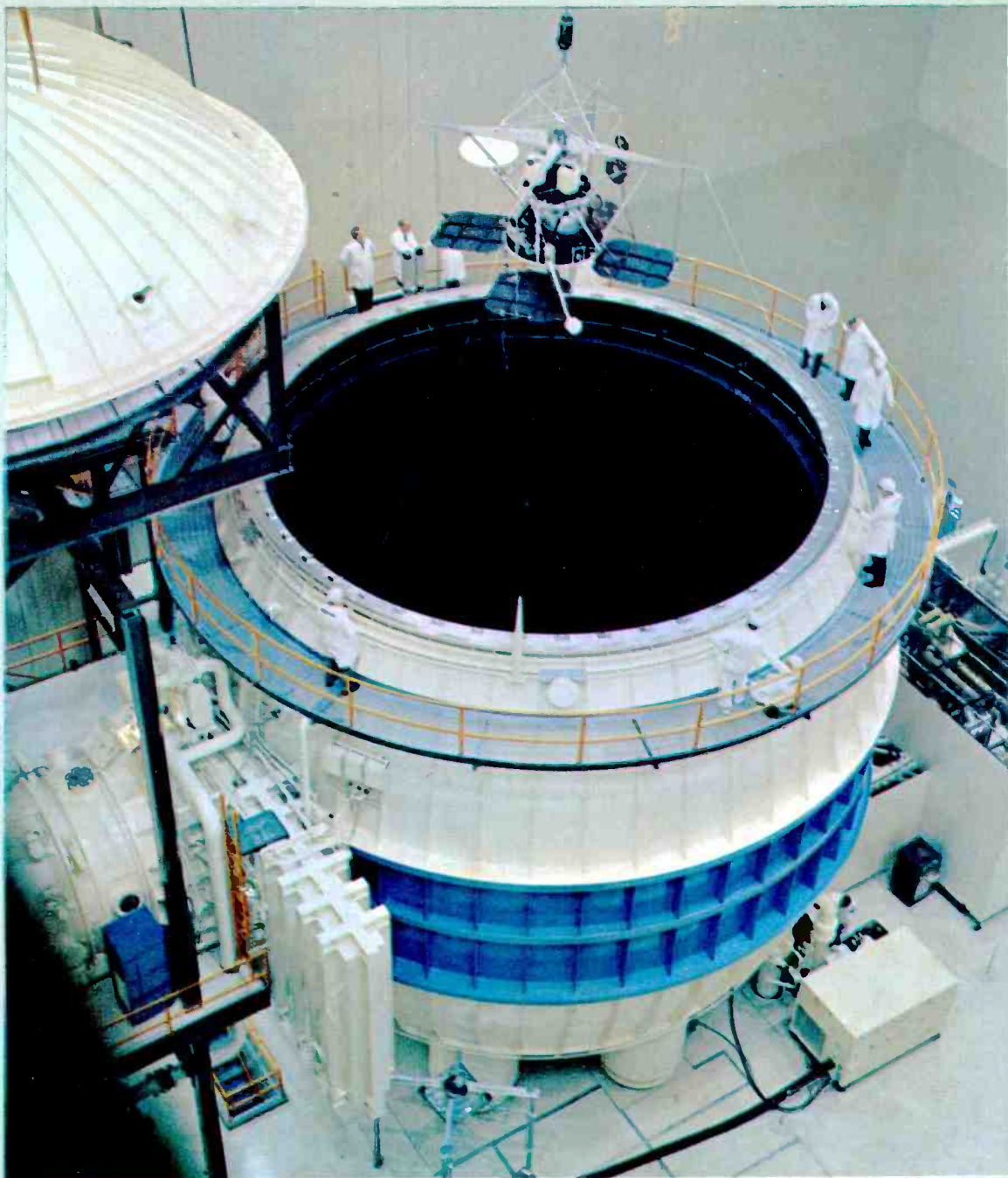


ELECTRONICS Australia

January, 1967

Incorporating RADIO, TELEVISION & HOBBIES

Vol. 28 No. 10



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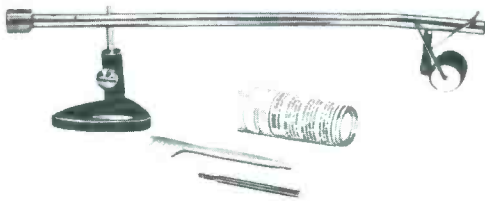
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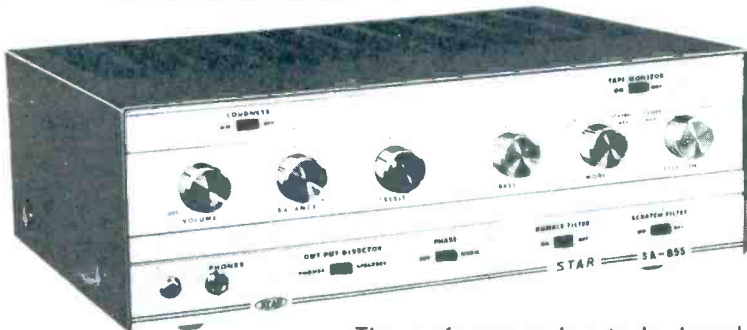
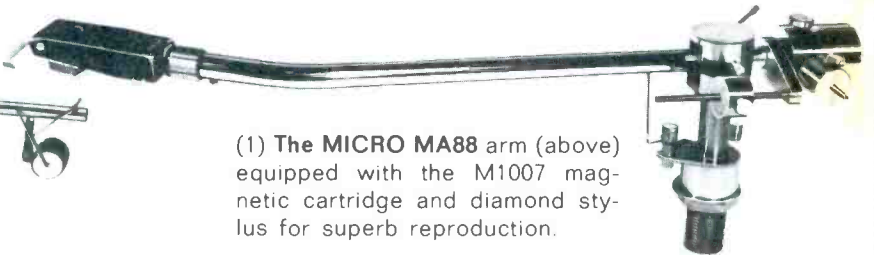
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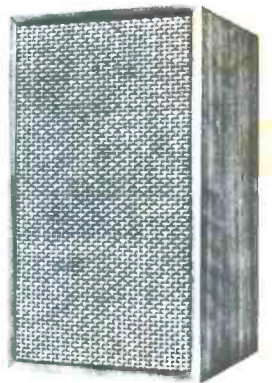
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INCORPORATING "RADIO, TELEVISION AND HOBBIES"

Australia

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FM . . . up-hill battle

Viewing the electronic industry's "where-do-we-go-from-here" dilemma, there are many who believe that FM broadcasting can be comfortably installed and operating ahead of colour television. Quite correctly, they stress that the Government is concerned at the cost of re-equipping its extensive television network for colour and, further, by the possible inflationary effect on time-payment activities. They point also to the mediocre financial position of some commercial television

stations and the difficulty of selecting technical standards.

Despite these problems—and they are very real—it seems distinctly possible that spontaneous pressures will hasten rather than retard the move to colour, in the major capitals at least.

Since 1957, local TV stations have dug deeply into stocks of black and white program material and, in fact, are using a high proportion of material really intended to be exhibited in colour. Is the program barrel deep enough to support another five years of monochrome television? Even now, local stations are probably looking hard at reports from the U.S. that stock television movies gain a new lease of life when re-exhibited in colour.

On other fronts, it is noteworthy that A.W.A. recently set aside an acknowledged appropriation for colour television development. It also seems likely that the recent sale of the Anodeon picture tube facility to Philips was motivated, as much as anything, by the knowledge that the alternative was to become one of four factories committed soon—and uneconomically—to colour tube expansion.

Most major receiver manufacturers already have colour receivers in developmental form, against the day when they can feed them down the hungry production lines.

Rather than being a matter for detached planning, it may well become one of how long the Government can hold the lid on!

But one conclusion is hard to avoid: The seeming inevitability of colour television within the next few years must surely prejudice the Government against becoming involved, in the interim, with a complete, alternative broadcasting system. Despite the efforts of the ERDA committee on FM and the optimistic predictions of FM enthusiasts, I doubt whether they realise how uphill their battle really is.

N. Williams

January, 1967

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COVER PICTURE: A lunar orbiter spacecraft, similar to the one now successfully orbiting the moon, is lowered into the Boeing Company's space simulation chamber. Here it will undergo a full picture-taking flight routine, with all systems subjected to space environmental conditions. (See article on page 4).

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INSTROL-PLAYMASTER No. 113 AMPLIFIER ("Electronics Australia," March, 1966). A high-quality 8-watts-per channel transistorised Stereo Amplifier. Available with control units 112 to suit various applications.

Kit of parts, \$64
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112 Control Unit (picture left)

Kit of parts, \$51
Built and tested, \$67



INSTROL-PLAYMASTER TUNERS.

No. 111 Program Source Tuner ("Electronics Australia," October, 1965).

Kit of parts (with Magic Eye), \$39
Built and tested (Magic Eye), \$53



No. 114 Tuner with R.F. STAGE ("Electronics Australia," September, 1966).

Kit of parts (with Magic Eye) \$47.00
Built and tested (Magic Eye) \$71.00

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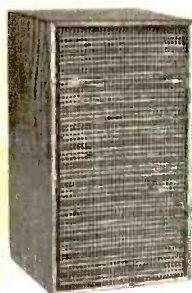


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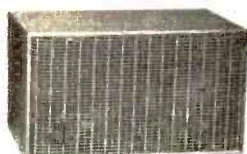
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Left:

The new M.S.P. "SHELF" enclosure with 4in and 8in newly developed speakers.

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\$49.50.



Centre:

The MINI-SPEAKER System as per the original Mullard and Magnavox specifications.

Price, per unit .. **\$27.90**

Right:

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INSTROL high quality cabinets, cover a wide range of speaker enclosures, all designed to the specifications laid down by the various Speaker Manufacturers. The Kits are complete with grille cloth, Innerbond acoustic wadding and assembly instructions.

Left: Vented enclosures, ideal for use with 8in and 10in Wharfedale and Goodmans Speakers.

Price:

Complete Kit of Parts	Maple	\$20.00
	Teak	\$22.70
Built and Polished	Maple	\$35.00
	Teak	\$38.00

Right: Distributed port (D.P.) Enclosures to the original Wharfedale Specifications.

Price:

8in D.P. Kit of Parts	Maple	\$15.80
	Teak	\$17.00
Built and Polished	Maple	\$29.50
	Teak	\$31.50
10in or 12in D.P. Kit of Parts	Maple	\$26.50
	Teak	\$29.00
Built and Polished	Maple	\$44.00
	Teak	\$45.90



Left:

A new Instrol cabinet design which has a wide range of applications. Primarily it is intended to take an amplifier and a player. It is large enough to take combinations of most makes of imported and local players and amplifiers. All Playmaster amplifiers will fit. The front panel is removable to facilitate amplifier fitting. A perspex cover, with stay-up hinges, covers the player section.

PRICE .. Maple or Walnut .. **\$37.50** Teak .. **\$40.00**

Right:

Instrol Slimline Enclosures.

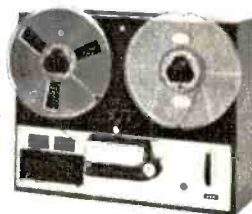
Designed on the D.P. principle, these speaker enclosures are suitable for most types of 8in, 10in and 12in speakers. Compact, only 6in and 7in deep.

PRICE: 8in Slimline Kit of Parts	Maple	\$11.00
	Teak	\$12.20
Built and Polished	Maple	\$21.50
	Teak	\$22.70
10in and 12in Slimline Kit of Parts	Maple	\$13.80
	Teak	\$15.20
Built and Polished	Maple	\$24.00
	Teak	\$25.40



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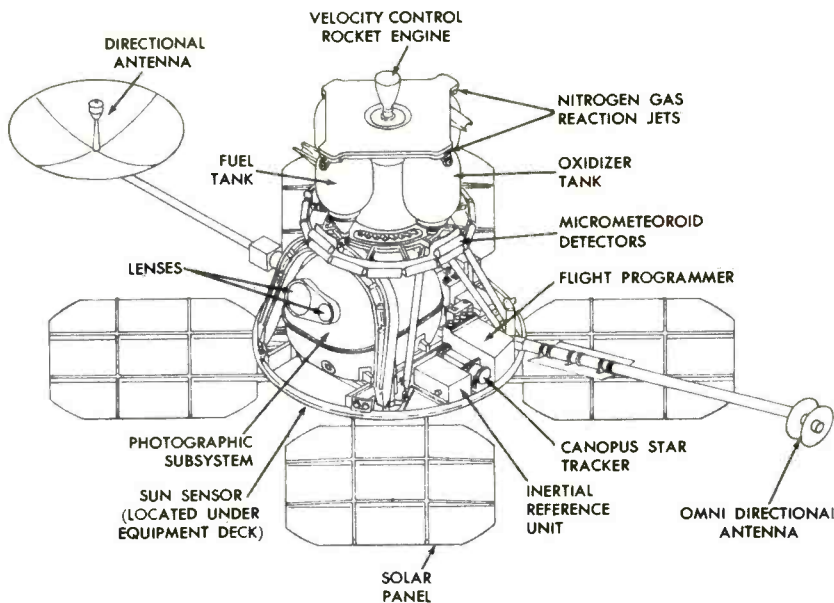
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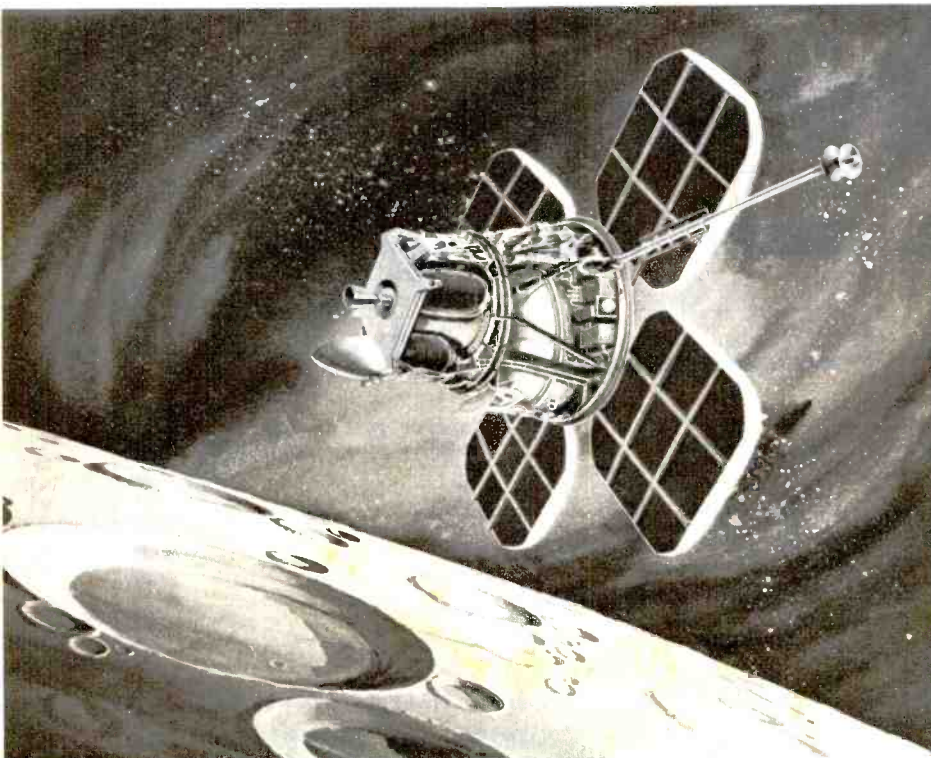
Orbiter Spacecraft Seek Lunar

Manned flights to the moon must be preceded by unmanned probes to gather data for examination and analysis of those areas where Project Apollo astronauts will one day land. For this reason the National Aeronautics and Space Administration has developed a systematic program for unmanned exploration of the moon.

The Lunar Orbiter is one of three types of unmanned spacecraft designed to scout the moon and its environment before the Apollo team of two astronauts descends to the lunar surface from an orbiting Command Module.



Above is a detailed drawing of the Lunar Orbiter, showing the main components. Note the photographic sub-system. Below is an artist's impression of the Orbiter only 28 miles above the Moon's surface, taking pictures for transmission back to earth.



In July, 1964, Ranger 7 gave man his first close view of the lunar surface and clues to its character. The Ranger spacecraft was guided to a selected area on the moon's surface. Its multiple television camera payload was activated minutes before impact. Television signals were transmitted to Earth, and the final display showed the impact area in detail.

On June 1, 1966, Surveyor I made the first soft landing for a U.S. spacecraft, at a predetermined spot on the moon. During landing, touchdown dynamics and bearing strength of the moon's crust were measured. After landing, additional data of local surface conditions was collected while eye-level television cameras scanned the nearby landscape. More than 11,000 pictures were returned to Earth.

On August 10, 1966, Lunar Orbiter I was launched and on August 14 was placed in orbit around the moon, the first United States spacecraft to achieve this feat. The perilune (or low point) of the orbit was dropped from about 130 miles to 36 miles on August 21, in preparation for the main mission of site photography in nine different areas on the earth side of the moon's equatorial belt.

Prior to beginning site photography, the versatile spacecraft obtained the first high-resolution pictures of the far side of the moon and the first photographs of the Earth ever taken from lunar distance from an altitude of about 130 miles above the moon. Because of a problem in the high-resolution camera system, most of the high-resolution photos taken near the moon's surface were blurred. However, the medium-resolution photographs obtained by the other camera system exceeded the performance expected.

Five flight and three ground test Lunar Orbiters were ordered by N.A.S.A. and a contract with Boeing was signed in April, 1964. Each flight Orbiter is designed to take pictures of the moon in two forms; medium definition pictures covering large areas and high definition pictures of a small central portion of the same areas.

These high and medium-resolution photos, together with information from soft-landing Surveyor spacecraft, will help scientists select recommended landing sites for Project Apollo astronauts. A flat, stable, crater-free area at least 25ft square with a slope not more than seven degrees is needed for actual touchdown of the Lunar Module, but detailed topographic data should be available for a circular landing site about 7½ miles in diameter, now considered well within Apollo guidance and control capabilities. The Lunar Module will have some descent manoeuvre capability, but it will not be sufficient to hit a 25-foot-square bulls-eye. The moon-landing astronauts must possess detailed information about areas several miles wide, because the aiming point and the actual touchdown point could be thousands of yards apart.

The Lunar Orbiter photographic subsystem is perhaps the most complex instrument payload ever launched aboard a spacecraft. This self-contained photo-

Landing Site

graphic laboratory was designed and built by Eastman Kodak Company. The major elements of the photographic subsystem are two cameras, a film processor, and a readout system. Photographs are interlaced on a single 260ft strip of Kodak Special High Definition Aerial Film, SO-243, 70mm (2.75in) wide.

One camera employs a 24in telephoto lens to provide high resolution pictures of small areas of the lunar surface. The second camera employs an 80 millimeter wide-angle lens to provide moderate resolution coverage of large areas. The cameras are aimed so that the high-resolution photograph records the same area as found in the centre of the companion moderate-resolution photograph.

From a nominal altitude of 28 miles, the 24in lens allows detection of objects on the lunar surface three feet in size. The moderate-resolution camera provides detection of objects 25ft in size. One exposure through the wide angle lens can cover an area measuring about 20 by 24 miles, and the telephoto lens will show an 11 by three mile area, centred in the field of view. The cameras may each take 194 photographs.

The total coverage by the high-resolution camera, allowing for overlap between frames to provide continuous coverage is 4,000 square miles. The coverage capability of the moderate-resolution camera, allowing for overlapping coverage yielding stereo photography, is 20,000 square miles. These two exposures, constituting one "spacecraft frame," fill a strip of film 11.7 inches long.

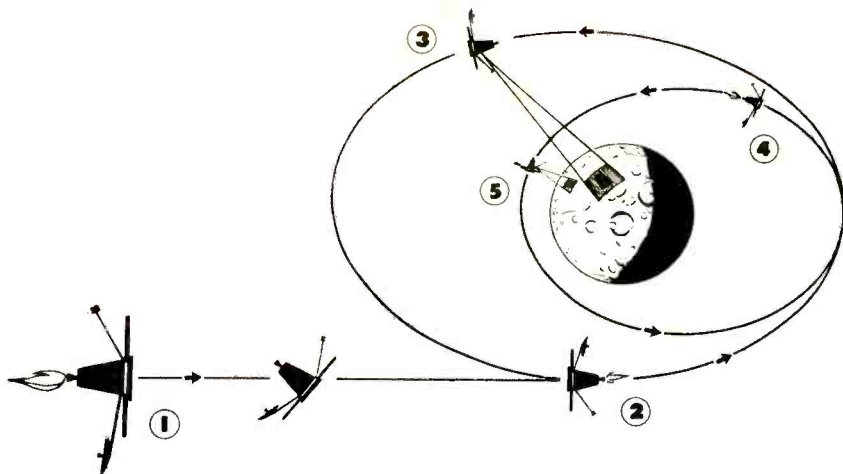
The 24-in camera uses a focal plane shutter and the three-inch camera a between-the-lens shutter. These are synchronised to operate simultaneously. Each camera employs a film platen which clamps the film and draws it flat during exposure by means of a pressure differential system.

The platens move during the exposure to reduce image blur, or smear, caused by the rapid movement of the spacecraft past the lunar surface. This image motion compensation (IMC) or platen movement is provided through a mechanical linkage by an electro mechanical device called a Velocity over Height (V/H) sensor.

The V/H sensor determines the ratio of spacecraft velocity (V) to spacecraft altitude (H) by optically locking on to an image of the lunar surface, computing the rate of angular motion of the vehicle over the reference, and translating this computation to mechanical motion for each of the camera platens. The sensor also provides a measurement of yaw of the spacecraft which can be employed to correct spacecraft attitude.

The cameras operate in response to commands to take sequences of 1, 4, 8 or 16 frame pairs. The interval between photographs depends on the V/H value and is nominally 2.2 or 8.8 seconds. Exposure times of 1/25, 1/50, or 1/100 second can also be selected by commands.

In a normal photographic sequence, the spacecraft is oriented for photography, the lenses are uncovered by opening a protective thermal door in



Major steps in the Orbiter flight. (1) Orbiter uses own rocket to make mid course manoeuvre. (2) Rocket used to decelerate spacecraft into elliptical orbit. (3) Takes preliminary pictures for relay to Earth. (4) Rocket fires to produce tighter elliptical orbit. (5) Takes main pictures from altitude of 28 miles.

the spacecraft, the V/H sensor is activated, and the camera turned on. After the "camera on" command the cameras operate in an automatic sequence to (1) clamp film on the platen and draw it flat by differential pressure, (2) start moving the platens in synchronism with the image motion, (3) open the shutters for simultaneous exposures, (4) return the platens to the rest position, (5) advance the film for the next exposure. This sequence is repeated until all photographs commanded are taken.

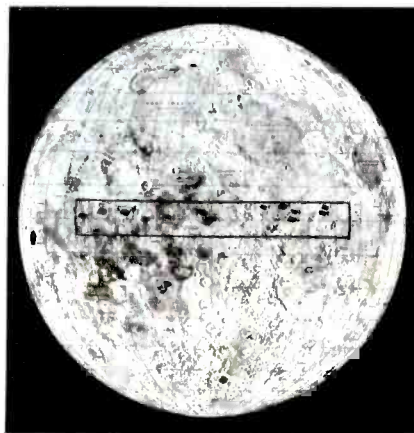
Film exiting from the camera is stored in the camera storage looper. This consists of a series of fixed rollers in a stationary carriage, and a series of rollers in a movable carriage which rides on a track. As film enters the looper, a spring causes the movable carriage to move away from the fixed carriage, providing a storage capacity for up to 20ft of film. This looper stores the film until it can be processed.

After the completion of photography, the photographic subsystem processor-dryer processes film from the camera storage looper at a rate of 2.4 inches per minute. The film is laminated to Kodak Bimat film, type SO-111, which accomplishes the processing. Kodak Bimat film is a product consisting of a normal film base, coated with a gelatin layer. This gelatin layer is presoaked with a special monobath processing solution. The solution both develops and fixes the photographic image during the 3.4 minutes the Bimat and film are in contact on the processing drum. Processing temperature is closely controlled to 85 degree F.

After processing, the Bimat and film are separated. The Bimat moves to a takeup spool and the film passes onto a dryer drum. The film is in contact with the dryer drum which is controlled to a temperature of 95 degree F for a period of 11.5 minutes. Moisture driven from the film by the heat of the dryer drum is absorbed by special chemical salts in pads around the dryer, thus maintaining a controlled humidity environment within the photo subsystem.

After leaving the dryer drum the film is transmitted through a readout storage looper, prior to being stored on a takeup spool. The readout storage looper is

Below. Black border shows main area of interest for Moon landings. Black patches are areas to be photographed by Lunar Orbiter II.



similar to the camera storage looper and provides the capacity for readout of up to 4 frame pairs at any time prior to the completion of the photographic and processing phases of the mission. These intermediate readout capabilities are provided to allow priority return of important data and to provide monitoring of system performance.

After being stored on the takeup spool the film is ready for the normal readout.

The readout section consists of an optical-mechanical scanner (OMS), and a flying spot light source.

During readout, film is clamped by the optical mechanical scanner. Scan in the one direction is by a high intensity spot of light generated by a special cathode ray tube (CRT) called a Line Scan Tube (LST). The flying spot is imaged on the film by a lens in the OMS. The OMS lens is mechanically moved slowly across the width of the film by a motor driven cam in a direction at right angles to the LST scan.

The combination of electro-optical and mechanical scan sweeps a "framelet" 0.1 inches by 2.25 inches long, the latter dimension being the useable width of the film. Each scan line is 0.1 inches

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long and there are 18,900 lines in the 2.25 inches.

