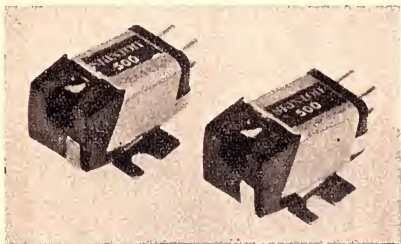
Frequency response	20Hz to 10KHz ± 1 dB
	10KHz to 20KHz ± 2 dB
Channel separation	35dB
Load	47Kohms
Cable capacitance	275pF
Cartridge weight	5 grams
Tracking weight (500A and 500E)	2-5 grams
Tracking weight (500AA)	2-3 grams

The specifications are notable in that few cartridge manufacturers have the confidence to quote decibel limits on the frequency response. The fact that Stanton does so indicates that quality control is of a high standard—it would have to be.

The 500A has a spherical stylus with a radius of 0.7 mil. The 500E has an elliptical stylus with radii of 0.2 and 0.9 mil. The 500AA has a spherical stylus of radius 0.5 mil.

In each case the stylus assembly, complete with guard and suspension tube, can be withdrawn with the fingers, so that stylus replacement is a simple matter. The body of the cartridge has a gold metal flake finish. The mounting bracket is suited to headshells having mounting centres of $7/16$ to $1/4$ in.

Mounting hardware and instructions are provided with each cartridge.



The Stanton 500 cartridges are identical in appearance and have interchangeable stylus assemblies.

The tracking range of the two "500" series cartridges submitted for review was 2-5 grams, which is towards the high side for really high quality equipment. However, according to the literature accompanying the cartridges, they are used extensively in American broadcasting studios where operating conditions would be far more exacting than in the normal listener's home.

To gain some initial impressions, we set the cartridges up in a high quality arm and teamed them with a high power amplifier and wide range speakers. We found that both cartridges tracked all our normal "listening test" records quite satis-



Below is the Stanton 681EE cartridge with its longhair brush and above is shown the cartridge in its presentation case.



factorily at 2 grams. They tracked the plus 16dB drum test track of the W&G 25/2434 test record with only slight embarrassment. Increasing the weight to 2½ grams allowed the cartridges to track this band correctly. For all normal records, the cartridges could doubtless be used at 2 grams and we used 2 grams for all subsequent tests.

Frequency response and channel separation were checked using the CBS STR-100 test record and a Hewlett Packard distortion analyser. With the cartridges loaded with 47K and connecting cable capacitance of 280pF, the frequency response checked out at plus or minus 2½dB from 20Hz to 20KHz, which, while it does not quite meet the specification, is still very good. It was remarkable how similar the frequency response curves were for the two separate cartridges. Channel balance was within 1dB over the whole range and channel separation was an exact 36dB in each direction at 1KHz for the 500E. Separation for the 500A was 33dB in one direction and 37dB in the other. Waveform on both cartridges was good, with some slight irregularities in the region from 6 to

12KHz. In this respect, the 500E was the better of the two. Square wave response was good, with very slight, well damped ringing. Sensitivity at 1KHz was 5mV at 5cm/sec.

On music signals both cartridges performed very well. Transient response was excellent and the definition on complex organ and orchestral passages was particularly good.

All in all, the Stanton 500 range performs well and substantially to specification. At the prices asked, they are very competitive with comparably priced units. Price of the 500A is \$25 while that of the 500E is \$35.

The 681EE was the other Stanton cartridge submitted for review. The 681 range is intended to be competitive with other manufacturer's top priced units and indeed, it is. Each cartridge is packaged with details of its actual performance under specified conditions, a knurled screw-driver, a small metal case (for spare stylus) and mounting hardware.

A unique feature of this cartridge is its "longhair" brush which travels in front of the stylus and prevents it from becoming clogged with lint and dust. The brush also acts to a certain degree as an anti-skating device so that, with arms incorporating anti-skating bias the compensation must be reduced slightly to achieve the best reproduction with the cartridge. The brush exerts a force of 1 gram on the record and this must be subtracted from the tracking force applied by the arm's counterweight and/or spring system. Normal tracking range is from ½ to 1½ grams.

The calibration data supplied with our particular 681EE showed that it had a frequency response flat within plus or minus ½dB from 10Hz to 10KHz; flat within 1½ dB from 10Hz to 15KHz and within plus or minus 2dB from 15KHz to 20KHz. We achieved the following test results which closely approximated the above: flat within plus or minus ½dB from 20Hz to 6KHz; flat within plus or minus 1½dB to 18KHz and within plus or minus 2dB from 20Hz to 20KHz. No further comment is needed here.

All tests were carried out with an effective tracking weight of 1½ grams at which the cartridge tracked the plus 16dB track of the W&G 25/2434 test record with very slight distortion. All normal records could be tracked at 1 gram. Square wave response was excellent, waveform was good over the entire range. Sensitivity was as specified—0.7mV/cm/sec. Channel separation was slightly lower than the specified 35dB at 1KHz but this is difficult to measure due to the very low signal levels involved.

As could be expected the cartridge gave an excellent performance on music. Transient response and clarity were the outstanding characteristics.

Retail price of the 681EE is \$60 and it is available, along with cartridges from the 500 range, from most hi-fi equipment retailers. (L.D.S.).

RF LOAD RESISTORS

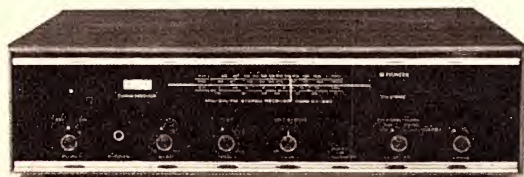
Warburton Franki has available the Terminaler RF load resistors manufactured by Bird Electronics Corp., U.S.A. These dry-air-cooled line terminations are designed for use in any position with 50-ohm systems during design, maintenance and adjustment phases, as well as for absorption RF power measurement in conjunction with insertion wattmeters. The medium-power series includes two 10W units with integral male or female N connectors, and basic 25W, 100W and 150W units with a choice of 17 coaxial connectors each. The 150W and 100W dry loads weigh 6lb and 3lb respectively, and both exhibit a VSWR of 1.1 from DC to 1GHz, and 1.2 to 2.5GHz. The 25W termination extends to 3.5GHz with a maximum VSWR of 1.25, while the 10W load maintains a low 1.2 VSWR to 4GHz. Inquiries to Warburton Franki Ltd., 372 Eastern Valley Way, Chatswood, N.S.W. 2067.



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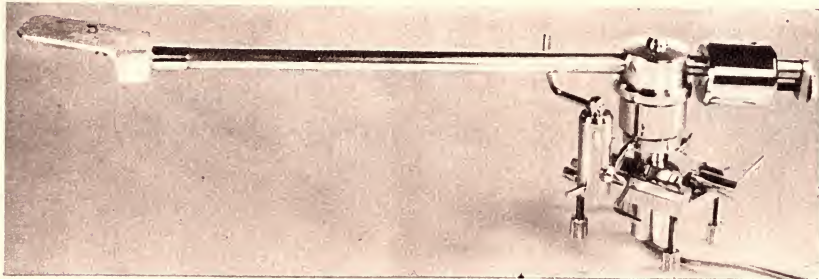
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TAS: 199 Collins St, Hobart. Phone 2 2711.
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AUDIO & DESIGN PICKUP ARM

The A & D M9BA transcription arm incorporates many new and unique features in its design, such as magnetic anti-skating compensation and complete elimination of friction due to pickup leads. The arm was submitted for inspection and possible review by G.R.D. Instruments Pty. Ltd., the Australian distributors.



The arm consists of a lightweight alloy tube with a non-removable headshell and fitted with a counter-weight for balancing and applying the stylus tracking weight. To achieve the lowest possible bearing friction, the arm is suspended on a single pivot. The bearing cup in the arm hub consists of a tiny ball-race which rests on a cone-tipped pillar fixed to the pedestal. Around this needle is a circular bath which holds silicone fluid to damp the motion of the arm.

Pickup leads do not add to the bearing friction of the arm. Instead, there are four mercury baths in the pedestal into which dip four pins carried in the arm hub. The liquid contacts replace the conventional pickup leads which must inevitably add to the pivot friction. The mercury contacts also allow easy removal of the arm from the pedestal to facilitate cartridge mounting or replacement.

The arm pedestal is mounted on a horizontal slide, in much the same way as a lathe tool-post, so that it can be moved back and forth and clamped for exact stylus overhang adjustment. The arm is also adjustable for height but there may be a problem if the arm is to be used with particularly shallow turntables.

The arm incorporates anti-skating compensation but, instead of using the usual hanging weights or spring arrangement, the anti-skating force is obtained by the attraction between the pins in the arm hub and a magnet in the pedestal. Because of this, the anti-skating is non-adjustable but we presume that it has been

optimised for stylus tracking pressures of 1 gram or so.

The counterweight can be moved back and forth and swivelled to obtain balance of arm in vertical and horizontal planes. Stylus tracking weight can be applied very accurately by moving the counterweight with a knurled screwhead — one turn corresponds to a tracking weight of $\frac{1}{4}$ gram.

The carrying arm is available separately so that enthusiasts can have several cartridges set up and balanced with the counterweight so that changeover is merely a matter of swapping arms. If they were of differing design the stylus overhang would also have to be adjusted.

The arm base is fitted with the usual pickup leads which are terminated with phono plugs. These leads have very low capacitance which is a good feature, since high lead capacitance can cause a resonance in the audible range with high inductance magnetic cartridge. Unfortunately, time did not permit us to set up the arm with a turntable to make a complete evaluation of performance. However, we can vouch for the very low pivot friction and the helpful assembly instructions. Perhaps a better mounting template would simplify setting up even further. We did foresee a problem with the hydraulically

damped lowering device. This has a very small travel so that, in the elevated position, the cartridge would only just clear the record. This could be a problem with warped discs.

Overall finish of the arm was good. If enthusiasts wish to use a low mass arm with the lowest pivot friction to obtain the highest performance their cartridges are capable of, then this arm certainly deserves consideration. Retail price of the arm is \$98 including sales tax. Information regarding accessories and availability should be directed to the Australian distributors, G.R.D. Instruments Pty. Ltd., 6 Railway Walk, Camberwell, Victoria. (L.D.S.)

TRANSISTOR SERVICE

All Japanese and local sets repaired

including . . .

Aristone	Aurora	Belair
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We do not sell spare parts

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Tel. 27-5831 (3 lines)

ALWAYS RELY ON R.D.S.

SPECIALS

R
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- Matched prs., AC127/128 trans., \$1.00 pair.
- 200V pl diodes at 500MA, 25c nett each.
- STD Stereo plug 3290, 45c nett.
- DPDT Rocker switch No. 16, 45c nett.
- DPDT Slider switch 3570, 19c nett.
- P53p Stereo plug. Line jack. 80c nett.
- Pkts. mixed pots & conds. Great value. \$1.00 nett.

AC127 TRANS. 50c each.
OAB1 DIODES 15c each.

The Independent Wholesaler

RADIO DESPATCH SERVICE

Radio and Electrical Distributors

**869 GEORGE STREET,
SYDNEY.**

Corner George and Harris Streets
Telephone 211-0816, 211-0191

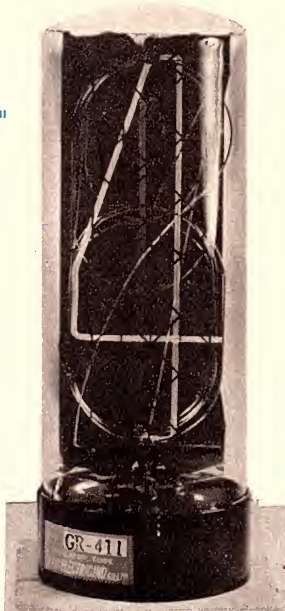
Open Saturday mornings

JUMBO-SIZE NUMERALS

The Rodan GR-411 indicator tube is made by Okaya Electric Industries of Japan and is available in Australia through Plessey Ducon Pty. Ltd. It has numerals from zero to nine with an effective height of 5 inches.

The tube is fitted with a bakelite 12-pin base. Minimum recommended supply voltage is 250 volts DC for a cathode current of 25mA, maximum. With a 250 volt supply a 5Kohm series resistor is used; with 300 volts, 7K. Life expectancy of the tube is typically 500,000 hours which is long compared with normal indicator tubes. The numerical display is very bright, sharp and eye catching. It would be ideal for use on switch boards, large digital clocks or on the score board at indoor sporting events.

Information regarding price and performance of this and other tubes in the Rodan range can be obtained by application on Company letterhead to the Professional Components Division, Plessey Ducon Pty. Ltd., P.O. Box 2, Villawood, N.S.W. who currently have ample stocks. (L.D.S.)





**SPECIAL
NEW YEAR OFFER**

Deluxe stereo headphones, stereo-mono switch, individual controls 8 ohms, 25-18,000cps, amazing value

\$12.50 including postage anywhere in Australia —
Rush these.

\$99.00
full price



TOP BRAND HI-FI SOLID STATE AMPLIFIER

POWER OUTPUT:— 42 watts total music power (IHF)

17.5 watts r.m.s. per channel into 8 ohms.

FREQUENCY RESPONSE:—20-20,000 HZ \pm 1db.

DISTORTION:—0.9 p.c. total at 15 watts r.m.s.

SIGNAL TO NOISE RATIO:—Phone 60db. Aux. Tuner 75db.

INPUT SENSITIVITY:—Phono magnetic 3mv. Phono Ceramic 50mv. Aux. 150mv. Tape Record 250mv.

LOW FILTER:— 80HZ Roll-off.

HIGH FILTER:—5,000 HZ Roll-off.

BASS CONTROL:— \pm 10db (at 50 HZ).

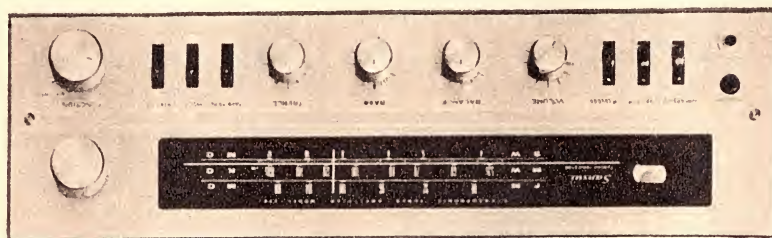
TREBLE CONTROL:— \pm 12db (at 9,000 HZ).

SPEAKER IMPEDANCE:—4, 8 and 16 ohms.

BUILT-IN CIRCUITS:—Loudness Control, High Filter, Low Filter, Headphone Jack.

DIMENSIONS:—14½" (W) x 4¾" (D).

WEIGHT:—13lbs.



Rush this further bulk release of Sansui Model 220 tuner amplifier at the amazingly low price of \$154 tax paid.

Limited quantity reserved for mail orders

Check us last for the lowest discount prices on all tape-recorders and Hi-Fi sound.

DOUGLAS TRADING P/L

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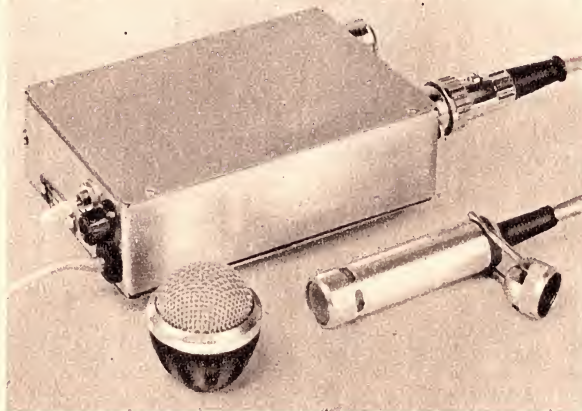
P.M.L. CONDENSER MICROPHONE

P.M.L. Microphones and accessories are manufactured in Sweden and distributed in Australia by Encel Electronics (Stereo) Pty. Ltd. Pictured is the P.M.L. EC-71 microphone and companion windshield and power supply.

The microphone itself is very light and is housed in an 11/16 inch diameter aluminium alloy tube. The preamplifier uses a 2N3819 FET to make the necessary impedance transformation. The EC71 can be had with an output impedance of 50 ohms, 200 ohms or 600 ohms balanced, or 50K unbalanced. Frequency response is quoted at 40 to 18KHz within plus or minus 3dB. Sensitivity at 200 ohms is minus 58dB referred to 1V/dyne/cm/cm. The directional pattern is cardioid.

The companion mains power supply contains a transformer and rectifier network for the high and low voltage supplies and a multi-impedance microphone transformer, the impedance being selected by the appropriate pin on the 5-pin DIN input plug. The output impedance was not quoted.

Set-up in conjunction with a high-quality amplifier and loudspeaker system the EC-71 microphone performed very well indeed and would appear to justify its performance specification. The



response was smooth and well balanced sensitivity was good while vibration sensitivity was quite low. (A full instrument check was not possible as we did not have the testing facilities.)

Retail price including sales tax for the microphone plus power supply is \$103. For further information on the P.M.L. range of microphones, inquiries should be directed to the Australian distributors, Encel Electronics (Stereo) Pty. Ltd., 257 Clarence St, Sydney, N.S.W. or their interstate branches (L.D.S.)

NOISE MONITOR

The Rohde and Schwarz Aircraft-Noise Monitor, type MFA, permits objective observation of noise produced by aircraft in affected areas including fly-over noise. The results from permanent checking can be used to control aircraft noise. It automatically measures, weighs, and records noise levels, and (in a modified form) lends itself for monitoring of road traffic and industrial noise. The first MFA system was installed at the Rhein-Main Airport at Frankfurt in 1964 with six check points. This is now being increased to 12 check points.

The system comprises several acoustic check points in the approach and departure corridors and a central station in the airport building. The noise at the check points is picked up by microphones and converted to audio frequencies, between 300 and 3000Hz, proportional to the measured loudness level. The coded signals are then transmitted to the central station via ordinary post-office lines or an RF link.

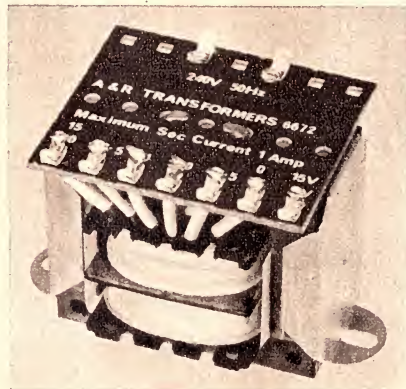
At the central station the levels measured at the individual check points are divided into five 2.5 or 5dB classes and, together with any departure from given reference values, are indicated by lamps on a monitoring panel. The classification of levels permits a differential weighing of the various types of aircraft and also enables special influences, such as weather conditions, to be recorded.

Printers record the level classes, flight numbers and landing times. Separate cumulative noise counters determine the overall duration in seconds of noise exceeding the reference level. Level recorders show the level curve for each check point.

Further information on the Rohde and Schwarz system by contacting Astronics Australasia Pty. Ltd., 161-173 Sturt Street, South Melbourne, Vic. 3205.

TRADE RELEASES -- in brief

A & R TRANSFORMERS PTY. LTD., P.O. Box 170, Box Hill, Vic. 3128. **Power Transformer type 6672.** Suitable for small power supplies, etc., this transformer is constructed in a manner such that, when mounted in a suitable enclosure, it conforms to the requirements laid down by approval authorities for extra low voltage transformers regarding insulation and construction of windings. Specifications: primary 240V, 50Hz; secondary 30V tapped at 27.5, 24, 20, 17.5, 15V at 1A; rectified secondary voltages for full 30V secondary — bridge rectifier 36.9V DC 0.6A (with 1000uF capacitor), 25.5V DC 0.85A (with resistive load), full wave

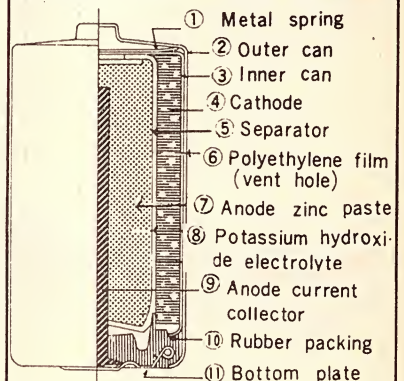


centre tap rectifier (15-0-15) 17.6V DC 1.0A (1000uF), 12.5V DC 1.25A (resistive); size — height 2 1/2 in, width 2-5/16 in, length 3-9/16 in; weight 2lb approximately.

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

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 \pm 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 \pm 12db. Treble 10 kc/s \pm 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 connection.

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.

**ABOVE AMPLIFIER
WITH INBUILT A.M.
TUNER**

\$144.00

FREIGHT
EXTRA



MODEL C300/20/T

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 15½in 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 \pm 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.

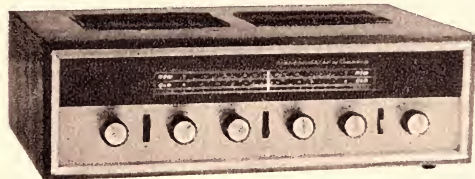
TONE CONTROLS. Bass 50c/s \pm 12db. treble 10kc. \pm 12db.

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.

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.

**MODEL C200V. BASED ON THE
PLAYMASTER 118 WITH TUNER**

Dimension 16½in x 5½in x 11in.

CABINET IN OILED WALNUT OR TEAK WITH METAL TRIM.

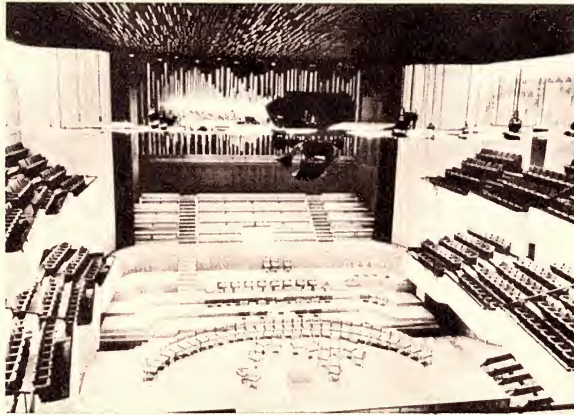
CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145

MAJOR ACOUSTIC INSTALLATION

RCA Ltd. recently completed a major sound installation at the United Grand Lodge of Victoria's new building in Albert Street, Melbourne. The equipment includes a cluster of 13 loudspeakers suspended precisely in an acoustically perfect auditorium. The installation includes the latest RCA audio console with eight microphone inputs, four high level inputs, and two independently controlled outputs each feeding up to four 600-ohm lines. The basic sound reinforcement system is designed round four type PA-100 solid state 100W RMS power amplifiers. The design goal was a uniformity of coverage of not exceeding plus or minus 4dB over the entire hall of 2,300 seats in the frequency range 40Hz to 8KHz.