The variation in light intensity as it passes through the negative film image is collected through an optical system and is converted to an electrical signal by a photomultiplier tube. Electronics associated with the photomultiplier tube process and amplify the signal thereby converting it to a television type video signal for transmission to Earth. After scanning across the film, the OMS moves the spacecraft film precisely 0.1 inch to allow scan of an adjacent framelet in a similar manner.

The video signals are sent to Earth by a communications subsystem. These signals are received on Earth at one of the Deep Space Instrumentation Facilities located at Woomera, Australia; Madrid, Spain; or Goldstone, California. Received signals are sent to ground reconstruction electronics (GRE) equipment supplied by Eastman Kodak Company. This equipment converts the video signal to a line scan on a cathode ray tube. The variations in light intensity on this cathode ray tube correspond to the variations in image density on the spacecraft film.

The line on the cathode ray tube is imaged onto slowly moving 35mm film and sweeps across the width of the film. The line on the cathode ray tube represents the 0.1 inch sweep made in the space craft, but is electronically enlarged 7.2 times. Thus each line is recorded on the 35mm film as just under $\frac{1}{4}$ in long, or about 18mm which is just short of the useful width (about 24mm) of the 35mm film. The 18,900 lines occupy an 18in length of the 35mm film.

The 35mm film is then processed and sent to Eastman Kodak Company in Rochester, New York. Special equipment has been built by Kodak for the reassembly of the photographic images from the 35mm film. This equipment prints the 35mm framelets adjacent to each other onto 9.5in film, with 14 framelets of the lunar scene side by side. Eleven of these "subframes" constitute a full spacecraft frame.

Each framelet takes a little over 20 seconds to transmit or a total of about 45 minutes for a full spacecraft frame consisting of 154 framelets. The total transmission time for the whole picture-taking project is expected to occupy 200 hours. Some pictures can be transmitted between picture-taking orbits, but most will be transmitted after the picture-taking phase has been completed.

The entire photographic mission will last about 35 days. Of this, about 17 days is required for photographic transmission to earth. Transmission can take place only when the orbit of the craft places it in plain view of the earth and its solar panels are illuminated by the sun.

Lunar Orbiter II carries a duplicate of the advanced power and communications systems which made the first moon-mapping mission such a success.

The special and unique systems were built by Radio Corporation of America's Astro-Electronics Division, Princeton, N.J., as a major subcontractor for The Boeing Company.

ENGINEERING PROBLEMS OF SATELLITE TV LINK

While the recent Australia-U.K. live television exchanges received quite prominent coverage in the daily press, many of the interesting technical sidelights were not mentioned.

Early planning for such a television exchange had been based on the idea of a three-stage signal path. The first stage was to have been via the "Early Bird" satellite to bring the signals from Britain to the Atlantic coast of U.S.A.; from there, the second leg was to have been overland, to the Pacific coast of the U.S.A.; the third and final stage would then have been via the Intelsat II Pacific area satellite, to Australia. This arrangement would have necessitated intermediate standards conversion, to the American standards of 525 lines 60 fields. Consequently, signals originated by the B.B.C. on the British standards were to be converted to the American standards by electronic conversion equipment, while the signals originated in Australia by the A.B.C. were to be generated by special 525 line equipment.

When, after launching, the satellite failed to take up its planned orbit, it was found that a direct signal exchange between Britain and Australia would be possible for part of its orbit period. Despite the omission of the overland section of the original planned route, for which the conversion to 525 line standards would be necessary, it was still most convenient to transmit and receive on the 525 line standards with the existing arrangements.

At the Australian end, signals received were first recorded on video tape. Conversion to local standards was achieved by scanning directly with 625 line equipment from the tube of a monitor. However, in the case of the B.B.C., which has previously been engaged in international television exchanges on numerous occasions, instantaneous conversion by means of special standards conversion equipment allowed the signals to go out live over both its 405 and 625 line systems.

Because of limitations in the receiving aerial at Carnarvon, the quality of pictures received in Australia were inferior to those shown in the U.K. The Carnarvon aerial was not intended for this type of service, having been designed for the U.S.A.'s Apollo (Man on the Moon) Project.

whereas the aerial at the U.K. terminal was a highly specialised type designed specifically for wide-band communication systems.

The Overseas Telecommunications Commission (Australia) which provided the transmission and reception facilities, and the A.B.C., which was responsible for programming arrangements, were both aware of the limitations as far as the Australian facilities were concerned, but decided that the opportunity to make the experiment should not be missed on this account.

The O.T.C. plans to build a station specially for wide band communications via satellite, at Moree, N.S.W. This is expected to be in operation in 1967. (See story, "Communications Satellite Scheme for the Pacific Area" in the October, 1966, issue of "ELECTRONICS Australia.")

The Intelsat organisation was not able to operate the satellite at full power during the experiment because of technical difficulties. In order to retain maximum video capability over the satellite path, and to ensure continuity of sound during the program exchange, it was decided to send the sound channel via conventional "surface" channels. This gave rise to a synchronisation problem because of the very much longer signal path travelled by the video signal component. Engineers calculated that the sound signals would arrive at the receiving terminals about 150 milliseconds before the video signals, so a 150 millisecond delay in transmission was achieved by means of a tape loop, with the recording and replay heads suitably spaced to allow the correct delay time.

The very narrow beam width used over the transmission paths necessitated extremely accurate tracking of the satellite at both ends. Although computers were used in Britain and Australia to control tracking, at one stage the video signal was lost for about 30 seconds because of tracking problems. It is not known whether the U.K. or the Australian end of the link was responsible for the loss of signal.

The two vital subsystems built by RCA provide electrical power for the unmanned spacecraft and transmit photographs and other data back to the Mission Control Center at Pasadena, California. RCA also built the equipment for ground and flight tests of the 850-pound spacecraft.

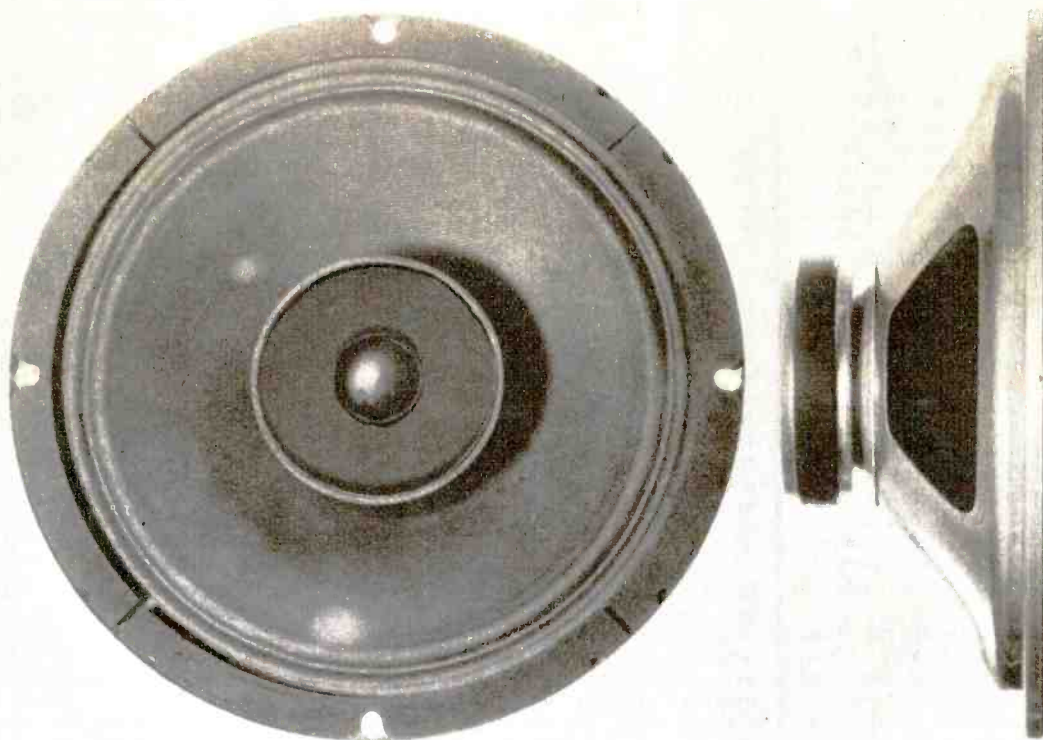
The RCA power system making all this possible during the prolonged period the spacecraft will orbit the moon consists of an array of nearly 11,000 solar cells that produce 375 watts of electrical power, and a 20-cell nickel cadmium storage battery.

The proper rate of charge for the

mission's maximum need while looking at the side of the moon farthest away from the sun — i.e., while photographs are not being taken but while the spacecraft is still in full sunlight — is maintained through a series of controls which "dump" excess power by means of a heat dissipating element attached outside the spacecraft.

Expected to remain in orbit for several months after completing its primary photographic mission, the power and communications will continue functioning in order to transmit radiation measurements, information on meteoroid bombardment and other scientific information.

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VM3Y

Written by one of the men behind the project, this story gives an insight into the problems of setting up a non-commercial transmitter to investigate technical aspects of FM and FM-stereo broadcasting in the UHF band — a matter of importance to the future of broadcasting in Australia.

by **Graham Ford**

Under a special experimental licence, issued by the Postmaster-General's Department in May 1965, the UHF FM transmitter VM3Y is now operating in Melbourne, on 55.4MHz. The practical experience which it will make possible, in transmitting and receiving FM signals on this unusually high frequency, may become a valuable pointer to technical requirements—if and when UHF FM broadcasting is established in Australia.

The transmitter is operating under the second such experimental licence to be issued in Australia, the first being held by Sydneysider, Raymond Allsop.

The Melbourne transmitter made something of an official debut when it was featured in a lecture and demonstration before the Institution of Radio and Electronic Engineers, at the Royal Melbourne Institute of Technology on October 11 last; the lecture was given by Mr Bruce Andrews.

The demonstration transmission was made from a 105ft tower, located in the Dandenong ranges, 25 miles from the heart of Melbourne. The transmitter used was a converted TACAN navigation beacon, which produced a clear signal, free from noise and interference.

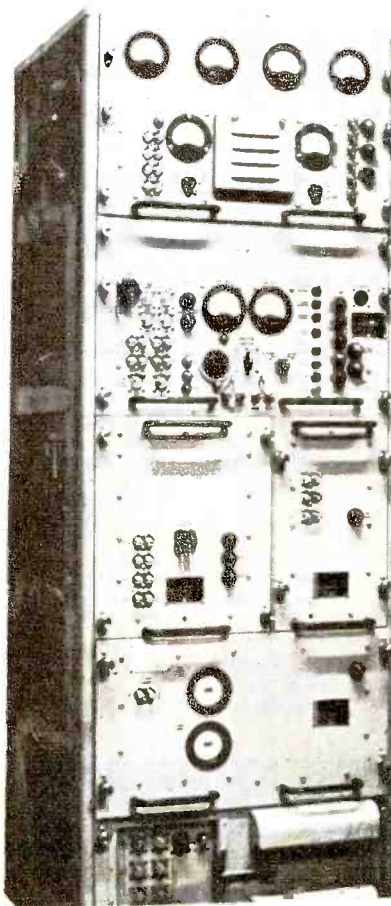
For those of us behind the project, Messrs Andrews, Lo and Ford (the author of this article) the lecture and demonstration came as the culmination of many months of spare-time work, motivated primarily by a strong personal interest in FM and FM-stereo. We formed ourselves into a small limited company—Matrix Laboratories—because of the magnitude of the project.

Upon receipt of advice that the application for an experimental licence had been successful, our thoughts naturally turned toward the choice of a transmitting site. Possible sites within the city or suburbs would have offered certain conveniences but limitations on antenna structures and propagation would have been inhibiting factors. Ultimately, the general area of the Dandenong ranges was selected, as offering the best likely coverage with the permitted amount of radiated power—500 watts.

The possibility of utilising one of the television towers on Mount Dandenong was not overlooked. However, we felt that, to operate an experimental system of this nature, access to the transmitter and antenna structure might be required at times which would be unsuitable to the owners of the television establishments. Feeder was another consideration; a run of several hundred feet of high quality co-axial cable, would be very expensive.

With these thoughts in mind, we decided to seek an independent site and

The transmitter hut and tower, high in the Dandenong ranges, near Melbourne—a pleasant bushland setting with a vocal commentary from parrots and kookaburras. Below, the VM3Y transmitter, reconstituted from an ex-disposals TACAN unit, now installed in the shack.



develop it from scratch. The site chosen was a block of land 60 x 213 feet in a bushland setting on Olinda. Advantages included: Height above sea level: 1,800ft. Power and telephone services available. Sealed road on the front boundary. Good access to the block itself.

After arranging purchase, members of the group had to attack certain obvious tasks:

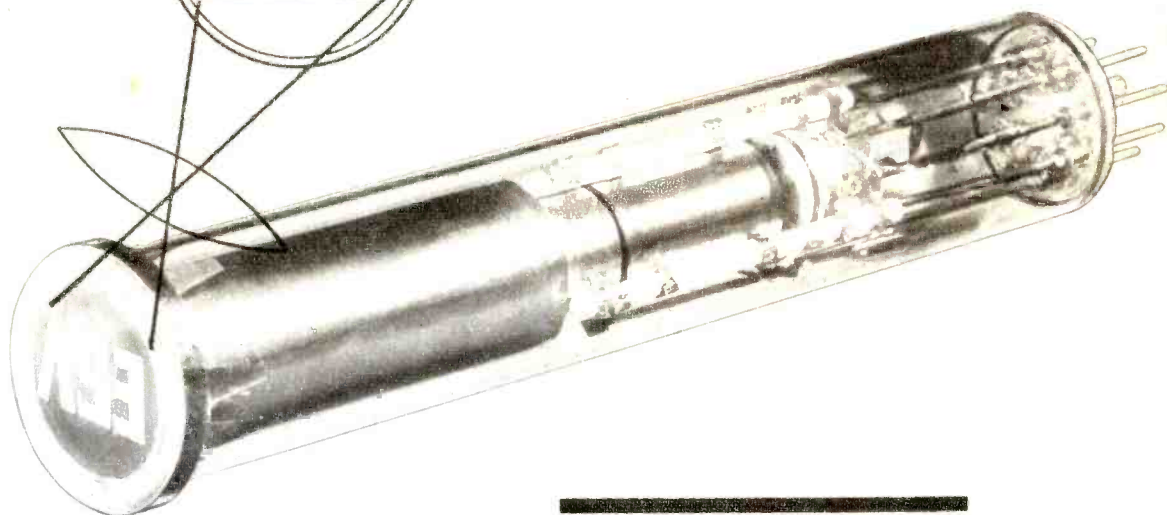
- Clear the land as necessary,
- Build a shack to house the transmitter.
- Prepare foundations for a tower and associated guying points.
- Construct a suitable transmitter.

It was calculated that, with a site elevation of 1,800ft above sea level, plus an additional 100ft of transmission tower, and an ERP of 500 watts, it should be possible to provide a suitable experimental signal over an area bounded by Geelong, through the city of Melbourne and suburbs, to the Mornington peninsula.

As we all had full-time positions in business elsewhere, and there was no likelihood of the project paying its way, we had to adopt the philosophy that, with steady work and the passage of time, the site would gradually take on a more respectable appearance. After several weekends of work, people who we did not know, began to arrive at the site to see what was happening and to offer practical assistance. Later, some of the visitors revealed themselves as enthusiasts, delighted to know someone was taking in interest in FM again.

It was decided to employ a simple design for the transmitter shack, by using wooden construction and with re-enforc-

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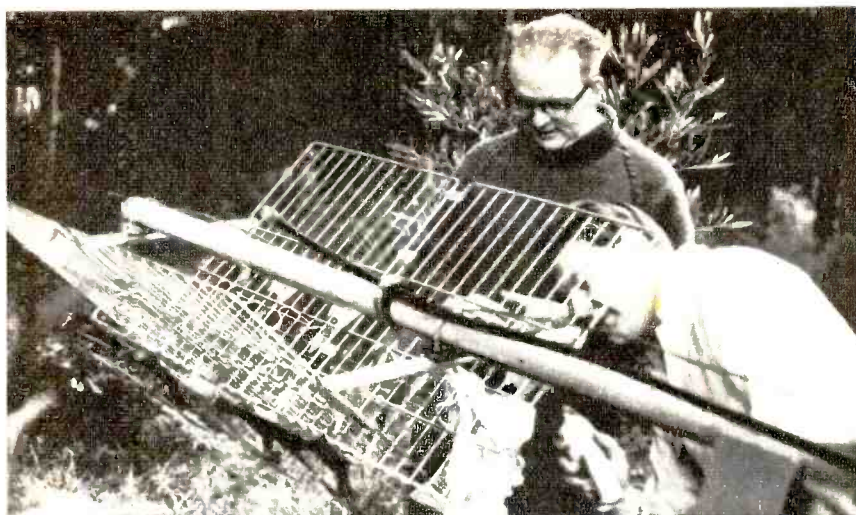
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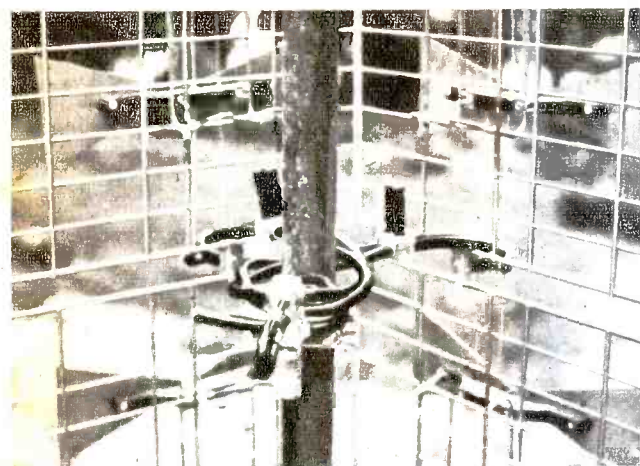
ing stumps under the flooring to support the weight of any heavy equipment. This type of construction was simple (an important consideration, as we had to build it); again, with careful workmanship, the hut could be reclaimed for private use, upon the cessation of the experimental transmissions.

In the specifications for the hut, provisions for weather extremes were considered, because the Dandenong ranges experience both severe summer and winter seasons. Reflecting foil, and 3in glass fibre insulation batts ensure some degree of protection from outside elements. An exhaust fan, thermostatically switched, attends to excess internal heat generated by the transmission equipment.

The interior of the hut was finished in a perforated board, behind which the insulating batts were placed. The treatment tended to attenuate any sound generated in the hut, an item worthy



Above: The bowtie antenna for VM3Y gets a final checkout before being hoisted aloft for the first experimental transmissions of FM in the UHF band. One of the major tasks ahead will be to clarify receiver techniques, the problems of UHF FM reception being quite different from UHF TV.



Left: The stub match and connecting harness for the VM3Y aerial, seen against a background of the reflector screens.

of attention, since it is possible that the hut may be used as a temporary studio from time to time.

The antenna was to be supported by a 100ft telescopic tower. Contact was made with the Hills Hoist people who generously donated a suitable tower "for the duration of the experiments." John Fitzpatrick from the Melbourne office gave a lot of very practical assistance.

There is no water laid on in the area—householders rely on rainwater stored in tanks for drinking purposes—so with each load of cement and screenings came five or six jerrycans of water for the mix. Natural granite rock chips conveniently outcropping on the land were used as fill for the tower base and guy points.

The width of the land ruled out a normal 3-guy system. To create an artificial fourth point on a 3-sided tower, a novel bridle was evolved. The bridle system consisted of a steel cable yoke between two of the three upright tower members. The fourth guy connected to the middle of the yoke. At the top of the tower, a few additional feet of height was obtained by fitting a galvanised steel pipe section, stabilised by a 4-point crown for the final set of guys.

As the construction work proceeded on the site, so did the efforts on the transmitter. The task of building a transmitter to meet specifications laid down by the P.M.G. was proving to be a challenging job.

One Saturday morning while searching through a war disposal store in the city, we discovered a beautifully made co-axial cavity capable of being tuned

to 550MHz. A search at the rear of the store revealed a complete TACAN navigational beacon transceiver. It was complete with power supplies, cavities and master control switcher. All valves were intact. It had just come into the store through government disposals a few hours before we came into the shop!

A thorough examination of the unit was made and, although a lot of work would obviously be involved, it could be converted to an FM transmitter capable of operating at 554MHz. After the usual haggling, we became the owners of

the system — two tons of metal racks, some lengths of cable and a huge 6ft high fibreglass drum containing a rotating aerial.

A truck was hired to remove the gear from the store to a private residence in Melbourne. With this wonderful piece of luck, the future of VM3Y now seemed assured.

In the conversion of the equipment, it was decided to utilise one of the racks containing the blower assembly and high voltage supply. Mountings for the other chassis already existed but some alterations would be necessary. Further slider mounts for the cavity chassis and master switcher were needed. As the metalwork of the rack was one-eighth steel channel, an oxy-acetylene torch had to be used to cut away surplus metalwork and rework the additional mountings!

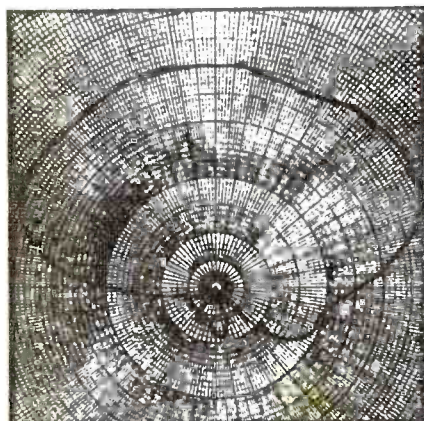
To take advantage of the interlocks and safety protective circuits, over 300 wires had to be re-routed from the main tag block. A regulated filament supply was added in the master control switcher.

The exciter section consists of a master oscillator frequency modulated by an audio signal and controlled in average frequency by an AFC system. This is followed by a buffer amplifier and frequency doubler. The generating frequency is 46.16667MHz doubling to 92.33333MHz, this being the output of the exciter chassis. Deviation of the master oscillator is one twelfth of the deviation of the final frequency, or 6.25KHz.

The AFC system consists of a crystal reference oscillator, frequency 46.29667-MHz, an RF mixer stage, squaring amplifier, a square wave amplifier, and a "bucket" pulse counter.

This is followed by a solid state DC amplifier and a voltage dependant capacitive diode, included in the oscillating circuit. The AFC system is coupled into the frequency multiplier chain, immediately after the buffer amplifier. The controlling method of the AFC system is as follows:

Assuming an increase in frequency of the modulated oscillator, the output of the mixer will be a frequency, reduced



The antenna radiation pattern developed by the bowtie transmitting antenna. It puts a good signal over Melbourne city, suburbs and adjacent areas.

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QV08-200	600	150	1.5	240
QV2-250C	2000	100	1.5	300
QY3-65	3000	15	1.0	130
QY3-125	3000	23	1.0	228
QY4-250	4000	50	1.0	454
YL1150	600	100	1.0	109

More detailed information on these valve types may be found in the Mullard Technical Handbook, Volume 3.

The following types are used extensively in SSB transceivers of American manufacture and are now available from Mullard for maintenance purposes—

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YL1150



QV2-250C

from the nominal 130KHz (high side-local oscillator). This reduced frequency signal is shaped by the following two amplifiers into a constant amplitude square wave. This square wave is differentiated and the output pulses counted, to produce an output voltage more positive than previously. This small positive increment is amplified through a high-gain DC amplifier and fed back to a frequency controlling capacitive diode. The phasing is such as to cause the oscillator frequency to reduce.

For a 1Hz original drift, the circuit will endeavour to correct 100Hz in the opposite direction. This action reduces any drift either positive or negative by a factor of 100.

The controlling signal from the AFC chassis is filtered against 50Hz hum and has a long time constant, sufficient to prevent the AFC system from following low frequency modulation signals.

Examination of the cavity chassis of the TACAN unit showed that the frequency multiplication chain could be used almost as it was.

The original functions of the three cavities were: tripler-doubler-doubler. This was modified to: tripler-doubler-amplifier in that order. In its original operation, the final cavity was used as a frequency doubler, converting 550MHz \pm 70MHz to 1100MHz \pm 140MHz. The input of this cavity was a three-quarter wavelength tuned line, in a grounded grid configuration.

The output cavity was also tuned to a three-quarter wavelength. Physically the output was coupled from the first quarter wave point with the anode operating at the third quarter wavelength point. Converting the cavity to a grounded grid amplifier involved the changing of the output cavity to a quarter wave resonator at 554MHz and shortening the tuned length of the cavity by approximately 30 per cent. The pickup probe was moved to a new coupling point right over the anode. Longer tuning bars were made to reach the annular shorting plate in its new position. Finally the cavity was silver plated.

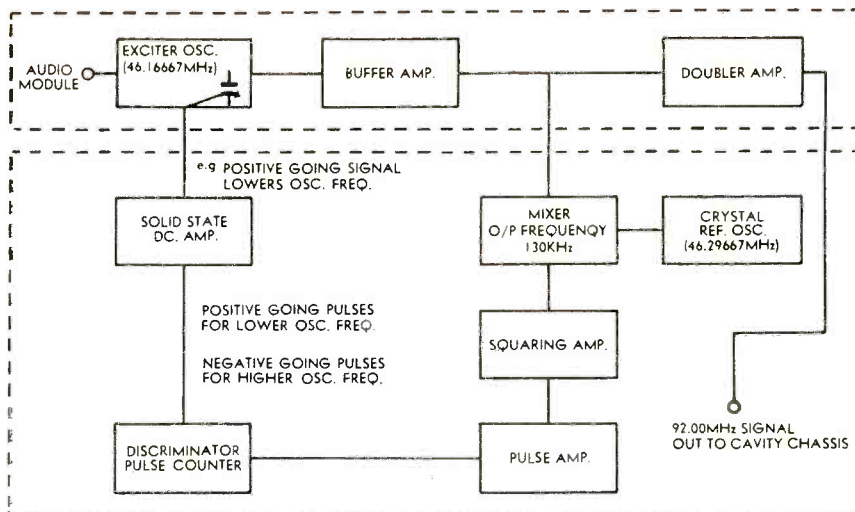
The original cavity blower was designed for pulsed operation and was completely unsuitable for CW duty. After much experimentation with such devices as household cleaners and squirrel cage blowers, all unsuitable, a blacksmith's forge blower, driven by a quarter horsepower electric motor, was obtained. This blower provided enough air, at 13 inches of water pressure, to keep the tubes located within the cavities cool.