The technical specifications of the electronic equipment from microphone input to power amplifier output are: overall gain 110dB; signal to noise ratio 75dB; distortion less than 1pc between 30Hz and 10KHz; frequency response (plus or minus 1.5dB) from 30Hz to 10KHz. Full information is available from RCA Ltd., 11 Khartoum Road, North Ryde, N.S.W. 2113.



RACAL ELECTRONICS PTY. LTD., 47 Talavera Road, North Ryde, N.S.W. 2113. **Selective Calling System.** Comprises a base station network control unit type LA 7911 and subscriber outstation units type LA 7912. It may be used over a variety of communication networks, including AM, FM, SSB, etc. or over telephone lines. The system allows the base station operator to selectively call any outstation; alternatively, any outstation subscriber may call the base station operator who can connect him to an external telephone line or to any other subscriber in the network. Once a call is established, a "Busy" signal locks out other outstations ensuring privacy. Should an emergency arise, an outstation subscriber may alert the base by depressing his "Call" button, but is unable to hear until the base has cleared the network.

Selective calling is accomplished with two-tone frequency combinations in conjunction with time integrated detection and narrow band filters, ensuring reliable noise-immune performance. For operation over SSB links where frequency shifts may be encountered, a 2.1KHz sub-carrier is used and the signalling frequency range is restricted to 270 to 800-Hz. A wide range AF AGC circuit prevents variations in the transmission path affecting the tone detection circuitry. The base and outstation transmitters and receivers in a radio network may be changed from day to night channel frequency by operation of push buttons on the front panel of the network control unit. Remote dialling and monitoring facilities are provided.

Two versions of the network control unit are available: the LA 7911A incorporates a standard telephone dial, and the LA 7911B has push buttons for outstation selection. The "A" version caters for up to 21 outstations, and the "B" for up to 38. Solid state and integrated circuitry techniques have been used throughout for low power consumption and high reliability over a wide range of ambient conditions. Both units are constructed in modular form, are completely self-contained and only require connection to the associated transmitter/receiver and to an AC or DC power source.

KODAK (AUSTRALASIA) PTY. LTD., branches in all States. **Orange Scribing Plate.** For the generation of micro-photography masters, precision printed circuits, and other applications requiring extremely clean, sharp lines. The specially formulated orange coating is opaque to blue light which can expose

orthochromatic-sensitive photographic reproduction materials, yet it is transparent enough to allow tracing of copy beneath one of the plates on a light table. The scribing surface also accepts pencil notations, or draughting, if required.

Scribing is easily done with chisel-shaped hand-held or mechanical scribing tools. The orange coating is capable of very high resolution at circle tangents, line intersections scribed at very small angles, and where lines are very closely spaced. Line widths are very uniform, due to the ease of scribing on the glass base and the excellent adhesion and scribing properties of the coating. The smooth glass surface completely eliminates gouging of the scribing material. Orange Scribing Plate is available in various sizes up to 30 inches wide.

IRH COMPONENTS PTY. LTD., The Crescent, Kingsgrove, N.S.W. 2208. Agents for Emerson and Cuming Inc., U.S.A. **Eccosorb FDS.** A high-loss flexible material based on silicone rubber which, when bonded to a metal surface, will effectively prevent the flow of microwave currents. It, therefore, reduces the backscatter or reflectivity of metal structures where these are caused by surface currents. It can also be draped over objects to alter the reflectivity characteristics.

RUTHERFORD ELECTRONICS PTY. LTD., P.O. Box 30, North Balwyn, Vic. 3104. Agents for National Semiconductor Corporation, U.S.A. **TTL Digital Counter Display Kit CSD 17.** Allows quick and easy assembly by anyone reasonably skilled with a soldering tool. May also be purchased already assembled. Each counter display kit is mounted in a printed wiring connector for easy insertion and removal; they may be mounted close together, three digits in only two inches. The units are said to have all the inherent advantages of Transistor Transistor Logic (TTL) over other forms of logic systems, and are the National equivalent to the standard 54/74 series TTL. Features: high noise immunity; high speed; easy interfacing; complex functions available; high reliability. The full kit containing decade counter, quad latch, decoder/driver, numerical indicator tube, connector, printed circuit board, and other minor components costs only \$32.50 for 100 up quantities, providing as well as the counting and display facilities BCD outputs to ancillary equipments. The many possible arrangements are described more fully in an application note available from Rutherford.

ELECTRONIC DESPATCH

P.O. BOX 149, AUBURN 2144

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RESISTORS from 1 ohm to 10 ohms now in stock, $\frac{1}{4}$ W at 8c, $\frac{1}{2}$ W at 6c. 1W 1-10 ohm 8c.

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The following are always in stock:

BC 107 . . . 70c	OCF 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	BF 179 . . \$1.50
. 65c	200 V Video amp
Comp. to 108	BF 115 . . . 70c
AD 161/162 \$3.60	FET 2N 549 \$1.20
AD 161 . . \$1.80	(MPF 105)
AD 162 . . \$1.80	UJT D13T1 \$1.20
SCR BTY 79/400R	2N 3055 . . \$2.50
OA 91 . . . 27c	10A 400 V \$3.75
	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
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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.

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10c per transistor.
24c per diode
Data sheet for most transistors and diodes supplied.
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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
Motor 240 V 0.4A. \$10.00.

Edge Connectors, single units . . 50c
16 pin 0.1", block of 8 50c
Plug in Cards with wires cut,
Gold plated Contacts 25c
Fuse Holders ex computer . . 20c

Consult the SOUND EXPERTS!

To achieve the optimum in stereo reproduction each component must be perfectly compatible with the other. This is a service offered by Convoy Technocentre, allowing you to select from our exclusive range of integrated stereo components. Each a leader in its class.

BUILD YOUR SYSTEM NOW FROM ONLY QUALITY GUARANTEED COMPONENTS, \$200 - \$2,000.

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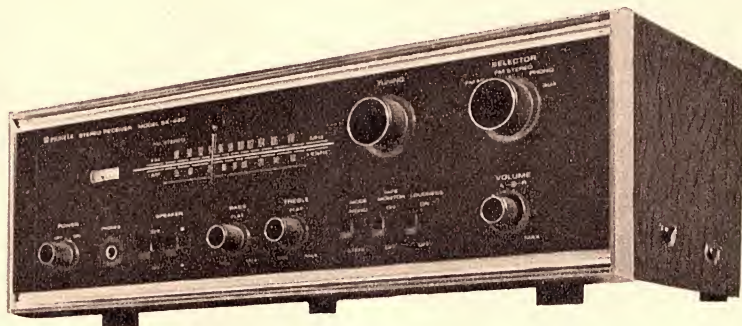
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Pioneer's new advance in AM circuitry, sensitivity only 8 μ V using FET RF stage, and 3 gang variable capacitor. 15W RMS per channel. S/N 85dB. Multi speaker selector.

\$250



SA-500

High power performance, incorporating Pioneer's exclusive design features—

- * 12W RMS per channel
- * Less than 0.5% distortion
- * 20Hz to 50KHz \pm 1dB
- * Full tape channel selection
- * New low price!

\$145

STOP PRESS!

AX330 AM-ONLY TUNER AMPLIFIER
JUST RELEASED\$185.00

Convoy Technocentre
FOR SOUND SATISFACTION

CONVOY INTERNATIONAL PTY. LTD., 449 KENT ST. SYDNEY
(NR. TOWN HALL) 29 6475.

INDUSTRIAL INVENTIONS INC., RD2, 463 U.S. Route 1, Monmouth Junction, New Jersey 08852, U.S.A. Logalog Strobed Latching Monitor model 33. Allows simultaneous monitoring of 10 changing binary circuit points and, when strobed, will store and display the data at the time of strobe. Strobing can be done by high or low levels, or it can be done manually from the instrument. The instrument is compatible with TTL, DTL and RTL circuitry, and can be used to 7.5MHz. The Logalog can also be used to monitor 10 slowly changing data points indicating a logic "1" or "0" condition. A strobe lock allows strobing on the first strobe pulse only, and will lock out any additional pulses. Clearing of the indicators and internal circuitry can only be accomplished manually.

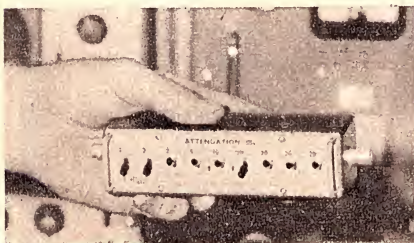


TEKTRONIX AUSTRALIA PTY. LTD., 80 Waterloo Road, North Ryde, N.S.W. 2113. **Field effect Transistor Probe, type P6051.** Designed for use with real-time and sampling oscilloscopes. Features: DC to 1GHz bandwidth; 0.35mS risetime; 1M input resistance and 2.8pF input capacitance (50 ohms at probe output); offset capability to allow the viewing of AC signals with DC potentials up to 5V (200V with a 40 x attenuator). The P6051 can be powered from the probe power of the 7000 series mainframe or by an accessory power supply unit, such as the type 1101. **Accessory Power Supply, type 1101.** Designed to supply power for up to four probes with outputs featuring short-circuit protection. Three output voltages: plus 15V; minus 15V; plus 5V. Each supply is rated at 400mA.

M-O VALVE CO. LTD., Brook Green Works, London W.6, England. **Instrument Cathode Ray Tube type 1400B.** A single gun, mesh-P.D.A., high performance type with a display of 10cm x 8cm and an overall length of only 13½in. The X-sensitivity is 11V/cm and the Y-sensitivity 5V/cm. Deflection linearity is better than 5 per cent. Typical final anode voltage is 12KV, and under these conditions it can be used in oscilloscopes with bandwidths of 100MHz.

FAIRCHILD AUSTRALIA PTY. LTD., P.O., Box 151, Croydon, Vic. 3136. **Bi-Meszar Power Transistor, type 2N3055.** A high-power silicon transistor manufactured by the new Fairchild process called Bi-Meszar. This is a high-volume, low-cost process producing exceptionally reliable power amplifiers and switches. The process uses double (BI) epitaxial growth, with a mesa (MES) collector-base etch, and a Planar (AR) emitter-base. Features: high forward and reverse bias safe area; leakage levels approaching Planar structures because of a Vapox protection of the mesa collector-base junction; high voltage; typical frequency response 2 to 7MHz; excellent switching performance in speed and saturation characteristics.

GRANGER ASSOCIATES PTY. LTD., 1 Dale Street, Brookvale, N.S.W. 2100. Australian agents for Hatfield Instruments Ltd., U.K. **RF Switched Attenuator.** Housed in a die-cast aluminium box fitted with nine switches, nine attenuator pads, and two coaxial sockets. Features: attenuation 0 to 100dB in steps of 1dB; switch sequence 1,2,2,5,20,20,20; impedance 50, 75, and 600 ohms; frequency range DC to 250MHz (50 and 75 ohms), DC to 5MHz (600 ohms); connectors BNC; size 5½ x 1-5/8 x 2½in; weight 15½ ounces.



Hatfield switched attenuator.

ASTRONICS AUSTRALIA PTY. LTD., 161-173 Sturt Street, South Melbourne, Vic. 3205. Agents for Rohde and Schwarz, West Germany. **VHF Directional Antenna Elements, type HA 52.** These dipole elements, covering 60 to 174MHz, can be mounted on masts and towers of practically any cross section in such a way that omni-directional or directional patterns are obtained as desired. The power gain of a vertically polarised omni-directional array is approximately 1.1 with reference to a half-wave dipole. To obtain greater gain, several arrays can be stacked.

The elements are extremely robust, lightning-protected, and suitable for use in any climate. All parts of the welded steel structure are dip-galvanised and weatherproofed by several coats of paint. Individual elements are connected by means of junction boxes which consist of printed circuits of high power handling capacity.

WARBURTON FRANKI LTD., 372 Eastern Valley Way, Chatswood, N.S.W. 2067. Agents for Narda Microwave Corporation, U.S.A. **Electromagnetic Radiation Survey Meter model 8100.** The unit combines a metering unit and a probe unit, and is designed to accurately test and check radiation emanating from consumer microwave ovens, industrial and commercial dryers and cookers, medical diathermy equipment, and other microwave equipment in the ranges of 915MHz and 2450MHz. A choice of three probes and metering unit range selection enable measurements in four density ranges in 10dB segments from a minimum of 10uW/sq. cm to 200mW/sq. cm.

An alarm will sound if the level of field intensity is greater than a preset level. If the test instrument becomes inoperative for any reason, including failure to connect a probe, an alarm sounds automatically to notify and protect the operator. To ensure consistency of measurement, each probe is fitted with a 2-inch spacer which enables the user to maintain a precise distance from the point

being measured. Specifications include: directly calibrated at 915MHz and 2450MHz; automatic selection of sensitivity range when probe is connected; direct reading to 1dB accuracy; battery or AC operation; recorder output for permanent record and maintenance; portable, lightweight, only 3½ pounds. Price, duty free, \$725 including one probe.

DISTRIBUTORS CORPORATION PTY. LTD., 24 Johnston Street, Fitzroy, Vic., 3065. Australian distributors for Atomichron Inc., U.S.A. **Atomichron model 3501 Atomic Clock.** A compact, solid-state, self contained, caesium beam primary time and frequency standard with an accuracy of 1 part in 10¹¹ designed primarily for military applications. A high quality quartz crystal oscillator, operating at a sub-harmonic of the transition frequency (9192MHz), is locked to the transition frequency by means of an electronic servo-control system. Output frequencies are synthesised from this primary loop oscillator. Units can be simply switched from the atomic time scale to the universal time scale by throwing a toggle switch and setting the unit to self calibration.

SIMON GRAY PTY. LTD., 22 Ridge Street, North Sydney, N.S.W. 2060, has been appointed exclusive distributor for Sansui Electric Co. Ltd., Tokyo, Japan, in N.S.W., Victoria, Queensland, South Australia, Tasmania, A.C.T. and Northern Territory. Sansui manufacture stereo amplifiers, stereo amplifier tuners, loud-speaker systems, and disc reproducing equipment including turntables and pickups. Previously, Sansui was represented in Australia by two companies on a split distribution basis.

HY-Q ELECTRONICS PTY. LTD., 10-12 Rosella Street, Frankston, Vic. 3199, has appointed Mr Peter J. Tennick to the position of senior production engineer. Mr Tennick was, until recently, a member of the engineering staff of Cathode Crystals Ltd., a U.K. crystal manufacturing company.



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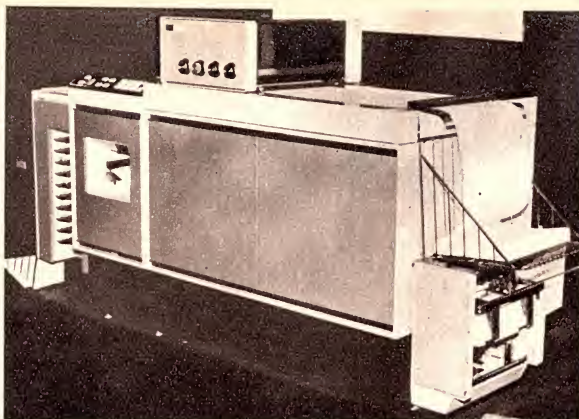


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RANK XEROX (AUSTRALIA) PTY. LTD., 49 Market Street, Sydney, 2000, offers a service for the high speed duplication of computer output fan-folds. The company's latest product, the Computer Forms Printer, is used for this service with a production rate of 40 dry copies per minute. The device duplicates small fan-folds same size and reduces larger fan-folds to a convenient quarto size, collating the copies into sets as it produces them. Rank Xerox claims that the new method is four times as fast and half as expensive as other methods which they have offered in the past. The cost, including collation, is based on a two mode scale. The longer the run-length, however, the lower the cost per copy.



HOWELL ENGINEERING PTY. LTD., Kyla Road, West Heidelberg, Vic. 3081, has been appointed Australian representative for Blue Giant Equipment of Canada Ltd., Brampton, Ontario. The product line includes manual and self-propelled trucks, narrow aisle stackers, electric lift trucks, mechanical and hydraulic dock levellers, hydraulic scissor lift tables, and elevating docks, as well as the personnel carrier called the "Mini Skoot." The products were recently introduced to the Australian market at the 5th International Engineering Show in Melbourne. Howell Engineering will manufacture the Blue Giant equipment under license in a new plant, scheduled for early this year. In the meantime, equipment and a complete service depot will be set up from Canadian stock.

PHILIPS TELECOMMUNICATIONS OF AUSTRALIA LTD., 113 Tapleys Hill Road, Hendon, S.A., has announced an increase of 320 per cent in the volume of exports in the past five years. Sales for the first three months of this financial year (July to September) have already exceeded last year's total exports by over \$55,000. In the last financial year equipment was exported to 15 countries compared with five in 1964-65.

NATIONAL CASH REGISTER CO. PTY. LTD., 14-16 York Street, Sydney, 2000, Australian agents for Mohawk Data Sciences Corporation of the U.S.A., has announced that Mr Walt J. Milas has been appointed Mohawk regional manager for Australia, New Zealand and South East Asia. Established in August, 1964, Mohawk is now one of the leading manufacturers of off-line computer peripheral equipment.



Mr Walt J. Milas, Mohawk regional manager, inspects a Mohawk magnetic tape encoder at NCR's headquarters in Sydney.

VOSPER LTD., the U.K. shipbuilding and engineering company within the David Brown Corporation, has set up an Australian subsidiary company, Vosper Pty. Ltd., with offices at 12 Parramatta Road, Stanmore, N.S.W. 2048. The new company is a joint venture in which Vosper Ltd. holds 60 per cent of the shares and David Brown Corporation of Aust. Pty. Ltd. 40 per cent. Vosper Pty. Ltd. will design, manufacture, and market in Australia and Zealand the products of Vosper Ltd. and its subsidiaries. Among the first to be marketed will be Vosper's Mini-fin stabiliser for power craft in the 40-60ft range.

IRH INDUSTRIES LTD. has appointed Mr W. D. Claren as manager of Sauter automatic control products activities within the equipment division of the company. Before joining IRH, Mr Claren was for 13 years export sales manager of the Swiss manufacturer of control equipment, Sauter A. G., of Basle.



Mr W. D. Claren

FAIRCHILD AUSTRALIA PTY. LTD., 420 Mount Dandenong Road, Croydon, Vic., 3136, has announced the following appointments: Mr David Finch, formerly Fairchild sales engineer in N.S.W., to the position of sales manager, Fairchild Ltd., Hong Kong; Mr Phil Cohen, formerly Fairchild sales engineer in Victoria, to the position of national sales manager for Australia and New Zealand; Mr Bob Hunt, formerly sales engineer in Melbourne, to the same position in N.S.W.; Mr Bryen Tanner and Mr Dan McLachlan to the positions of sales engineers in N.S.W. and Victoria respectively.

MATSUSHITA ELECTRIC CO. (AUST.) PTY. LTD. has opened a new sales and service centre at 30 Russell Street, Melbourne. Mr Robert Murrie has been appointed Victorian sales manager, and Mr Graeme Duncan service manager of the new branch. As in Sydney, Matsushita organised a series of trade functions to introduce the new National television sets to retailers.

UNITED DATA CENTRES PTY. LTD., A.D.C. House, 189 Kent Street, Sydney, 2000, has appointed Mr G. Firth to the newly created position of data processing manager. Mr Firth, who will be located at the company's Rydalmere centre, will be in charge of computer processing activities at both the city and Rydalmere centres. The group's operations system team and the two centre managers are responsible to Mr Firth.

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50mf	21c	18c	50mf	17c	14c
100mf	25c	21c	100mf	19c	15c
200mf	29c	23c	200mf	25c	21c
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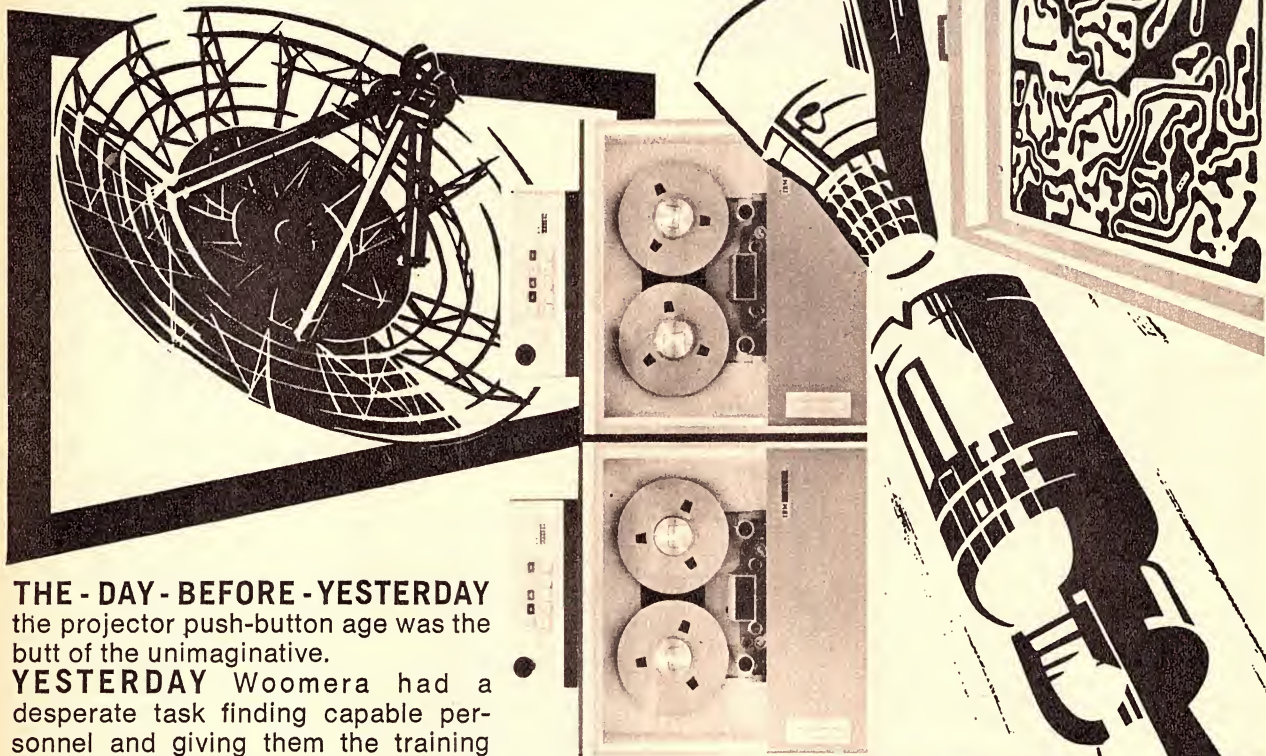
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TECHNICAL BOOKS AND PUBLICATIONS

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ELECTRONICS by Roland Worcester. Published by Sun Books Pty. Ltd., 346 St. Kilda Road, Melbourne, 3004. Paper covers, 7in x 4-3/8in, 160 pages, profusely illustrated in full colour. Price 99c.

The activities of the Paul Hamlyn publishing group are manifold, and this present volume is one of a new series of paperbacks which the group has launched in Australia. Common to all books in the series is the liberal use of beautifully prepared illustrations in full colour. In the book under review, 150 of the 155 pages which make up the text proper have at least one such illustration, while many have three or four. These visual attractions will obviously catch the eye of bookshop browsers, but what of the text?

In the limited space available, one would not expect to find a detailed explanation of the many aspects of such a wide-ranging subject as electronics. It is not surprising, therefore, to find that all the matters covered are discussed quite superficially but, at the same time, quite accurately. This itself is gratifying since, all too often, simplified explanations of matters electronic contain glaring inaccuracies. In this

case, we are told by the publishers that the name "Roland Worcester" is a nom de plume for "one of the leading authorities in Britain on the theory and applications of electronics." Whatever this may signify, the book does impress by its accuracy. The style is terse and simple, easy to read and assimilate.

The main part of the text is concerned with giving the reader a brief insight into the workings of electronic equipment which the average person comes into contact with in the course of daily life—sound radio, television, audio amplifiers and recordings on disc and tape. This is preceded by a summary of basic facts relating to electricity, magnetism, circuit laws and units and components. Some of the more specialised aspects of electronics are covered in the last part of the book—counters, computers, radar, instruments, and so on. A short glossary of technical terms is provided, and a detailed index.

In summary, this book should admirably meet the needs of those with little or no prior knowledge of electronics, seeking an introductory text. It is extremely good value at 99c. (H.A.T.)

Sound effects

SOUND EFFECTS ON TAPE by Alan Edward Beeby. Published by Tape Recording Magazine, London. Paper covers, 7 1/2 in x 5 in, 64 pages, some illustrations. Price in Australia 75c post free.

This book presupposes that there is a body of people who have made tape recording their hobby to the extent that they make dramatic recordings which require the numerous sound effects one hears in radio drama, for example. Allowing that there is such a body of enthusiasts, and also allowing that they would scorn to use the sound effects records available commercially for a few dollars, here is a book which should meet their needs for practical instruction in the simulation of all kinds of sounds, from a gentle breeze to a hurricane, from the wheels of a carriage turning to an army on the march.

The style of writing is the facetious one adopted by many non-professional writers, replete with inaccurate allusions and faulty metaphors, but this hardly matters. The main thing is that it does contain a good deal of practical advice, based on experience, on a highly specialised subject. Chapter 1 deals with the place of the sound effects man in the scheme of things, his studio and his equipment, if the

collection of odds and ends used can be so called. This theme is developed further in the next two chapters, and in Chapter 4 comes the real meat—the mechanics of producing a wide range of miscellaneous sound effects. The rest of the chapters deal with more specialised sound effects and their application; and practical management of tapes as a library is built up.

One weakness which should be pointed out is that some of the home-made equipment described by the author did not have accompanying illustrations, and it is difficult to envisage the construction from his descriptions. Conclusion: A book with some faults, but a practical one which should be useful to its envisaged readership.

Our review copy came from the agent, who is: B. T. Lovett, 5 Glover Street, Willoughby, N.S.W., 2068, from whom copies may be ordered by post (H.A.T.)

Power supplies

ELECTRONIC POWER SUPPLIES, by Joseph Grabinski. Published by Holt, Rinehart and Winston (Aust.) Pty. Ltd. Soft covers, 6in x 9in, 233 pages. Price in Australia, \$4.35.

Although power supplies are a fundamental part of most electronic equip-

ment, they are often treated very briefly in electronics texts of a general nature. And, in publications dealing with more specific aspects of electronic circuit designs, the importance of the power supply arrangements again tends sometimes to be minimised.

"Electronic Power Supplies," however, is a comprehensive text covering the various aspects of power supply operation and design, written for students of technical colleges and technological institutions. With a concise but easily readable style, the author has treated the various topics in some depth and has provided revision questions at the end of each chapter.

The chapter headings are:

1. Single phase rectifier circuits.
2. Polyphase rectifiers.
3. Magnetic amplifiers.
4. Gaseous-tube circuits.
5. Controlled rectifiers.
6. Regulators.

In the preface, the author indicates the assumed academic level of the reader as an understanding of algebra, trigonometry and elementary integral calculus, as would be covered in most courses of study in electronics. He also states that all mathematical derivations are given in full, without making irri-

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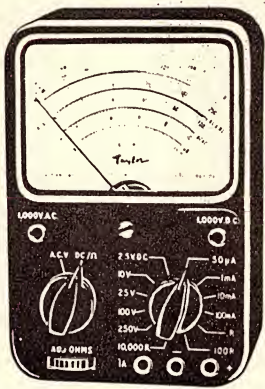
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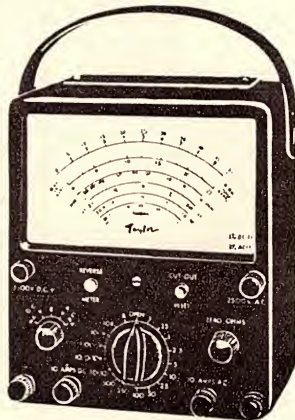
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(Left) Model 127A: SENSITIVITY: 20,000 Ω/V d.c., 1,000 Ω/V a.c. RANGES: d.c. current—50 μ A to 100mA. d.c. volts—0.15 to 1,000 a.c. current—100 μ A. a.c. volts—10 to 1,000. Resistance—0 ohms to 20 megohms (3 ranges). Decibels—10 to +62 db. ACCURACY: D.C. ranges— \pm 3%. A.C. ranges— \pm 4%.

(Right) Model 88B: SENSITIVITY: 20,000 Ω/V d.c., 2,000 Ω/V a.c. RANGES: d.c. volts—0.1 to 2,500. 25 kv with adaptor Model 488. a.c. volts—1 to 2,500. d.c. current—0.05 to 10A. a.c. current—1 to 10A. Resistance—1 ohm to 50 megohms (5 ranges). Decibels—10 to +68 db (8 ranges). Capacitance—1,000 pF to 100 μ F (4 ranges). Inductance—0.2 to 20H (2 ranges). ACCURACY: D.C. ranges— \pm 2%. A.C. voltage ranges— \pm 3%. METER: 5" mirror scale. OVERLOAD PROTECTION: automatic mechanical cutout.



(Left) Model 100A: SENSITIVITY: 100,000 Ω/V d.c., 5,000 Ω/V a.c. RANGES: d.c. voltage—5 to 2,500. High voltage probe for 25 kv a.c. voltage—10 to 2,500. d.c. current—10 μ A to 10A. Resistance—0 ohms to 200 megohms (4 ranges). Decibels—10dB to +62db (5 ranges). ACCURACY: D.C. ranges— \pm 2%. A.C. ranges— \pm 3%. METER: 8 μ A M/C with mirror. OVERLOAD PROTECTION: automatic mechanical cutout. REVERSE POLARITY. Also available: Model 101. A simplified version of the 100A, without the 2,500 V measuring ranges, the Overload Protection Switch and Polarity Reversal Switch.



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tating assumptions or omitting steps. On sampling the book, the mathematical treatments do appear to be quite complete.

While the author has given an indication of the minimum academic requirements for the reader, he nevertheless begins from fundamentals in the first chapter dealing with simple rectifier circuits. But the book goes on to cover polyphase rectifier circuits and magnetic amplifiers in a comprehensive manner and at some depth and, for these, the reader would really need to have some background in electronics and the stated mathematical subjects.

The chapter on controlled rectifiers deals rather well with the fundamentals in silicon controlled rectifier operation and applications, beginning with a brief description of their construction. However, there is no mention made of the triac as the AC counterpart of the SCR. Nevertheless, the book gives a thorough treatment of those topics covered and at \$4.35 represents good value for the electronics student and technician. Our copy was supplied by the publishers. (A.J.L.)

LITERATURE—in brief

MULLARD OUTLOOK, Vol. 12, No. 5, September/October, 1969. Published by Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2000. Contents: Viewpoint with Mullard; Colour television, part 7 — A solid state colour television receiver; Electronics in domestic appliances, part 3 — Simple speed control and lamp dimming circuits; Light units in SI (discusses photometric units based on the metric base unit, the candela); New Mullard reed switch meets British Post Office specification; Spark-gaps for protection of radio receivers; Power supply with overload protection for 20/40W amplifier; Pandicon ZM1200 14 decade indicator; 26in colour tube for 110 degrees deflection; Transistor DC-DC converter — additional notes.

TECHNICAL COMMUNICATIONS, Vol. 11, No. 101, September, 1969. Published by Mullard Ltd., U.K. Inquiries to Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2000. Contents: Integrated sound intercarrier amplifier and transformerless audio stage for colour TV receiver, by J. C. Beckley; Matched field effect transistors in the differential input stage of an operational amplifier, by B.J.M. Overgoor; Economical 3W record-player amplifier, by D. R. Hyde; Portable AM/FM radio receiver, by A. Garskamp. Also included with this issue is the index to Vol. 10, Nos. 91 to 100, January, 1968 to July, 1969.

PLANAR, November/December, 1969. Published by Fairchild Australia Pty. Ltd., 420 Mount Dandenong Road, Croydon, Vic. 3136. Contents: The small computer is here; Good connections are half the battle; Light sensors—how do they work?; No little strangers but the Fairchild family is growing; Mini skirts are good fun, mini computers make good sense; The voice of doom; Elco Corporation offers wide range of connectors.

IONIZATION POTENTIALS, APPEARANCE POTENTIALS AND HEATS OF FORMATION OF GASEOUS POSITIVE IONS, by J. L. Franklin and J. G. Dillard, Rice University; H. M. Rosenstock, J. T. Herron and K. Draxl, National Bureau of Standards Institute for Materials Research; and F. H. Field, Esso Research and Engineering Co. National Standard Reference Data System NBS-26, price \$1.25 (U.S.) Orders to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. This volume covers the literature published in this field since 1955. It

Draft Australian standards

The Standards Association of Australia, 80 Arthur Street, North Sydney, N.S.W. 2060, is seeking comment on a number of draft Australian standards. Copies of the various documents may be obtained, without charge, from the offices of the Association in all capital cities and Newcastle.

Doc. 1470. Draft standard specifications for power reactors and earthing transformers, based upon I.E.C. recommendations amended in the light of Australian practice.

Doc. 1471. Draft standard for moulded case circuit-breakers having voltage ratings up to and including 600V AC and 250V DC and interrupting ratings of 10KA or more, based on an I.E.C. draft standard.

Doc. 1472. Draft "approval and test" specifications for mineral-insulated metal-sheathed (MIMS) cables. It is a proposed

revision of AS C351, Part 1, Copper-Sheathed Cables with Copper Conductors, and is intended to become one of a series of approval and test specifications issued by the Association under Part II of the SAA Wiring Rules.

Doc. 1473. A proposed complementary specification to Doc. 1472, it specifies requirements for terminations for MIMS cables.

Doc. 1474. Draft recommendations for partial discharge measurements, dealing mainly with electrical measurements but some reference is also made to non-electrical methods.

Comment on the provisions of the draft standards is invited from persons or organisations experienced in design, manufacture, testing, sale and use of the respective items. Comment should reach the head office or any branch office not later than January 31, 1970.

presents essentially all the values of appearance potentials of positive ions obtained since 1955, provides a set of "best" values of heats of formation of gaseous ions, and serves as a guide to the literature.

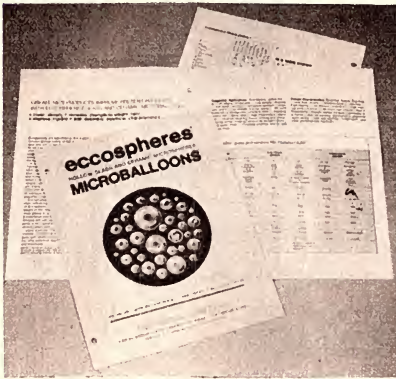
SUN BOOKS PTY. LTD., 346 St. Kilda Road, Melbourne, Vic. 3004, has launched a new series of original non-fiction all-colour paperbacks for which advance royalties totalling over \$1 million were paid by international publishing houses. The series was conceived by Mr Paul Hamlyn and produced in London at a cost of more than \$2 million. More than 100 titles are in preparation, and it is intended to expand the range of titles every two months, including the first of many specifically Australian titles in 1970. Sun all-colour paperbacks will be widely displayed in bookshops and newsagents throughout Australia. A review of the first release of Sun books appears earlier in this section.

INVENTUS, Vol. 6, Issue 4, September, 1969. The Journal of the Inventors' Association of Australia Ltd., Box 3400, G.P.O., Sydney, 2001. Contents: Editorial; Inventions for space research and on the moon; National President's address; Head office and branch reports; The Hartnett Award; Inventors' corner; Product feasibility studies and cost analyses; Technical news.

NEFF INSTRUMENT CORPORATION, U.S.A., has published an illustrated 8-page brochure describing its complete line of amplifiers. The catalogue includes descriptions, specifications and photographs. Wide-band and narrow-band, differential and single-ended, chopper-stabilised and direct-coupled models are shown. Standard accessories are also included as well as a quick reference chart for comparison of all models. Inquiries to Data-matic Pty. Ltd., P.O. Box 171, Crows Nest, N.S.W. 2065.

TELECOMMUNICATION NEWS, No. 3. Published by The Marconi Company Ltd., England. Inquiries to Amalgamated Wireless (Australasia) Ltd., P.O. Box 96, North Ryde, N.S.W. 2113. Contents: Keeping up to date; Important expansion of telecommunications in East Africa; Stamp of approval; Star finder extraordinary; Telephone line sharing for computer bureaux users; Manager, line communications division; Naval communications; East African earth station; Guyana-Trinidad tropo link opens; Latest order for Marconi PCM is largest yet; Space communications hat trick; Tropospheric scatter communications for NATO forces; Communication to Kuwait; Marconi "thin-line" tropospheric scatter system links Europe and Africa.

ECCOSPHERES. Published by Emerson and Cuming Inc., U.S.A. Inquiries to Emerson and Cuming U.K. Ltd., Colville Road, Acton, London W.3, England. A 4-page folder gives a description of the company's line of glass/ceramic micro-balloons. Eccospheres are free-flowing, thin-walled, hollow, glass and ceramic spheres ranging from 10 to 300 microns



in diameter. They provide a controlled means of loading resins to increase strength while reducing weight. Other advantages with Eccosphere loading include good matching properties, excellent thermal and electrical characteristics, and improved flow qualities in the uncured resin. The folder lists application and property data on six different types of Eccospheres, including electrical, industrial and hydrospace grades.

NEGATIVE DRAFTING SYSTEM. Technical Bulletin 1002. Published by Bishop Graphics Inc., 7300 Radford Avenue, North Hollywood, Calif. 91605, U.S.A. Describes and illustrates a method of making negative artwork for printed wiring board prototypes without photography by using negative drafting symbols, components, and opaque masking. Invented and recently introduced by Bishop Graphics, the "B" Neg. System (patents pending) can also be used to "rescue" existing negatives in which circuit corrections or missing components must be added. Section headings are: What is Bishop "B" Neg?; "B" Neg advantages; From "B" Neg to ready-to-drill board; To change existing negatives with "B" Neg; Little special equipment necessary; "B" Neg becomes a ready-to-drill board in minutes, not days; "B" Neg the quick-change artist; Summary; "B" Neg kit; "B" Neg artwork patterns.

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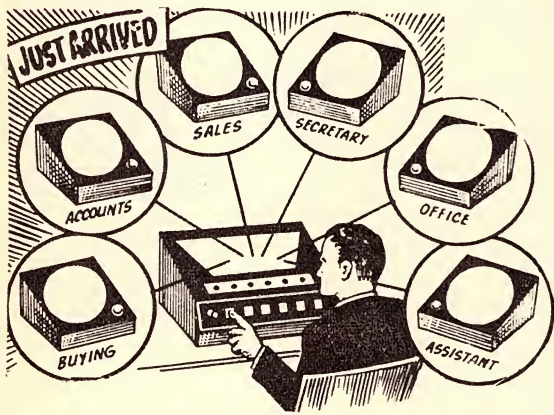


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MAIL ORDER SPECIALISTS

RADIO: Unofficial history

During the 1939-45 war years everything was in short supply, from food and clothing to dry batteries and technical "know-how."

Torch batteries, when available, were restricted to two per customer. Joe had a portable whose "A" battery complement consisted of nine torch batteries, but this presented no great problem to him. When the local chain store had batteries available he would buy two, walk around the counter and then buy another two, until he had the required number. Each time around, the girl behind the counter would give him a larger smile. Perhaps the fact that he was wearing an R.A.A.F. Flight Sergeant's uniform helped!

Radio "B" batteries were more difficult to obtain. It soon became general knowledge that a few of the radio stores with a repair department reserved their quota for "repairs." If you were prepared to pay the price, you took your radio with flat batteries in for repairs. They were replaced, and an additional charge was made for fitting and testing. Of course, with this legalised form of black marketing the inevitable sometimes happened. One customer took his radio in to a repair shop, but failed to make it clear that all he really wanted was new batteries. You can imagine what he said when he collected his radio and was presented with an account for alignment and the replacement of a weak valve with a note saying, "Sorry, no batteries." The moral of this story, for customer and serviceman alike, is still valid today.

Toward the latter half of the war, the Japanese Forces were making their way relentlessly southward toward the Australian mainland and additional troops were stationed in Western Australia. The equipment of the Armed Services was becoming more sophisticated and the shortage of personnel for servicing the radio and telephone equipment was becoming more acute. The local technical college assisted by providing training programs for selected personnel from established units, as well as for new recruits.

The selection of trainees for these

courses was an ever-pressing problem. The Commanding Officers of units could ill afford to lose the services of their good men, while most potential new recruits with any electronic background had already volunteered or were in reserved occupations.

One new recruit said that the method of his selection was as follows: He and his fellow inductees were lined up one morning and asked for a volunteer with some electrical knowledge to attend a course for Signal Electricians. When no one stepped forward, the Sergeant Major looked at him and asked, "Can you turn a light switch on and off?"

"Yes," replied the recruit.

"Right, you know something about electricity, you'll do."

Whether this story is true or not is a matter for conjecture, but some years later this trainee occupied the position of technical representative for a large manufacturer of television antennas.

Part of the training program involved familiarisation with the circuit and components of the Army radio receivers. One of the methods originally used for this purpose was to send the trainees outside of the room while the instructor hastily unsoldered and reconnected one or two of the wires or components on an Army 109 type radio receiver. Using the circuit diagram the trainees were then required to find out what changes had been made.

One group had outstanding success at this exercise and it was not until the wind-up dinner that the secret was out. As soon as each trainee returned he would quickly run his fingers over the soldered joints and find out which ones were still warm! Any lack of technical know-how on the part of this group was certainly compensated by native shrewdness.

Eventually the War was over. Many of the Services personnel introduced to electronics as a result of war-time shortages have remained in the industry as successful engineers, technicians or technical sales representatives. (P.E., Como, W.A.)

(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.)

Navigation Net Around the World

(Continued from page 17)

probably be computer controlled and would give a direct readout of position. The accuracy with which a position can be fixed will be limited by the slight variability in the positions of the hyperbolic phase line. At worst, a position may be determined to within two kilometres and in many cases closer than this.

Despite these and other difficulties, a VLF navigational system seems to be a worthwhile proposition. Four stations

of the Omega network are already in existence and have been used for detailed measurements along various propagation paths. A wealth of experimental data now exists. We can look forward to a time in the early 1970s when the entire surface of the earth will be covered by a matrix of constant phase lines and the human navigator will be replaced by a computer-controlled Omega receiver giving a direct and continuous read-out of position. ■

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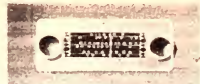


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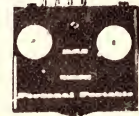


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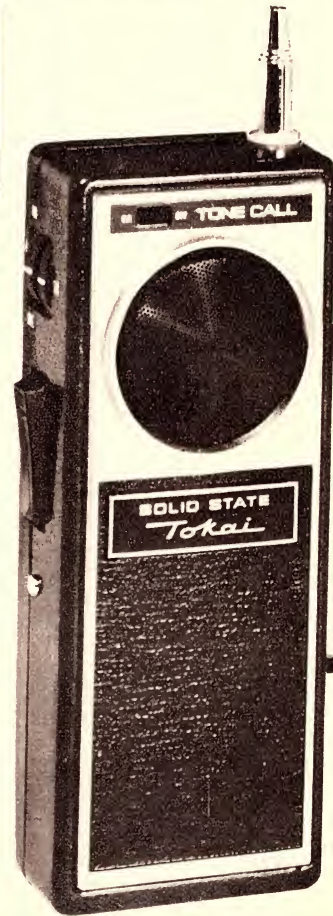
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AMATEUR BAND NEWS AND NOTES

W.I.A. Youth Radio Club Scheme

Formulated by the Wireless Institute of Australia as a means of introducing school students to the technical aspects of radio and electronics, the Youth Radio Scheme continues to be an outstandingly worthwhile activity.

by Pierce Healy, VK2APQ

Each month these notes include news of the activities of the Youth Radio Clubs in the various States. Recent inquiries regarding the scheme have indicated that a more general coverage of the project would assist in providing information necessary to enable preliminary planning to be made for the formation of a club, prior to the commencement of the school year.

The background of the scheme dates back about ten years when members of the New South Wales Division of the Wireless Institute of Australia realised the benefits young people of school age would gain by being given the opportunity to learn more about radio and electronics than that covered by normal school curricula. Also, they would be introduced to a worthwhile and rewarding hobby—amateur radio.

The scheme was submitted to and accepted as a working project by the Federal Council of the Institute, at the Annual Federal Convention held in Perth in 1962.

The scheme was, then, the latest addition to the various educational activities of the Institute, which by the terms of its "Memorandum and Articles of Association," is obliged to provide "information, instruction and advice on matters pertaining to radio communication" and to "encourage and assist all persons interested in any or all aspects of amateur radio and to promote the extension of interest and active participation in such pursuits."

Since 1962 many Government organisations, commercial undertakings and public associations have shown a keen interest in the progress of the scheme and the achievements of the members. Among those interested are branches of the P.M.G.'s Department, Overseas Telecommunications Commission, Department of Civil Aviation, Education Departments, personnel officers of radio and electronic manufacturers as well as many local shire and municipal bodies.