When the transmitter was installed in the shack, the blower, complete with air filters, was mounted beneath the floor to eliminate mechanical noise. Connection of the air supply was by flexible plastic hose.

Initial tests of the transmitter, apart from dummy load, utilised a modified radio altimeter cut to 554MHz with a driven director. It was a simple but effective approach. We realised that, in due course, a more refined antenna would need to be designed.

About the time of the early testing, some representatives of the New South Wales E.R.D.A. technical committee on FM came down to have a look at our progress. After some discussion we inquired if E.R.D.A. could help in the design and fabrication of a suitable antenna to replace the little radio altimeter.

Performances figures were specified



Block schematic of the transmitter AFC system. The signal passing through the multiplier chain is compared with a reference oscillator and any difference converted to a DC control voltage.

SPECIAL EXPERIMENTAL LICENCE No. H2048

Special Conditions:

- The grant of this licence does not imply that the Government intends to introduce broadcasting services in the U.H.F. band in the future, or mean that the licensee, Matrix Laboratories, would receive priority of treatment if it is decided at any time to authorise such services.
- The experimental transmissions shall not include any advertising matter and shall not simulate in any form a broadcasting service.
- Prior notice of the date, time, duration and nature of each transmission shall be notified to the Postmaster-General's Department.
- Receiving equipment used in connection with the experiments at locations other than at the site of the transmitter shall be operated by or on behalf of the licensee and covered by a Special Licence issued in respect of each such location.
- Announcements transmitted by the station shall be limited to the call sign which shall be announced at the beginning and end of all transmissions and at 30 minute intervals on the hour and half hour.
- Radiation shall be confined to within $\pm 100\text{Kc/s}$ of the assigned frequency of 554Mc/s and the frequency of the emissions shall be maintained to within ± 0.002 per cent of 554 Mc/s.
- Operation of the station shall not cause interference to the reception of any other radio station.
- The assigned frequency (554 Mc/s) may be shared on a time basis with other stations which may be licensed to conduct similar experiments.

and, some weeks later, through the delivery system came a bow-tie antenna. It consisted of two bays of four stacked bow-ties mounted at right angles to a reflector screen. Some final critical adjustments were necessary to the matching, before the antenna was hoisted aloft. Final performance figures were as follows:

PATTERN: 167° — 3dB points.

GAIN: 6dB.

V.S.W.R.: 1.05.

With the E.R.P. of 500 watts and a convenient transmitter operating power of 250 watts, the antenna gain of 6dB exactly made up for the 3dB loss of the Heliex feeder line.

The purpose of the transmissions will be to develop practical knowledge of the behaviour of FM signals in the UHF band. Questions to be investigated include:

- What is the most suitable form of modulation and polarisation of signal to obtain the best possible coverage.
- Deviation of signal.
- Pre-emphasis of signal.
- Stereo systems for broadcasting.
- Power considerations.

AUTHOR'S ACKNOWLEDGEMENTS:

To Lilydale Shire Council for their co-operation.

To the technical staff of the Australian Broadcasting Control Board for advice and assistance.

To the following for practical help with the project: Simon Gray Pty. Ltd., Ampex Aust. Pty. Ltd., Hills Hoists Pty. Ltd., Cyclo Engineering, Sample Electronics (Vic.) Pty. Ltd., Fairchild Aust. Pty. Ltd., the E.R.D.A. technical committee on FM, Prof R. Huey, Univ. of N.S.W., Ferris Ind. Ltd.

EDITOR'S COMMENT: The terms of the licence emphasise the experimental nature of the licence issued for VM3Y and, in particular, appear to restrict the use of receivers to the licensee, or to parties operating on his behalf. In any case, a special receiving licence is required. Neither the P.M.G. Department nor the licensee of the transmitter assumes any responsibility for providing a continuity of signal or service, and any equipment built to receive the transmissions may become redundant upon cessation of the experiments. Note also the requirement that the program does not simulate a broadcast service.

*** MODEL X-100D SOLID-STATE STEREO PLUS CROSS-FIELD HEAD CUSTOM DECK**

TAPE SPEED: 1½, 3¾, 7½ and 15 ips optional **WOW AND FLUTTER:** (PLAYBACK ONLY) Less than 0.15% RMS at 7½ ips Less than 0.25% RMS at 3¾ ips Less than 9.35% RMS at 1½ ips **FREQUENCY RESPONSE:** 30 to 23,000 cps ±3 db at 7½ ips 30 to 18,000 cps ±3 db at 3¾ ips 30 to 9,000 cps ±3 db at 1½ ips **SIGNAL TO NOISE RATIO:** Better than 45 db **OUTPUT LEVEL:** 0 VU (1.23V RMS) **RECORDING LEVEL INDICATOR:** VU meter x2 **RECORDING SYSTEM:** 4 track stereo monaural, CROSS-FIELD bias system **MAXIMUM REEL SIZE:** 7" reel **TRANSISTOR:** Transistor x11 Diode x2 Rectifier x2 **POWER SUPPLY:** AC 100 to 240V, 50-60 cycles **POWER CONSUMPTION:** 55W **DIMENSIONS:** 13½" H x 13½" W x 9" D **WEIGHT:** 30 lbs.

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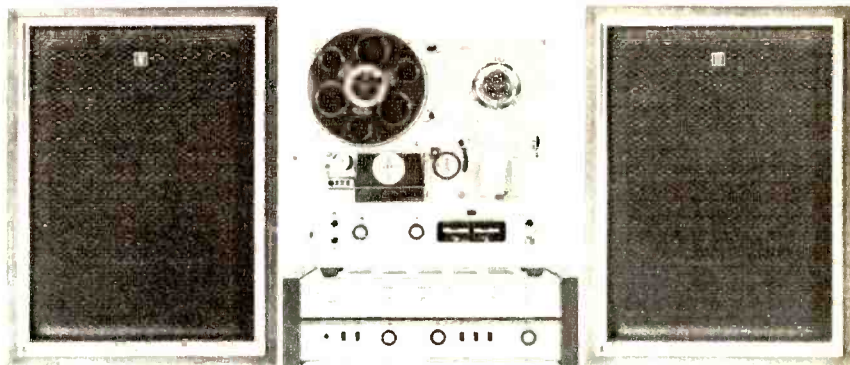
*** SPEAKER SYSTEM SW-130**
Speaker: 12" Woofer and 3½" Tweeter Impedance: 8 ohms Max. power input: 25W Frequency response: 50~18,000 cps. Dimensions: 16½" W x 11½" H x 12¾" D Weight: 28.9 lbs (piece)

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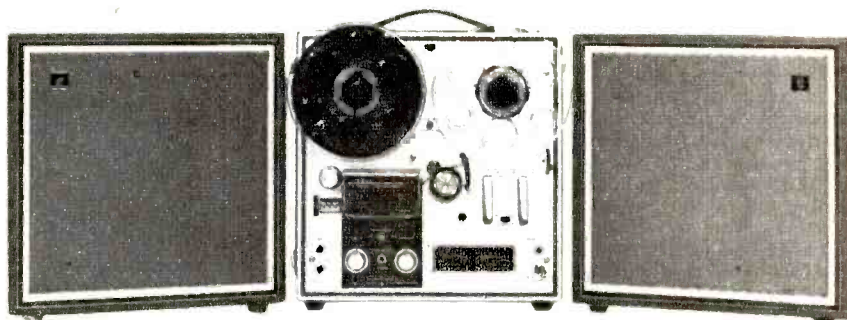
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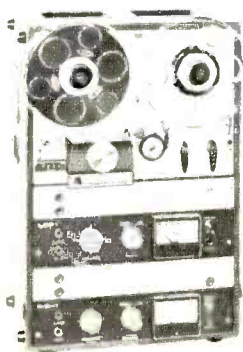
MODEL X-100D
MODEL AA-5000

SW-130



MODEL 1710

SS-30



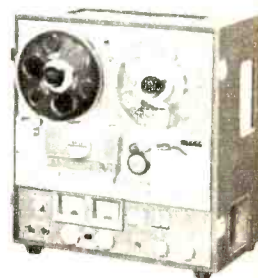
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A revolutionary type of HF radio communications aerial, designed and developed in Australia by Standard Telephones and Cables Pty. Ltd., is certain to play a major part in Australia's future defence requirements.

The new aerial, known as a "rotatable, high frequency, high power, log periodic type" is ideal for long-range communications with moving stations such as aircraft and ships, operating over a wide band of frequencies.

The aerial was perfected at the STC Liverpool plant, and occupies a space of about 450 square yards (approximately 1/30th of the area needed for the older rhombic aerial now in wide use).

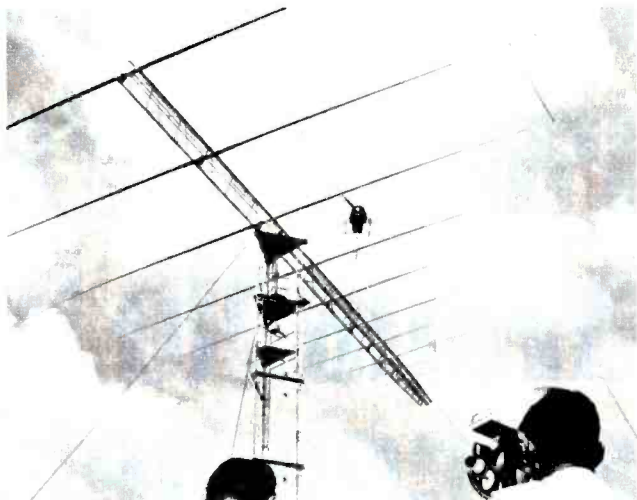
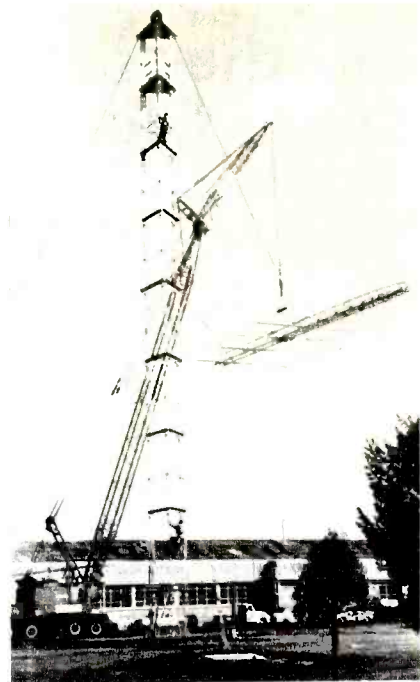
Designed to cover the HF band from 4 to 30MHz, the longest elements measure 86ft, the shortest 6ft, and the boom 84ft. The longest elements, which operate at the lowest frequency, have an electrical length of 123ft, the reduction in physical length being achieved by means of capacitive end loading.

The central boom is pivoted on its point of balance and is capable of continuous rotation in either direction. It is driven by a remotely controlled electro-mechanical system and remote

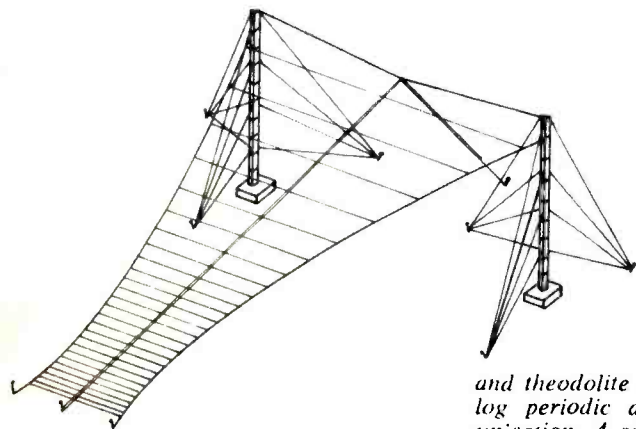
The total weight of the aerial is 7,000lb including the tower, the rotating boom for the aerial elements and the radiating spars. It is constructed entirely from magnesium silicon aluminium alloy, which is highly corrosion resistant, and no protective finish of any kind is necessary. The makers advise that their aerials have been successfully installed in localities of extremely high corrosion, including one in the vicinity of a tidal swamp on a tropical island north of Australia.

Although similar directional aeralis have been made in several overseas countries, STC claims it has been able to produce its new aerial at a lower cost than any other comparable one.

The aerial can be trained on any re-



Top: The rotatable aerial is lifted into position on a 100ft tower at the STC Liverpool plant. It can be assembled without a crane. Above: Checking the field strength pattern with the aid of a helicopter. A sextant and theodolite check the helicopter's position. At left: One of the fixed log periodic aeralis designed for permanent point to point communication. A second fixed type is also available.



indication of the aerial azimuth is provided.

It is designed to handle radiated power up to 40KW PEP, and has a gain of approximately 10dB at 4MHz, rising to 14dB at 12MHz and maintaining this figure to 30MHz. The VSWR is better than 2 at 4MHz.

Important for defence and export purposes, the new aerial is easily transportable, being capable of division into man-pack loads and pre-assembled sections. Seven men can assemble and erect it in three days without special tools.

Two complete aeralis, including the 104ft supporting tower and guying systems can be loaded on one semi-trailer. It is also designed to be carried by transport aircraft (none of the sections is more than 20ft long) and can be erected completely by helicopter in difficult locations without any mechanical aids.

ceiving point. If the object is moving, such as an aircraft or a ship, the aerial can follow it, operating as it travels. Designed to operate with maximum efficiency as a transmitting aerial, it naturally performs just as effectively as a receiving aerial.

The aerial has particular benefits in long-range communications. Bases wishing to contact ships or aircraft can change from one direction to another as they wish.

For defence purposes, the navy, air force, and the Department of Supply have already shown great interest in the new aerial. The Department of Civil Aviation and the army are also interested.

These authorities may have to keep in touch with a large number of bases in different directions, or with a distant station which is moving. The rotatable

aerial or an aerial farm is the only answer.

Aerial farms occupy as much as, and in some cases more than one square mile of land. Usually, these farms have eight separate rhombic shaped aeralis facing outwards so that each points in a different direction.

Each of the rhombic aeralis covers 45 degrees of the compass and, together, they give penetration for considerable range in all directions. But this is an elaborate and costly business. Besides the expensive real estate values incurred, a square mile of level land must be found and cleared, and eight aeralis erected involving many months of work, as well as the basic materials cost of the eight aeralis.

With the rapid spread of urban development in all Australian cities, and the subsequent increase in real estate

(Continued on Page 18).

Another first to **Miniwatt**
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Recent additions to the **Miniwatt**
range coupled with Australian
manufacture offers you

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range of Zener Diodes
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5% TOLERANCE

VOLTAGE	400mW (a) 25°C ambient	1.5W (a) 25°C ambient	8.5W (a) 25°C ambient Rth (j-a) = 15°C/W	15W (a) 25°C ambient Rth (j-a) = 10°C/W	50W (a) 100°C Tc
3.3	BZY88/C3V3				
3.6	BZY88/C3V6				
3.9	BZY88/C3V9				
4.3	BZY88/C4V3				
4.7	BZY88/C4V7	BZY96/C4V7			
5.1	BZY88/C5V1	BZY96/C5V1			
5.6	BZY88/C5V6	BZY96/C5V6	BZZ14		
6.2	BZY88/C6V2	BZY96/C6V2	BZZ15	BZY93/C6V2	
6.8	BZY88/C6V8	BZY96/C6V8	BZZ16	BZY93/C6V8	
7.5	BZY88/C7V5	BZY96/C7V5	BZZ17	BZY93/C7V5	
8.2	BZY88/C8V2	BZY96/C8V2	BZZ18	BZY93/C8V2	
9.1	BZY88/C9V1	BZY96/C9V1	BZZ19	BZY93/C9V1	
10	BZY94/C10	BZY95/C10	BZZ20	BZY93/C10	*BZY91/C10
11	BZY94/C11	BZY95/C11	BZZ21	BZY93/C11	*BZY91/C11
12	BZY94/C12	BZY95/C12	BZZ22	BZY93/C12	*BZY91/C12
13	BZY94/C13	BZY95/C13	BZZ23	BZY93/C13	*BZY91/C13
15	BZY94/C15	BZY95/C15	BZZ24	BZY93/C15	*BZY91/C15
16	BZY94/C16	BZY95/C16	BZZ25	BZY93/C16	*BZY91/C16
18	BZY94/C18	BZY95/C18	BZZ26	BZY93/C18	*BZY91/C18
20	BZY94/C20	BZY95/C20	BZZ27	BZY93/C20	*BZY91/C20
22	BZY94/C22	BZY95/C22	BZZ28	BZY93/C22	*BZY91/C22
24	BZY94/C24	BZY95/C24	BZZ29	BZY93/C24	*BZY91/C24
27	BZY94/C27	BZY95/C27		BZY93/C27	*BZY91/C27
30	BZY94/C30	BZY95/C30		BZY93/C30	*BZY91/C30
33	BZY94/C33	BZY95/C33		BZY93/C33	*BZY91/C33
36	BZY94/C36	BZY95/C36		BZY93/C36	*BZY91/C36
39	BZY94/C39	BZY95/C39		BZY93/C39	*BZY91/C39
43	BZY94/C43	BZY95/C43		BZY93/C43	*BZY91/C43
47	BZY94/C47	BZY95/C47		BZY93/C47	*BZY91/C47
51	BZY94/C51	BZY95/C51		BZY93/C51	*BZY91/C51
56	BZY94/C56	BZY95/C56		BZY93/C56	*BZY91/C56
62	BZY94/C62	BZY95/C62		BZY93/C62	*BZY91/C62
68	BZY94/C68	BZY95/C68		BZY93/C68	*BZY91/C68
75	BZY94/C75	BZY95/C75		BZY93/C75	*BZY91/C75
CASE				<p>* Also available in reverse polarity.</p> 	
	D07	D01	D04	D05	

ANCIENT ART MAKES MODERN CORES



No, it is not a picture from a science fiction movie. It is a genuine picture of an ant towering above a group of experimental computer memory cores comparable in size with grains of sand.

Scientists of International Business Machines Corporation have shrunk the size of computer memory cores—tiny doughnuts of magnetic material — to an almost invisible size by using the ancient art of the candlemaker.

The magnetic core is the basic storage element used in the main memory of most modern digital computers. Information can be stored or read from the main core storage in less than a millionth of a second. It is the speed of core storage which makes it so attractive for use in computers.

The core memory is considered the internal memory of the machine. Information, from tapes, discs, or cards is transferred into this memory for processing. Here, the data can be processed at high speed. As a result, as the size of the core memory is increased, it becomes possible to process larger and larger blocks of information, with a resultant decrease in the overall processing time.

A main memory of cores is assembled by threading the cores with wires. When two wires passing through a core are energised, a magnetic field is set up in the core, in either a clockwise or counterclockwise direction depending upon the direction of the pulses. Thus the core can be switched from one state to another, representing either a "one" or "zero", or a "yes" or "no", the basic vocabulary of the digital computer.

Reducing the size of the memory cores permits increasing the capacity of the computer memory. Over the years the size of the units have shrunk to where today millions can be assembled in a single computer.

However, as the size shrinks, it becomes increasingly difficult to form the magnetic doughnuts in a pressing operation, the commonly used technique. The new experimental cores, just a little larger than a human hair, would be virtually impossible to form in a pressing operation.

I.B.M. scientists found that they could be formed easily by using the ancient art of the candlemaker. In fact, the relative size of the hole in the core could be expanded. The fabrication process starts with the hole — a "wick" of nylon. In a continuous operation, a long filament of nylon is passed through a bath of varnish and magnetic powder. The magnetic "taper" then passes through a drying oven and is recycled until the desired thickness is built-up. In a similar operation, a covering of non-magnetic material is added for strength.

The magnetic taper is then cut into sections which are frozen in a block of wax. At this point the nylon filaments are withdrawn, leaving hollow tubes of magnetic ferrite material. The wax block is then sliced on a precision milling machine. In a single slice, hundreds of thousands of cores can be cut from the tapers. The slices are then fired in an oven, vaporising the wax and sintering the magnetic material.

The experimental cores contain an inner shell of magnetic ferrite and an outer supporting shell of non magnetic ferrite.

The outer supporting shell permits the inner magnetic shell to be much thinner than if the core were made of solid magnetic material. As a result, the ratio of the diameter of the hole to the ring of magnetic material is very small, 1.36, and the cores can be switched with very little power. The overall diameter of the core is 7.5 thousandths of an inch and the diameter of the hole is 4.5 thousandths of an inch. ■

Aerials—cont.

values, communications agencies have to make the decision of either retaining the land for old established aerial farms or realising on it. At least one major station in Australia will have to move within two years because of urban development.

Many radio communication paths call for similar aerials but for operation to a fixed, distant, station. STC have designed and developed further aerials of the high-power log-periodic type which are fixed during erection to operate in one direction. These have a frequency range from 2 to 30MHz.

One of these is illustrated by a line drawing on the previous page. It is a horizontally polarised aerial and, although larger than the rotatable type, it is still relatively economical in regard to the land area it occupies. It measures approximately 200ft for the longest element, 240ft along the boom, and is supported by two towers 144ft high. A third tower, at the apex, measures only 6ft high.

Another design is for a vertically polarised, low angle log periodic aerial, which is physically fixed but electrically steerable. This consists of four aerial arrays radiating at 90 degree intervals from a central 144ft mast. Each arm is 330ft long and is terminated on a 42ft mast. The active elements, following the classic log periodic dimensions, are supported vertically between cables strung between the central mast and the four peripheral masts.

A most valuable feature of the vertical aerial is its extremely low angle of radiation, making possible long one-skip circuits.

These designs are unique because the fixed log-periodic aerials vastly reduce the ground area (hence the cost) by comparison with the older rhombic aerial.

A typical application for the fixed versions of the aerials exists in the Antarctic where the Department of External Affairs maintains communications with mainland Australia and New Zealand, and the Department recently placed an order for several of these.

Because of the limited power supply available at Antarctic bases, the most efficient aerial system must be employed. The older type rhombic aerial system depends for its efficiency on the presence of a good conductive ground beneath the aerial. But the ground at Wilkes and Mawson and other such bases is dry and non-conductive, and it is here that the new log periodic aerial can be employed to provide a marked increase in efficiency.

The aerial will withstand winds in excess of 150mph.

On the export side, the company has already received inquiries from Ethiopia, Portugal, Spain, Japan, Britain, the United States, New Zealand, Africa and Argentina.

REFERENCE

Proc. I.R.E.E. Vol. 27, No. 2, February 1966, "Radiation Patterns of a Horizontally Polarised Log Periodic Antenna Over Ground," by Dr R. F. J. Guertler. ■

THE NEW COSMOS SW-30C STEREO AMPLIFIER

With 8 watts R.M.S. or 15 watts I.H.F.M. in each channel... push pull 6BM8's... and a wide frequency response of up to 20 kHz; this budget priced stereo amplifier has many attractive and functional features. Speaker matching is 4, 8 or 15 ohms. Pick-up sensitivity is 5 mV, a headphone jack is provided together with all controls for necessary flexibility. Encel price **\$69.50**

NEW KELLY 15" WOOFER SPEAKER (MK. VII)

Rated at 50 watts, the frequency response of this new bass reproducer is 30-5000 Hz. total flux is 350,000 maxwells. Recommended cross-over frequency is 2500 Hz. (The Kelly Cross-over costs \$11). The Mk. VII uses a laminated aluminium former with the voice coil embedded in polyester resin... the metal core acts as a heat sink allowing larger power outputs than normal. Guitar models also available at the same price. **\$55**

NEW MODEL KELLY MK. V 12" BASS SPEAKER

This new 12" bass reproducer has a basic resonance of 25 c/s and total flux of 250,000 maxwells. A new magnet assembly is a major feature... frequency response is 30-5000 Hz. Power rating is 35 watts... use being made of a new type laminated former with the voice coil actually embedded in polyester resin, allowing greater power outputs. Transient peaks of 100 watts will not damage the assembly. Price **\$45**

THE MK.II KELLY RIBBON TWEETER

Regarded as the most effective and advanced tweeter available for domestic speaker systems, the Kelly Mk. II is priced at only \$39. The use of the Acoustic Lens to disperse high frequencies is recommended for improved performance. **\$39**

KELLY ACOUSTIC LENS

Designed for use with the Kelly Mk. II Ribbon Tweeter the Acoustic Lens effectively disperses H.F. radiation. Up to 15 kHz the sound pattern is constant to within 3 db. over a 150 degree angle; at 20 kHz dispersion is maintained within the same limits over 135 degrees. **\$12.50**

WHAT IS AN EMQ?

Many Encel prices cannot be advertised because of trade agreements... so we invite you to write for an EMQ... an Encel Mail Quote. When requesting prices on amplifiers and tape recorders, please give some specifications. Combinations of many components are possible... just tell us of your requirements. Please supply your full name and address printed in BLOCK LETTERS.



THE NEW ENCEL CSM-40 M.F.B. STEREO AMPLIFIER!