Suggestions for club leaders and instructors:—

Conditions vary so greatly from club to club that it is inadvisable to be too dogmatic about methods which should be followed by club leaders and instructors. However, there are various schemes which

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.

have been tried and found practicable. It is necessary for club leaders to assess local conditions and situations and to consider age group and ability level of club members before embarking on any proposed line of activity or follow any particular method of instruction or administration.

In some schools, provision is made for a definite "Hobbies" period in the class timetable. In others, enthusiastic teachers are prepared to devote lunch time and after school hours to Radio Club activities. Some schools have staff members who are licensed radio amateur operators and who construct and operate amateur transmitting stations in conjunction with their radio clubs.

Over the years an increasing number among school science staff have realised that Youth Radio Club activities can usefully reinforce certain aspects of the formal science courses.

Whatever the circumstances, the formation of a Youth Radio Club is not to be undertaken lightly. A considerable amount of preliminary work and organisation must be undertaken in order to ensure success. It is important to present club members with a very definite program of activities which will hold their interest from the beginning. It is thought that the Radio Proficiency Certificate incentives can do much to assist club leaders by providing ready-made programs and by offering incentives to those who attain certain standards of skill and knowledge in the radio field.

Constructional projects are also included as part of the scheme's activities. For each certificate of the basic series, candidates must construct various pieces of equipment to satisfactory standards of workmanship and efficiency. The acquisition of components for these projects is the responsibility of the individual clubs. One method which has proved to be effective is for club leaders to make up kits of parts for suitable projects. These are issued to members who have reached a standard which allows them to cope with the particular project. Afterwards, the unit is dismantled, and issued to the next eligible member.

Western Australia. In Western Australia, 1969 has been the most active year on record for the Youth Radio Scheme. There are seven active Clubs and a number of smaller groups that show sporadic activity.

The clubs registered with the Scheme are:

Name of Clubs	Membership
Aquinas College	100
Wesley College	20

Christmas Island (Indian Ocean)	7
Bunbury High School	20
Carmel College (7th Day Adventist)	10
Christchurch Grammar	10
Perth Modern School	20

Of those listed the most active are:
 Aquinas College: Club Leader, Rev. Bro. J. Marks.
 Wesley College: Club Leader, Laurie Jessop, VK6ZEA.
 Perth Modern School: Club Leader, Tom Tuffin, VK6ZGG.

Each of these clubs has its own amateur station, licensed to operate on the VHF amateur bands, although operation is mainly on the 52MHz band.

During 1969, 97 certificates were awarded to members of Western Australian Youth Radio Clubs. These consisted of:

Grade	Number
Elementary	72
Junior	17
Intermediate	8

In addition, one member of the Wesley College Club passed the examination for the Amateur Operator's Limited Certificate of Proficiency.

Bob Trepp, VK6BT, State supervisor, Y.R.C.S., Western Australian Division, W.I.A., reports that from the proceeds of sale of radio components, unsuitable for Y.R.C.S. use, donated to the scheme, he was able to distribute \$100 to clubs.

Bob makes the point that the success of each club is largely dependent on the zeal and enthusiasm of the group leader. "Some clubs lack in activity because the group leader is not a licensed amateur operator, and therefore the added interest to the club members of 'getting on the air' is absent," he says.

Bob also thinks that if more practising amateur operators would take an interest in a club, the amateur population would show a distinct increase.

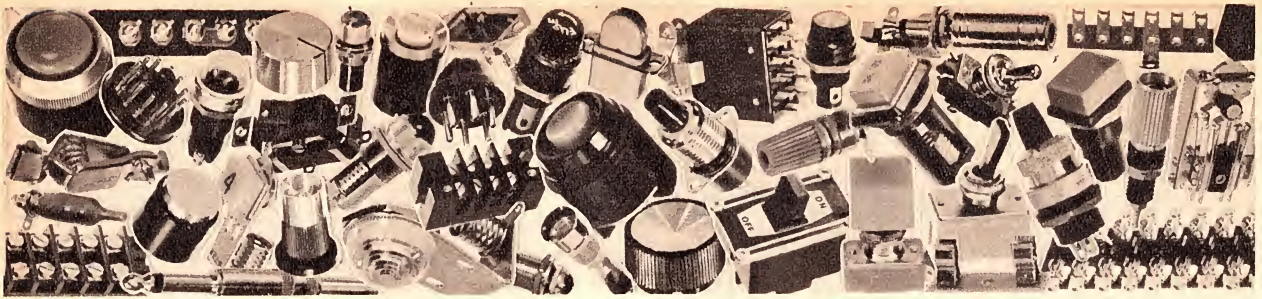
Victoria. During 1969, the number of clubs registered with the Y.R.C.S. was 12.

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.

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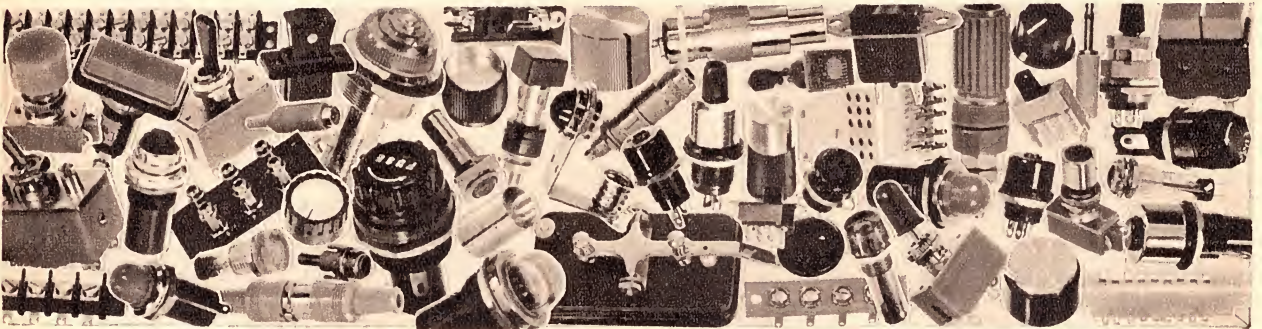


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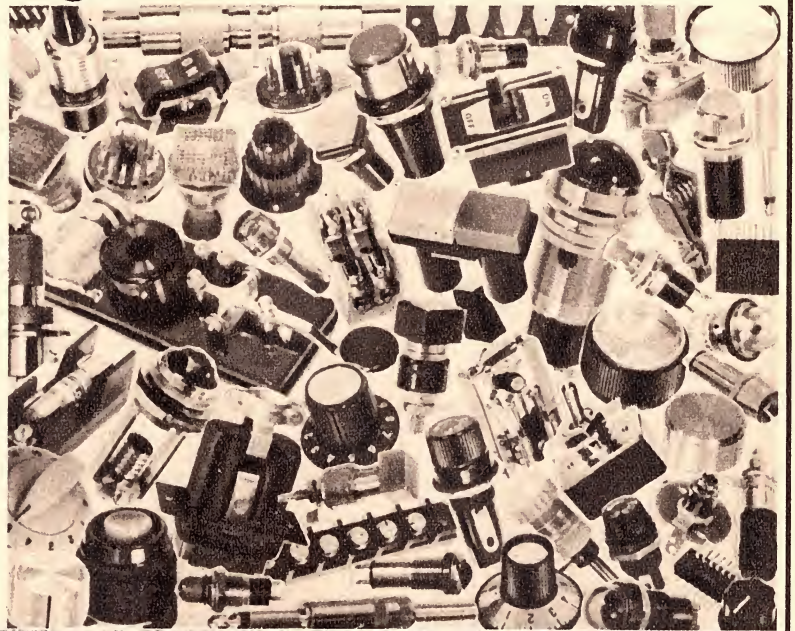
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YOUTH RADIO CLUB SCHEME RULES

OBJECTIVES

(a) To develop in young people an interest in radio and electronics as a vocation or as a hobby throughout life.

(b) To provide school students with a hobby activity which will reinforce their school activities in science and mathematics.

(c) To assist present and future leaders and instructors of Youth Radio Clubs and Non-Club Participants by providing ready-made programs of activity.

(d) To co-ordinate the activities of present and future Youth Radio Clubs and Non-Club Participants and to promote co-operation and interchange of ideas among club leaders.

(e) To co-operate with schools and youth organisations in fostering Youth Radio Clubs.

(f) To give encouragement and recognition to Youth Radio Club members and Non-Club Participants who attain certain specified standards of skill and knowledge in the field of radio.

ADMINISTRATION

(a) The Federal Executive of the Wireless Institute of Australia has appointed a Youth Radio Scheme Co-ordinator whose duties are:

(i) To maintain correspondence with State Supervisors of the Youth Radio Scheme in order to ensure uniformity of administration, procedures and training.

(ii) To advise Federal Executive on matters relating to the Youth Radio Scheme.

(iii) To put into operation any directives issued by Federal Executive relative to the Youth Radio Scheme.

(iv) To submit reports as directed regarding the progress of the Youth Radio Scheme.

(v) To compile statistical information which Federal Executive may require.

(vi) To perform such other duties and functions as directed.

(b) With the exception of Victoria, the State Councils of the various Divisions of the Wireless Institute have appointed Youth Radio Scheme Supervisors, whose duties are:

(i) To administer the Youth Radio Scheme within State Divisions and to ensure uniformity of administration, procedures and training.

(ii) To advise State Councils on matters relating to the Youth Radio Scheme.

(iii) To put into operation any directives issued by the Federal Co-ordinator and by State Divisional Councils.

(iv) To submit to State Councils and to the Federal Co-ordinator annual reports regarding development and progress of the Youth Radio Scheme activities within their respective States.

(v) To compile statistical information and maintain registers as directed by the Federal Co-ordinator and State Divisional Councils.

(vi) To co-opt other qualified persons to specific duties in connection with the Youth Radio Scheme.

(vii) To advise Club Leaders and Instructors on matters relating to administration and training.

(viii) To perform such other duties and functions as may be directed.

(c) In Victoria, the Supervisor is elected by a majority vote of financial Member Clubs at a Special General Meeting convened for that purpose. His name is then submitted to the

Federal Co-ordinator and the Victorian Division of the Wireless Institute of Australia. Re-election of the Supervisor takes place every three years and his duties are similar to those mentioned in section (b) above.

REGISTRATION

(a) To entitle Youth Radio Club members to participate in the Youth Radio Club Scheme activities, club leaders must apply in writing to their State Supervisor for registration for their club.

(b) Applications for registration must be at the beginning of EACH YEAR and must include the following information:-

(i) Name of Club.

(ii) List of Office-bearers.

(iii) List of members with ages and school classes.

(iv) Name(s) and qualifications of instructor(s).

(v) Callsign of club amateur radio station (if any).

(vi) Name and call sign of supervising operator.

(vii) Postal address and telephone number of supervising operator.

(viii) Such other specific information as may be required by the Supervisor.

(c) Applications for registration of school or college radio clubs should be countersigned by school principals or headmasters.

NON-CLUB PARTICIPANTS

(a) To meet the needs of boys who are interested in radio and do not belong to Youth Radio Clubs provision is made for their registration as "Non-Club Participants." As such they are entitled to present themselves as candidates for the various Radio Proficiency Certificates and to engage in competitions and other activities arranged within the Youth Radio Scheme.

(b) Non-Club Participants must apply in writing to their State Supervisor and request registration. Such applications must include applicant's name, address, age, school and class level and where possible nominate an adult person who would be willing to supervise written examinations.

CERTIFICATES

(a) To provide and to give due recognition to members who demonstrate specified skills and knowledge, there has been developed a basic series of Radio Proficiency Certificates on a graded basis at the following levels:-

(i) Elementary. (ii) Junior. (iii) Intermediate. (iv) Senior. (v) Advanced.

(b) Radio Proficiency Certificates may be awarded to the following classes of candidates:-

(i) Associate members of the Wireless Institute of Australia.

(ii) Financial members of affiliated Branches, Sections and Clubs.

(iii) Registered members of Youth Radio Club Scheme.

(iv) Registered Non-Club Participants in the Youth Radio Scheme.

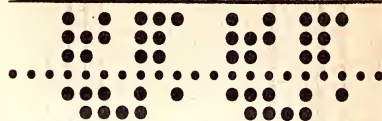
(c) Radio Proficiency Certificates are awarded in three Grades, based on results obtained by candidates in the written examination. "Pass Grade" Certificates are awarded to candidates who gain from 70 per cent to 79 per cent. "Credit Grade" Certificates are awarded to candidates who gain from 80 per cent to 89 per cent. "Honours Grade" Certificates are awarded to candidates who gain 90 per cent to 100 per cent.

FEES

At the present time fees are levied in Victoria, but due to rising costs and other contingencies it is possible that other States may follow suit.

In this regard details should be obtained from Supervisors in each State.

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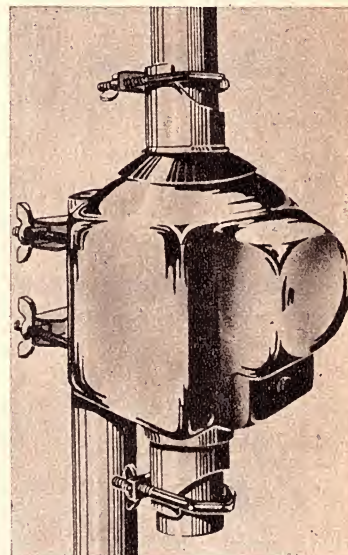
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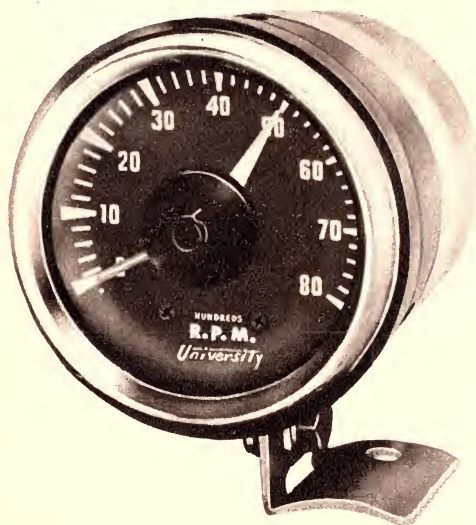
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This was slightly less than in previous years, and this is due to a lack of available instructors to get the clubs functioning on a sound footing. The number of students enrolled is 130.

Thirty-one certificates were issued to successful students during 1969. These consisted of:

Grade	Number
Elementary	12
Junior	8
Intermediate	7
Senior	4

A section of the Youth Radio Club Scheme operating from Victoria is the Correspondence Course. This section is supervised by Bill Tremewen and several group leaders. The total enrolment in this course is ninety. This section provides a service to students throughout Australia where there is no organised school club operating. Indications are that this aspect of the scheme is going to grow into the largest single group within the scheme.

Under the Editorship of Don Reid, VK3EI, a bulletin called "Zero-Beat" is published. This bulletin contains Y.R.S. and short-wave news for DX listeners, as well as technical articles and quizz questions for various grades of Y.R.C.S. members.

The bulletin is published every two months and the subscription rate is 60 cents per year, post paid.

South Australia: There are 13 active clubs registered with the Youth Radio Scheme in South Australia with a total of 156 members. Details of the clubs as supplied by the State secretary, Y.R.C.S., South Australian Division for 1969 are as follows.

Club	Members
Port Pirie Y.R.C.	25
Port Augusta Y.R.C.	15
Elizabeth A.R.C.	20
Barossa Valley Y.R.C.	8
Christies Beach Y.R.C.	5
Plympton High School	24
Birdwood Y.R.C.	4
Prince Alfred College	14
5th Elizabeth Boy's Brigade Company	13
3rd Adelaide Boy's Brigade Company	12
1st St. Marys Boy Scouts Y.R.C.	16

Plans are being finalised for two more clubs to begin activities in February. In Adelaide there will be the Y.M.C.A. Electronics Club at which members of the W.I.A. will be instructors. Those interested in joining the club should contact: The Director of Youth Activities, Y.M.C.A., 146 Flinders Street, Adelaide, 5000. The Kadina Radio Club is being formed by the Rev. Bob Guthberlet, VK5OD, Y.R.C.S. State Supervisor, who is moving to Kadina.

John Allan, VK5UL, liaison officer for the Y.R.C.S. in South Australia, reports that where school clubs exist they are encouraged by headmasters. Some science masters who would otherwise organise a club are unable to do so because of extra teaching commitments due to the shortage of teachers in S.A.

Youth groups, such as the Boy Scouts, Boys Brigade and Y.M.C.A., are showing a greater interest in the scheme than before. Fifth year Physics students, who have done Y.R.C.S. courses found their end of year examination "a piece of cake."

Parents as well as students realise the value of Y.R.C.S. certificates when school-

leavers are seeking employment. Government departments and commercial enterprises give favourable consideration to applicants who have these certificates in addition to the necessary academic qualifications.

On the last Sunday of each month, a ten-minute segment devoted to Youth Radio Scheme activities is included in the VK5WI news broadcast on Sunday morning.

The executive committee of the South Australian Division of the Y.R.C.S. is:

State Supervisor: Rev. Robert C. Guthberlet, VK5OD. 3 Hay Street, Kadina, S.A. 5554.

State Secretary: Allen Dunn, VK5FD, 18 McKinlay Street, Elizabeth Downs, S.A. 5113.

Y.R.C.S. Liaison Officer: W.I.A. Divisional Council: John Allan, VK5UL, 27 Devonport Tce. Ovingham S.A. 5082.

Country Clubs Representative: Lloyd Douglas, 126 Flinders Tce. Port Augusta. S.A. 5700.

Metropolitan Clubs Representative: Steve Johnston, VK5ZNJ.

New South Wales: There are 34 Youth Radio Clubs registered with the New South Wales Division. There are many clubs located in country centres, as well as those in the Sydney and Newcastle areas. The two largest groups are the Westlakes Radio Club at Teralba near Newcastle, the president being Keith Howard, VK2AKX; and the Maitland Radio Club, East Maitland, with president Kev Watson, VK2ZKW. Both these clubs have memberships in excess of 100 and have had outstanding success in the number of members who have gained their amateur operators certificates.

A very successful Youth Radio Club Scheme get-together was held at the Wireless Institute Centre, 14 Atchison Street, Crow's Nest, on Sunday, November 30, when 115 members, club leaders and

Y.R.C.S. CLASSES

Classes to train students for certificates of the Youth Radio Club Scheme will commence at the Wireless Institute Centre, 14 Atchison Street, Crow's Nest, on February 22, 1970, at 1.30 p.m. Classes will be held every alternate Saturday afternoon from the commencement date.

The classes are open to any student attending a High school where there is not a Y.R.C.S. club operating. Initially 12 students will be enrolled for the Elementary Certificate course which will take about five months to complete. By August, 1970, a further 12 students (boys or girls) will be enrolled.

Enrolment fees will be \$3 per year, payable in advance. All notes and printed matter for the course will be included. There will be lectures on theory as well as demonstrations and practical workshop training.

Club officials will be at the Wireless Institute Centre on Saturday afternoon, February 15, at 2.30 p.m., to interview any interested student and/or their parents. In the meantime, inquiries should be addressed to: Mr J. Flynn, Secretary Y.R.C.S., New South Wales Division, 30 Sharp Street, Belmore, N.S.W. 2192.

officials were present. This was the first gathering of its kind to be held.

The proceedings were opened by Dave Jeanes, VK2BSJ, Supervisor of the Y.R.C.S. New South Wales Division. This was followed by a series of lectures and demonstrations.

The first was by Jim Webster, VK2ZCW, Y.R.C.S. Federal Co-ordinator,



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assisted by his son Paul, who demonstrated several pieces of equipment suitable for Y.R.C.S. projects.

The second lecture was given by Keith Woodward, VK2BAU, who demonstrated the making of printed circuit boards. Several of the students present assisted Keith in the making of the boards, which they were allowed to keep.

A talk and demonstration on building sniffers for 144MHz was given by Chris Jones, VK2ZDD.

The final lecture demonstration was given by Vic Barker, VK2ZVV. The subject, amateur television, held the attention of all present, many seeing themselves and their friends on the television screen for the first time.

In addition to the lectures, competitions for pieces of equipment built by Y.R.C.S. members as projects in conjunction with the various certificate grades was held. All attending agreed that it was an excellent event and a credit to the organisers.

Maitland Radio Club: Early in November, in conjunction with the Mardi Gras arranged by the East Maitland Swimming Pool Committee, the Maitland Radio Club organised a display of radio equipment in the A.N.Z. Bank. The station was manned by several members of the club who, in addition to answering questions on amateur radio and the operation of the equipment, maintained contacts with stations on the 52.525MHz FM net frequency.

During 1969 the members of the club had a number of successes in the Y.R.S. examinations. Seventeen members gained certificates in the Elementary and Junior examinations. Of these eight were Honours, seven were Credits. A further 24 members sat for examinations at the end of November for the Elementary, Junior and Intermediate grades. All examinations are held at the Maitland Technical College and supervised by the club's examination supervisor, Mr Cec Cook.

Up till the end of November, 1969, the Maitland Radio Club conducted two elementary, two junior, one intermediate and two Morse code classes each week. "On the air" instruction was also given. It is expected that additional classes will be necessary in 1970.

Information on the Maitland Radio Club's activities may be obtained by writing to the Secretary, Box 54, P.O., East Maitland, N.S.W. 2323 or by telephoning Maitland 33-7286, STD area code 049.

Westlakes Radio Club: Work is progressing on the new premises for the Westlakes Radio Club at Teralba. The brick toilet block has been completed, also the installation of work benches, lighting and canteen.

To further encourage the use of transistors, and in the interest of safety first no 240V mains supply will be available anywhere in the work area. Distribution panels on the work benches will, however, have provision for a nine volts DC from a central supply source.

Low voltage soldering irons will be used throughout and a community aerial will be connected to all work positions. It is anticipated that the move from the old premises will be completed in time to enable the club to begin all phases of its activities in January, 1970.

Club secretary, Bruce Morley, VK2ZNB, P.O. Box 1, Teralba, N.S.W. 2284. Telephone, Newcastle 59-1667.

Parramatta Marist Radio Club. This club has been operating for 18 months. The interests of participants have varied, many being satisfied with the crystal set stage 73 sets have worked successfully; but others have gone on to far more exciting jobs, such as electronic organs, 3-valve receivers, signal injectors and transistor amplifiers. Some are having success with guitar amplifiers.

A 1946 ex-army superhet receiver has interested many in amateur and short-wave listening. The Elementary Certificate tally at October 1969 stood at 9 Honours, 7 Credits and 8 Passes. One Credit and

one Pass have so far been gained at the Junior level.