The remarkable new Encel CSM-40 offers more features, more performance, more value... similar units are usually twice the Encel price. Output is over 15 watts RMS (over 35 watts I.H.F.M.) in each channel, frequency response is 20-40,000 Hz, input sensitivities are as low as 1.5 mV. Loudness control, rumble filter, scratch filter, separate bass and treble controls, tape monitor, headset jack, motion feedback control and circuitry, substantial grain-oriented output transformers... all are standard on the Encel CSM-40. The balance meter may be switched in and out of circuit... the filaments of the pre-amplifier are DC... the output of cartridges such as the ADC 10E and 4E will load the CSM-40 and provide excellent results. Above all, this stereo amplifier is most satisfying to sit and listen to... see and hear the CSM-40 at Encel Stereo Centres in Melbourne and Sydney. Mail orders will be care-packed and freighted anywhere. Encel price is only **\$129** **\$64/10/-**



THE TRUVOX TSA-100 SOLID STATE STEREO AMPLIFIER

One of the most expensive and a top seller in the competitive U.K. market, the TSA-100 offers flexibility and simplicity of control, an output of 10 watts R.M.S. in each channel, pick-up sensitivity as low as 3.5 mV and inputs for tape recorders, tuners, pick-ups (magnetic and ceramic/crystal) and auxiliary equipment. At full output frequency response is 20-20,000 Hz, plus or minus 1 db. Encel price is only \$156. This amplifier was priced at \$270 until recently... and Encel Electronics made the change! See the review in the "Gramophone" **\$156**

TRUVOX R44 SEMI-PROFESSIONAL RECORDER

A brilliant new fully transistorised recorder for 240V AC operation. All controls interlock, VU meter provides positive indication of recording level. Three speeds, 7 1/2-3 1/2-1 1/2 i.p.s. Takes 7" spools. Frequency response is 40-15,000 Hz, plus or minus 3db. at 7 1/2 i.p.s. Signal to noise is better than 46 db. Output is conservatively rated at 3 watts R.M.S. (6 watts peak) into a 15 ohm load. Wow and flutter is less than 0.15% at 7 1/2 i.p.s. Independent microphone and radio/pick-up controls are standard—full mixing is hereby simplified. Eleven transistors and two rectifiers. Encel price **\$135**



TRUVOX STEREO TAPE UNITS MODELS PD 102 and PD 104

With four independent pre-amplifiers, complete mono and stereo monitoring facilities are provided on the new TRUVOX PD-102 and PD-104. Twin VU meters, Mixing buttons for sound on sound, Separate solid state record and playback amplifiers. Three motors, including pabst drive motor, three speeds. Sensitivities match any ancillary equipment of any make. Frequency response — 30-17,000 Hz at 7 1/2 i.p.s. — plus or minus 2 db. Signal to noise is better than 50 db. Input sens. are Microphone — 1 mV at 50k ohms, Radio Tuner or Pick-up—50 mV at 100k ohms.

A recent British technical review says "At last we have an all British recorder which equals the best Continental and Scandinavian products in accurate equalisation and wide frequency response, and which at the same time gives that subtle subjective satisfaction and impression of smoothness and effortless dynamic range which is so difficult to define and measure."

Write for complete specifications and copies of reviews; both the PD 102 (2 track) and PD 104 (4 track) are now in stock PD102 \$246. PE104 **\$236**

TRUVOX R102 (\$226) AND R104 (\$236)

TWO AND FOUR TRACK MONO RECORDERS

Featuring three heads, three motors and three speeds, the Models R 102 and R 104 have been very favourably reviewed overseas. Frequency response at 7 1/2 i.p.s. is 30-17,000 Hz., plus or minus 2 db. Separate record and play-back amplifiers. VU meter. Write for complete specifications **\$236** and copies of reviews — R-104

CONNOISSEUR

CRAFTSMAN III TURNTABLE

Perfection in a precision 3 speed transcription turntable is the only way to describe the Craftsman III. Fitted with a 12" non-ferrous lathe turned turntable and a hysteresis synchronous motor... and a built-in illuminated stroboscope. Speed variation of 8% may be made. See the reviews in "Gramophone" and "Hi-Fi News". Encel price **\$67.50**

CRAFTSMAN II TURNTABLE

Very popular overseas, the Craftsman II features two fixed speeds and a full 12in lathe-turned non-ferrous turntable. This precision instrument employs an hysteresis synchronous motor which is dynamically balanced—wow is 0.15%, flutter 0.1% and rumble—50 dB at RIAA characteristics when referred to 7 cm/sec. at 1 kHz. Encel price **\$49**

CONNOISSEUR CLASSIC TURNTABLE

Incorporating two slow speed synchronous motors, the Classic features a lathe turned aluminium turntable. Speeds are 45 and 33-1/3 r.p.m. Spindles are high quality carbon steel, mirror finished—and soft rubber wheels disengage when not in use. Encel price **\$33.50**

CONNOISSEUR PICK-UP ARM MODEL SAU-1

This new arm has been favourably reviewed overseas... ask any Encel Stereo Centre for copies of the reviews in "Hi-Fi News", etc. Bearings are silicone grease damped and are single point pivot type... and an automatic raising/lowering device is fitted as standard equipment. Height is adjustable, the arm is easily mounted by means of a 1/4" diameter hole. Stylus force is adjusted by a set of precision weights... the counterweight is offset for dynamic balancing. Finish is polished nickel chrome and unbreakable black nylon plastic. Encel price **\$18.50**

CONNOISSEUR STEREO CARTRIDGE MODEL SCU-1

Regarded as the finest ceramic stereo cartridge produced anywhere in the world, the Connoisseur SCU-1 will load any normal amplifier or tape recorder. Tip mass is 1 milligram, lateral compliance 8 x 10-6 cms-dyne, vertical compliance 12 x 10-6 cms-dyne. Sound qualities are exceptional—and include a pleasant musical transparency. Ask for copies of reviews in the "Gramophone" and "Records and Recording". Encel price **\$10.80**

SPECIAL OFFER!

Although Encel value is always substantial, here's a special offer on Connoisseur equipment

1. Classic turntable, SAU-1 tone arm with lift, SCU-1 ceramic stereo cartridge with diamond stylus **\$59.50**
2. Classic turntable, SAU-1 tone arm with lift, Micro stereo cartridge with diamond stylus **\$56.50**

• The Connoisseur SAU-1 tone arm was recently awarded the coveted U.K. Design Centre "Seal of Approval"

ASK FOR AKAI PRICES

All AKAI models are in stock... M8, N4, S55, X100D and 1710. Trade-in valuation and end-user prices are more than attractive at Encel Electronics!

THE ACOUSTECH X ELECTRO-STATIC LOUD-SPEAKER SOLID STATE AMPLIFIER STEREO SYSTEM

An all out form of integrated stereo, incorporating advanced amplifier and speaker techniques on a most elaborate scale. When used with the Acoustech VI Control Centre the combination represents the most effective stereo reproduction equipment available anywhere in the world. We use this phrase advisedly. This Acoustech equipment is built without compromise. If price is the least of your worries write for further information to Head Office, 431 Bridge Road, Richmond, Vic.

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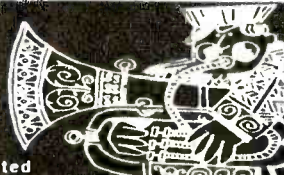
City Branch: 18 Bourke St., Melbourne. Tel. 32 2672

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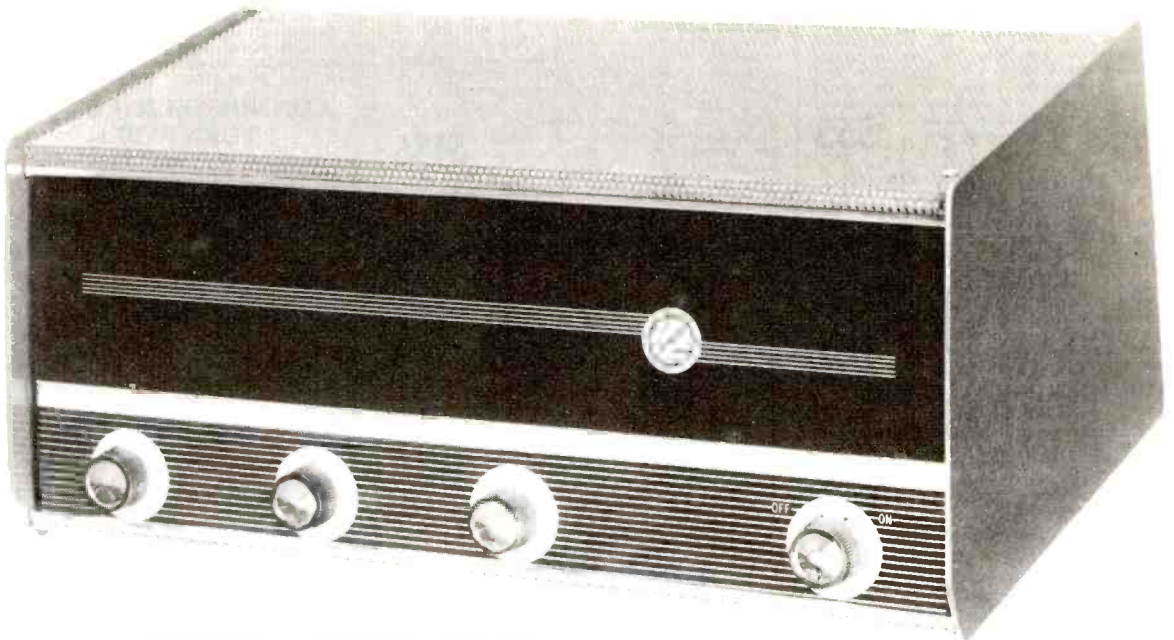
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Public Address Amplifiers

Models PA 35 and PA 65

These amplifiers are intended to cover a large range of requirements where reinforcement of speech and/or music is required. They are eminently suitable for installation in clubs, conference rooms, restaurants, hotels, etc.



TECHNICAL SPECIFICATIONS

	PA 35	PA 65
Nominal power	35 watts	65 watts
Peak power	40 watts	70 watts
Microphone sens.	3MV (100K ohms)	As PA 35
Pickup sens	125MV (1 megohm)	"
Tone control	Minus 20DB at 10KC	"
Response	30-17,000 CPS + 3DB	"
Noise	Minus 60 DB	"
Inputs	1 microphone/ 1 pickup	"
Provision for	50 ohm Input	"
Output impedance	100V Line (330 ohms)	"
Regulation	3 DB	"
Valves	Two 12Ax7 Two 6DQ6B	"
Rectifier	5 x IN3194 Silicon Diodes	As PA35
Fuse	2 amp.	2 amp.
Dimensions	16" x 9½" x 6½"	As PA 35
Gross Weight	21 lb.	21 lb.

PA 35 \$117.25

£58/12/6

PA 65 \$138.60

£69/6/-

Price Retail Plus Sales Tax



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TAS.: Homecrafts-Tasmania, 199 Collins St., HOBART.
Nichols Radio, 91 Wellington St., LAUNCESTON.
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N.Z.: P. H. Rothschild & Co. Pty. Ltd., 83 Pretoria St., LOWER HUTT, P.O. Box 30/170.



Technical Review

BLIND LANDING SYSTEM FOR AUSTRALIA

The Department of Civil Aviation has ordered from Standard Telephones and Cables Ltd, of U.K., four of the company's Category 3 Instrument Landing Systems (I.L.S.). This system, which was announced recently in the U.K., is the first Category 3 I.L.S. to be offered commercially. The equipment is also to be installed in major British airports

Cost of the new equipment enables a typical I.L.S. installation for Cat. 3 to be offered at a lower price than a comparable Cat. 2 system, such as the STC STAN 7/8/9.

In Australia, Sydney Airport and the new Tullamarine Airport for Melbourne will be equipped.

First U.K. installations will be at Birmingham and Stansted, and shortly after at London (Heathrow).

Designation of the new I.L.S. is the STAN 37/38/39, and when installed for Cat. 3 use, it will consist basically of dual localiser and glide slope transmitters and dual markers with a predicted minimum time before failure (M.T.B.F.) of 10,000 hours.

To comply with performance and reliability requirements for all-weather operation, monitoring is performed at three levels — at localiser and glide slope outputs, in the near field of the radiation patterns, and at points about 300ft distant.

During Cat. 3 use, dual transmitters

are in continuous operation, with one working into a dummy load, to ensure instant changeover in the event of main channel failure or degradation. Automatic change-over is accomplished through a "two-out-of-three" monitoring agreement arrangement, and this operation takes less than half a second.

To achieve the high quality of azimuth guidance which is needed for all-

weather landing, without adding complexity to the system which might jeopardise reliability, STC have developed a unique technique which they term "quadrature clearance" to provide protection against course bends and spurious reflected signals.

Separate signals for "course" (the actual approach guidance beam) and "clearance" (the pattern radiated to provide guidance into the "course" transmission) are radiated on the same carrier frequency and from the same aerial. But the two signals are in phase quadrature so that unwanted reflections from buildings, etc., of the "clearance" radiation pattern, which covers a far greater area, do not interfere with the course signals.

According to STC this technique pro-

I.C.A.O. Categories for Landing Systems

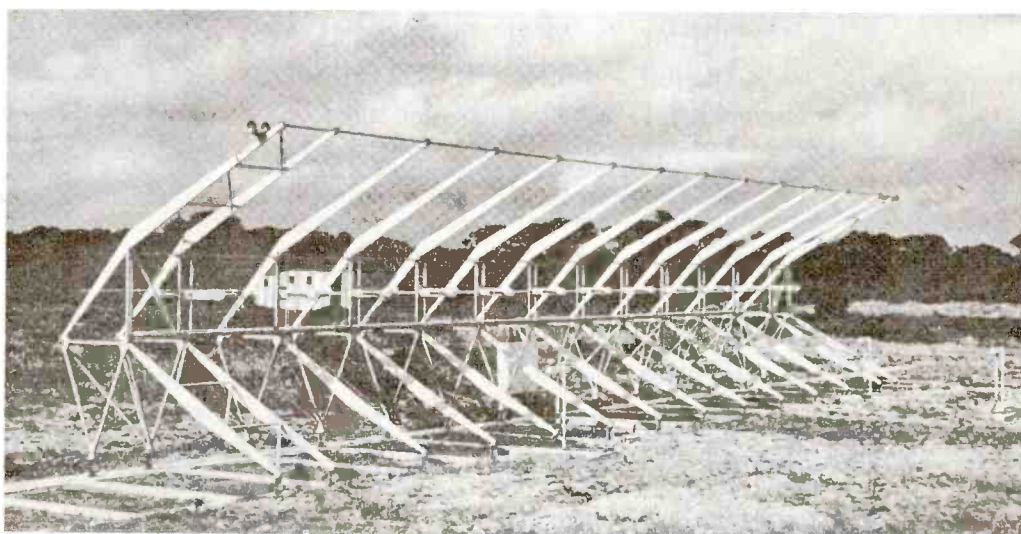
Existing I.C.A.O. (International Civil Aviation Organisation) classifications of all-weather landing conditions define three sets of weather minima, and operations are planned to be introduced in three major stages which conform with the three following categories:

Cat. 1: 200ft cloudbase, 2600ft visibility.

Cat. 2: 100ft cloudbase, 1300ft visibility.

Cat. 3: This has not yet been precisely defined, but will include all conditions inferior to Cat. 2, eventually taking in completely blind landing. It is possible that this category will be further sub-divided to define specific stages within Cat. 3.

The 85ft localiser array radiates both the accurate course pattern and the clearance pattern, eliminating the need for a separate aerial behind the main localiser.



HEY, you there, quit fooling around



(Instead, switch to the TELEFUNKEN M401, with instant Cassette loading)

You're wasting good playback — or recording — time. And fraying your nerves. Who needs it? Just clip in the Cassette, press a button — and that's up to 120 minutes, set ready to go. Time's up? Right. Press another button and the Cassette is automatically ejected. If you want to play your tape on someone else's machine, you can probably do that, too. The Cassette conforms to the 'DC System International' . . . you'll find it in other

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Flat design, total weight about 6½ lbs. — and you can reach all controls with one hand. Use torch or 'Dryfit' rechargeable batteries — or mains adaptor. Record an elephant in the zoo, or that symphony concert in the park — with a 40-14,000 C.P.S. response and brushless motor, your sound is magnificent anywhere. In all, M300 performance is true to fine Telefunken standards — and, we stress



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vides even greater rejection of unwanted reflections than the two-frequency course/clearance method of earlier I.L.S. designs, and quoting a site which gives a beam-bend of 0.4 per cent D.D.M. (difference in depth of modulation), using the two-frequency system, quadrature clearance would reduce this to 0.14 per cent D.D.M.

A version of the same system is one of several glide slope transmission systems offered to cater for sites of varying difficulty.

The normal type of frequent routine maintenance has been virtually designed out of the STAN 37/38/39, and STC intend the system to be installed on a "lock-up-and-leave" basis, with such repair and overhaul of routine-removed modules preferably performed by the company or its agents.

One reason for this is that for such work clean room facilities similar to those being used in initial production will be needed for many elements of the system.

Other technical features of the equipment are the use of constant impedance mechanical modulators (S.T.C. engineers are looking at electronic methods, but for the time being prefer the mechanical solution for reasons of reliability and simplicity); all solid-state design; and high Q stripline matrices for the RF structures feeding aerials, such as power hybrids, phasers and matching units.

The latter offers close tolerances and repeatability in manufacture.

The 85ft localiser aerial array is a frangible structure, mainly of Reddubonded balsa/metal construction, and mechanical fuses are incorporated so that the whole array can collapse forward or backward if struck by an overshooting or undershooting aircraft.

Marker beacon real estate requirements have been drastically reduced to the room needed to erect a pole and a trench for the remote cable connections. As with the localiser and glide slope transmitters, the marker installation is equipped with high-grade batteries to render the system completely independent in the event of their failure.

The new STC I.L.S. is the product of a two and a half year private venture on the part of the company, but close co-operation has been maintained throughout between BLEU, the Royal Aircraft Establishment and the National Air Traffic Control Service in U.K.

As yet there is no firm official specification for a Cat. 3 I.L.S., but it is hoped that one will emerge from an I.C.A.O. meeting next October. STC have based their system upon meeting recommendations already made by all-weather landing interests, and to comply with the overall system failure risk of one in 10^7 , the I.L.S. component has been designed to contribute a landing failure risk less than one in 10^6 .

Current delivery time, for an order placed today, is quoted as 12 months, but as production facilities now being set up are completed this will be reduced to four months.

A typical Cat. 3 installation is stated to be £43,300 (\$A108,300), export packed, FOB, London, and a market amounting to several million pounds is foreseen over the next few years. ■

BATTERY ISOLATION USING DIODES

In our issue of January, 1965, we reprinted from "Mullard Outlook" an article by B. P. A. Beresford describing a circuit which would allow the storage capacity of a vehicle's electrical system to be increased by means of a supplementary battery isolated from the main battery by means of diodes, to prevent accidental discharge of the main battery. We now publish a further article by the same author showing how the circuit may be modified to allow both batteries to be isolated from each other.

Millard Outlook Volume 7, No. 5, (Sept./Oct., 1964) contained an article describing the use of the BYZ14 silicon power rectifier diode to provide isolation between two batteries being used to increase the storage capacity in an automotive electrical system.

While this system has proved its reliability over a period of two years of actual operation, on changing to a new vehicle the author decided to incorporate an idea which had been in mind for some time and which was indeed suggested by a telephone conversation with one of our customers.

The original circuit figure 1 may be modified by incorporating additional diodes as shown in figure 2, thus providing perfect isolation between the two battery systems during discharge. While both batteries will charge simultaneously, the discharge cycle will be confined to the equipment actually connected to each individual battery.

The introduction of low cost automotive silicon diodes as used in motor vehicle alternators, such as the BYX21-200 and the opposite polarity version, the BYX21-200R, enables the

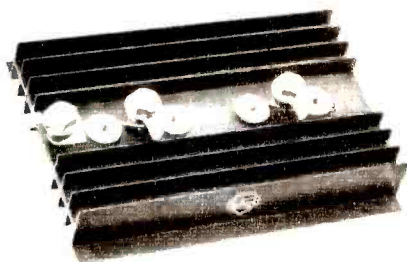


Figure 3. Heatsink diode assembly.

dual system to be incorporated for approximately the same price as the single diode system developed earlier. In this case four diodes are pressed into a single 6in length of Mullard 35D heatsink (type 35D6C or 35D6CB) and the heatsink itself used as the common connection. Two parallel diodes are then wired to the normal car battery, while the other two are similarly wired to the accessory battery. The actual mechanical arrangement of such a system may be left to the individual; however, it may be of interest to refer to figure 3 which shows just how these devices were physically arranged in the author's own installation.

Where two or more diodes are connected in parallel without any additional circuit elements, a derating factor must be applied in order to ensure safe operation. The derating

$$\text{factor } d = 0.8 + \left(\frac{0.2}{n} \right) \quad (\text{where } n =$$

number of diodes in parallel) of the nominal published value and also requires that effective thermal coupling exists between all diodes. With two BYX21-200 diodes in parallel in each case and with the heatsink recommended (either vertical or horizontal) the system may be considered safe with a generator or alternator having an output of up to 40A.

Where the reference voltage for the regulator is provided by the generator, it will be necessary to increase the voltage regulator setting by 0.75V to allow for the voltage drop across the diodes and thus ensure that both batteries are adequately charged. In some systems the voltage reference will be provided by the car battery and the voltage regulator will not require readjustment. ■

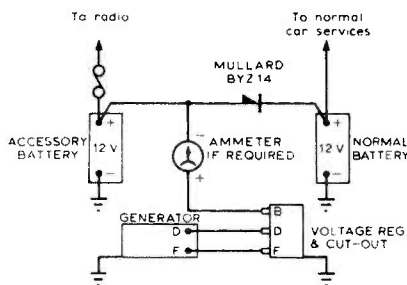


Figure 1. The original circuit.

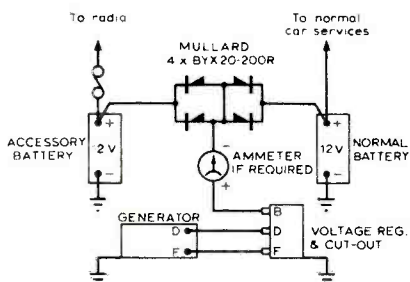


Figure 2. The revised circuit, incorporating four diodes.

COMARK LTD. NEW VERSATILE METERS

ELECTRONIC MULTIMETER TYPE 130S

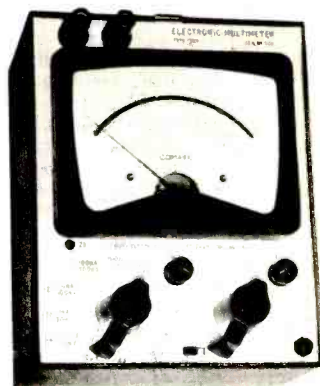
The Electronic Multimeter 130S combines the versatility of the familiar multimeter with the sensitivity of the valve voltmeter. This meter has 58 ranges and is fully protected against overload. Mercury Batteries are used for power.

For all DC measurements a transistor-chopper amplifier with heavy feed-back provides input resistance of 1 Meg/Volt on voltage ranges. On AC the input resistance is 2 Megs on voltage ranges.

SPECIFICATIONS

Voltage:	0-10-30-100 300 mV	} AC/DC
	0-1-3-10-30-100-300-1,000 V	
Current:	0-1 0.1uA A (DC): 0-10-10-100-100uA A: 0-1-10-100 mA (AC/DC)	
Accuracy:	DC 2%: AC 3%	
Resistance:	Linear (R. min.) 1-10-100 ohms: 1-10 Kohms	
	Reciprocal (R. max.) 10-100 Kohms: 1-10-100 megs	
Accuracy:	Linear 2% Reciprocal 5%	
Response:	To 1 Mc/s: Flat 20 c/s-100 Kc/s (AC)	

PRICE: \$164.00 Plus 12½% Sales Tax FOB/FOR Sydney



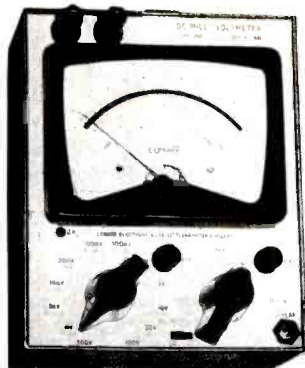
DC MILLIVOLTMETER 120S

The 120S is a robust portable multi-range DC unit designed primarily for low level signals but is equally suitable for general use due to its wide dynamic range. With an input resistance of 1 Meg/Volt the effect of connecting the 120S into a circuit may often be neglected. A one microamp (full scale) range is included.

SPECIFICATIONS

Voltage:	0-1-3-10-30-100 300 mV: 0-1-3-10-30-100-300 V
Current:	Accuracy 2% current and voltage 0-1-10-100 uA A: 1-10-100 mA
Resistance:	Linear (min.) 1-10-100-1,000-10,000 ohms Reciprocal (max.) 10-100-1,000 Kohms: 10-100 megs
Accuracy:	Linear 2% Reciprocal 5%
Recorder:	Terminals provided for DC Recorder drive

PRICE: \$135.00 Plus 12½% Sales Tax FOB/FOR Sydney



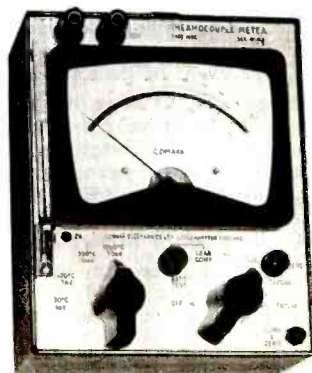
THERMOCOUPLE METER 160C/160F

A sensitive portable instrument for temperature measurement. All scales read directly when used with any of the thermo couples in common use. Errors due to lead resistance and non-linearity are eliminated electronically. A transistor-chopper DC amplifier gives high sensitivity, low drift and 1200 hours battery life.

SPECIFICATION RANGES

	160C (Centigrade)	160F (Fahrenheit)
Cr/Al Thermocouple	0-1000°	0-2500° (3000° range)
Fe/Con Thermocouple	0-700° (1000° range)	0-1600° (3000° range)
Cu/Con Thermocouple	0-300°	0-800° (1000° range)
mV 1 Meg/V	0-30° mV	0-30 mV
Accuracy	2% at 20° C. (Amb)	2% at 68°F. (Amb)
Variation	0.1% per °C.	0.05% per °F.
Wkg Range	0-40° C.	32-100 °F.

PRICE: \$138.00 Plus 12½% Sales Tax FOB/FOR Sydney



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SCIENTIFIC AND INDUSTRIAL NEWS

Educational fuel cell

A hydrogen-oxygen fuel cell designed for educational purposes has been announced by G. Cussons Ltd., of Lower Broughton, Manchester 7, England. The overall diameter is 6in and the active area of the electrodes is 7 sq. in. On open circuit a single cell has an EMF of 0.95V. The maximum current which can be supplied is 3A.

The cell construction consists of a sandwich of two circular electrodes of thin porous plastic, metallised on one side and coated with a catalyst, with a central compartment for the electrolyte, potassium hydroxide. The cell is constructed to allow air and hydrogen to be distributed at the activated side of each electrode. The efficiency of a cell can be calculated from the amount of hydrogen used.

New Tasmania/Mainland trunk system

The first batch of circuits on a new large-capacity microwave radio system between Launceston and Melbourne was brought into service on November 14. The new system will permit the extension of Subscriber Trunk Dialling (S.T.D.) between Launceston and the mainland. These extensions to the S.T.D. system are part of the overall plan which has as an objective direct dialling of all trunk calls by 1975.

From November 14, certain Launceston subscribers have been able to dial Melbourne numbers direct as they could previously to Hobart, Deloraine and Devonport. At the same time, Melbourne subscribers already using S.T.D. facilities have been able to dial Launceston numbers direct. From the same date, the Melbourne subscribers have also been able to dial Adelaide numbers direct.

Transistorised heating controls

A new series of compact, low-cost transistorised heating and air-conditioning controls has been developed by Satchwell Control Systems Ltd., of Farnham Road, Slough, Bucks, England. The new controls use printed circuits, transistors and dry reed relays. The makers claim that the price is only two-thirds that of existing equipment, and offers increased reliability.

Experimental 400 picosecond circuit

A monolithic circuit with basic propagation delays of less than 400 picoseconds has been developed by International Business Machines Corporation, of U.S.A. I.B.M. say they believe it to be the smallest and fastest silicon monolithic circuit so far developed. It contains five transistors and three diffused resistors and occupies an area less than one 10-thousandths of a square inch. The miniaturisation is primarily due to refinements in masking techniques and photolithography.

The 400 picosecond speed of the circuit is a function of both its reduced size and of its current switch logic. In this form of logic, one of a pair of transistors is always fully on, while the other is slightly on, rather than off. This reduces the turn-on time substantially.

Kyogle television translator station

A National Television translator station established at Kyogle began regular transmissions in November. This is the sixth national translator to be established in Australia. It is located

1½ miles west of Kyogle on Geneva Hill. The power output is one watt and it relays on Channel 3 the programs of the National station ABRN6 at Lismore. The national translator is installed at the same site as, and shares a common building with, the commercial translator, which has been operating for some months.

Navigation aid contract

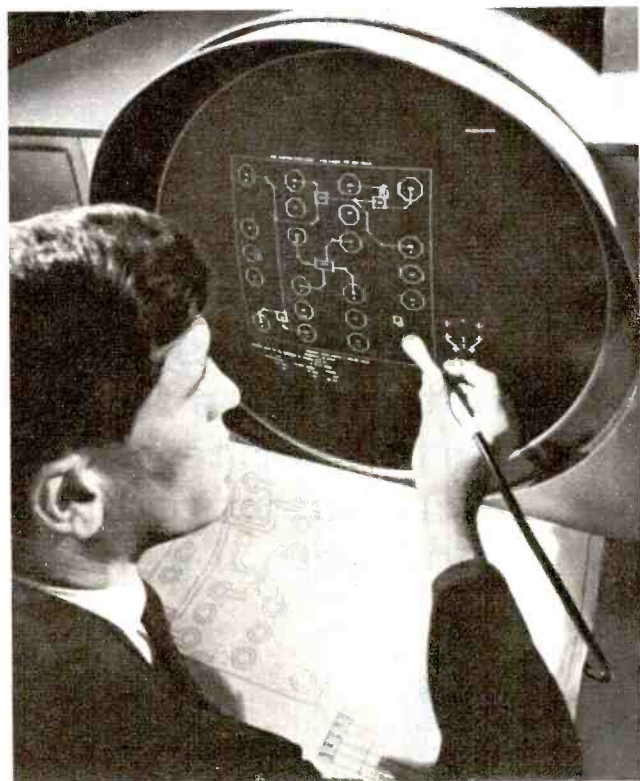
An initial order for about \$300,000 worth of improved aircraft navigation aids has been placed with Amalgamated Wireless (Australasia) Ltd. by the Department of Civil Aviation. The navigation aids are ground based distance measuring equipment (D.M.E.) beacons which give aircraft important distance information. The national D.M.E. system was originally developed in Australia in the 1950s, and now has 86 units operating.

A special unit in the aircraft sends a signal to the ground beacon which retransmits the signal back to the aircraft. The travel time of the signal is measured by an electronic circuit in the aircraft and is automatically converted into distance in miles from the ground station. This distance is then shown on an indicator in the cockpit.

AWA says the new beacons are transistorised and much smaller and more reliable than the existing units, and can operate from a variety of power sources. Maintenance and installation costs are said to be reduced, thus enabling the D.M.E. network to be extended to areas not previously considered because of high costs.

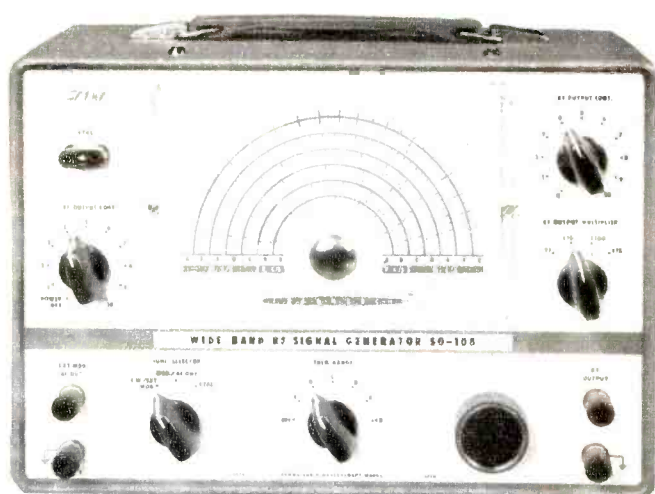
Alarm system

A scientific aid which is claimed to be proving a success as a crime deterrent in London was described recently in the B.B.C. World Service. The Radio Activated Intruder Detector — or RAID for short — is an electronic alarm system with two basic components. One is a small sensing device which can be hidden in a cigarette packet or other suitable container and planted on premises which the police suspect may be burgled. If an intruder does



Engineers at the IBM plant at East Fishkill, N.Y., are experimenting with a technique which reduces significantly the time between a design idea and a finished scale drawing. By moving an electronic "pen" over the CRO type display screen an image is created on the screen and retained there by the computer which controls the equipment. The engineer is laying out a design on the screen and may change it by manipulating the images of the various components. When he is satisfied with his design, the computer produces a precise scale drawing of the circuit sketched on the screen. A copy produced by the computer is in the photo below the display screen.

SANWA RADIO MEASUREMENT WORKS



choose from the economical range of Sanwa testing and measuring instruments for outstanding performance, long service life □ illustrated model S.O.108 wide band signal generator — \$46.95



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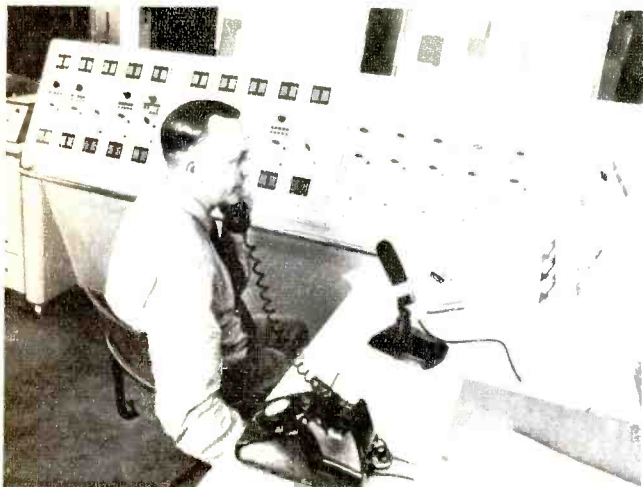
SCIENTIFIC NEWS — cont.

break in, the device signals to the other component which may be in a different building, and a warning signal is passed to police headquarters.

The makers claim that the introduction of the system has allowed the number of men on patrol to be reduced, and also that the records show a reduction in the City's crime rate.

Portable surge counter

A transient voltage surge counter has been developed by A.E.I. Electronics, of Leicester, England, to replace rule of thumb methods used to design protection circuits. It is claimed to be especially useful where pulses occur at irregular intervals. It is not intended as a precision measuring instrument, and is only intended to count the number of voltage surges which occur above four pre-set voltage levels (set between 10 and 5000V). The instrument is battery operated and once connected to a circuit can operate for two years or 1 million counts.



The main control room at Britain's new G.P.O. transmitting station at Leafield, Oxfordshire, is manned by only one operator. Messages received here from London centres are sorted and transmitted to various countries by one of the station's transmitters. The operator merely throws a switch for the allotted frequency, the rest is automatic. Each of the 18 transmitters (12 of 30KW and six of 85KW) is capable of handling 24 messages in radio telephony or wireless telegraphy, or both at any one time. All transmission frequencies are controlled by a master oscillator buried 30 feet below ground to maintain constant temperature.

Anti-corrosive additive

A fluorinated compound of chromium which is expected to be a powerful rust inhibitor when included in paints has been developed in conjunction with the Israel Paints Research Association. The protective effect is said to be as good as that obtained from a coating of 70 per cent lead oxide or 20 per cent zinc chromate. It is pale in colour and could thus be added to most paints.

The developing company, Chemicals and Phosphates, of Haifa Bay, Haifa, Israel, reports that it has received several inquiries from overseas and anticipates that paints containing the new chemical will shortly be on the Israel market.

Talking computer

A talking computer called AUDREY (for AUDio REplY) has been developed by the Missile and Space Division of the General Electric Company. The new device is intended to supplement existing desk-side teletypewriters and CRT display units as part of the time-sharing computer systems located at G.E.'s Space Technology Centre. AUDREY achieves her voice talent through the use of photographic memory tape on which her vocabulary is stored. Her voice output is totally non-mechanical and responses are said to be natural and pleasant sounding.

After the initial connection is made with the computer through a special terminal telephone, the user hears "This is AUDREY," and he can then present his problem, or request previously stored information. All computer answers are in the form of a human voice. The makers conceive that AUDREY may someday be a significant travelling aid to scientists, engineers and business men while on trips. It may be possible for them to use AUDREY to obtain information or perform calculations at any airport or other location where the required terminal phones are in service.

International conference on electronics

A symposium will be held in Paris from April 10 to 15, 1967, to investigate how the new constraints imposed by space applications have led to an adaptation or renovation in electronics. The program is in three principle sections. An attempt will be made to draw up as exhaustive a list as possible of the constraints imposed by space utilisation. Papers will be presented on the subject of "on board" electronics showing how the approach to the problem has been guided by the space environment. Finally, papers will be presented on the subject of "ground" electronics, indicating the steps taken to reduce difficulties in the manufacture of the spacecraft. Further details can be obtained from the organisers, Colloque International Sur L'Electronique et L'Espace, 16, rue de Presies, Paris 15e, France.

Banking automation in South Africa

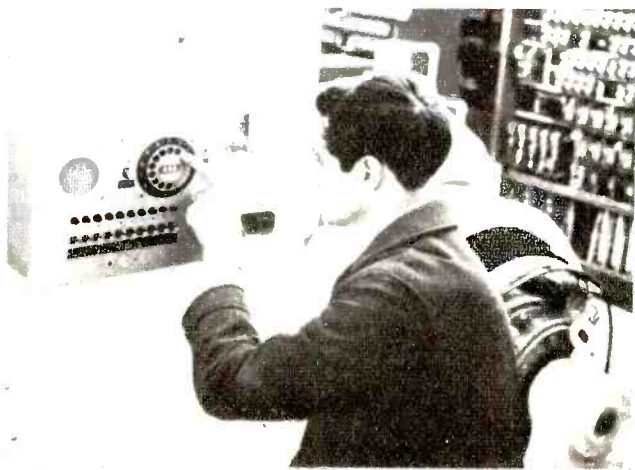
The Trust Bank of Africa has announced their decision to install a massive nation-wide Data Processing system. Two Burroughs B3500 computers are to be installed in each of the bank's main centres in Capetown, Durban and Johannesburg. All six systems will be completely interlinked to form one of the largest and most advanced on-line computer complexes in the world, and able to provide simultaneous processing in all aspects of the bank's operations. All accounts will be accessible to tellers in any Trust Bank office throughout South Africa, enabling them to complete transactions with a minimum of delay.

The B3500 systems have been purchased by The Trust Bank for \$6 million. They include a 350 million character high speed disc file memory, 200 window teller machines, 100 inquiry terminals, and 50 communication terminal units for on-line transmission. The peripheral magnetic tape, paper tape, punched card and printer units complete the systems. Some unique types of memory included in the B3500 are the scratch pad address memory, the read only memory, and a special systems memory which is a single disc unit used as an extension of core memory for storage of the operating system program and the program library.

Alumina tubes in new large sizes

Alumina tubes which can work in reducing or oxidising atmospheres at temperatures up to 1950 degrees Centigrade are now made in large standard sizes, up to 6 1/2 in internal diameter by 48 in long, by Morgan Refractories Ltd., Neston, England. The new large sizes, originally developed for the United Kingdom Atomic Energy Authority, are expected to find widespread use in high-temperature research, particularly in electrically-heated tube-furnaces. This type of furnace with the tube wound with tungsten or molybdenum wire in a controlled atmosphere, overcomes the difficulties of building structural furnaces for very high temperature use.

The increased capacity will give research workers greater freedom of design, and will also be of value to manufacturers of transistors and ceramic or sintered products.



An emergency telephone system, supplied by the Communication Systems of Australia division of Plessey Telecommunications, will play an important role in the smooth running of lifts in Australia's tallest office structure, the N.S.W. Government Office Block, when it is fully occupied. As a safeguard, each lift is equipped with an emergency communication system that provides contact with a number of points, including a commissionaire's desk and one of two motor rooms. The lift speaking system is part of a telephone network that also enables contact to be made between floors of the building and an underground nerve centre in the event of fire.

One of the best
TRANSCRIPTION UNITS
 in the world...



4-Pole constant velocity (15 watt) Motor. Speed variation continues from 15 to 80 R.P.M. with Click stop at 16—33 $\frac{1}{3}$ —45—78 R.P.M. Wow & Flutter Maximum 0.2%; Rumble and Hum negligible. Turntable 12" x 8 lb. Unit: 15 $\frac{3}{8}$ " Long; 13 $\frac{1}{4}$ " Wide; 5 $\frac{1}{2}$ " High.

GOLDRING Lenco

GL-70

The new Goldring Lenco GL70 Transcription unit is unique. It features an 8 lb. non-magnetic diecast turntable dynamically balanced with lapped steel centre spindle running in sintered bronze bush bearings. The on-off switch automatically disengages the idler wheel from the turntable underside, preventing "flats" developing and also operates a microlift mechanism for the pick-up arm, allowing precise selection of record track and manual lowering of pick-up head. The positive vertical drive system allows for continuously variable turntable speeds. Adjustable pick-up arm with detachable head shell.

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GE:P343

New rocket motor

A new rocket motor has been developed by the Lockheed Propulsion Company for the National Aeronautics and Space Administration (N.A.S.A.). The rocket is being tailored for possible use in space where it could start, stop and restart on command and vary its thrust to perform a wide variety of manoeuvring jobs. The system could also lie dormant in space for months and then come to life on command to perform its functions. Lockheed has received a follow on contract from N.A.S.A. for \$US210,000 to develop the device further.

The rocket is called R.S.V.P., for Restartable Solid Variable Pulse. It is powered by a solid propellant that will not burn in the vacuum of space. When it gets a few drops of highly reactive fluorine compounds, the rocket boils instantly to life to develop various levels of thrust depending on the amount of liquid fed to it. The fire is extinguished instantly when the liquid is removed.

Latest in locks

A new security lock for the protection of vehicles which is claimed to be completely foolproof was described in the B.B.C. World Service. It is a low-priced unit which uses computer techniques with a five-letter code. Unless the code is set on the 24-letter dial, the engine cannot be started. When the letters are dialled in the correct order, the device energises a relay which allows the ignition circuit and the starter solenoid to operate. When the ignition is switched off, the logic circuit controlled by the dial is automatically scrambled. The code-letters are selected when the unit is installed, and can easily be changed if required.

Acoustic traffic detector

A simple type of traffic sensor which detects vehicles passing a point has been developed by the Marconi Co. Ltd., Chelmsford, England. The device is mounted on lamp standards, bridges or other convenient structures over a traffic lane. The transistorised instrument emits bursts of ultrasonic energy and detects the difference between echoes from the road surface or objects in the path of the beam. It is also possible for the unit to differentiate between cars and heavy vehicles.

Laser television display

An experimental system of producing a television display using the deflection and modulation of a beam of laser light instead of electrons has been developed by the Zenith Radio Corporation, Chicago, U.S.A. The deflection and modulation are both achieved by the diffraction of the laser beam in ultrasonic waves. For very small scanning angles, the system is satisfactory, but it is necessary to rotate the water cell in which the refraction takes place to give the scanning angles necessary for television.

An electronic eye able to see in the same way as we see, as opposed to the simple electronic eye which is only sensitive to light and darkness, may be possible as a result of research being carried out by Dr Christopher Pedler at the Institute of Ophthalmology in London. He is studying the cells at the back of the human eye and has already proved them to be more complex than originally believed. Dr Pedler is trying to produce a circuit diagram of the retina, and is seen examining a polystyrene model of part of the retina.

Schoolboys' device for measuring moisture

Two British schoolboys have discovered the answer to a problem that has been baffling scientists. They have invented a device which can measure exactly the moisture content of moulding sand used for casting. For their device, the boys, Michael Breton and Barry Lewis, have won top prize in the "Science Fair '65" organised by the B.B.C.

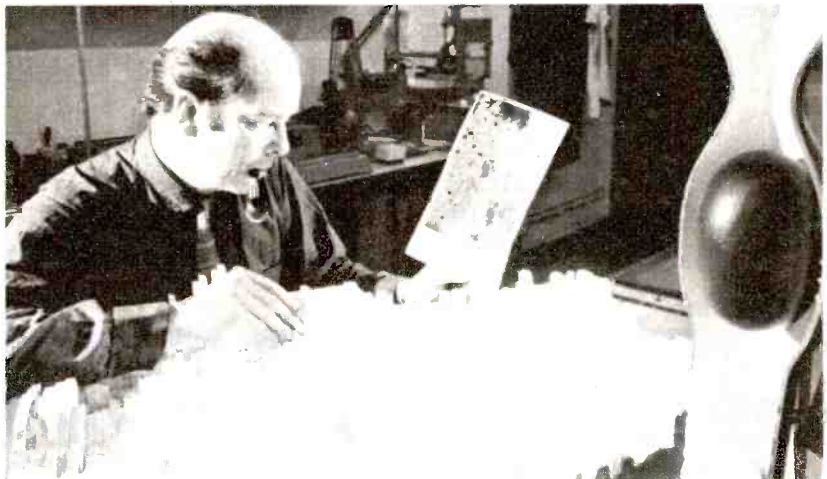
The device yields a very simple but extremely accurate solution to an industrial problem that at present can only be measured by chemical methods. The invention



The two boys — Michael Breton (left) and Barry Lewis — are showing their invention to their headmaster, Mr W. W. Williams.

is being patented and has already interested commercial concerns.

The device consists of a box containing a battery and incorporating a meter and weight scale. Two probes from the box are plunged into the sand which has been compressed firmly into a container according to the standard weight chosen for the test series. As the current passes between the two probes, the moisture content is indicated on the meter.



Radio distress beacon

The growing number of small boat owners and the increasing use of private aircraft has encouraged Burndep Electronics of West Street, Erith, Kent, England, to develop a radio distress beacon, Compact BE 355, specially for this market. Constructed on the lines of the well-established Sarbe range of beacons, it was scheduled for production towards the end of 1966.

Designed for VHF or UHF transmission on the distress frequencies, its battery will last for 24 hours. A larger battery to be made available will supply power for signals up to 48 hours.

Weight of the beacon with attached battery is 25 ozs and dimensions with telescopic aerial retracted are about 6 x 4 x 1 1/2 in. The only action needed to bring the beacon into operation is to extend the aerial. This starts transmission of a signal which can be picked up by an aircraft and thus enable it to home to the position of the survivor.

Dragon on full power

The O.E.C.D. Dragon Project's high-temperature, helium-cooled Reactor Experiment at Winton, Dorset, England, has successfully completed its first phase of full power operation.

By operating consistently at higher temperatures than any other reactor in the world, the Dragon Reactor has given a convincing demonstration of the practicability of its advanced design, say O.E.C.D. nuclear scientists.

Coin-operated "cine studio"

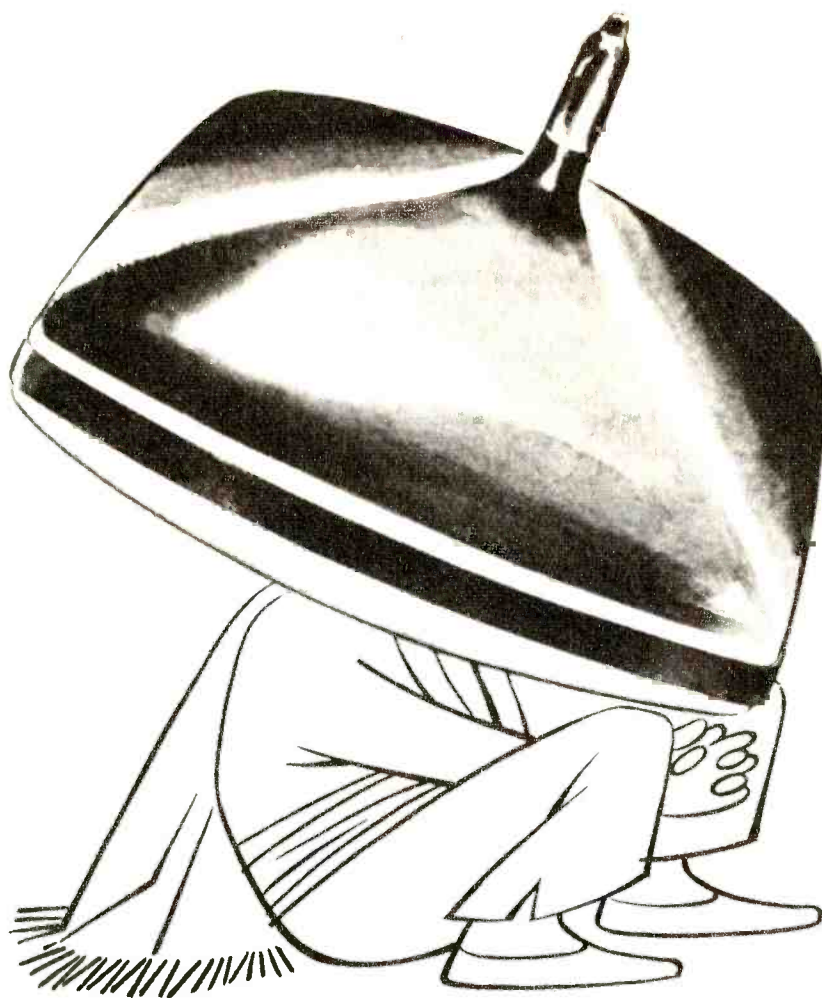
Automatic cameras taking 25 pictures in quick succession are said to provide a cine-like effect for the subject. The camera and processing equipment, coin-operated for unattended locations, are available from Movie-matic Industries Corp. of 90 Beacon Boulevard, Miami, Florida.

The 25 photographs are stacked and bound together by the machine. When they are flipped over by the thumb in quick succession, they give an appearance of the subject's movements.

Rotary engined car

The Japanese car manufacturer, Toyo Kogyo, has announced details of the hitherto experimental rotary-engined Mazda "Cosmo Sport." The unusual car is to be marketed early in 1967, but no price has been announced. It uses a 982 cu. cm. two-rotor rotary piston engine which has been developed in collaboration with the West German company N.S.U.-Wenkel.

This is only the second production car to use this engine design, although the N.S.U. "Spyder" has a rotary engine with only a single rotor. The engine is claimed to produce 110 brake horsepower, and the manufacturers say that the car will have a top speed of 105mph.



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Force in superconductors

An experiment carried out by Dr Judea Pearl, of the RCA research centre, has revealed for the first time the identity of a newly observed force in superconductors. He found that the force is analogous to the force which causes a spinning ball to move sideways as well as forward when thrown.

In the case of the ball, the force is exerted because of the difference in air pressures against the sides of the ball. In superconductors, a similar effect occurs when magnetic lines of force are moved from one side of the material to the other. This causes the simultaneous movement of tiny electric currents across the material.