One project was used in a public display for a function at the boys' own school, and also at another large school nearby. The unit displayed contained 52 lights operated by automatic switching devices.

Successful students for the Elementary Certificate were:—

Honours	F. Blow
D. Lark	P. Callaghan
M. Lindfield	J. Kennedy
P. Gibbs	S. Hoile
P. Green	
J. Maquire	

Credit	E. Blow
R. McCormack	C. Hones
J. Younane	G. Kelly
P. Murphy	
P. Robinson	

Pass	D. Casey
P. Wrightman	G. Cash
J. Meddows	R. Peacock
S. Zielinski	T. Nolan
G. Campbell	

Junior Certificate
P. Gibbs —Credit P. Murphy —Pass

WARNINGS ISSUED

During November 1969, a number of 146MHz FM net operators received direct warnings from the Superintendent Radio Branch, P.M.G.'s Department, for breaches of the Regulations applying to the amateur service, including on-air matter and on-air manners, reported by the monitoring station in the Sydney area. It is understood that any future breaches of that nature and any other activity contrary to the regulations could result in the suspension or cancellation of the offenders' licences.

AMATEURS' CODE

In addition to the regulations issued by licensing authorities, the amateur service, like many other associations catering for the interests of the members, has a code of ethics recognised the world over by

operators who value their amateur operator's licence and privileges.

1. The amateur is gentlemanly — he never knowingly uses the air for his own amusement in such a way as to lessen the pleasure of others. He abides by the pledges given by his Society on his behalf to the public and the Government.
2. The amateur is loyal — he owes his amateur radio to the efforts of his Society and he offers it his unswerving loyalty.
3. The amateur is progressive — he keeps his station abreast of science. It is built well and is efficient. His operating practice is clean and regular.
4. The amateur is friendly — slow, patient sending when requested, friendly advice and counsel to the beginner, kindly assistance and co-operation for others: these are the marks of the amateur spirit.
5. The amateur is balanced — radio is his hobby. He never allows it to interfere with any of the duties he owes to his home, his job, his school, or his community.
6. The amateur is patriotic — his knowledge and his station are always ready for the service of his country and his community.

PROPAGATION RESEARCH

As an aid to ionospheric research, the International Amateur Radio Club in Geneva founded in 1963 the C.P.R. Award (Contribution to Propagation Research). A map showing the 90 geographical zones was published in "Electronics Australia" in February, 1967. A list of countries with their prefixes and zones is published overleaf.

AUSTRALIS LAUNCH

The Australian amateur satellite "Australis-Oscar V" is scheduled to be launched on January 9.

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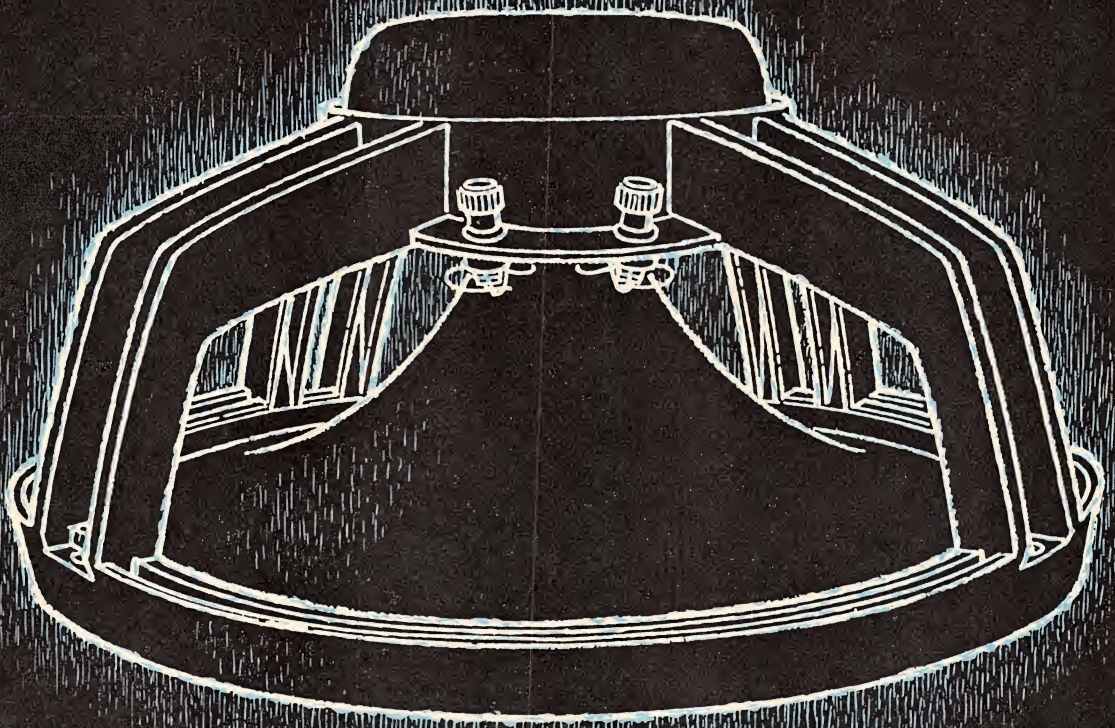
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I.A.R.C. CPR LIST OF COUNTRIES

Prefix	Country	Zone	Prefix	Country	Zone	Prefix	Country	Zone
A2	Botswana	57	HK0	San Andres & Providencia	11	PA, PE, PI	Netherlands	27
AC1, 2, 5, 0	Bhutan	41	HK0, KS4B	Serrana Bank	11	PJ2	Curacao	11
AC3	Sikkim	42	HL, HM	Korea	44	PJ3	Aruba	11
AC4	Tibet	42, 43	HP	Panama	11	PJ4	Bonaire	11
AP	East Pakistan	41	HR	Honduras	11	PJ5	St. Eustatius	11
AP	West Pakistan	41	HS	Thailand	49	PJ6	Saba	11
BV	Taiwan	44	HU, YS	El Salvador	11	PJ7	St. Martin	11
BY	Chinese P.R.	33, 42, 43, 44	HV	Vatican City	28	PX	Andorra	27
CE1, 2, 3, 4, 5	Chile	14	HZ, 7Z	Saudi Arabia	39	*PY 1, 2, 3, 4, 5, 9	Brazil	15
CE6, 7, 8	Chile	16	I	Italy	28	*PY 6, 7, 8	Brazil	13
CE9A	Chile (Antarctica)	73	IS	Sardinia	28	*Also PQ, PR, PS, PT and PU		
CE0A	Easter Island	63	IT	Sicily	28	PY0	Fernando Da Noronea	13
CE0X	San Felix Island	14	JA, JH,	Japan	45	PY0	St. Peter & Paul Rocks	13
CE0Z	Juan Fernandez Island	14	JR	Marcus Island	45	PY0	Trinidad	15
CM, CO	Cuba	11	JD	Bonin & Volcano Isl.	45	PY0	Martim Vaz. Island	15
CN2, 8, 9	Morocco	37	JD	Mongolia	43	PZ1	Surinam	12
CP1, 8, 9	Bolivia	12	JT	Svalbard	18	SK, SL,	Sweden	18
CP2, 3, 4, 5, 6, 7	Bolivia	14	JW	Jan Mayen	18	SM		
CR3	Portuguese Guinea	46	JX	Jordan	39	SP	Poland	28
CR4	Cape Verde Islands	47	JY	(See W)		ST	Sudan	48
CR5	Sao Thome and Principe	46	K, W			SU	Egypt (U.A.R.)	38
CR6	Angola	52	KA	Japan	45	SV	Greece	28
CR7	Mozambique	53	KB6	Baker and Howland Isl.	61	SV	Crete	28
CR8	Timor	54	KB6	Canton, Enderbury and American Phoenix Isl.	62	SV	Dodecanese Islands	28
CR9	Macao	44	KC4	Navassa Island	62	TA, TC	Turkey	39
CT1	Portugal	37	KC4AAC	Vostok Station	70	TF	Iceland	17
CT2	Azores Islands	36	KC4AAD	Byrd Long Wire	72	TG	Guatemala	11
CT3	Madeira Islands	36	DC4USB	Byrd Station	72	TI	Costa Rica	11
CX	Uruguay	14	KC4USH	Hallett Station	71	TJ9	Cocos Island	11
DJ, DK, DL, DM	Germany	28	KC4USL	Brockton Station	74	TJ8	Cameroon	47
DU, DX	Philippines	50	KC4USM	Byrd Noise Facility	72	TL	Central African Republic	47
EA	Spain	37	KC4USN	South Pole	74	TN8	Congo Republic	52
EA6	Balearic Islands	37	KC4USP	Palmer Station	73	TR8	Gabon	52
EA8	Canary Islands	36	KC4USV	McMurdo Station	71	TT	Tchad	47
EA9	Ifrni	37	KC4USX	Williams Field	71	TU	Ivory Coast	46
EA9	Ria de Oro	46	KC6	Eastern Caroline Islands	64	TY	Dahomey	46
EA9	Spanish Morocco	37	KC6	Western Caroline Islands	64	TZ	Mali	46
EA0	Spanish Guinea	47	KG4	Guantanamo Bay, Cuba	11	UA1KAE	Mirny Station	69
EI	Rep. of Ireland	27	KG6	Guam	64	UA1KED	Franz Josef Land	75
EL, 5L	Liberia	46	KG6R, S, T	Marianas Islands	64	UA, UV, UW1-6	European U.S.S.R.	19, 29
EP, EQ	Iran	40	KH6	Hawaii	61	UA2	Kaliningradsk	29
ET3, 9E, 9F	Ethiopia	48	KH6	Kure Island	61	UA, UV, UW9 A-G, Q-T, W	Asiatic U.S.S.R.	30
F	France	27	KJ6	Johnston Island	61	UW9 H, I, M-P, U, V, Y	Asiatic U.S.S.R.	31
FB8W	Crozet Island	68	KL7	Alaska	01	UA, UV, UW9 J, L	Asiatic U.S.S.R.	21
FB8X	Kerguelen Islands	68	KM6	Midway Islands	61	UA, UV, UW9X	Asiatic U.S.S.R.	20
FB8Y	Terre Adelie	70	KP4	Puerto Rico	11	UA, UV, UW0 A, B	Asiatic U.S.S.R.	22
FB8Z	Amsterdam and St Paul Is.	68	KP6	Palmyra Islands	61	UA, UV, UW0A, B	Dickson Island	22
FC	Corsica	28	KP6	Jarvis Island	62	UA, UV, UW0 C, D, G, K-M	Asiatic U.S.S.R.	34
FG7	Guadeloupe Island	11	KR6, 8	Ryukyu Islands	45	UA, UV, UW0 E, F, Z	Asiatic U.S.S.R.	35
FH8	Comoro Islands	53	KS4	Swan Island	11	UA, UV, UW0I	Asiatic U.S.S.R. Magadan Region W of 155E	24
FK8	New Caledonia	56	KS4B,	Serrana Bank and Roncador	11	UA, UV, UW0I	Asiatic U.S.S.R. Magadan Region btwn 155 & 170E	25
FL8	Fr. Somaliland	48	HK0			UA, UV, UW0I	Asiatic U.S.S.R. Magadan Region E of 170E	26
FM7	Martinique	11	KS6	American Samoa	62	UA, UV, UW0I	Wrangel Island	26
FO8	Clipperton Island	10	KV4	Virgin Islands (U.S.)	11	UA, UV, UW0I	Asiatic U.S.S.R.	33
FO8	French Oceania	63	KW6	Wake Island	65	UA, UV, UW0I	Asiatic U.S.S.R.	32
FO8M	Maria Theresa Reef	79	KX6	Marshall Islands	65	P, S, T, U, V		
FP8	St. Pierre & Miquelon Isl.	09	KZ5	Panama Canal Zone	11	UA, UV, UW0, R	Asiatic U.S.S.R.	23
FR7	Glorioso Islands	53	LA, LG	Norway	18	UA, UV, UW0Y	Asiatic U.S.S.R.	43
FR7	Juan de Nova Island	53	LA	Antarctica	67, 69	USAR-TEK	Ukraine	29
FR7	Reunion Island	53	LU-A thru U, LU-Y	Argentina	14	UB, JT	Ukraine	29
FR7	Tromelin Island	53	LU-V, W, X			UY5		
FS7	St. Martin	11	LU-Z	Antarctica	73	UC2	White Russian S.S.R.	29
FU8, YJ	New Hebrides	56	LX	Luxembourg	27	UD6	Azerbaijan	29
FW8	Wallis and Fortuna Isl.	62	LZ	Bulgaria	28			
FY7	French Guiana & Inini	12	MP4B	Bahrain Island	39			
G, GB	England	27	MP4D	Das Island	39			
GC	Guernsey and Dep.	27	MP4M	Muscat & Oman	39			
GC	Jersey Island	27	MP4Q	Qatar	39			
GD	Isle of Man	27	MP4T	Trucial Oman	39			
GI	Northern Ireland	27	OA	Peru	12			
GM	Scotland	27	OD5	Lebanon	39			
GW	Wales	27	OE	Austria	28			
HA, HG	Hungary	28	OH, OF	Finland	18			
HB	Switzerland	28	OH0	Aaland Islands	18			
HB0, HE	Liechtenstein	28	OK, OL,	Czechoslovakia	28			
HC	Ecuador	12	OM					
HC8	Galapagos Islands	12	ON	Belgium	27			
HE, HB0	Liechtenstein	28	OR4	Antarctica	67			
IH	Haiti	11	OX, XP	Greenland	05			
II	Dominican Republic	11	OY	Faeroe Islands	18			
HK	Colombia	12	OZ	Denmark	18			
IK0	Bajo Nuevo	11						
IK0	Malpelo Island	12						

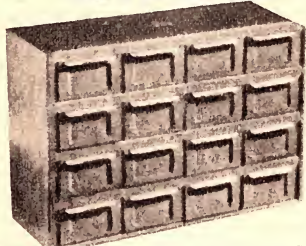
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Three types of Galvanised Chests measuring 17½in x 6¼in x 11½in, containing 16 drawers, each measuring 6¾ x 3¾in x 2¼in.

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Supplied with "UNBRAKO" High Tensile Socket Screws and Wrenches. Cut holes in sheet metal up to 18 gauge.

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32.S	¼in	0.507in	—	¼in	\$2.17
40.S	¾in	0.618in	¼in	5/16in	\$2.17
48.S	¾in	0.742in	¾in	5/16in	\$2.80
56.S	¾in	0.884in	¾in	¾in	\$3.80
64.S	1in	1.008in	—	¾in	\$4.10
72.S	1¼in	1.133in	¾in	¾in	\$4.53
76.S	1 3/16in	1.172in	—	¾in	\$4.53
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Radax 05XR Power Supply \$20.40
Lapel Microphone X67 .. \$00.90
Table Microphone BM3 .. \$ 7.50

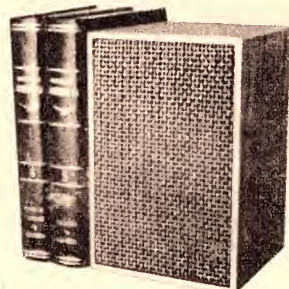
8 WATT STEREO AMPLIFIER MODEL SA-80S



SPECIFICATIONS

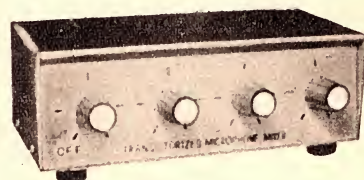
Output Power: 8 Watt, 4 Watts per channel.
Frequency Response: 60 to 15,000 cps. plus or minus 1 db.
Harmonic Distortion: Less than 3%.
Hum and Noise: 52 db below rated output.
Sensitivity: Phone (Crystal) 100mV 250K ohm.
Tuner 100mV.
Tube Complements: 12AX7x1, 30A5x2, 1S315x1 (Silicon Rectifier).
Dimensions: 5.11b, 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: 9¾in (H) x 6¼in (W) x 3¾in (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

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UF6	Georgia	29	VQ9	Seychelles Islands	53	ZP	Paraguay	14
UG6	Armenia	29	VR1	British Phoenix Isl.	62	ZS1, 2, 4	South Africa	57
UH8	Turkomen	30	VR1	Gilbert, Ellice, Ocean	65	5, 6		
UI8	Turkmen	30	VR2	Fiji Islands	56	ZS2	Prince Edward & Marion	57
UJ8	Tadzhik	31	VR3	Fanning and Christmas Is.	61	ZS3	Southwest Africa	57
UL7	Kazakh	30	VR4	Solomon Islands	51	3A	Monaco	27
UM8	Kirghiz	31	VR5	Tonga Islands	62	3B, 3C	See VE	
UN1	Karelo-Finnish Region	19	VR6	Pitcairn Island	63	3V8	Tunisia	37
UO5	Moldavia	29	VS5	Brunei	54	3W8, XV5	Vietnam	49
UP2	Lithuania	29	VS6	Hong Kong	44	3X, 7G	Republic of Guinea	46
UQ2	Latvia	29	VS9A	Aden	39	3Y	Bouvet Island	67
UR2	Estonia	29	VS9K	Kamaran Island	39	4A, XE	Mexico	10
VE1, 2	Canada	09	VS9S	Socotra Island	48	XF		
VE3	Canada	04	VU	Andaman and Nicobar Isl.	49	4S7	Ceylon	41
VE4, 5	Canada	03	VU	India	41	4U1ITU	U.N. Geneva	28
VE6, 7	Canada	02	VU	Laccadive Islands	41	4U1TIC	U.N. Turin	28
VE8	Canada	02, 03, 04, 75	W, K1, 2	U.S.A.	08	4W	Yemen	39
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VK2	Lord Howe Island	60	W, K5, 0	U.S.A.	06	5A	Libya	38
VK4, 8	Australia	55	W, K6, 7	Mexico	10	5B4, ZC4	Cyprus	39
VK4	Willis Island	60	XE, XF			5H3	Tanzania	53
VK6	Australia	58	4A			5L, EL	Liberia	46
VK9	Cocos-Keeling Island	54	XF4	Revilla Gigedo Island	10	5N2	Nigeria	46
VK9	Christmas Island	54	XP, OX	Greenland	05	5R8	Malagasy Republic	53
VK9	Norfolk Island	60	XT	Voltaic Republic	46	5T	Mauritania	46
VK9	New Guinea	51	XU	Cambodia	49	5U7	Republic of Niger	46
VK9	Papua	51	XV5,	Vietnam	49	5V	Togo	46
VK9	Nauru Island	65	3W8			5W1	Western Samoa	62
VK0	Mawson Base	69	XW8	Laos	49	5X5	Uganda	48
VK0	Wilkes Base	70	XZ	Burma	49	5Z4	Kenya	48
VK0	Heard Island	68	YA	Afghanistan	40	6O1, 2, 6	Somali Republic	48
VK0	Macquarie Island	60	YB, YC,	Indonesia	54	6W8	Senegal	46
VO1, 2	Newfoundland and Labrador	09	YD, 8F			6Y5	Jamaica	11
VP1	British Honduras	11	YI	Iraq	39	7G1, 3X	Republic of Guinea	46
VP2A	Antigua, Barbuda and Anguilla	11	YJ, FU8	New Hebrides Islands	56	7P8	Lesotho	57
VP2D	Dominica	11	YK	Syria	39	7Q7	Malawi	53
VP2G	Grenada and Dependencies	11	YN, YN0	Nicaragua	11	7X	Algeria	37
VP2K	St Kitts and Nevis	11	YO	Romania	28	7Z, HZ	Saudi Arabia	39
VP2L	St Lucia	11	YS, HU	El Salvador	11	8F, YB,	Indonesia	54
VP2M	Montserrat	11	YU	Yugoslavia	28	YC, YD		
VP2S	St Vincent and Dep.	11	YV	Venezuela	12	8J	Antarctica	67
VP2V	British Virgin Islands	11	YV0	Aves Island	11	8P	Barbados	11
VP5	Turks and Caicos Islands	11	ZA	Albania	28	8Q	Maldive Islands	41
VP7	Bahama Islands	11	ZB2	Gibraltar	37	8R	Guyana	12
VP8	Falkland Islands	16	ZC4, 5B4	Cyprus	39	8Z4	Saudi Arabia/Iraq	
VP8	South Georgia Island	73	ZD3	The Gambia	46	8Z5, 9K3	Neutral Zone	39
VP8	Graham Land	73	ZD5	Swaziland	57	9A1	Saudi Arabia/Kuwait	
VP8	South Orkney Island	73	ZD7	St. Helena Island	66	9G1	Neutral Zone	39
VP8	South Sandwich Islands	73	ZD8	Ascension Island	66	9H1	San Marino	28
VP8	South Shetland Islands	73	ZD9	Tristan da Cunha & Gough Island	66	9J	Ghana	46
VP9	Bermuda Islands	11	ZE	Rhodesia	53	9K2	Malta	28
VQ8	Agalega and St. Brandon	53	ZF1	Cayman Islands	11	9K3, 8Z5	Zambia	53
VQ8	Chagos Island	41	ZK1	Cook Islands	63	9L1	Kuwait	39
VQ8	Mauritius	53	ZK2	Manihiki Islands	63	9M2, 4	Kuwait/Saudi Arabia	
VQ8	Rodriguez Island	53	ZL	Niue Island	63	9M6, 8	Neutral Zone	39
VQ9	Aldabra Island	53	ZL	Auckland & Campbell Is.	60	9N1	Sierra Leone	46
VQ9	Desroches Island	53	ZL	Chatham Islands	60	9Q5	West Malaysia	54
VQ9	Farquhar Island	53	ZL5	Kermadec Islands	60	9U5	East Malaysia	54
			ZM7	New Zealand	60	9V1	Nepal	42
				Antarctica	71	9X5	Republic Of Congo	52
				Tokelaua Islands	62	9Y4	Burundi	52
							Singapore	54
							Rwanda	52
							Trinidad and Tobago	11

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RUBBER NON-HAZARDOUS VAPOUR

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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 db
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 Silicon diodes
- Double-jewelled ± 2 per cent Meter
- ±1 per cent Temperature-stabilised Film Resistors
- Polarity Changeover Switch
- Mirror scale, instruction for operation with circuit diagram.