Integrated circuit television

A West German designer, Hans Jeurgen Mosel, of the applications laboratory of Standard Elektrik Lorenz AG, Stuttgart, has developed an integrated circuit which does away with coils in the IF and discriminator stages of television sound channels. Although the mixer stage needs a coil, it does not need to be adjustable.

The circuit can thus be fabricated on a thin film hybrid circuit, and on a monolithic chip would require only a single fixed external coil. Although the integrated circuit has yet to be incorporated in a production model, the designer says that the same basic principles were used in a conventional circuit in a receiver last year.

Character recognition

Character recognition equipment capable of reading hand-printed numerals and all letters of the alphabet has been developed in the U.S.A. by Recognition Equipment Inc.

While it is anticipated that the machine will be used mainly with printed and typed characters, it is also able to recognise hand printed characters. Special characters, such as the Greek alphabet used in mathematics, can also be included in the machine's

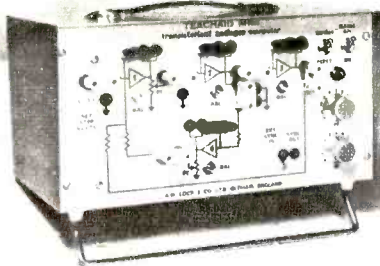
recognition system. The machine reads at the rate of 2,000 characters a second.

At present, the manufacturers expect that the main use for the equipment will be for limited "add-on" applications, since it is about 10 times faster to use a conventional adding machine than to print characters by hand.

Computer teaching aid

A small inexpensive analogue computer has been introduced by J. M. Lock and Co. Ltd. Oldham, Lancs., England. Called the TEACHAID MK. 1, it is intended primarily for students in colleges, but will have applications in industry. It is claimed to be able to solve problems up to third order differential equations.

The unit comprises four operational amplifiers, a power supply and a 25Hz



The TEACHAID analogue computer teaching aid.

synchronising square wave circuit. All sub-assemblies use transistors and printed circuit techniques with flying leads. The operation rate is 25 per second, the computing period is 35 milliseconds, and the reset time is 5 milliseconds. The operational amplifiers are drawn on the front panel showing the position and method of inserting feedback components and of making adjustments.

New electrocardiograph

The instrumentation field station of the American Public Health Service has developed a new electrocardiograph after 10 years of research. It has fewer controls than current models, can plug into a telephone to transmit readings to remote places, and can take heart readings in only three minutes. A prototype of the machine has been developed to the department's specifications by the G.C.A. Corp. of Bedford, Mass., U.S.A.

The electrocardiograph has only three controls—a switch to change readings from lead to lead, an on-off button, and a device to centre the recorder's stylus. It is hoped in production models to eliminate the centering control. The unit, which is self-calibrating, gives an analogue output for telephone transmission or for recording on magnetic tape.

New tunnelling device

I.B.M. scientists have discovered a negative resistance effect in a metal-oxide-semiconductor (M.O.S.) planar structure. The effect is less pronounced than in a conventional tunnel diode, but the scientists believe that it may be strengthened by the use of different combinations of materials.

The new experimental diodes are made by depositing a thin strip of aluminium on a glass substrate. The aluminium is exposed to oxygen, forming a thin insulating layer of oxide. A strip of semiconductor material (germanium telluride or tin telluride) is deposited across the aluminium oxide strip. The intersection of the two strips forms the diode junction.

A new flowmeter has been developed by the Fluid Dynamics Laboratory of Elliott-Automation, Ltd., London. It is claimed to be only a third the size of standard designs, and to offer little resistance to fluid flow. The device consists of a venturi-shaped tube suspended at the centre of a pipe. It is said to allow accurate measurements over a ten to one range, and down to flow rates equal to a third those of normal design.



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Digital - Analog CONVERSION

Digital-to-analog conversion—the weighted resistor DAC—the ladder network DAC—a simple practical circuit—analogue-to-digital conversion—the analog comparator—a simple circuit—the simultaneous ADC—the counter-type ADC—the continuous ADC—other types.

by Jamieson Rowe

In the preceding article of this series, it may be recalled, we looked at the processes of encoding and decoding—two important aspects of a general digital procedure often given the name “information transformation.” Let us now turn our attention to a related aspect of the same general procedure, an aspect which arises whenever information must be transformed either from digital to analog form or vice-versa: **digital-analog conversion.**

By way of recapitulation, it should perhaps be noted at this point that information in digital form usually may possess only two values, whereas information in analog form may possess a large or possibly infinite number of significant values.

As one might expect, conversion is similar to code translation in that there are two complementary processes—digital to analog conversion or “DAC,” and analog to digital conversion or “ADC.”

Digital-to-analog conversion finds its main use wherever information in digital form must be fed to, or used to control, equipment which accepts information most conveniently in analog form. Examples of this are where paper-chart recorders are to be used to plot continuous graphs of digital information and in digital machine control where a digital control signal may be required to drive a motor or solenoid unit.

A secondary application of DAC, but one which is rapidly growing in importance, is the generation of analog signals which must conform with a high order of precision to given mathematical functions. Where the function concerned is a highly complex one and/or where high orders of precision are required, generation of the signal by digital means and subsequent DAC will often give a superior result to more conventional analog generation techniques.

An example of this is where a highly linear voltage ramp or gradient must be generated, particularly over an extended period of time. Using conventional analog techniques, this is quite a difficult task, but using a DAC approach it can be relatively easy. A large-capacity pure binary counter fed with pulses at a suitable rate and itself driving a many-bit DAC will produce an accurate “staircase” voltage or current, the steps of which can be made small enough to be negligible for the application concerned.

Similarly, a DAC approach is sometimes the only feasible way of generating or synthesising a complex non-periodic waveform.

Quite apart from its direct applications, DAC has an indirect application in the complementary process of analogue-to-digital conversion. The reason for this is that most ADC's employ a DAC as a feedback element, as will be explained later in this article.

Fundamentally, a DAC constructs an analog equivalent of a digital input signal by adding together voltages or currents having magnitudes proportional to the weights of those bits in the digital information which are logically true ($=1$) at the time concerned. Thus if the digital input is decimal number 5, perhaps encoded in pure binary or a BCD code, the DAC constructs an analog equivalent by adding together four units and one unit of voltage or current.

In practice, most DACs employ current addition as this usually proves somewhat easier to perform than voltage addition. The diagram of figure 1 shows the general principle of operation of a current-adding DAC for a single decade of 2421 BCD code.

As may be seen, it consists of four constant-current generators controlled by the four input BCD bits. The generator controlled by the first or least significant (LSB) bit, when gated, produces a constant current “ I ”; those for the second, most significant (MSB) and fourth bits produce “ $2I$,” “ $4I$ ” and “ $2I$ ” respectively, corresponding to the appropriate bit weighting.

The outputs from the four generators are connected together so that they add to produce an output “ nI ,” where n is the decimal number represented by the BCD input. To produce an analog voltage signal from this current signal, it is simply necessary to feed the current through a resistor R , giving an output nE where $E=IR$.

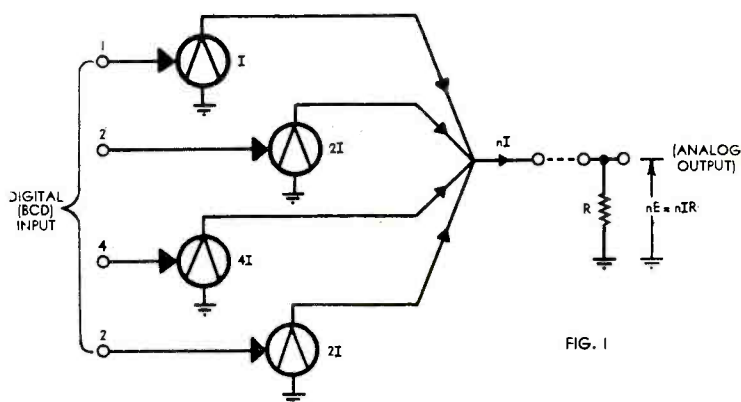
There are two methods used in practice to perform the general operation shown in figure 1. These are usually known as the “weighted resistor” and “ladder network” methods, and are illustrated in figure 2. Both diagrams show four-bit converters, the first for 2421 BCD and the second for 8421 BCD.

In the weighted resistor DAC each input bit operates a switch connecting one of four precision resistors to a precision voltage supply. The resistors connect to the input of a high-gain DC amplifier, across which is fitted a negative feedback resistor R_f .

If the DC amplifier is assumed to have infinite gain, the effect of the feedback resistor R_f is to give the amplifier a virtual input resistance of zero. Its active input terminal thus remains at earth potential regardless of the current supplied by the input resistors. Under these conditions the current controlled by each of the input switches will be independent of any current flowing through the other switches.

Since the input resistors have values weighted inversely for the BCD code concerned, this means that each switch can provide the amplifier with a constant current whose magnitude is proportional to the weighting of the corresponding BCD bit. If the output of the precision voltage supply is E volts and $E/R=I$, switch S_a will therefore control a current of I while S_b , S_c and S_d will control currents of $2I$, $4I$ and $2I$ respectively.

The input current to the DC amplifier is thus nI , where n as before corresponds



GENERALISED DIGITAL-TO-ANALOG CONVERTER
(SHOWN FOR 2421 BCD CODE)

An important application of digital-to-analog conversion is where digital information must be used to drive paper-chart recorders and similar analog equipment. The recorder pictured is part of the computer installation at the University of Adelaide.



to the number encoded in the BCD input bits.

Because of the negative feedback resistor R_f , the amplifier will convert this analog current input to an analog voltage output nE' , where E' will be equal to IR_f . The reason why the amplifier produces a voltage output of nE' is that this output voltage produces a feedback current through R_f which is just sufficient to cancel the input current nI and maintain the amplifier input at effectively zero potential.

As may be seen, the DC amplifier acts as an "operational" amplifier, connected to the precision reference voltage E with a voltage gain equal to the ratio of feedback resistor R_f to the effective input resistor R/n . The analog output voltage may thus be expressed as

$$nE' = n \cdot \frac{E \cdot R_f}{R} \quad \dots (1)$$

In other words, the output is directly proportional to the digital input number n .

In the foregoing discussion, it was assumed that the voltage of the DC amplifier was infinite, whereas, in fact, no practical amplifier has infinite gain. This means that, in practice, the output voltage of a simple weighted resistor DAC tends to be non-linear, giving errors in the analog output corresponding to each input number.

The errors are generally small enough to be negligible providing the amplifier gain is higher than about 10,000. However, for applications requiring extreme accuracy, the basic circuit configuration can be modified in order to render the conversion linearity independent of amplifier gain.

The modification required for this is shown in dashed lines. As may be seen, it simply involves earthing the ends of the unused input resistors, to provide across the amplifier input an effective shunt resistance of $R/(9-n)$.

The shunt resistance, in conjunction with the effective input resistance R/n forms a voltage divider across the precision supply. The divider action is such that the amplifier receives input currents which are directly proportional to the BCD input bit weightings, despite the non-zero value of the amplifier input voltages.

The analog output voltage nE' thus becomes exactly proportional to the digital input number n , as in the ideal case. It may be expressed as

$$nE' = n \cdot \frac{A \cdot E \cdot R_f}{9R_f + R(A+1)} \quad \dots (2)$$

The second type of DAC method is the "ladder network" method, as illustrated in the lower diagram of figure 2. Here the current contributed to the DC amplifier by each switch is determined not just by the specific value of its series resistor, but also by the position of the resistor in a network arranged as a ladder-type attenuator.

The ladder is usually arranged so that there is a constant $\times 2$ (or 6dB) division between successive steps. Actually it is rather difficult to use a ladder giving unequal steps, or even equal steps of other than 6dB — a fact which makes the ladder-type DAC suitable only for pure binary or 8421 BCD conversion.

In the diagram, switch S_d controls the largest input current contribution, being nearest to the amplifier input; it therefore corresponds to the MSB input. In contrast switch S_a controls the smallest contribution, and therefore corresponds to the LSB input.

Using the same symbols as before, the analog output voltage of the ladder network DAC shown can be expressed as

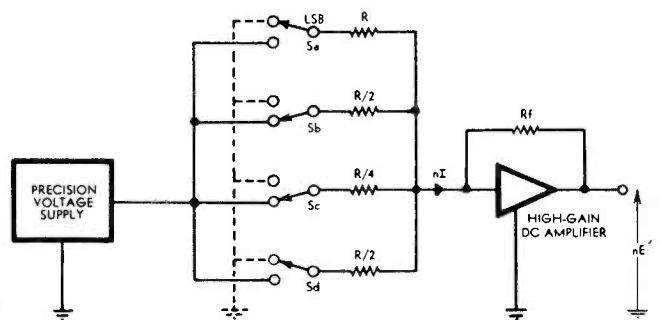
$$nE' = n \cdot \frac{A \cdot E \cdot R_f}{16(R_f + R(A+1))} \quad \dots (3)$$

As may be seen, the output is again

directly proportional to the digital input number n , and conversion is linear for any value of amplifier gain A .

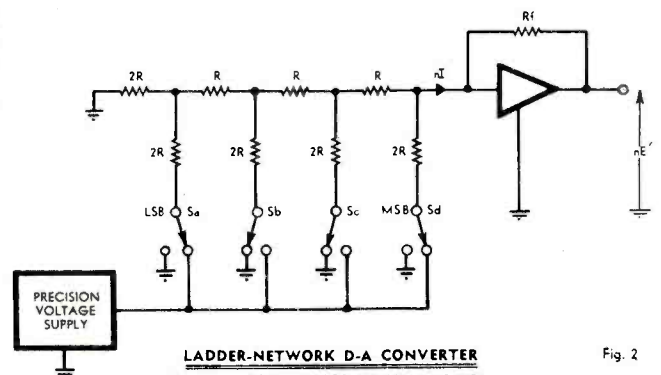
In comparison with the weighted resistor DAC the ladder network configuration tends to have a more uniform current and dissipation distribution; all switches and resistors can thus be designed for approximately the same currents. Also, the weighted resistor DAC uses five different precision resistor values per decade of four bits, whereas the ladder network DAC uses only three different values; this can in some cases

The two methods most commonly used to perform DAC. While the second method is somewhat better suited to high speed conversion, it is less flexible in terms of acceptable input coding.



WEIGHTED-RESISTOR D-A CONVERTER

(RESISTOR WEIGHTINGS FOR 2421 BCD. SWITCHES SHOWN IN POSITIONS FOR DECIMAL "6")



LADDER-NETWORK D-A CONVERTER

(RESISTOR WEIGHTINGS FOR 8421 BCD. SWITCHES SHOWN IN POSITIONS FOR DECIMAL "9")

Fig. 2



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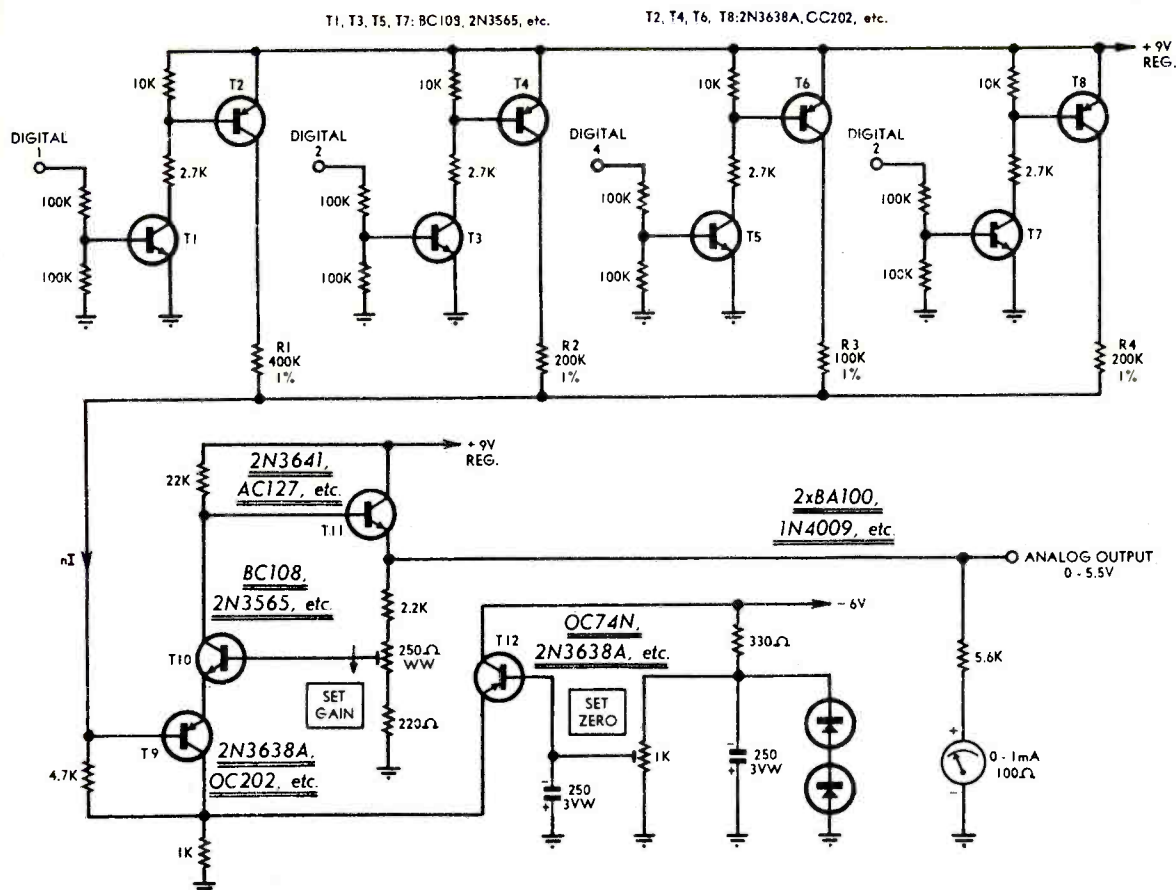


Figure 4: The circuit of a simple DAC for 2421 BCD code.

make the ladder network DAC a more economical proposition.

Although both the DAC examples given in figure 2 are only four-bit converters, intended for conversion of a single decade of BCD code input, both configurations can be used for converters dealing with larger numbers of bits.

To extend the capacity of the weighted resistor configuration, it is simply necessary to add further switches and resistors of appropriate value. However, with the ladder configuration, simple expansion is possible only for pure-binary or similar continuous codes. Multi-decade BCD or similar decimal code conversion must be performed using multiple 4-bit converters.

In both the weighted resistor and ladder network DACs the input switching may be performed in a variety of ways. The main requirement is for switches which are as close as possible to an ideal switch—SPST in the case of the simple weighted resistor DAC, or SPDT in the case of the modified weighted resistor and ladder network DACs.

In slow-speed conversion applications, relays and transistor drivers may be used as in figure 3(a). A driver and relay as shown are required for each input bit, the relay contacts being either SPST or SPDT as required.

Where operating speed and reliability are important, transistor switching is usually employed. Figure 3(b) shows a suitable configuration, again for a single input bit. For SPDT switching, an NPN transistor is added as shown by the dashed lines.

While more reliable and capable of extremely high operating speeds, tran-

sistor switching involves problems arising from the fact that transistor switches do not have zero voltage drop even when fully saturated. The transistor saturation voltages introduce a further source of DAC non-linearity, particularly in the case of the weighted resistor configuration.

Despite this, however, transistors are the most often used switches in both types of converter. By careful design the errors produced by transistor saturation voltages are kept to an acceptably low level.

Figure 4 shows the circuit of a practical DAC of the simple (SPST) weighted resistor type. The circuit uses transistor switching and is designed for 2421 BCD conversion using positive input logic. In fact, it forms the major part of the "Conversion" section of the third panel of the author's digital demonstration unit, the construction of which will be discussed later.

Transistor pairs T1-T2, T3-T4, T5-T6 and T7-T8 are the input driver-switch combinations, in each case turning the second transistor "on" when logical 1(=+9V) is applied to the input terminal. The emitters of the switch transistors connect to the +9V line, which acts as the reference voltage E; the collectors connect to the appropriate high-stability resistors R1, R2, R3, R4.

Transistors T9-12 form a simple DC amplifier. T9 is an input emitter follower, in "inverted" configuration to give low "offset." The latter term describes a range in input quantity values which is treated by a device as if all the values included do not differ from zero—it is

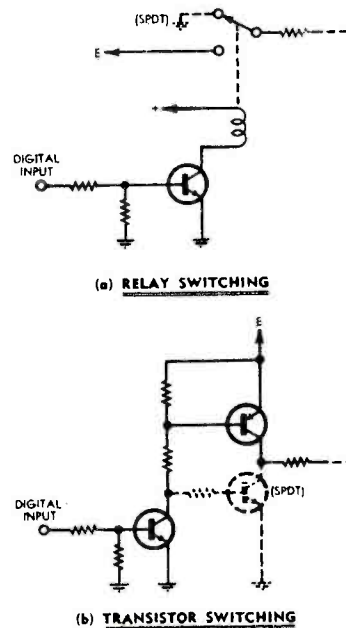


Fig. 3

largely a function of the turn-on voltage of transistor and diode junctions.

T10 is a feedback mixer and voltage amplifier used to stabilise and adjust the gain; T11 is an output emitter follower, while T12 is used to provide an adjustable bias on T9 for zero setting the DAC output. The 1mA FSD meter connected to the output is used to indicate converter operation.

Let us now turn to the complementary aspect of conversion — analog-to-

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digital conversion or "ADC." As one might expect, this aspect finds application wherever information in analog form must be fed to, or used to control, equipment designed to handle digital information.

A very practical application of ADC is the digital voltmeter or "DVM," in which the analog input is simply the voltage to be measured while the digital output is the number indicated by the readout display system.

Many other digital instruments are also applications of ADC. Examples are digital thermometers, pressure gauges, flowmeters, resistance bridges and Q meters.

There are many different ways of performing ADC—many more, in fact, than we can hope to discuss here. However, in general, all ADC's depend for their operation on an analog logic element usually called a **comparator**.

The function of an analog comparator is to deliver a digital output signal whose value depends upon the relative values of two analog input signals. This is illustrated in figure 5, which shows the logic symbol of a comparator together with the expressions which define its operation.

As may be seen, the digital output C is true (=logical 1) if the positive input A is larger than the negative input B. Conversely C is false (=logical 0) if B is larger than A. The comparator thus performs a comparison between A and B and gives the answer in binary form.

Figure 6 shows the circuit of the simple analog comparator used in the author's digital demonstrator unit. A brief look at this circuit may help in understanding how comparators operate.

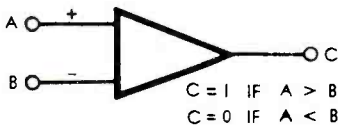


Fig. 5 THE ANALOG COMPARATOR

In this circuit, T1 and T2 are input emitter followers, again of the "inverted" type to provide low offset. They share a common emitter resistor, T2 being coupled to the resistor via a diode D1, which serves to provide it with a small initial hold-off bias. The collector of T2 is coupled to the base of T3, which in turn couples to output transistor T4 to give a high voltage amplification.

Operation of the circuit is as follows: With both inputs at zero, T1 is saturated so that point X is only a few hundred millivolts positive with respect to ground. The turn-on voltage of D1 is such that the emitter of T2 is at near-zero potential under these conditions; thus T2 is cut off, despite the fact that its base and collector are both at ground. And with T2 non-conducting, T3 and T4 are similarly cut off and the output is also at ground (= logical 0).

The output will remain at logical 0 if a positive signal is applied to input B, because T2 will already be cut off. However, if B remains at zero and input is applied to A, transistor T1 will come out of saturation and the voltage at point X will rise. As soon as it rises sufficiently to overcome the turn-on voltage of D1, this voltage will be applied to T2.

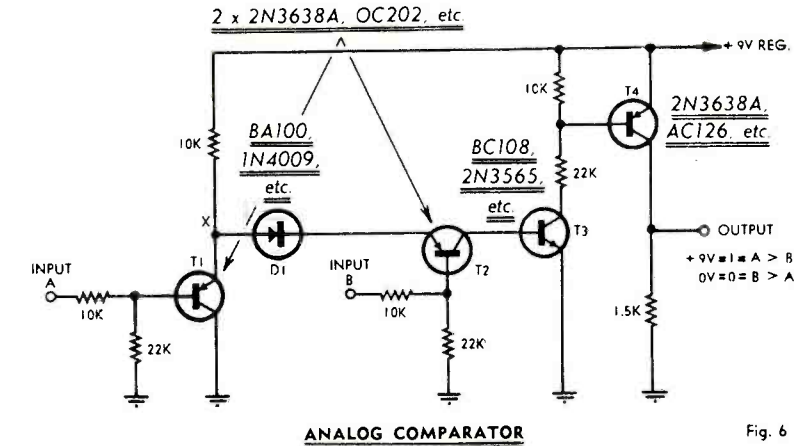


Fig. 6

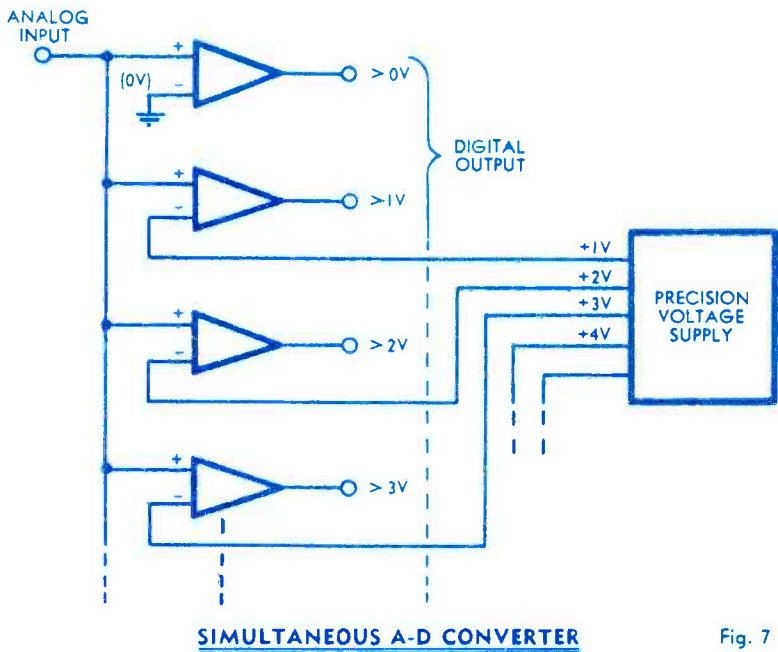


Fig. 7

With the B input at zero, T2 will saturate immediately this occurs, and will provide input current to T3. Hence T3 and T4 will be driven rapidly into saturation and the output will rise to +9V (logical 1). The circuit thus acts as a high-gain DC amplifier if we consider input A alone.

However, as soon as positive voltage is applied to input B, T2 is provided with hold-off bias which tends to counter the forward bias applied to its emitter via D1. A signal applied to B can thus be used to balance the effect of a signal at A and restore the output voltage to zero (= logical 0).

In order that the circuit may have minimum offset, diode D1 is selected so that with inputs A and B both at zero its turn-on voltage is just high enough to prevent T2 conducting due to the saturation voltage of T1. Thus T2 will tend to conduct immediately input A rises, and input B will be able to counter A on a 1:1 basis.

Under these conditions the circuit has very low offset and a very high gain, giving a small "aperture." The latter term describes the value of (A-B) or (B-A) required to change the output from logical 1 to 0 or vice-versa.

The diagram of figure 7 shows one way in which analog-to-digital conver-

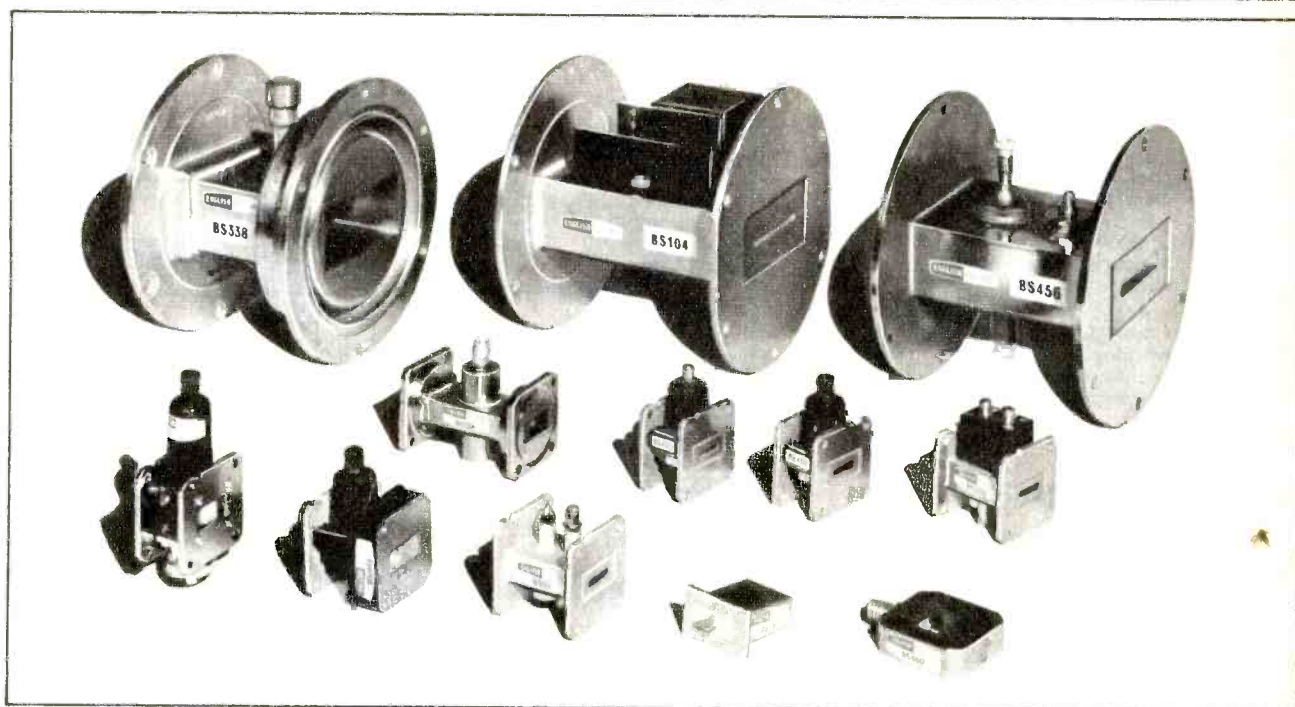
sion may be performed using analog comparators. The system shown is usually called "simultaneous ADC," as it provides a continuous and almost instantaneous digital output.

The **simultaneous ADC** consists of a series of analog comparators whose "+" or "A" inputs are connected in common to the analog input, and whose "-" or "B" inputs connect to a series of graduated precision reference voltages. The output of each comparator thus indicates whether or not the analog input is greater or less than the reference voltage concerned, and the comparator outputs as a whole give a digital representation of the magnitude of the analog input.

The output is in the form of what might be described as "cumulative decimal" notation, but this can be translated fairly easily into standard decimal, pure binary or BCD code as desired. The signal-handling capacity and resolution of the simultaneous ADC is more or less directly proportional to the number of comparators employed.

While the simultaneous ADC is extremely fast in operation, it tends to be rather costly as a result of the number of comparators and precision voltages required. For this reason it is used only in applications requiring maximum pos-

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sible conversion speed with cost of little concern.

Naturally enough, in most applications, cost and its reduction are of vital concern. It is therefore not surprising that designers have found many alternative ADC methods to obviate the need for multiple comparators and reference voltages. Some of the more common of these methods will now be briefly discussed.

Figure 8 shows the logic diagram of the most economical ADC method, which is usually called "counter conversion." It may be noted that the ADC includes a DAC as one of its components, a feature possessed in common by most single-comparator ADCs.

The counter-type ADC consists of a counting register fed via an AND gate with pulses from a "clock" pulse generator. The second input of the AND gate connects to the output of an analog comparator, so that the comparator effectively controls the flow of pulses into the register.

The analog input signal is applied to the + input of the comparator, and thus tends to open the AND gate and allow pulses to flow into the counter. When this occurs, the digital registration of the counter will rise and the analog DAC output will rise also.

As the DAC output is connected to the - input of the comparator, the latter will be forced to close the AND gate as soon as the DAC output voltage equals and exceeds the input voltage. Counting thus stops when the digital registration of the counter is equivalent to the analog input voltage, giving the required analog-to-digital conversion.

It may be seen that the counter-type ADC uses a counter and DAC to generate a rising analog "staircase" waveform which forms the reference voltage for the single comparator. In effect, it "tries" a series of increasing reference voltages at the negative comparator input, and stops when the reference balances the analog input.

The counter-type ADC tends to be rather slow in operation as it must build up a balancing reference voltage by cumulative counting. It has the additional disadvantage that it can only operate continuously for increasing input signals. To cope with decreasing signals at all it must be arranged to "sample" at periodic intervals by resetting the counter and forcing it to reach a new balance.

As a result of its shortcomings, the counter-type ADC is restricted mainly to applications where slow-speed sampling-type conversion is required. Probably the most common application is in low-cost digital voltmeters.

The "continuous" ADC is a development from the counter type. In place of the simple counting register the continuous converter employs a bi-directional register, and uses two analog comparators to control both pulse input to the counter and counting direction. It is thus able to give a continuous conversion, as it can follow both upward and downward variations in the analog input.

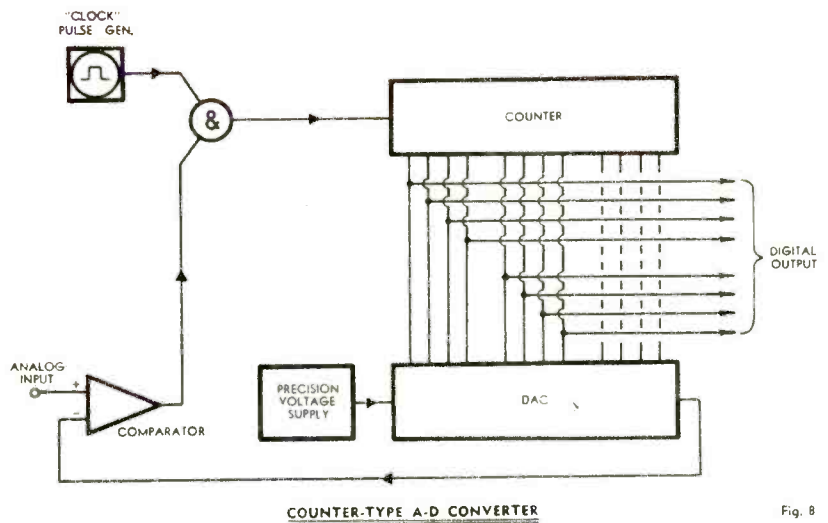
Although the continuous ADC lacks one of the shortcomings of the counter type, it retains the disadvantage of slow following speed with respect to large changes in input. Thus it, too, tends to be restricted to slow speed applications although less so than in the case of the counter type.

In general, ADCs designed for higher

operating speeds adopt "short-cut" means to generate the comparison voltage, rather than generate the voltage using simple or bidirectional counting. For example, there is the "sequential approximation" ADC, which achieves a rapid balance by commencing with a large reference voltage step and then applies smaller and smaller corrections to this depending upon the state of the comparator. Very high-speed ADC's use even more complex balancing techniques and sometimes use a combination of a number of techniques.

As mentioned earlier, the space is not available in the current series of articles for a complete description of all methods of analog-to-digital conversion. However, the foregoing should give some insight into the general principles involved.

Although it was intended in the present article to give brief constructional details of the third panel of the author's digital demonstrator unit, lack of space forces deferment of this until next month.



COUNTER-TYPE A-D CONVERTER

Fig. 8

SELECTED BIBLIOGRAPHY

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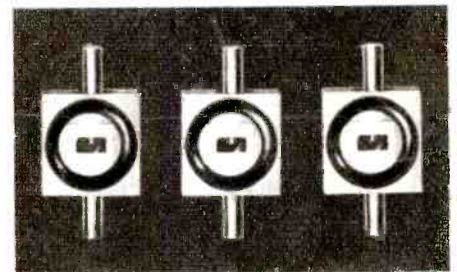
PEARMAN, C. R. and POPODI, A. E. "How To Design High-Speed D-A Converters," in *Electronics*, V. 37, No. 8 (Feb. 21, 1964).

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THE DIGITAL LOGIC HANDBOOK, 1966-67 Edition. Digital Equipment Corp., Maynard, Massachusetts. (Available by request on company letterhead from Digital Equipment Australia Pty. Ltd., 89 Berry Street, North Sydney, N.S.W.)

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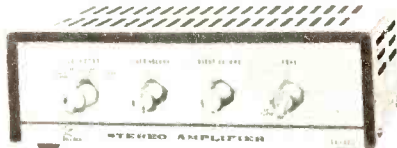
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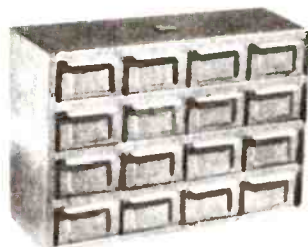
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Of all the faults likely to drive a serviceman up the wall the intermittent is way out in front. It seldom follows a set pattern or responds to a set servicing technique. Each one has to be treated on an individual basis, and one never stops learning how to track them down.

This story of an intermittent fault is unique as far as I am concerned. Over the years I have encountered almost every conceivable type, and used a multitude of techniques to track them down. But this was the first time that I have been able to nominate the source of such trouble by simply studying the circuit diagram — and it may well be the last.

Was it just good luck?

Well, it would be foolish to deny that luck played a part in the story, as indeed it does in tracking down any intermittent fault. At the same time, I think the story illustrates how logical deduction can play a valuable part in such cases. Maybe it will not always produce as clear-cut an answer as in this case, but it can still be helpful.

To really start at the beginning I should go back a few months (March and July) to a story I related about a portable tape recorder and how it was fitted with nickel-cadmium batteries in place of the original sealed lead-acid battery.

My present customer was a professional journalist, who had bought one of these tape recorders for use in his work. It was the same make as the one in my previous story, but an earlier model, which he had obtained second-hand at a reasonable price.

For the most part he was quite happy with the transaction, but two things bothered him. One was the condition of the battery, which appeared to be poor, and the other was a strange fault which he had encountered.

The poor battery did not really surprise him and, at the price he paid for the machine, he cheerfully accepted that he would probably have to buy a new one. However, in seeking information on a new battery he had encountered my previous customer, also a journalist, who needed no second bidding to tell him the whole story of the nickel-cadmium cells. It was in regard to these that he sought my aid.

The "strange fault" was not quite so straightforward. Shortly after he acquired the machine, he attempted to make a recording but found that the machine refused to record. Eventually, by setting and re-setting all the switches several times he was able to get it working, and

it had performed satisfactorily ever since. However, he was naturally very concerned at the intermittent nature of the fault and fearful lest it occur in the middle of an important interview.

I could see his point, of course, but privately I wasn't too keen about the problem. Portable transistorised tape recorders are not the kind of thing I tackle every day and, as far as this particular make was concerned, I had never looked beyond the battery compartment. Add to this the intermittent nature of the fault and the whole thing took on a rather forbidding aspect.

Nevertheless I told him I would do what I could, and explained that a good deal depended on whether I could make the fault recur, since it is almost impossible to diagnose an intermittent fault without observing it at least once.

In the meantime I did my best to get an accurate picture of the customer's own observations. This wasn't easy, since his was an essentially "non-technical" outlook. At one stage he had almost convinced me that the failure was in the transport mechanism, but further questioning proved this theory false. Eventually I settled for a simple failure to record, in the purely electrical sense.

In addition to the matters already raised, the customer had asked whether I could make him up a simple connector lead to permit recording from a radio receiver, via the voice coil, and also an earphone to permit private listening. Since the recorder was already equipped with the necessary sockets, it was simply a matter of providing a couple of matching DIN plugs and wiring them to the appropriate devices.

It was while I was testing the lead for recording radio programs that I had my first break. The first time I tried it everything worked perfectly and I produced a first-class recording. However, when I tried to make a second recording immediately after, the system broke down.

The first thing I was aware of was that the recording level meter failed to respond. Not knowing whether it was the meter itself which had failed, or whether it simply was not receiving any signal, I switched the recorder's own speaker to the monitoring position. When it gave forth signals, loud and clear, I

assumed that the meter had probably failed and let the tape run.

The first real shock came when I rewound the tape and tried to replay what I had just recorded. Instead, I was treated to the previous recording, with only a faint distorted version of the second recording audible during quiet passages of the first recording. Suddenly I realised that this was the intermittent of which the customer had complained, and a lot of vague statements he had made began to make sense.

I also realised that enough facts had emerged during the experiment to positively pinpoint one aspect of the fault. The fact that the previous recording had not been erased and that the attempted recording was weak and distorted clearly indicated that the bias oscillator had failed. However, this did not explain why the recording level meter had failed to register any audio level.

This part of the fault was made even more puzzling by the fact that the whole of the amplifier system was working correctly, as indicated by the monitor speaker during the recording experiment. So, what kind of fault would be common to two apparently unrelated sections, the bias oscillator and the level meter?

I need hardly add that, having staged one performance, the intermittent flatly refused to stage another. I went through the "record" switching procedure over and over again in the hope that it would show up. It was no use, I was on my own.

At this point I reached for the circuit, which the owner had been fortunate enough to acquire with the machine, and took my first really good look at it. It wasn't the easiest diagram to read, being of continental origin, and using lots of little squares and rectangles in place of conventional symbols — something which takes quite a lot of getting used to. (I have had the relevant portion translated into the local circuit dialect and reproduced herewith!)

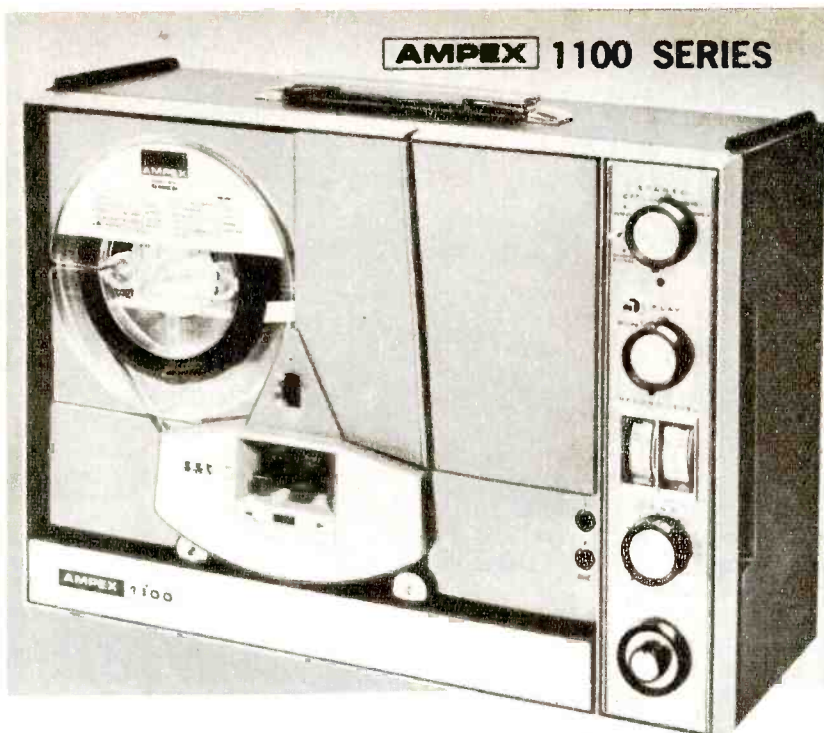
I found the bias oscillator section without too much bother, then started looking for the level meter to find what, if anything, they had in common. It turned out to be right nearby and, after tracing a few connections and working out in which position the various switch contacts were shown, I found the common factor.

The level meter was fed with audio signal from the output transformer secondary circuit which fed the recording head. However, it did not go directly to the meter. Instead, it fed the base of a transistor connected in an emitter follower configuration, and which was also unbiased. As nearly as I could judge, the emitter follower provided a degree of matching between the audio line and the meter, while the lack of bias provided the detection necessary to make the meter read the audio level.

The common factor was the fact that both this transistor and the bias oscillator transistor operated from the same (negative) collector supply line, after it passed through a set of switch contacts operated by the main recording switch.

With the switch in the "record" position, collector voltage was fed to both stages but both were rendered inoperative with the switch in the "replay" position. They were the only two stages to be fed from this part of the supply line.

Having digested all this, it seemed almost automatic that I should suspect the



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switch contacts. After all, switch contacts are easy things to suspect anyhow, and these were sitting right in the hot seat.

Nevertheless, I didn't want to be caught out by my own enthusiasm. As a double check, I traced the collector supply line right back to the battery, but keeping in mind the essential fact that the possible failure of any other component must effect only the two stages mentioned.

The closest I came to another "possible" was the discovery of a decoupling network from which this collector line was taken. At first glance it looked as though the failure of either decoupling component could cause identical symptoms, but closer examination contradicted this. The decoupling network was a two section affair, the first section feeding the bias oscillator and meter circuit, the second the first four stages of the main amplifier. Therefore, if the first stage failed it would also put the amplifier out of action — something which hadn't happened.

So, it was back to the switch contacts. And the more I thought about it — which included the period over a weekend — the more convinced I became that this was the trouble. I could readily visualise a set of contacts which needed either straightening or tightening. All I had to do was open up the recorder and find the contacts.

In fact, this turned out to be the more difficult part of the job, though I must give the makers full marks for their efforts to make servicing easy. The circuit carried a separate diagram showing the physical layout of the switch with each contact (there were 30 in all) numbered to correspond with a number on the circuit proper; lead identification for each transistor was given in a series of separate diagrams, and the location of each transistor was given on a cover plate inside the case. One could hardly ask for more, and I only wish some local manufacturers would learn a lesson from it.

Thus aided, I set about locating the switch. The main circuit was built on a printed wiring board which was pivoted along one edge so that, by removing one screw, the whole board swung out to reveal its reverse side.

As well as the rest of the circuitry and components, this board also carried the switch, which was a "straight line" type running the full length of the board. Broken down to its separate functions, it really consisted of 10 single pole, two-position switches.

The main mechanical portion of the switch, consisting of the actuating mechanism, locking mechanism, and mechanical and electrical interlocks, was located on the main chassis, the movement being conveyed to the contact shaft by means of a lever which engaged in a slot in the shaft when the board was restored to its normal position. With the board swung down, there was no mechanical connection between the two.

Having identified the meter transistor and the nearby bias oscillator transistor and bias oscillator transformer, it was relatively easy to pick out the collector supply line in the copper pattern, and trace this back to the switch. The switch diagram helped confirm that I had located the correct contact.

There was only one snag. The switch was covered with a metal shield; a "U" shaped channel of light tinplate which,

inverted, completely enclosed the portion in which I was interested. It was held in position with a large blob of solder at each end. Thus, although I had identified the suspect contact on the underside of the board, I was still unable to see it. Most frustrating!

A few minutes work with the soldering iron freed the ends of the shield and I gently eased it clear. Then I identified the suspect contact and took a close look at it. I didn't find what I expected. The contact was neither damaged nor lacking in tension. On the contrary, it appeared to be very good in the latter respect. Nevertheless, a likely cause of the trouble was plainly evident.

Whereas all the other fixed contacts on the switch were rectangular, this particular contact was triangular. As nearly as I could judge this was a form of non-shorting, or "break-before-make" contact, though the exact reason for its inclusion in this part of the circuit escapes me. The only suggestion I can offer is that it may be to prevent clicks appearing on the tape every time the "record" switch is operated.

Be that as it may, the fact remained that it was the shape of the contact that was contributing to the fault, since the moving contact, when in the "record" position, appeared to move only just far enough to barely touch the fixed, triangular, contact. There was no evidence of any spreading movement on the part of the moving contact. In these circumstances it would be surprising if there wasn't an intermittent condition.

However, I had to go to some trouble to confirm this. Because the contact section of the switch was disengaged from the mechanical portion when the board was swung out where I could examine the switch, I had to be quite sure that the contact position, as I saw it, was a true one, and not due to a spurious movement after the two switch sections had disengaged.

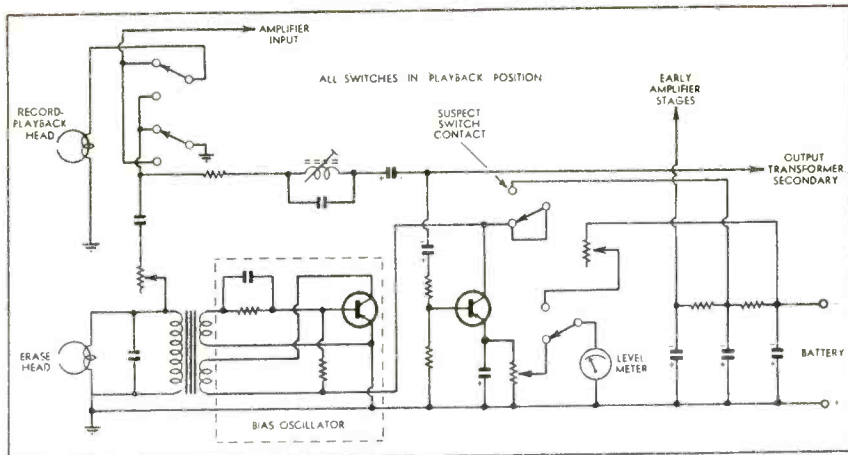
Fortunately, the moving contacts gripped the fixed ones quite firmly, making the whole movement relatively stiff and unlikely to move after disengagement from the lever mechanism. So I evolved a little ritual of swinging the board closed, engaging the switch mechanism, switching to "replay" then back to "record," then carefully swinging the board out and examining the contact position. I repeated this several times, even using a small magnifying glass to examine the contact position.

The result of this left no doubt in my mind. In the "record" position the two contacts were barely touching and undoubtedly the cause of the trouble. The next question was, what to do about it?

Although the triangular contact had contributed to the trouble, it was not, of course, the actual fault, since it was intended to be that way. The real fault was that the switch mechanism was not moving the contacts far enough to permit positive engagement in this case. More precisely, the whole system was not correctly "centred," the contacts being too far in the opposite direction when in the "replay" position, but without this creating any problems.

At first, it looked as though the only way to correct this would be to deliberately bend the actuating lever by a small amount, although I wasn't too happy about this, since it rather smacked of butchery. As it turned out, I am glad I didn't rush in.

Closer examination revealed a more



The relevant portion of the tape recorder circuit (translated into Australian) showing the suspect contacts in the collector supply line. The common failure of two sections provided the clue to the fault.


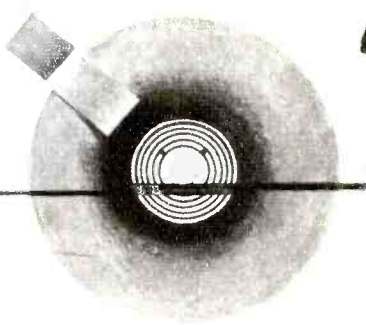
legitimate approach to the problem. The lever from the switch mechanism engaged a slot in a metal plate mounted on the end of the bakelite contact shaft; the moving contact portion of the switch. The plate was secured with a small screw passing through a slotted hole on the bakelite. Fairly obviously, someone had already anticipated the need for this adjustment.