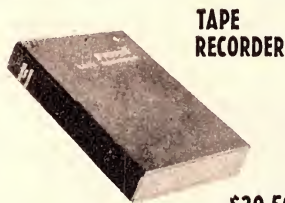
SPECIFICATIONS:
DC Volts: 0.6, 3, 12, 60, 300, 600, 1200V (100,000 /V)
AC Volts: 6, 30, 120, 300, 1200V (10,000 Ω/V)
DC Current: 12μA, 300 μA, 6mA, 60mA, 600mA, 12 amps DC and AC Current 12 amps.
Resistance: 20KΩ, 200KΩ, 2MΩ, 20MΩ
Decibels: -20 to + 17, 31, 43, 51, 63.
Accuracy: DC ±3 per cent, AC ± 4 per cent (of full scale)
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915



Actual Size

MINI-TORCH

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TAPE RECORDER

\$20.50

BOOK TYPE

The latest model portable Tape-recorder. 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

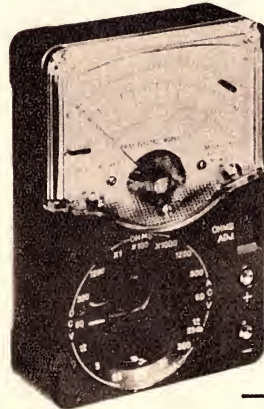


20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

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

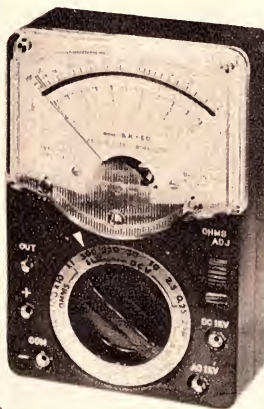


30,000 Ohms per Volt DC
14,000 Ohms per Volt AC

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 silicon 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 silicon 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.

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306-308 PITT STREET: 6 ROYAL ARCADE & 760 GEORGE STREET, SYDNEY



LISTENING AROUND THE WORLD

Survey of European transmission

The latest of our six-monthly surveys of European signals shows an increased use of lower frequencies with the best reception during the hours of darkness.

by Arthur Cushen

ALBANIA: Radio Tirana has several transmissions in English for the Pacific area, but best reception is at 0630GMT when using 9495KHz. Another service at 2000GMT can be received on 7090KHz.

AUSTRIA: Vienna has a special transmission to Australia and New Zealand on 17855KHz from 1000 to 1200GMT. The programs are mainly in German, but an increasing number of English broadcasts are now being provided.

BELGIUM: Brussels Radio has only two transmissions in English, and at this time of the year reception is possible only of the program beginning at 2205GMT. This 10-minute program can be received on 9550, 9660 and 11715KHz. A more reliable signal is at 1000GMT on 21510 and 17860KHz when programs are beamed to Africa in French or Dutch.

BULGARIA: Radio Sofia has transmissions in English to Europe and North America neither of which gives good reception in our summer.

GMT	KHz
1930-2000	6090, 9700
2130-2200	6090, 9700

CZECHOSLOVAKIA: Radio Prague has an English transmission to Australia and New Zealand which can be heard 0700-0800GMT. The best frequencies are 9575, 15310 and 21485KHz. The full schedule of Prague's transmissions is listed in the section "New Schedules Operating" in this issue.

DENMARK: Radio Denmark in Copenhagen is scheduled to cease its English broadcasts on April 1, 1979, unless listener reaction is sufficient to warrant a change in these arrangements. The program in English to the Pacific at present is at 0815-0845GMT on 15165KHz.

FINLAND: Radio Finland, at Helsinki, has an English program at 1800-1830GMT on 6210, 9555 and 15180KHz, in its special transmissions to Europe and North America. Broadcasts in Finnish and Swedish can also be received at 0600GMT on 9555KHz.

FRANCE: The O.R.T.F. in Paris can be received in several transmissions in English throughout the broadcast day. These are:

GMT	KHz
0515-0530	9700, 11920, 11970
1100-1115	17720, 21580
1945-2000	15185, 21580

GERMANY (East): Radio Berlin International has several transmissions, which

provide good reception in New Zealand:

GMT	KHz
0615-0700	9500, 15145
1115-1200	21540
1215-1300	21600

GERMANY (West): Deutsche Welle, Cologne has two transmissions in English for listeners in the South Pacific:

GMT	KHz
2100-2200	7130, 15275
0920-1020	11795, 17845, 21560

GREAT BRITAIN: The B.B.C. World Service is on the air 24 hours a day in English, and has three transmissions directed to Australia and New Zealand:

GMT	KHz
0545-0915	6110, 7150, 9640, 11955
0900-1315	11750, 15070, 21550, 25710
2000-2245	9410, 11750, 15070, 15260

HOLLAND: Radio Nederland in Hilversum is very well received in this area, as its programs are now relayed from the Bonaire station in Nederland Antilles. Transmissions in English and Dutch are available from this relay station each evening:

GMT	KHz
0630-0750	11730 (English)
0630-0750	9715 (Dutch)
0800-0920	9715 (English)
0800-0920	11730 (Dutch)
0930-1050	21570 (Dutch)

HUNGARY: Radio Budapest has several English transmissions and these are now broadcast to the following schedule:

GMT	KHz
1930-2000	6235, 9833, 11910
0400-0430	9833, 11910, 15160
0800-0815	15160, 17795, 21665

ITALY: Rome Radio has few broadcasts in English, and the one best received is actually beamed to Japan. The transmission is 2200-2225GMT, on 9710, 11905, 15340KHz. A broadcast in Italian for listeners in Australia is carried from

0600 to 0645GMT on 11810, 15335, 17795KHz.

NORWAY: Radio Norway has a 30-minute program in English several times every Sunday in the series "Norway This Week." Two broadcasts which give good reception in New Zealand, and Australia, are

GMT	KHz
0800-0830	21655, 21730, 25730
1200-1230	11735, 21655, 25730

The transmission actually opens an hour earlier, and for the first part of the broadcast it is in Norwegian.

POLAND: Radio Warsaw provides a fair signal in some services beamed to Europe. Reception is generally good in the transmission at 0700-0730GMT on 9675 and 11840KHz. A further session is on the air at 1930 on 6010 and 7125KHz.

ROMANIA: Radio Bucharest English services are intended mainly for listeners in Europe, Africa and North America. The principal transmissions are:

GMT	KHz
1930-2030	9510, 11940
0430-0500	9570, 11810, 15250
1100-1130	11810, 15380, 17850

SPAIN: Madrid Radio has few programs in English and the main target area is North America. The only possible reception is of the transmission at 0300-0345-GMT on 6130 and 9760KHz.

SWEDEN: Radio Sweden, Stockholm, has several programs in English which are well received in this area. The transmissions which should give best reception are:

GMT	KHz
1230-1300	9625
1900-1930	11785
2045-2115	9625
2245-2315	15155

SWITZERLAND: The Swiss Broadcasting Corporation in Berne has several transmissions in English which provide good reception in this area.

GMT	KHz
0700-0800	9590, 11775
0845-0945	9665, 11760, 21520
0445-0545	6120, 9720

U.S.S.R.: Radio Moscow has a special service to Australia and New Zealand, and uses both medium and short-wave frequencies for the broadcast in English.

GMT	KHz
1100-1130	629, 9750, 12060
1130-1200	629, 1475, 9750

RADIO DENMARK

The present schedule of Radio Denmark broadcasting from Copenhagen is as follows:

GMT	KHz	Area Served	Language
0100-0145	9520	North America	Danish
0145-0215	15165	North America	English
0730-0815	15165	Far East	Danish
0815-0845	15165	Far East	English
0945-0950	15165	Greenland	Danish
1130-1155	15165	Greenland	Danish
1200-1245	15165	North America	Danish
1245-1315	15165	North America	English
1330-1345	15165	Greenland	Danish
1400-1445	15165	South Asia	English
1445-1515	15165	South Asia	English
1730-1815	15165	Greenland	Danish
1830-1915	15165	Africa	English
1915-1945	15165	Africa	English
2100-2145	15165	South America	Danish

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.

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STOPS Squeaks!



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Dielectric Constant per ASTM-877:

Dielectric Constant 2.11 Dissipation Factor: 0.02

Dielectric Strength per ASTM D-150:

Breakdown Voltage 0.1 inch gap. 32,000 volts

Dielectric Strength volts/inch 320,000 volts

Flash Point (Dried Film)

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VATICAN: The Vatican Radio has two transmissions in English for listeners in Australia and New Zealand.

GMT	KHz
1125-1140	17845, 21690
2210-2225	9645, 11745

YUGOSLAVIA: Radio Belgrade has a service to South-East Asia in English which is a little late for listening in this area. The programs for Europe are well received as follows:

GMT	KHz
1530-1600	9620, 11735, 15240
2000-2030	6110, 7200, 9620
2200-2215	6100, 7200, 9620

RADIO NACIONAL—PARAGUAY

Another country to commence an International Service is Radio Nacional, Paraguay, according to the Radio Nederland "DX Jukebox" program. This is expected to result in world-wide reception of this difficult South American country. The station will use 100KW transmitters, and will operate on the 49, 41, 31 and 25M bands. Programs will be in Spanish, English and French and transmissions are expected to be in operation this month on a test basis. Up to now, this Government-operated radio service was for local reception only.

FREE ANTENNA COURSE

Radio Nederland, P.O. Box 222, Hilversum, Holland, is to commence a series of talks on aerial systems for short-wave listeners in March. The material will be available in printed form, free of charge. Enrolments are now being accepted to take part in this course, which will be included in "DK Jukebox," broadcast each Thursday.

We all are aware that a good short-wave antenna is a necessity for DX reception, yet few short-wave listeners take the trouble to try out various types to improve their reception. The aerial does not have to be costly, to be effective. Printed text and diagrams will be sent in ample time before the course begins on the first Thursday in March.

BEIRUT ON 11790KHz.

Radio Beirut, Lebanon has been heard in Invercargill at very good strength in the service to North America on the new frequency of 11790KHz. The move, from the 19M band, has resulted in much improved reception of this program, which has English from 0230 to 0300GMT, including news and commentary. At 0300 GMT follows a program in Arabic and at 0330 GMT transmissions for 30 minutes in Spanish. Radio Beirut verifies with a colourful QSL card, and the station answers reports from listeners promptly.

INDIAN OCEAN RADIO

Two stations operated from islands in the Indian Ocean by the Australian Department of External Territories are listed in the Annual Report of Christmas Island and Cocos Islands.

The Christmas Island station has the call sign VLU2 and operates on 1420KHz. The station commenced operation in 1967 and all receivers are licensed with the Postmaster-General's Department, Australia. Territory time is 7 hours ahead of GMT. Christmas Island is located south of Indonesia and to the west of Perth.

Cocos Island Radio operates on 1400KHz with the power of 100 watts. The station is a community project, and broadcasts educational features. Cocos Island is located in the Indian Ocean, 1,720 miles north-west of Perth and 2,290-miles almost due west of Darwin.

XERMX ON 9533KHz

"Radio Mexico," which we had been hearing on 11720KHz in Invercargill, has made a frequency change to 9535KHz. The station has the call sign XERMX and

NEW SCHEDULES OPERATING

The International Service of Radio Canada, Montreal, is now operating to the following schedule.

GMT	KHz	Daily	Area
0710-0805	9625, 5990		Central Africa
0825-0935	9630, 5970		Australia and New Zealand
1055-1215	17820, 15325, 9625		Europe, North Canada
1217-1313	17820, 11720, 9625		Europe, United States
1315-1343	21595, 17820, 11720		Europe, Antilles
1345-1515	21595, 17820, 15325		Europe
1516-1529	21595, 17820, 15325		Europe, North Canada
1530-1630	21595, 17820, 15325		Europe
1631-1659	21595, 17820, 15325		Europe, North Canada
1700-1830	21595, 17820, 15325		Europe
1832-1835	17820, 15325		Central Africa
1835-1950	17820, 15325, 11905		Central Africa, North Africa
1950-1958	15325, 11905		Central Africa, North Africa
2000-2152	15325, 11720, 9610		Europe
Sunday to Friday			
2158-2234	15190, 11720, 9625		North Canada, Europe
2234-2250	15190, 11720		North Canada
Saturday			
2158-2250	15190, 11720, 9625		North Canada, Europe
Daily			
2258-0046	15190, 11945, 5970		South and Central America
0058-0400	11720, 9625, 5970		North Canada
0400-0557	9625, 5970		North Canada
0557-0558	5970		North Canada
0558-0630	9625, 5990, 5970		Europe, North Canada
0630-0631	5970		North Canada
0631-0706	9625, 5970		North Canada

DX SPECIAL RETIMED

A letter from Al Stewart, of Trans World Radio, Monte Carlo, says they have retimed their DX program. The session is now on the air on Saturday at 1745GMT on 11705KHz. The beam is expected to provide good reception in the Middle East, Australia and New Zealand.

Some frequency changes have been made by Trans World Radio for gospel programs, and below are the sessions on the air daily.

GMT	KHz	Language
0725	7290	English
0905	7230, 9570	German
1145	5960, 7260	French
1215	9735	Greek
1220	5960	Italian
1300	7260	Spanish
1315	7260	Spanish
1430	7230, 9655	German
1445	7230, 9655	German
1520	11845	Russian
1530	11845	Russian
1545	11845	Russian
1600	9585	Polish
1715	9585	Norwegian
1715	7275	Hungarian
1830	11705	Armenian
1900	11705	Hebrew
0400	11820	Russian
0445	11820	Arabic

MALDIVE ISLAND SERVICE

According to "Sweden Calling DXers," the Maldive Island Broadcasting Service has issued the following new schedule.

GMT	KHz
0500-0630, 1500-1730	1507
1300-1430	3331
1515-1730	4740
0300-0430, 1100-1230	6150
0100-0230, 0900-1030	7225
0700-0830	9538

The station confirms reception with a card, sent by registered mail.

NEW SCHEDULES OPERATING RADIO PRAGUE

The present schedule of Radio Prague, Czechoslovakia, valid to May 3 is:

GMT	KHz	Area Served	Language
0800-0930	6055, 9505	Europe	German
0930-1100	6055, 9505	Europe	German
1100-1200	6055, 9505	Europe	French
1200-1300	6055, 9505	Europe	Italian
1200-1230	6055, 9505	Europe	English
1230-1330	9560, 11960, 15285	Europe	Spanish
1300-1500	6055, 9505	Europe	Italian
1630-1700	5930, 7345	Europe	English
1700-1730	5930, 7345	Europe	Spanish
1830-1900	5930, 7345	Europe	Spanish
1900-1930	5930, 7345	Europe	Spanish
1330-1400	15445, 17840, 21735	North America	Czech (Sun.)
1400-1500	15445, 17840, 21735	North America	English (Sun.)
0100-0200	5930, 7345, 9540, 9630, 11990	North America	English
0300-0400	5930, 7345, 9540, 9630, 11990	North America	English
0700-0800	6055, 9505, 9575, 11800, 15310, 21485, 21700	Australasia	English
0800-0830	6140, 15310, 21485, 21700	Australasia	Czech

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 $\frac{1}{2}$, 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.



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 $\frac{1}{2}$ 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.

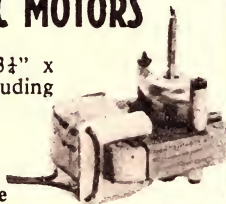
NEW 240V ELECTRIC MOTORS



3300 R.P.M. Size $3\frac{1}{2}$ " x $2\frac{1}{2}$ " x $3\frac{1}{2}$ ", including spindle.

\$2.75

plus 60c postage



SOLID STATE GUITAR AMP.

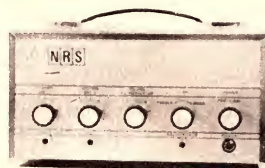
Here is a fully solid state guitar amplifier rated at a nominal 50 watts continuous power. Featuring two totally independent tone control channels and tremolo facility, the amplifier offers unique flexibility in a light and compact unit. (Featured in July-August issue Electronics Aust.)

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**

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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

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Solid state amplifier using 9 transistors, with separate bass and treble controls. Dimensions 12in x 6in x 9in. Weight 22lb.

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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.

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reception has been at good strength around 0430GMT. At 0530GMT the signal is blocked by the S.B.C. at Berne, Switzerland. The S.B.C. transmission (to Europe) commences at 054GMT but its carrier is on the air at 0530GMT.

Station XERMx announces in English and is still giving its frequency as 11720KHz in the 25m band. Announcements in Spanish, French and German are also inserted in the program every 20 minutes. These appear to be on tape. Reports are requested from listeners, and should be sent to Apartado 20100, Mexico City.

CHANGES IN COLOMBIA

Some frequency changes made by Colombian stations have been observed in Invercargill, and by listeners reporting to "Sweden Calling DXers."

"Radio Horizonte" Bogota has been received on the new frequency of 5950KHz. The station formerly operated on 5970KHz and caused some interference to Radio Canada when using this frequency to the South Pacific 0825-0935GMT. The station has been heard in New Zealand opening at 0845GMT.

Radio Catatumbo, Ocana, was heard on the new frequency 4865KHz at 1300GMT. Ondas del Meta, Villavicencio, has moved from 4885 to 6115KHz.

Emisora Nueva Granada, Bogota on 6160KHz operates 24 hours a day, while "La Voz de Cali" in Cali on 6195KHz also is on the air around the clock. Both these signals can be received at 0800GMT.

ZAMBIA'S HIGHER POWER

Radio Zambia has been offered some high-powered transmitters by Communist China following a visit to Peking by a mission from Zambia. It is understood that the offer involves two 50KW short-wave transmitters, and one 200KW medium-wave transmitter. The gift of the transmitters will result in signals powerful enough to beam to Rhodesia and South Africa. Sites are being prepared, but it is not known when installation will begin.

GERMAN STATIONS

Considerable power increases and frequency changes have been reported from Federal Germany in recent weeks. In a recent issue of "Sweden Calling DXers," this information is itemised.

The short-wave outlet of Sudwestfunk on 7265KHz will soon increase power from 1.5KW to 20KW. Bayerischer Rundfunk is to increase the power of its medium-wave transmitter on 1602KHz to 400KW. Norddeutscher Rundfunk, Hanover, has moved from 971 to 520KHz and the power has been increased from 5KW to 20KW. A DX program in German is broadcast on Sueddeutscher Rundfunk, Stuttgart, on 575KHz with 300KW and on 6030KHz with 20KW each month.

"Sweden Calling DXers" says a new medium-wave transmitter of the Bayerischer Rundfunk has operated since October 15 from Munich-Ismaningen on 1602KHz. Output is 370KW in the daytime and 185KW during the night. The station at Nuremberg-Dillberg has left 1602KHz and is now broadcasting on 800KHz with an output of 100KW.

SWEDEN'S HIGHER POWER

Information from Arne Skoog, DX Editor of Radio Sweden, gives additional information about the expansion of the Radio Sweden short-wave service. The Swedish Government has recently made a grant of 11 million Swedish crown (about \$2 million Australian) to purchase three 500KW transmitters from France. The transmitters will have a range of 5950 to 26100KHz covering the 49 to 11 metre bands.

The first transmitter is due to come into operation in 12 month's time, and will be located at a new site. (The present two 100KW transmitters are at Horby). The second 500KW transmitter is due to be tested in the second part of 1971. The third transmitter, also to be at Horby, is due to be on the air early in 1972.

The present transmitter use a curtain array. The new transmitters will have log-periodic antenna systems.

EDWARD STARTZ TO RETIRE

The world's best known short-wave announcer, Edward Startz, of the Happy Station, Hilversum, Holland, has retired and handed his weekly Sunday program over to Tony Meyer.

Edward Startz celebrated his 40th anniversary of short-wave broadcasting with special programs in November 1968. When in Holland last year we interviewed this genial announcer, who has so many friends throughout the world, and whose Happy Station program is so popular. Speaking six languages, and with a knowledge of another dozen, his versatility on the air is unsurpassed.

Tony Meyer, who replaces him, is 31, is a staff announcer of Radio Nederland. He will keep on the tradition of the old PCJ slogan, Peace, Cheer and Joy, in the programs in the 1970s.

SEYCHELLES: The test transmissions from Seychelles of the Far East Broadcasting Associates, Box 234, Victoria, have already been heard and reports requested to this address. The power of the transmitter is 3KW and the present schedule is:

GMT	KHz
0030-0330	15165
1300-1630	17755
1700-2000	21460

ASIA

JAPAN: The Home Service of N.H.K. has been relayed on short-wave for some years from the transmitter at Nazaki which uses 5KW. We have heard a new outlet in recent weeks when programs have been observed on 6130KHz. The frequency suffers interference from Moscow Home Service. At 0955, a five-minute news bulletin in English is broadcast and at 1000GMT the time signal and N.H.K. announcement can be heard.

KOREA (South): The new frequency of 6135KHz for the Korean Home Service has been tuned at 1000GMT in Invercargill. The program is in Korean and at 1000GMT identification is broadcast. This follows the time signal and "K.B.S. HLKA." Signals are received at good strength and are free from direct interference.

RYUKYU ISLANDS: Okinawa station, "Voice of United Nations Command" has been verified by Bob Padula. The station is located at Okinawa, and is now using the new frequency of 9913-KHz which replaced 9840KHz. The verification came airmail in four weeks, and shows the United Nations emblem and antenna tower. No return postage was sent.

PHILIPPINES: The F.E.B.C. in Manila is reported by Bob Padula on the new frequency of 15310KHz from 0000-0030GMT. The program continues then on 15385KHz. This new frequency has been chosen to avoid interference from Havana, now on 15300KHz, the frequency formerly used by the Manila station.

INDONESIA: Radio Republik Indonesia, Djakarta is now using the frequency of 11795KHz for "Voice of Indonesia" programs. News in English is heard at 2330GMT, on this frequency. This frequency has been used in place of 11770KHz, which has been favoured by Djakarta in recent months.

INDIA: All India Radio from Delhi has two transmissions to Australia and New Zealand. The first is on the air from 1000-1100GMT and broadcast on 15105, 17800, 21485KHz beamed to North East Asia; and 11715, 15205, 15430, 17820KHz are on the air for the Pacific area. The second service

(Continued on page 152)

FLASHES FROM EVERYWHERE

EUROPE

AUSTRIA: The Austrian Army Radio, on the frequency of 6255KHz, is reported to be operating 1100-1230, and 1630-1900GMT. The first transmission consists of popular music and educational features for soldiers, and the second is of Morse lessons, Army news and popular music. All programs are in German. Reception reports should be sent to Schulungssender, Gussriegelstrasse 45, A-102, Wien, Austria.

ITALY: Rome Radio has one English service for reception in Australia and New Zealand. This is at 2200-2225-GMT, and on the frequencies of 15340, 11905 and 9710KHz.

POLAND: Radio Warsaw is using the new frequency of 6010KHz. Our observations have been at 0700GMT when an English news bulletin is broadcast. This new channel is providing good reception. Another frequency, 7125KHz, also carries the same program.

VATICAN: Radio Vatican is using 21610KHz as a communication link with Radio Veritas in Manila. At 0800GMT both stations have been heard discussing future programs. At this time Radio Veritas uses 21690KHz. Our reception of another new Vatican frequency, 15265 at 1935GMT in English, has been good.

ROMANIA: Radio Bucharest has been heard by Mike Highley of Wellington, N.Z., at 1100GMT. At this time English is broadcast on the new frequency of 17850KHz, and at the same time is carried on 11810 and 15250KHz.

AFRICA

ETHIOPIA: ETLF, "The Voice of the Gospel," broadcasting from Addis Ababa has been heard at our location, with a transmission to Madagascar. The station uses 15270KHz and has been heard at 1510GMT. A test transmission of five minutes with English and French announcements precedes the opening of transmission at 1515GMT. The program which follows is in Malagasy and includes a gospel program.

CONGO: Radio Brazzaville has been logged by Bob Padula, of Melbourne on the frequency of 4880KHz. The station was heard around 1830GMT and at 1900GMT relayed a program from the O.R.T.F. in Paris. This program concluded at 1930GMT.

GHANA: Radio Accra has been received on two frequencies at fair level. The station is using 6130KHz and carries English news at 1800GMT. On 21545-KHz the station has been heard at 1500GMT with a local program.

MOZAMBIQUE: According to "World Bulletin," the Radio Club of Mozambique is nearing the completion of new facilities at Beira. The transmitters installed are two 10KW short-wave, as well as one 25KW and one 50KW units. On medium-wave they will use two 10KW and one 50KW units. The proposed frequencies are 872 and 1043-KHz. Later this year they plan to install two 100KW units for short-wave and one 100KW for medium-wave. The proposed 500KW transmitter has been shelved for the time being.

A. CE.

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MODEL SK-100



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100,000 Ohms per Volt DC
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- DC Volts: 0.6, 3, 12, 60, 300, 600, 1200V.
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Speaker Enclosures to suit
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2 Pioneer 15in Speakers,
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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".
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Lock Down, 3" 6" ... \$4.75

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D.C. Volts, .5, 2.5, 10.50, 250, 500, 1,000.
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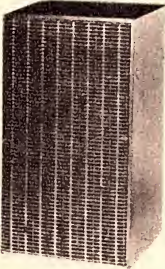
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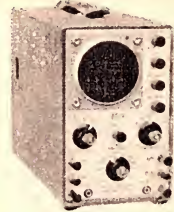
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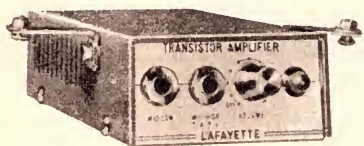
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is on the air for Europe, Africa and Australia/New Zealand.

GMT	KHz
1745-2030	11620
1745-2230	7215
1945-2230	9912
1745-1945	15080
1945-2045	9690, 11775
2145-2230	11740

HONG KONG: A report in "Contact," the bulletin of the World DX Club, reports that a radio city is to be built at Hong Kong. Within two years, 50 acres of barren mud flats a few miles from the colony's border with China will be turned into a radio city. Millions of dollars have been spent on studios, offices and equipment for the two commercial television companies and the government radio station already broadcasting from the city. By early this year they will be joined by a commercial radio station and two government-run television channels — one designed solely for educational purposes. When everything has been completed by the end of this year, Radio City will be able to broadcast a choice of nine radio and six television programs at the same time — for a potential audience of 4 million.

OCEANIA

NEW HEBRIDES: Radio Villa, which operates on 3905KHz has been heard with news in Pidgin at 0645GMT by Richard Wood, in Hawaii. The station has been received with improved signal strength. Reports are now verified with an attractive verification card which gives full details.

THE AMERICAS

EL SALVADOR: According to the Danish Short Wave International bulletin. Radio El Salvador, station YSS now uses two frequencies. The station has been observed on 5980 and 9555KHz. The new schedule is 1700-0500GMT. **PANAMA:** La Voz del Baru, Panama City, uses 6045KHz and is now on a longer schedule. Signals have been observed to close down at 0400GMT, while a report from Florida gives sign on as 1000GMT, making reception possible in the Pacific area.

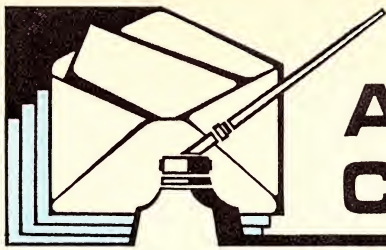
VENEZUELA: Two programs have been observed on 4870KHz originating from Venezuela. The station alternatively identifies as Radio Cultura, Caracas, or Radio Tricolor, Barquisimeto. The frequency was formerly used by Radio Tropical, and it seems this station has now ceased operation. Radio Vallues Del Tuy is active again on short-wave, and is using 6128KHz for its transmissions.

BRAZIL: Radio Guaiba, Porto Alegre, is on the air 24 hours a day and reception in Invercargill is best at 0800GMT. The station operates on 5965KHz. Signals from the station suffer from light sideband interference from Montreal using 5970KHz.

BROADCAST BAND NEWS

PHILIPPINES: A new station heard in Invercargill is DYLB operating on 1450KHz. The signal has been mixed with Taiwan on the channel, but reception has been possible at 1600GMT when DYLB signs off. The station is located in Cebu City, uses 1KW and is on the air 2100-1600GMT. Popular music program was broadcast up to sign off. DYLB is not listed in any reference book, and seems to be a new station.

SOUTH VIETNAM: A Press report states that the Australian forces in South Vietnam are shortly to have their own radio service. A 500W transmitter is being installed at Vung Tau. The station is to be supplied with program material from the A.B.C. and commercial radio services. As yet, its operating frequency and schedule are not known.



ANSWERS TO CORRESPONDENTS

HETRODYNES AND TECHNICAL TERMS: I have a portable radio with which I listen to 4BH (1390KHz) at night. There is an annoying hetrodyne on this frequency which I am unable to remove entirely by any means that I know of. Also atmospheric disturbances are more pronounced on this channel than most others. Could you give me a brief explanation of the terms "TRF radio" and "Leslie speaker system"? I appreciate your magazine greatly and I like the new layout of the contents pages. I hope that in future you could publish some articles that would be useful supplements for the Senior Physics Course. (W.N., Yeerongpilly, Qld.)

● It is difficult, at this distance, to suggest what might be responsible for your hetrodyne or generally poor reception of this station, particularly since you would appear to be within the primary service area. The only comment we can make in regard to the poor reception generally, and which may indirectly be the cause of the hetrodyne situation, is that the directional aerial of the receiver may happen to be orientated for minimum pickup from this station. In any case, the aerial should be deliberately orientated for maximum pickup in this direction. The term "TRF" stands for "tuned radio frequency," meaning that the incoming signals are tuned and amplified at their own frequency, rather than being changed to an intermediate frequency as in the case of the more conventional superhet type receiver. The term "Leslie speaker" is used somewhat loosely, but generally refers to a loudspeaker system in which the path length between the loudspeakers and listener is constantly changed, the resulting Doppler effect giving the sound a particular vibrato characteristic. Sometimes the loudspeaker is rotated, sometimes there is a rotating shell around the loudspeaker, as well as other, similar, approaches. We described one such version under the heading "Rotating System For Organ Speakers" in our March 1968 issue. (File No. 1/SE/19). Thank you for your kind comments about the magazine. Your suggestions have been noted and will be kept in mind.

TRANSMITTER: I have constructed an "advanced" communications receiver and am looking for something more advanced to tackle. I had in mind a transmitter, but as yet I have found no suitable circuits to make use of a diode, a variable capacitor, a coil and a crystal earphone. I would like an output of about 80W on the amateur bands from 10 to 80 metres, in SSB. Could "Electronics Australia" design a transmitter to suit my requirements? (R.H., Punchbowl, N.S.W.)

● We would like to take this opportunity to clarify an important point for the benefit of R.H. and others: the Information Service exists (1) to provide a reprint service of past projects and (2) to provide assistance for readers who have encountered trouble when constructing one of our projects. We simply do not have the staff or facilities to do more than this. The design of special circuits for individual readers is completely impossible, even assuming that the reader's request is a reasonable one — which in many cases it is not. We have published a number of transmitter circuits in the past

and, while no one design is likely to satisfy your requirements, R.H., we think you would get a good idea of basic principles from them. In addition we suggest such text books as the A.R.R.L. Handbook and the R.S.G.B. Handbook and a planned course of study for the Amateur Operator's Certificate of Proficiency (A.O.C.P.) examination. By the time you are ready to sit for this you will have a very much better idea of what is really involved in transmitter design and construction. The Wireless Institute of Australia conduct classes for the above exam and would be the best people to advise you on a course of study.

YOUNG READER: I am only 11 years of age and read your magazine every month. I think it is stupendous. Have you ever published simple circuits such as an audio amplifier, a crystal set, a one-transistor radio receiver, etc? Also, can you tell me where the nearest radio clubs are in my area? Finally, did you print any articles about the "Expo Electric '69" held in Melbourne several months ago? (R.P., Deepdene, Vic.)

● We are glad you like our magazine. R.P., we try to cater for all types of readers including beginners. From time to time we publish simple circuits for readers like yourself. We published a "Midget Amplifier for Crystal Sets" in May, 1961 (1/XA/7) followed by a "Transistor Amplifier for Small Receivers" in June, 1961 (1/XA/8). Alternatively if you want a valve circuit, we published a "Basic Stereo Amplifier" in June, 1966 (1/SA/24) and a "Basic Mono Amplifier" in May, 1967 (1/MA/47). We published an article describing "Simple Crystal and Transistor Sets" in July, 1969 (4/TR1/11) and, when

you feel a bit more ambitious, you could try our "All Wave Two-Transistor Set" of June, 1960 (4/TR2/3). Copies of the articles mentioned can be obtained through the Information Service for 20c — please quote the appropriate file numbers. To locate the nearest radio clubs in your area we suggest that you contact the Victorian Division of the Wireless Institute of Australia at P.O. Box 36, East Melbourne, Vic. 3002—phone 41-3535. No, we did not publish a story covering the Melbourne Exhibition, mainly because exhibitions like this are covered at the time by the daily press and weekly magazines. They would be "ancient history" before they could be covered in a monthly magazine with early publication schedules.

MOTOR CYCLE IGNITION: The flow of small two-stroke motor scooters and cycles has been tremendous in recent years. Would you consider an article in the form of a home project for improving the ignition system of this type of motor. battery or magneto? I would also be interested in an electronic tachometer for this type of motor but I think its range would have to be to 9000rpm, or even a little higher. I am sure that many thousands of people would benefit from these two projects. (R.G., Brisbane, Qld.)

● It would be quite uneconomic for us to tackle a problem like this. A staff member would first have to become familiar with the problem, relate it to all the scooters and cycles likely to be in the hands of our readers, and then go away to seek a solution in both the electrical and the physical sense. The finished unit would have to be proved in a representative range of vehicles before presentation.

"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-disposal 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

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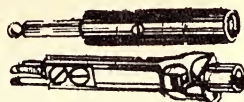
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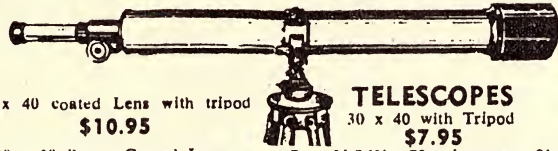
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SORRY, NO C.O.D.

ANSWERS - continued

It would add up to a very long and costly exercise. The most likely source of such an article is from a motor cycle club which happens to have one or more electronically inclined members. They would have the background, the vehicles, the means of evaluation and time to invest in their hobby which doesn't have to be paid for on a per-hour basis! Your estimate of "many thousands" sounds wildly optimistic. Undoubtedly there are many thousands of scooters and cycles on the road but the proportion of riders who would want to become involved in building and fitting special ignition circuitry would be very low.

CAPACITOR FAILURE: Recently my stereo amplifier of Japanese origin blew a fuse, accompanied by a loud "pop" from inside. Upon investigating, I found that a .001uF capacitor from one side of the power transformer primary to earth had blown up. I fitted a new .001uF 400V capacitor in its place but, half an hour later, this blew up also. Why is such a capacitor fitted in the first place? Did the two capacitors fail because of undue heat where they are mounted? Finally, I would like to add my appreciation for the extremely well balanced content of your journal. (D.B., Lawson, N.S.W.)

● Capacitors on the primary circuit of the power transformer sometimes help to minimise modulation hum, where a radio tuner is involved. We can't speak for the manufacturer of your particular equipment. The second failure was almost certainly due to using a capacitor with inadequate voltage rating. The 400V rating is for a DC condition only. With AC applied, the dielectric is stressed not only by the peak value of the AC wave (about 350V) but also by the constantly changing potential and polarity. Capacitors connected to 240V mains should preferably be rated for AC operation but, if a capacitor is used intended primarily for DC circuits, it is wise to use one with a rating of not less than 1000V and preferably 2000V.

ROOF AERIAL: Our house has a tiled roof and I wish to install an aerial between the ceiling and the tiles to improve interstate reception on my radio. Could you tell me whether this would be practical? I have been a subscriber for five years and find the magazine provides helpful and informative reading. (R.L., Cumberland Park, S.A.)

● Use plastic covered wire and staple it under the rafters a couple of feet above the ceiling line. Bring the wire up from the receiver by a route reasonably clear of power wiring. Tack the aerial

around three sides of the roof structure and then possibly run the end up the rafters to the peak of the gable. It may also be worthwhile to provide the receiver with its own earth, run to a water pipe driven into damp soil.

METAL LOCATOR: After your article on metal locators, I felt I must write and inform you and your readers of my super metal locators. This locator is small enough to fit in the pocket . . . works on three well-known principles, personal vibration, indicator vibration and paraminer vibration . . . can locate something of the order of a 20c piece at 2ft . . . sells for only \$100. (Name supplied but withheld at correspondent's request.)

● Remembering all the arguments there were some years ago about divining rods and other such devices, we wilted at the thought of reproducing your letter in full. Some would have treated it as serious, some as a joke and still others as a money-making gimmick. We would have become the meat in a three-decker paper sandwich!

SIMPLE ORGAN: I have built the Keyless Organ from your January, 1969, issue. How about something half-way between this and the Stromberg Carlson complete electronic organ? I have in mind a 3-octave fully polyphonic keyboard, with a range of voices and facilities, pedal clavier, swell pedal and arranged for mounting on a desk or a set of legs. It would not be a toy and would probably cost \$100 or so. However, it could be plugged into a P.A. system and should be useful for bands and groups. (R.H., Para Hills, S.A.)

● We have discussed propositions like this before in these and other columns. The gap between a monophonic toy or gimmick and a polyphonic instrument which is expected to produce real music is very great and you would find the cost soaring way above the \$100 you have in mind. Admittedly, money could be saved by reworking an existing keyboard but only those who have been through this experience know how much work is involved and how much heartbreak, too, unless the constructor goes the right way about adapting his particular unit. While we are not ruling out the possibility of an instrument along the lines you suggest, we are much less optimistic than you are. In the meantime, why not "haunt" the premises of shops in your area who are dealing in electronic organs? There is a good chance, these days, of picking up a traded-in instrument at modest cost and repayable on terms. It is much easier for an electronic handyman to recondition an existing instrument than to build up one from basic hardware.

Type numbering

TYPE NUMBERS: Could you give me some information on the classification system used on valves and semi-conductor components? (W. McN., O'Connor, A.C.T.)

● This is a difficult question to answer in the limited space of these columns. Briefly, the American system of numbering valves and semiconductors tells very little about the device. The first number, in the case of a valve, indicates its heater or filament voltage but the following letters and numbers are purely serial numbers denoting different types but with little tie-up with the functions of the valves. In the case of semiconductors, the first number tells broadly what type of device it is, i.e. 1 denotes a diode, 2 a transistor, and 3 a miscellaneous device. Other than that no information can be gleaned from the American system of coding. Under the European method, a little more can be gleaned from a device's designation. With valves, the first letter indicates the heater or filament voltage, e.g. E corresponds to 6.3V; the second letter (and third in some cases) indicates the broad type of valve, e.g. C is a triode, CC a double triode; the first number tells the base type of the valve, e.g. 8 is a B9G base; the remaining number (and sometimes additional numbers or letters) are again only serial numbers to distinguish types within the broad framework of the system. With transistors, the first letter indicates the material from which the device is made, i.e. A is germanium, B is silicon, C is other semiconductor materials such as gallium arsenide; the second letter indicates the broad type of device, e.g. C is an AF transistor not power type; a third letter if used designates an industrial or professional type; the remaining numbers are purely serial numbers.

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TRANSISTORS
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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.
\$15.00.
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.

CAPACITORS
80 for \$2 in Poly Packed Bags. Mixed values only.

TAPE HEADS
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.
Price: \$9.70.

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.
Large range. Only 50c each.

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5U4	\$1.00	6SK775
5V4	\$1.00	6SL7	\$1.00
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6AC720	6U5	\$1.00
6AM665	6U760
6B6	\$1.50	6X460
6B8	\$1.50	6X575
6BF6	\$1.00	12AT750
6CH650	85A275
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	
6K7 . . . .	.50	QQV02/5)	\$2.00
6K8	\$1.00	ECC33 . . . .	.50
6SA7	\$1.00	872A	\$1.00
		KT61	\$1.50

All prices subject to alteration without notice. All items PLUS POSTAGE.

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RECEIVERS, TRANSMITTERS
TEST EQUIPMENT.

280 LONSDALE STREET,
Melbourne. Phone 663-3815.

(Opposite Myers)

HAM RADIO SUPPLIERS

Mail Order Specialists

323 ELIZABETH STREET,
(2 Doors from Little Lonsdale Street)
MELBOURNE, VIC. 3000
TELEPHONES: 677329, 674286

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 6¼in. 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 Mc/s, 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, TVI 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 1-8.

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 1¼.

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 1¼in.

PRICE: \$19.50 post 30c.



NEW MODEL US-100. Overload protection. Shockproof Movement. polarity 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: 7¼in x 5¼in x 2¾in.

PRICE: \$34.50. Post 75c



MODEL A10/P. GIANT (6¼-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: 6¼in 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 pc. 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

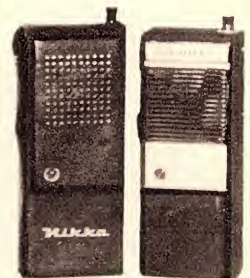
4 band receiver covering 550 Kc/s to 30 Mc/s, continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit, 4/8 ohm output and phone jack. SSB-CW. • ANL • Variable BFC • S meter • Sep. bandspread dial • IF 455 Kc/s • Audio output 1.5 W • Variable RF and AF gain controls. 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

I.R.E.E. Convention

The Institution of Radio and Electronics Engineers Australia is conducting the 13th National Radio and Electronics Engineering Convention at the School of Architecture, University of Melbourne in May, 1971. The actual period will cover the middle week of the academic vacation, and exact dates will be announced as soon as they become available.

The School of Architecture is one of the modern new buildings on the University campus. The facilities chosen incorporate large, easily accessible display areas

which will enable exhibitors' space requirements to be met, well equipped lecture rooms, and—in an adjoining building—dining, refreshment and entertainment facilities for the exclusive use of Convention delegates and visitors. The University is about one mile from the centre of Melbourne, and is well served by public transport and by motels in the adjacent area.

(The Institution of Radio and Electronics Engineers Australia, Science House, 157 Gloucester Street, Sydney, 2000.)

MODEL RAILWAYS: I am about to build a model railway system, but have not been able to find any suitable circuits. Have you published any circuits for lighting, power supplies, speed controllers and change-overs? Also, have you ever published circuits for guidance systems and direction finding equipment? (J.R., Edwardstown, S.A.)

● We have published the following articles for model train layouts:

April, 1960. Carrier Control for Model Trains (File No. 2/MC/1).

February, 1967. Control Unit for Model Trains (File No. 2/MC/2).

March, 1967. Model Train Control with Simulated Inertia (File No. 2/MC/3).

October, 1967. Lighting for Model Trains, part 1 (File No. 2/MS/12).

November, 1967. Lighting for Model Trains, part 2 (File No. 2/MS/13).

December, 1967. Lighting for Model Trains, part 3. (File No. 2/MS/15).

April, 1968. Train Power Supply (File No. 2/PS/19).

Copies of all these articles can be obtained through the Information Service for 20c each. We cannot assist you with guidance systems and DF equipment.

SAILING ENTHUSIAST: Being a sailing enthusiast, I was very pleased with your article on the Apparent Wind Direction Indicator in the November, 1969 issue. Do you plan to include more information on electronic sailing equipment? Equipment that would be of particular interest includes wind speed indicator and electronic log. (R.S., Point Clare, N.S.W.)

● We have no plans for further articles on these items at the moment, R.S., but if the opportunity presents itself, we will remember your request. We point out, however, that we published details of an Anemometer (wind speed meter) in our April, 1965 issue. Reprints of the article (File No. 3/MS/10) are available through the Information Service for the usual 20c fee.

TAPE CASSETTES: I have recently purchased some good quality hi-fi equipment but when I mention supplementing it with a cassette player, people have suggested that it is like putting 50mph tyres on an E-type Jaguar. Some have suggested that the response of cassettes will be lifted to 20KHz during 1970 but they omit to explain how this is to be achieved. Should I wait or would it be reasonable to purchase as an interim measure? Frankly, I have been so impressed by the handiness and compactness of stereo cassettes and players that the advantages outweigh their lack of hi-fi characteristics. (G.B., Rabaul, New Britain).

● At present, normal cassettes and cassette players give pleasant quality but miss out above about 7 or 8KHz. Improved tapes and techniques could push this limit up, but market demand will have a hand in the quality. Tapes have to be copied at many times the ultimate replay speed and the need to maintain a high production rate operates against obtain-

ing the ultimate in quality. Since you are so keen on the aspect of handiness and compactness, you have really answered your own question. Why not buy a unit and tapes that please and use them for the situations when you are not going to be searching aurally for the last bit of treble response. You could still maintain a collection of top quality discs for the special occasion. As regards the various brands and models, we cannot undertake to advise. Even if it were not against our policy, it would be a Herculean task to keep ourselves constantly informed about all the makes and models which are coming on to or going off the market, their performance, their reliability, their price, the service back-up and any other such factors which would help determine a value-for-money decision.

CASSETTE RECORDER: Have you any plans for the description of a stereo tape recorder designed around the now-popular cassettes? I am sure that many readers of your magazine would be interested in such a project. (R. B., Hawthorn, Vic.)

CASSETTE TAPE ADAPTER: Would you consider the description of a stereo tape adapter unit based on a tape cassette deck and compatible with the Playmaster series of amplifiers? The current popularity of tape cassettes would surely make this a worthwhile project. I am aware that the availability of a suitable deck may present problems, but surely one of the larger manufacturers would be willing to co-operate. (R. B., Thirroul, N.S.W.)

● Thanks for each of your letters, R.B. and R.B., and we are certainly giving the idea some serious thought. From comments we have heard around the trade, the main problem is likely to be the availability of a suitable cassette deck. However, we will look into the matter and see if something can be arranged. We can make no promises about a possible publication date because even if a supply of decks can be found, there are still some development problems to be solved.

DEAD LETTER: We are holding a letter addressed to Mr J. Kuiper, 6/205 Mason St., Newport, Victoria, 3015. This has been returned by the P.M.G.'s Department marked "Not at this address." Would the person concerned please advise the correct address? ■

DELCO 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

THE SERVICEMAN (continued from page 59)

Almost immediately I realised that, in terms of channel numbers, I was lost. Whereas one channel down from 10 should have been 9, it turned out to be 7. And 9 was on the other side of 10, where 11 should have been. What was going on? Closer examination revealed that Channel 10 was being received with the set tuned to Channel 8.

When I pointed this out to the owner, and asked whether he could explain it, he had the answer all ready.

"The last bloke who serviced it adjusted it that way. We've always had trouble with 10 and he said that we would get better results by using channel 8. It was a bit better, too, but not as good as the other stations."

My curiosity thoroughly aroused by now, I told the owner that I felt that it should almost certainly be possible to get better results. Did he want me to try? Yes, he did. I could hardly wait to get at the tuner.

Removing the cover, I sought out the channel 10 biscuit. I half expected to find this position empty, with the channel 10 biscuit moved down to channel 8. But no, both biscuits, clearly marked with their channel numbers, were in their correct positions. I slipped the channel 10 biscuit out and, as I did so, the oscillator coil slug slid out on to the carpet. Was this all that was wrong with this biscuit?

Closer examination revealed that there was nothing mechanically wrong with the biscuit or slug. All that had happened was that someone had screwed the slug so far that they had "lost" it. By way of explanation,

Guitar Loudspeakers

(continued from page 71)

of a larger enclosure serving a 100-watt channel, the two forming a pillar about 4ft high.

The dimensions shown are internal. As already mentioned, the enclosures should be constructed from material not less than $\frac{1}{2}$ in thick, all joints being glued and screwed to ensure rigidity, freedom from rattles and complete air sealing. The back panel will need to be removable, but should fit snugly and should preferably be screwed down against a thin gasket of felt or foam plastic. Voice coil connections should be made through an airtight plug or flying leads brought out through a hole, sealed with a plastic putty.

The larger enclosure should have an internal brace, as illustrated, attached to the baffle between the loudspeakers and accepting screws through the rear panel.

Any fret material covering the front of the enclosure should either be glued firmly to the surface of the front baffle or supported sufficiently far from it so that it will not buzz when the loudspeakers are being driven hard. The remaining surfaces can most appropriately be covered with black vinyl cloth.

The 12U50 and 12U50X loudspeakers are available with a voice coil impedance of either eight or 15 ohms. For the 100-watt enclosure, two 15-ohm loudspeakers connected in phase and in parallel will approximate eight ohms. The series mode of connection is not recommended. ■

the particular biscuit does not use a former threaded in the conventional way; it uses a small retaining spring which runs in one groove of the slug thread. If one is unfortunate enough to wind the slug beyond the control of the spring it cannot be restored without opening the tuner and extracting the biscuit.

Now that I had the thing apart it was easy enough to restore the slug, slip the biscuit back in the tuner, and set about tuning it up for channel 10. But there the easy part vanished. Try as I might, I couldn't make the oscillator coil peak. It came within striking distance of it, but no more.

Then I remembered that I had a similar tuner in the truck. It took only a few moments to slip the channel 10 biscuit out of that and into the customer's tuner. Whereupon, everything came good. The slug needed only a turn or so to set it spot on and the picture came up bright and sparkling, with not even a suggestion of snow. It was, according to the owner, "Better than it had ever been."

AUDIO TOPICS (continued from page 85)

Some tests were also carried out to verify the theoretical noise reduction afforded by screen walls on the numerous noise sources such as cooling fans, pumps and electric motors which were to be installed at or near ground level. An experimental screen wall, approximately 25ft high, was erected between an existing reforming plant and the nearest houses. Tests with this proved successful and similar screen walls constructed of a steel framework with sound absorbent cladding were ultimately built on the residential side of most of the new plants.

A different problem was presented by ships' cabins to ensure adequate privacy for passengers. Surveys were undertaken on several vessels on the North Atlantic crossing and it was found that the degree of acoustic privacy between cabins depended not only upon the sound insulation afforded by the partitions but also upon the level of background noise due, for example, to ventilation.

Further laboratory tests revealed that partition insulation could be exchanged directly for background noise level. In other words, if an increase

So I put everything back together and went on my way, leaving behind a very satisfied customer; one who will undoubtedly come back to me the next time something needs attention.

But what of the other serviceman. It was now apparent that there was a fault in the channel 10 biscuit which needed more than a simple adjustment of the slug. But in trying to adjust the slug he had "lost" it in the manner I have already described. Then, rather than provide access to the tuner, and either repair the biscuit or replace it, he had resorted to a cunning but not very honest trick. He fiddled the slug in the channel 8 biscuit until it tuned to channel 10, its ability to do this being a happy set of circumstances for him.

What he was not able to do was adjust the RF tuned circuits in the biscuit, which remained tuned to channel 8. Small wonder there was snow in the picture; any signal reaching the converter was doing so in spite of the RF tuned circuits, rather than because of them.

And that bloke has the hide to call himself a serviceman! ■

Communications Receiver (continued from page 83)

suit the particular need. Such a design could be readily adapted for "amateur bands only" and, if necessary, a second set of tuned circuits could be added to the RF amplifier, between it and the emitter-follower. No doubt other ideas will suggest themselves to the individual reader.

We now come to the tunable IF section. From here on the system is a single conversion receiver in its own right, albeit one which tunes only the 3-6MHz range. The tunable IF amplifier is another junction FET, with input and output circuits tuned, although the step-up available in the input transformer is not used, as there is ample gain without it. This stage is

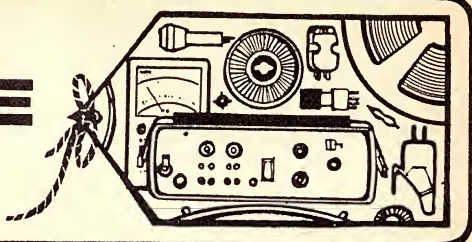
also connected to the AGC system. As with the RF amplifier, it is necessary to transform from high to low impedance between the amplifier and the mixer and this is done with an emitter-follower as before.

The second mixer is a ring, identical with the first mixer. It is followed by a simple amplifier at 455KHz.

The VFO which tunes from 3.455-6.455KHz is the heart of the receiver, as far as stability is concerned. We have used a version of the now well known "synthetic rock," which we have used very successfully for a transmitter VFO as well as other applications. As it has to tune over a wider range and

(continued opposite)

MARKET PLACE



FOR SALE

SELL all back issues "Electronics Australia" in stock at all times. 1939-63 50c; 64 to date, 60c. Post free. T. Weir, 56 O'Connor St., Haberfield, Sydney, N.S.W., 2045. Phone: 798-7569. Wanted to buy copies also.

BURLAR ALARMS. 12V, 15uA. Transistor control units, \$12, plus 12 p.c. s.t. unit on 4 x 2 plate and case, \$16, plus s.t. 4½V rotary siren, \$10.50. All above plus 60c p. and post. Foil tape terminals, mats, key switches, bells, reed switches, Infra-red ray unit. Complete quote and installation service to insurance requirements.

EDORE ENTERPRISES,
802 Doncaster Rd., Doncaster, Vic. 848-1386.

CHANNEL MASTER "Telstar" transistorised aerial booster amplifiers. Normally \$40, our price \$25 each. Ideal for poor signal areas and in fringe areas. J. Yalden, 21 Oxford St., Glen Innes, N.S.W. 2370.

NEW OC44 45, 71, 72, 6 for \$2 or 40c ea. OC84, AC128, BC108 109, 2N3638, 5 for \$2 or 50c ea. 2N3642, 3643, 3638A, OC171, 2N370, 371, AF116N, 117N, BF115, 2N-3694, AC127, 4 for \$2 or 60c ea. Power types 2N176, \$1 ea. 2N301, \$1.20 ea. OC28, 29, 35, 36, \$1.50 ea. 2N3055, 8DY20, 40250, \$1.60 ea. OA210, EM404, IN4004, 40c ea. OA211, BY100, EM410, 70c ea. UJT 2N2160, FET 2N4360, \$1.10 ea. MPF105, 2N5459, 90c ea. BA100, 25c ea. OA81, 85, 91, 95, 12 for \$2, or 20c ea. No S.A. sales. Post and pack 15c. Custom Electronics, Box 1452, G.P.O., Adelaide, 5001.

PORTABLE Tape Recorder for professional or hi-fi enthusiast: Uher Report Stereo 4400, with many accessories new \$210 below list price. Ring Sydney 37-6174 after 5 p.m.

NORDMENE Globetrotter 15 bands transistor radio. Battery or main power operation. 12 SW bands plus M-L-FM. New \$275 or best offer. Sydney 37-6174, ring after 5 p.m.

CABINETS, kits, stereo equipment, innerboard, grille fabric, accessories, available from Robert N. Smallwood, Sound Specialist, 205 Brisbane Rd., Booval, Qld. 4304. Mail orders, write for price lists or phone 82-1550, anytime.

ALL WAVE 7 receiver. Built to E.A. design (Dec. 67), and housed in attractive metal cabinet. Outboard Q multiplier. Cost \$135. Best offer, Michael Taylor, 36 Patrick Street, Dalby, 4405.

AMATEUR gear. Professional quality laminex wood veneered console with 20 veneered steel panels, contains four metered power supplies, regulator, CRT-module, plus mobile 2-metre rig. \$200. Melbourne 277-3389.

TAA 300 IC class B AF amp. 9V rail. 8mV at 15K in, 1W RMS to 8-15 ohm load. \$3.15 incl. data, cct., post. Pedalfer Associates, 28 Paringa Ave., Somerton Park 5044.

MODEL engineering supplies for technical students. Castings, blue prints. Bolton, 72 King Street, Sydney. Illustrated catalogue \$1.50.

CHEAP transformers, chokes, amplifiers, chargers, fans. Gistinger, Post Office, Alderley, 4051.

FOR SALE 250W amp booster, best offer. Ring Sydney 93-7466.

IMPULSE counter 4 digit 12-50V suit slot car lap counters, Morse sets, traffic, and event counters etc. \$1. Free postage. B.T.G., 6 Anstey St., Howrah, Tas. 7018.

FOR SALE

FERROGRAPH recorder. Stereo model 422. Fully operative with inbuilt 600 ohm phones mono amp. Mixing facilities. \$250. Melbourne 95-1559.

CAPACITOR discharge ignition systems, \$32.00. 12V systems only. State whether positive or negative side of battery connected to car body. Two Way Radio Service, 31 Rotherham Street, Kangaroo Point, Brisbane, Queensland.

PLAYMASTER 118. Almost new, new reservoir capacitors and valves. Low flux leakage power transformer, suitable for adding magnetic pre-amp. Castle Hill, N.S.W. Phone Sydney, 634-2676.

WESTON LM6 radio telephone 240V, 2 Western LM9 radio telephone 12V, 2 whip aerials to suit, 3 microphones, 2 cradles for LM9s. All in good order, no reasonable offer refused. T. N. Fiser. "Embywest", Gulargambone, 2828. Phone Coonamble 84K.

RECORDING tapes, discount prices. Catalogue sent on request. Miniwide, Box 863, G.P.O., Sydney. 798-5388.

Classified Advertisers

For the February issue your advertisement must reach our office by January 8th, 1970. Please address your advertisement to the Advertising Manager, "Electronics Australia," Box 2728, G.P.O., Sydney, N.S.W. 2001.

RECORDING tape 3 x 225 53c; 5 x 1800 \$2.70; 7 x 3600 \$5. Cassettes C90 \$2.50. Empty reels 5in 30c. 15 brands of tape to choose from and all accessories. Full lists free. All the best brands at lowest prices for hi-fi needs, recorders, players, radio, etc. Musical instruments and photographic equipment sent everywhere. A1MO, Box 15, Footscray, Vic. 68-4436.

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READER SERVICE

PRE-RECORDED TAPE hired to members of Australian Tape Recording Society. Bi-monthly release. "The Microphone," newspapers round robins, sales, service, tape-sponding. Send 5c, 9in x 4in S.A.E. to ATRS, Box 9, P.O., Crow's Nest, N.S.W. 2065, or phone (2) 43-667, after hours.

REPAIRS to receivers, transmitters, construction, testing; TV alignments; Xtal conv., specialised electronic equip. Eccleston Electrics, 146a Cotham Rd. Kew., Vic. 80-3777.

READER SERVICE

TGP quality discs from your tapes. Any quantity, all sizes and speeds. We guarantee our work to comply with R.I.A.A. and A.B.C.B. standards. Enquiries welcome. Write for details A.A.V.R., 87a Muliens St., Balmain 2041. Phone: 82-5158, Sydney.

TV picture tubes: Sure Brite Pty. Ltd., now at 542 King St., Newtown, N.S.W. Now the largest factory of its kind in N.S.W. Daily delivery Sydney, suburbs, and to railway station. Lowest prices in Sydney to the trade. Duds bought. Send all duds to Sydenham Station freight paid. Customer sales rear of building. Phones 519-3403, 51-5928. Brisbane area: 1120 Oxley Rd., Oxley, 79-6828.

TAPE to disc service. Take advantage of W. and G. Records' professional experience when next needing a tape to disc service. W. and G. Record Processing Co., 185 A'Beckett Street, Melbourne, Tel: 329-7255.

ELECTRONIC organs: Do not build yourself an organ without first finding out about the superb Schober (U.S.A.) Assemble-It-Yourself Kits. Inquiries to Schober Organs (Australia), 124 Livingstone Ave., Pymble, N.S.W., 2073. (Mail only, please.)

TRANSFORMERS wound. Output or mains and specials to orders. Reply with S.A.E. Paris Radio Electronics, 7a Burton St., Darlinghurst, N.S.W. 31-3273.

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DETAILS for converting TV to CRO, preferably suitable for display of speech patterns. Write Atkinson, 60 Branyan Street, Bundaberg, 4670.

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WANTED. Studio tape deck, prefer without heads and preamps, 7½ and 15ips. Wow and flutter below 0.1% per cent RMS, 3 motors. Write with full particulars and price to Mr Lawson, Box 2340, G.P.O., Sydney, or phone 649-7106, evenings.

IDLE equip. and bits, specially TV FM and VTM. Made OK, Priv., cash 31 Carson St. Dundas, 2117, Sydney. 85-4220.

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to a somewhat higher frequency than is normally required of it, we had to make modifications to circuit parameters to meet this need. This results in a small degradation in frequency stability. In spite of this, a check made in the middle of its range revealed that the drift was 710Hz in the first hour, after a cold start. This figure increased slightly in the next hour but was still slightly short of a total of 1KHz. This compares very favourably with the Deltahet receiver, which has quite a reputation for high frequency stability!

We have provided for a fine tuning control, which can be used as such, or as a means of dial calibration. This is a reverse biased BA102 silicon diode

which functions as a variable capacitor. With the circuit constants given, the following frequency shifts are obtained: At 3MHz, plus and minus 2KHz; at 3.5MHz, plus and minus 20KHz; 6MHz, plus and minus 43KHz. The wide variation between opposite ends of the scale is due to the large change in L/C ratio of the tuned circuit. These figures can be reduced simply by reducing the value of the potentiometer, or by increasing the value of the 4.7K resistors at each end of the potentiometer.

Although a BA102 variable capacitor diode is specified we have tried a BA100 general purpose silicon diode, and the results have been quite satisfactory.

ELECTRONICS Australia

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COVER DATE	Issue ON SALE Mondays	BOOKINGS Fridays	COPY I Reset Material Mondays	COPY II Ready for Camera Fridays
FEBRUARY	February 2	December 19	December 22	January 2
MARCH	March 2	January 16	January 19	January 30
APRIL	April 6	February 13	February 16	February 27
MAY	May 4	March 20	March 23	April 3
JUNE	June 1	April 17	April 20	May 1
JULY	July 6	May 22	May 25	June 5
AUGUST	August 3	June 19	June 22	July 3
SEPTEMBER	September 7	July 24	July 27	August 7
OCTOBER	October 5	August 21	August 24	September 4
NOVEMBER	November 2	September 18	September 21	October 2
DECEMBER	December 7	October 23	October 26	November 6

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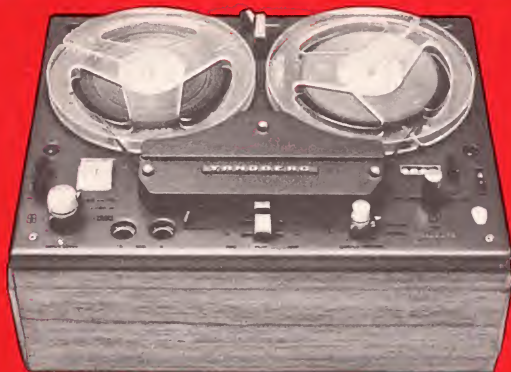
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On the left is the popular, completely self-contained, Tandberg Model 1241X . . . the solid state stereo recorder that's taken the music loving world by storm. Performance is quite amazing . . . even at the middle speed of $3\frac{3}{4}$ i.p.s. frequency response is 20-18,000 Hz.! At $7\frac{1}{2}$ i.p.s. response is 20-25,000 Hz. and signal-to-noise better than -58 dB. Input sensitivity suits magnetic or ceramic stereo cartridges. Power output is 10 watts R.M.S. per channel — double volume controls are provided for both inputs and outputs. Twin wide range speakers are built in. *The 1241X can be the heart of any high fidelity stereo system . . . no external amplifier is required.*

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 Built-in wide range stereo speakers.
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Three speeds — $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{1}{2}$ i.p.s.
 Frequency response at $7\frac{1}{2}$ i.p.s. — 20-25,000 Hz.
 Signal-to-noise at $7\frac{1}{2}$ i.p.s. — Better than -58 dB.
 Twin VU meters.
 Inputs for radio, dynamic microphones, pick-ups.
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 All desirable control facilities.
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Ask for complete and unabridged specifications.

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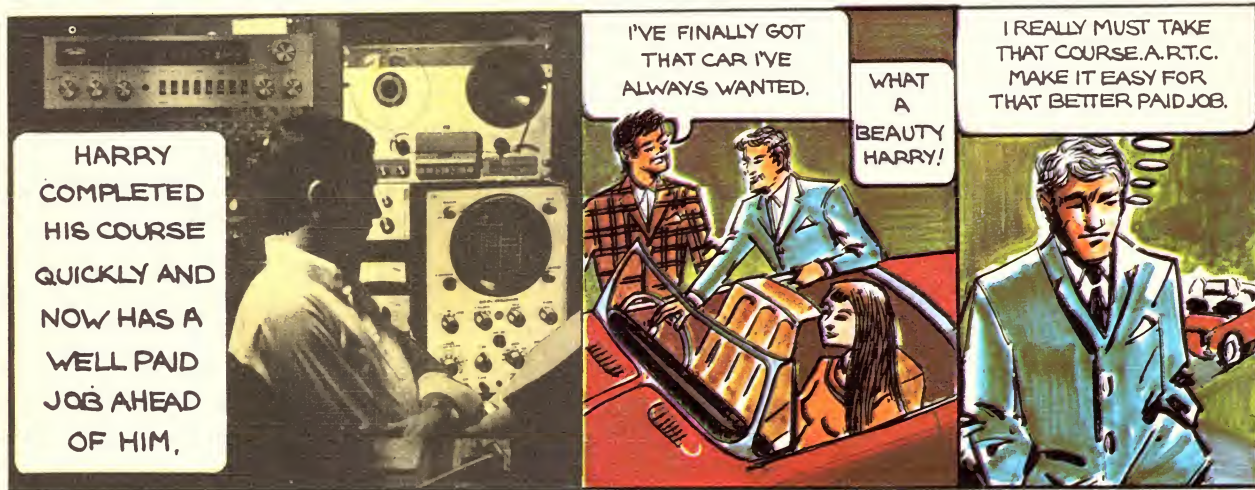
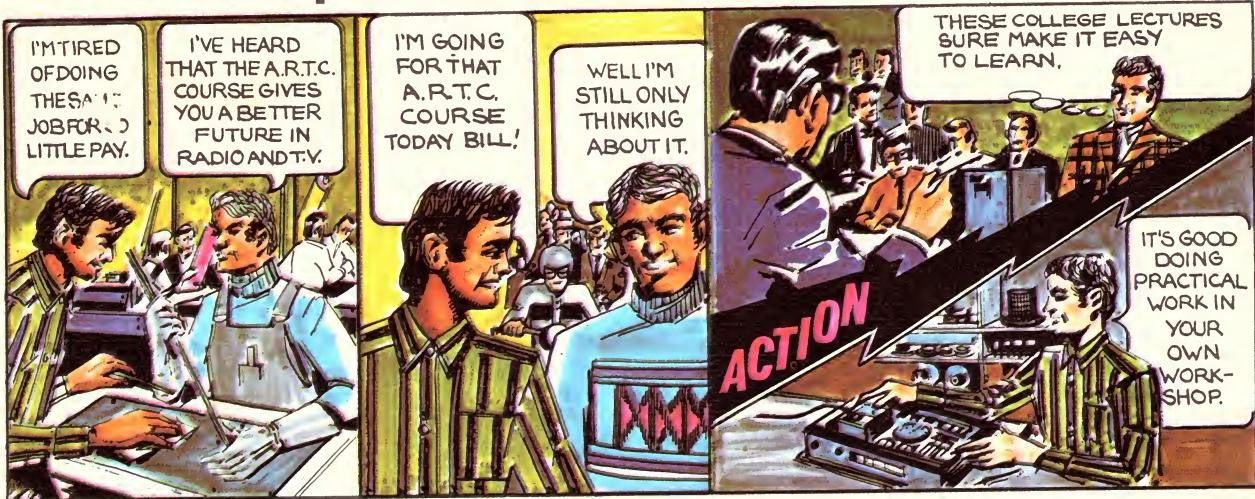
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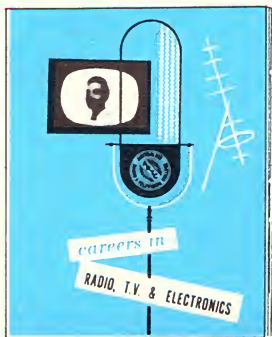
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