All I had to do was loosen the screw, move the metal plate about 3/32in in the appropriate direction, and tighten the screw. However, I took the precaution of marking the original position of the plate, using the point of a pin to scribe a line on the bakelite, so that I could

check precisely how much I had moved it.

Having done this I repeated the previous ritual, checking for both "record" and "replay" positions several times, until I was satisfied that the contacts were correctly located in both. Then I replaced the shield, fitted the wiring board permanently back in place, and generally restored the machine to full working order.

On test, it worked perfectly, although this, in itself, was no proof of success. Only prolonged use without failure would provide this, but I was sufficiently confident to advise the customer that he was unlikely to have further trouble. □





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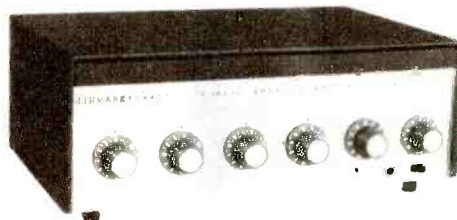
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Forum

Hauraki Pirates of Penzance

While "radio" interests in Australia are currently — but not very urgently — discussing the future of FM-stereo broadcasting, colour television and vertical polarisation in certain TV areas, readers in New Zealand have a much more immediate topic of conversation — that of "pirate" radio broadcasters. To judge by certain letters to hand, an earlier correspondent, Mr V. M. Stagpoole, may not speak for quite as large a majority as he seemed to imagine.

Conducted by the Editor

In discussing, in a monthly magazine, something as immediate and topical as pirate radio transmitters, there is a very great danger that the whole situation will have changed drastically before the issue gets into the hands of readers. This is particularly true of New Zealand, where publication is delayed by an inconvenient shipping service across the Tasman.

Be that as it may, it seems appropriate to record some of the reactions which readers have registered and which contradict the attitude of the correspondent mentioned above. From a reader in Hamilton, N.Z., comes a letter in the following terms:

Dear Sir,

I could hardly believe my eyes when I saw V. M. Stagpoole's letter on pirate radio stations in your October issue.

If there is any real conviction in your mind that the pirates may be in for a lean time—forget it!

A poll taken in Auckland showed 70 per cent of the population to be very much in favour of the pirate radio. Hundreds of pounds have been given to them to tide them over their rough start.

Someone gave them a brand new electric stove.

An incredible 2,000 people turned up for a public meeting in support of the radio!

Petitions have been signed with thousands of names.

With regard to the comments about lack of political pressure: In the six weeks preceding this year's general elec-

tion, all the political commentaries (which are usually given by university lecturers, representatives of women's federations and journalists) were taken off the air until after the election. Isn't that incredible in a democratic country? No political pressure?

As far as the "well-rounded programs" are concerned, they are pathetic.

An example:

When the pirate station set off from Auckland's wharf, the Minister of Broadcasting announced that he had hired an announcer from a potential rival of Radio Hauraki. A morning session was instigated—in the form of a breakfast session on a non-commercial music station.

Immediately, a majority of listeners switched from the commercial station to the new breakfast session, and the advertisers are now screaming. So much for the quality of N.Z.B.C. programs.

Another thing: When Radio Hauraki precariously announced its plans to broadcast, N.Z.B.C. announcers deserted in droves. They said that there were so many restrictions under the N.Z.B.C. that they felt oppressed.

You should also know about the series of censorship scandals—producers resigning, etc.

A reader from Manurewa has much the same thing to say, though in more moderate terms:

Dear Sir,

With reference to the letter from Mr Stagpoole on Page 67 of the October

issue of "ELECTRONICS Australia," it would appear that the "responsible persons" in New Zealand are in the minority.

In an over-legislated social-welfare State, any free-enterprise stand against the powers that be, no matter how mis-directed, receives considerable public support.

In this case the support has been overwhelming.

This has probably been the hottest subject around town for the past few weeks and every comment heard so far, both in the trade and on the streets, has been in their favour.

Even the Prime Minister has joined in the general commendation of the step they have taken!

D.M. (Manurewa, N.Z.)

Attached to the latter is a clipping identified as coming from the "Auckland Star," dated Thursday, November 17. It reads as follows:

P.M. IN SALUTE TO PIRATES

The Prime Minister, Mr Holyoake, last night commended the Radio Hauraki pirates for their "ingenuity, energy and imagination," and hoped they would eventually get a licence to legalise their work.

He admitted that the Government may have expected too much from the New Zealand Broadcasting Corporation by making it the licensing authority for private enterprise radio and television.

Because of this, the Government had drawn up a new policy which would create an independent licensing authority.

Mr Holyoake told the 1,600 people in the Town Hall that the Labor Party was against any private radio or television stations.

The well known American journal "Electronics" has its own comment on the situation in New Zealand. Under the heading "Static On Network," it has this to say:

"Pressure is building up on the State-owned New Zealand Broadcasting Corp. and its long-standing monopoly seems in jeopardy.

"Convinced that commercial television isn't far off, a group of businessmen in the country's capital, Wellington, has formed a company called the New Zealand Television Corp., and is clamouring for independent television stations. G. A. Wooler, chairman of the N.Z.T.V.C., says three major United States broadcasting companies want a piece of the action. N.Z.T.V.C. will initially invest \$7 million, \$2.8 million of it from the U.S. if it gets a Government go-ahead.

"N.Z.T.V.C., though, is just one challenger of the State broadcasting monopoly. This month, the network got a first taste of competition when a 'pirate' radio

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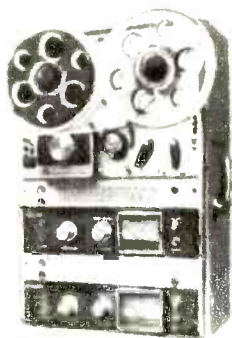


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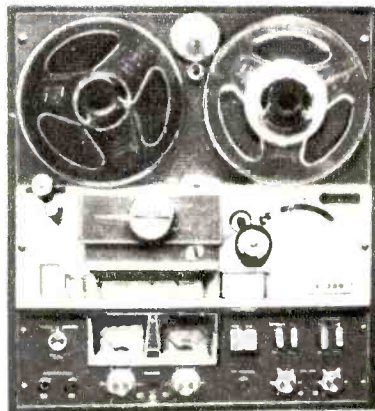
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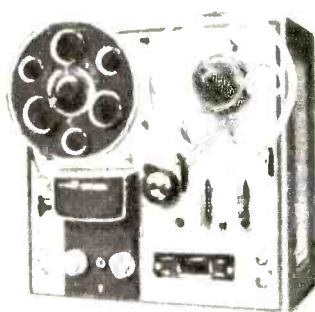
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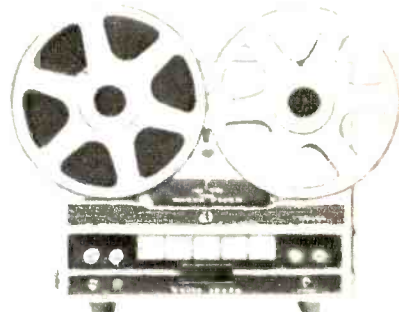
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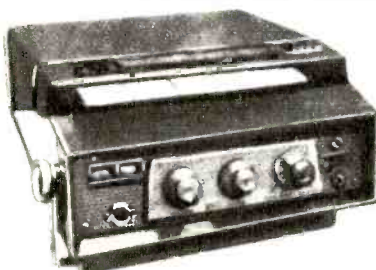


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station began broadcasting from a ship in the Hauraki Gulf, off the north coast. Radio Hauraki, as it is known, faces some competition itself. Two other pirate operations, Radio Southern Cross and Radio Ventura, plan broadcasts from ships.

"So far the Government has made no move against the pirates. Rather than the marines, the Government looks to Pacific storms to silence the renegade transmitters!

"But more than the NZTVC and the pirate stations, what threatens the broadcasting monopoly is the position of the ruling Liberal-National Party. At its congress this summer, the party backed establishment of an independent TV network and has been agitating for action ever since.

"The feeling in Wellington is that the Government will be forced to decide soon."

Such then is typical comment in the situation in New Zealand — comment which adds up to a very different point of view from that put forward by Mr Siagpoole, in the October issue.

Without pretending to any special knowledge of the facts and forces, it does seem that a better system of administration and control is long overdue in New Zealand. And, in the search for a new system, it would also seem wise to envisage something along the lines of America's Federal Communications Commission, rather than the half-and-half system currently operating in Australia, with the Australian Broadcasting Control Board and the Postmaster General's Department both involved in cutting up the radio frequency cake.

If the situation does change drastically in New Zealand, and more transmitters appear on the air, the question of channels automatically follows. Maybe, New Zealand will begin to give back to Australia some of the interference problems it has for so long received, thereby disturbing the Australian Government's apparent hopes for a broadcastband Utopia.

And could it be that this row about "pirates" in New Zealand waters will turn out to be a catalyst for a more serious look at FM on both sides of the Tasman?

Stranger things have happened.

Correspondence and comment about our adoption of the term Hertz seems to have passed its peak, but there are still those who feel strongly enough about it to "have a go."

In a way, this is a good thing because, by keeping discussion alive, they are making the term more familiar more rapidly, thereby speeding its adoption into our everyday vocabulary, as distinct from our official technical language.

And this certainly needs to be done. No one who has lived with "cycle" terminology for half a lifetime, can suddenly switch to Hertz without lapses and without some feeling of awkwardness.

In the letter opposite, R.A. emulates my earlier efforts to bring a little humour into the discussion but, in so doing, lays himself wide open to retort.

He lives in a house surrounded by a cyclepersecondzone fence; he rides to work on a bicyclepersecond; he expresses an interest in cyclepersecondotrons; the amateurs of his ken study sunspots in terms of cycles per second — a rather amazing repetition rate for such phenomena!

HERTZ — "Whether we like 'em or not!"

Dear Sir,

So — like conscription and fluoride — we're going to have "Hertz" whether we like 'em or not. No referendum. Pity. Still I suppose in time I'll get used to jumping my Hertzzone fence, picking up my biHertz from the gutter and pedalling my way to work. The scientists will get used to fiddling with their Hertzotrons at Lucas Heights (or wherever they keep 'em) and the hams will continue to study the sunspot Hertzies.

You see, Mr Editor, what you and all the other apologists for this horrible European term have overlooked is the fact that there WAS an existing term for periodic happenings before old Hertz even found Hertzian waves. I've no doubt that the English "cycles" had its equivalent in Spanish, French, German, Dutch or any other language you'd like to mention (from Europe of course) just as long ago. Now — you bring up amperes, volts and farads. Who's arguing with you? I'm not. There WERE no terms in existence to describe these quantities. So let's honour the pioneers by all means.

What are you going to do when you deal with acoustics? Are we to honour Hertz for waves in air? I doubt if it's even logical to use the term for electrical impulses flowing along wires or through components; Hertz discovered electro-magnetic radiations in space.

Are the electric supply authorities of the world in on this thing too? From now on will they describe their excellent and indispensable product as "50 Hertz" power? They can have it that way in the Common Market if they wish but it's not for me. Next thing you'll be changing your circuit drafting style (one of the best in the world at present) and we'll have resistors looking like rectangles, transformers made up of straight lines — and valves with no glass around them.

I'm sorry the Americans fell for this Hertz thing — they couldn't have been doing too much logical thinking — probably just woolly-headed sentimentalism. It seems that we have one more thing in common with the Yanks — the higher up the educational or cultural ladder you go in both our countries, the more you find people apologising for being Americans (or Australians, as the case may be) and feeling they owe something to Europe. Maybe both countries do — a great deal — but the real debts are left unpaid and the imaginary ones paid with a flourish.

If the scientifically and etymologically thoroughbred word "cycle" is now to become a dirty word you can count me out. Use it if you must up and down the l.f., h.f. and v.h.f. bands and I'll go along (although gigaHertz and nanoHertz are going to sound a bit silly) but leave my amplifier's response and my piano's tuning in cycles per second — PLEASE.

R. A. (ALBANY, W.A.)

MARCONI — HERTZ

The following is a quote from the Marconi Company's circular "m.i. measuretest," published in England:

Terminology: The decision has been made at Marconi Instruments that, henceforth, the term "hertz" will be used instead of "cycles per second" in all published literature. Quite a decision — the abandoning of an established, intrinsically meaningful, term in favour of one that has meaning only by accepted usage.

Imagine the heart searching, the arguments, even the quarrels that may have been involved. Try to appreciate the resistance to such a decision in the conservative minds of the engineering staff. Get a mental picture of the word "hertz" appearing on the agenda of a policy meeting; think of the misgiving of those reading it, knowing that it will cause hours of discussion with the probability of a late sitting.

Well, it wasn't like that at all. Somebody said to the Technical Director, "Considering our vast number of overseas customers, wouldn't it be a good idea to join this trend towards using Hz instead of c/s?"

The Technical Director said, "Yes." And that was that. What he says goes; so it's Hz from now on. Of course, this does not mean that we shall make bonfire of the existing stock of literature; and there is bound to be a period of inconsistency with Hz and c/s running in parallel. By the time the changeover is complete we shall probably have got used to the idea and stop mentally translating "10 MHz" to "ten megacycles." Eventually we must learn to use the term naturally in technical conversations, but, judging by the number of engineers who write about "inductors and capacitors" yet still talk about "coils and condensers," the overall mental transition is likely to take a long time.

Nor is the doubt about our correspondent's interpretation of the term resolved in his following paragraph. He seems still to be equating Hertz to "cycle."

Whether or not this is a genuine error on the part of R.A., it certainly is an error that others have made.

Hertz is NOT a synonym for cycle(s) and it is not intended to supplant it in the general language of cyclic phenomena. It has no place, therefore, in discussion of sunspot cycles, weather cycles or any other such topics. "Cycle" remains as a valid, general term, which would normally be associated with some relevant time period: Eleven years, one

year, one month, one day, one hour, one minute, etc.

Nor would there be any room for confusion if cyclic phenomena were expressed at any time in the future in cycles per second. The term remains as legitimate and unambiguous as cycles per day, per year or per anything else — PROVIDED the time period is indicated.

Therefore, if R.A. chooses to adhere to cycles per second for his thinking, his speaking and his writing, there will be no danger of his being misunderstood. He will merely become progres-

(Continued on page 99)



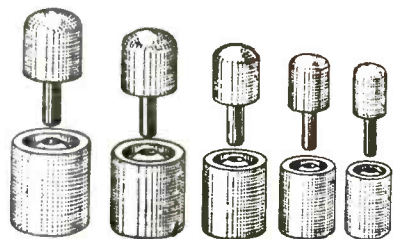
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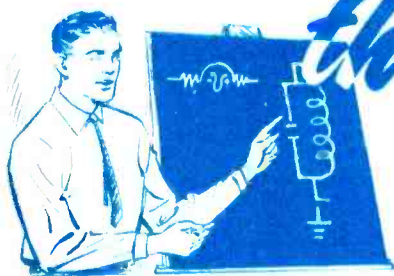
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the "Answer Man" Explains

HOW CAN A DIODE AMPLIFY AND OSCILLATE?

The Answer Man's first question, this month, calls for an explanation of the tunnel diode—an explanation which turns out to be simpler than most. Having duly stowed it away, you may feel inclined to go into the subject more deeply.

I have seen the circuit of an amplifier which used only a diode marked with a T. How does this diode amplify?

The diode used in the circuit is probably a tunnel diode, which can amplify if it is operated on the negative resistance portion of its characteristic. It could also be used as an oscillator by using this mode of operation. Tunnel diodes were described in articles in this magazine (then "Radio, Television and Hobbies") as follows:

"Understanding Tunnel Diodes," February, 1961.

"Practical Aspects of the Tunnel Diode," September, 1961.

A tunnel diode can be used at a much higher frequency than conventional valves or transistors and, because of its very low power requirements, is often a more convenient device to use at the microwave frequencies. The tunnel diode is a comparatively new semiconductor device which has a completely different mode of operation from normal diodes.

A tunnel diode is a single P-N junction, but with a very high level of doping. The conductivity is thus much greater than that of a normal junction diode.

Although the mechanism of a tunnel diode is still not fully understood, an electron from one side of the depletion layer seems to disappear, to appear simultaneously at the other side. This makes the electron appear to "tunnel" through the layer, giving rise to its name. Because of this tunnelling action, the characteristic of a tunnel diode is different from that of a normal junction diode, under both forward and reverse bias conditions.

If a tunnel diode is biased in the reverse direction, it displays an avalanche breakdown immediately, the current rising rapidly for a very small applied voltage. This negative portion of the characteristic of a tunnel diode is not therefore used. (A near relative of the tunnel diode with a very similar characteristic is the back diode, which is used in the reverse biased mode. This will be discussed briefly after the tunnel diode.)

As most readers will know, when a small forward voltage is applied to a normal diode, no current flows until the

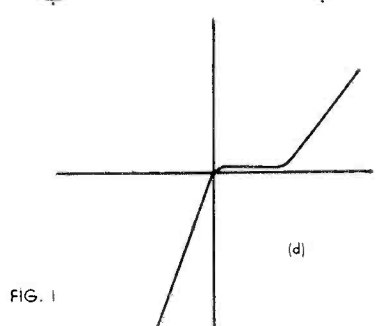
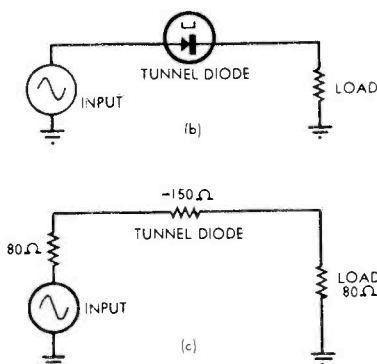
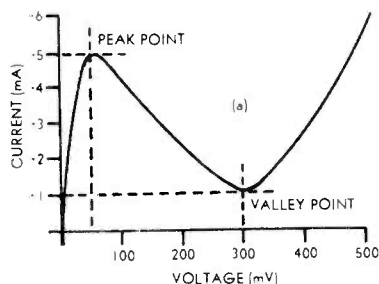


FIG. 1

depletion layer potential "barrier" is overcome. With a tunnel diode, however, some electrons "tunnel" through the barrier when a small forward voltage is applied, and initially the current rises rapidly with applied voltage. (Figure 1a).

Above a certain voltage, known as the

"peak" point, changes in the nature of the depletion layer barrier gradually inhibit the "tunnelling" effect, and current falls with increasing voltage. Above a second point, known as the "valley" point, the current rises once more as in a normal diode.

Since the current falls with increasing voltage between the peak and valley points, over this part of the characteristic the tunnel diode has an effective negative resistance.

Diagram 1b shows the basic arrangement of a tunnel diode amplifier. In a complete circuit, there would be inductors and resistors added and, of course, a bias supply. For a simple discussion, let us assume that the diode is biased in the middle of its negative resistance region.

In diagram 1c the tunnel diode has been replaced by a hypothetical negative resistance, its simplest equivalent circuit. The internal resistance of the input generator has been added, and values allotted for purpose of illustration. The resistances can be considered as forming a voltage divider with the output developed across the lower one of the chain. The output is given by the formula:

$$\begin{aligned} V_{out} &= V_{in} \times \frac{80}{80 + (-150) + 80} \\ &= V_{in} \times \frac{80}{10} \\ &= V_{in} \times 8 \end{aligned}$$

This means that merely by adding a negative resistance between the input and the output, the circuit has given a gain of 8.

If the negative resistance had been made a little larger, say 155 ohms, the total circuit resistance would have fallen to 5 ohms with a resulting increase in gain to 16. Obviously then, by biasing the tunnel diode to a point where its negative resistance is nearly equal to the sum of the positive resistances in the circuit, the gain can become very large.

If the negative resistance of the tunnel diode is made so as to be exactly equal to the sum of the positive resistances in the rest of the circuit, the gain becomes theoretically infinite. At this point, and with more negative values of resistance for the tunnel diode, the circuit has become an oscillator. The negative resistance can be placed in parallel with a tank circuit and will replace all the energy lost in the resistance of the circuit.

The voltages needed to bias a tunnel

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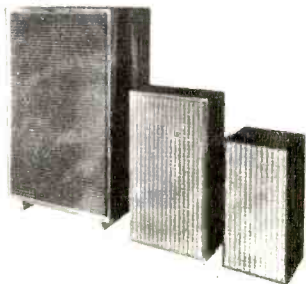
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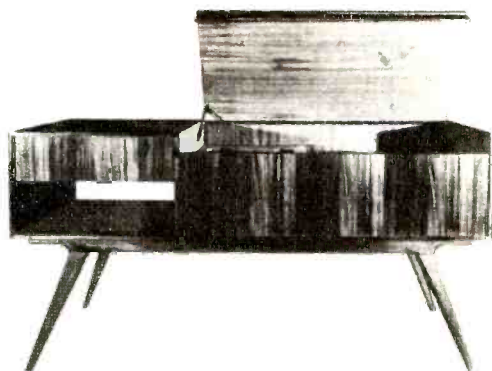


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diode are very small, too small to obtain from a conventional power supply unit directly. The bias needed for most tunnel diodes to place them in the negative resistance region is of the order of 120 to 200mV.

The necessary bias can be obtained by using a voltage divider chain with a forward biased silicon diode used as a reference diode, or from solar cells. The small voltages used for biasing mean that the input signal can only be of the order of 10mV. However, as the tunnel diode is a very low noise device, it is very useful for the front end of a receiver in the microwave region.

The final diagram (d) shows the characteristic of the back diode, which, as mentioned earlier, is a near relative of the tunnel diode.

As may be seen, the "reverse" current rises very sharply with increasing voltage, as with the tunnel diode. However, the "forward" characteristic is arranged so that it lacks the usual current peak of the tunnel diode. As a result if the device is operated "back to front," over a small voltage range in both directions it exhibits a characteristic far closer to the ideal diode than that of a normal junction diode.

The back diode therefore finds use wherever a near-ideal diode action is required at low voltage levels.

★ ★ ★

I have been told that very thin recording tapes (i.e., triple play) are unsuitable for high quality recording, because they have a poor high frequency response. Is this true?

Frankly, this is a new one on us and we have no idea where the story originated. It does not appeal to us as a logical statement, and we have been unable to find anyone able to confirm it.

According to the generally accepted basic principles governing high frequency response, thickness is not a factor. The high frequency response is dictated by the physical dimensions of the individual magnetic particles which form the magnetic surface on the tape.

Tapes using a thinner base may be subject to "print through"; that is, the magnetic state of one section of tape can affect the magnetic state of an adjacent section of tape, when the tape is wound tightly on a reel. This, in itself, may be sufficient to render thin tapes less suitable for high quality recording unless very careful attention can be paid to the recording level, to ensure that it is kept below the likely "print through" value. However, such a restriction may well create other problems where a wide dynamic range is involved.

Other problems associated with thin tapes are mainly of a physical nature, such as a tendency to undue stretch with poor quality base material, or less tolerance to the starting and stopping cycles of some machines not specifically designed with such material in mind.

However, while these limitations need to be kept in mind and due care exercised in handling thin tape, there is nothing to suggest that it is unsuitable for reasons of poor high frequency response.

It seems probable that, somewhere along the line, somebody's unfortunate experience with a thin tape has been badly garbled.

KEEPING UP WITH

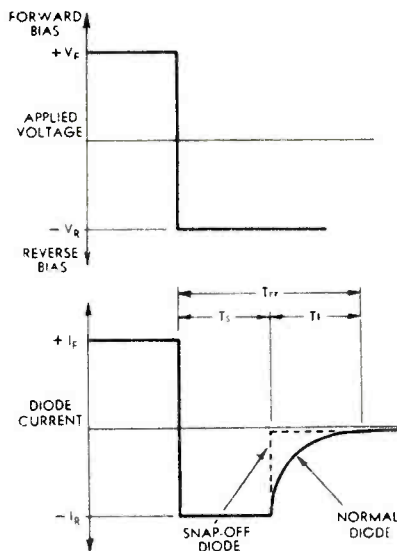
semiconductors

... Snap-off diodes

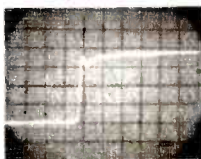
In a normal semiconductor junction diode which is conducting in the forward direction, electrons from the N-type material and holes from the P-type material stream in opposite directions through the P-N junction. In both cases they exchange their role of **majority** current carriers in their "home" material for the role of **minority** current carriers in the material which they are entering.

As minority current carriers in the new material, their lifetime tends to be short, for in the region as a whole there is a high probability that they will be met and annihilated by majority current carriers. However in the immediate vicinity of the junction this probability is lowest, for the reason that most of the majority current carriers which would normally exist in this area have been themselves attracted across the junction.

This being the case, during forward conduction there is a high concentration



A 200 pico-second step obtained with a snap-off diode.



The time taken for the current to fall to its static value is called the **transition time**.

This is illustrated in the diagram, where T_s is the storage time, T_t is the transition time and T_{rr} is the total "reverse recovery" time.

In a normal diode, T_t is relatively high—typically about one microsecond. This can cause embarrassment in pulse and high-frequency circuitry, and accordingly device designers have sought to produce diodes with a much shorter transition time. (Note that the storage time T_s is more or less inevitable.)

The **snap-off, step-recovery or charge-storage diode** (the names are synonymous) is a diode in which the transition time is made extremely short by controlling the doping of the diode so that minority carriers are restricted to very narrow regions in the immediate vicinity of the junction. At the end of the storage phase such diodes thus appear to "snap" off, recovering their static behaviour in a single rapid step. This is shown in the diagram by the dashed curve.

Typical snap-off diodes have transition times as small as 0.1 nanoseconds (100 picoseconds). The speed of snap-off is not related to the speed of the input waveform reversal; thus in most cases the snap-off will be considerably faster than the input reversal.

Because of their ability to produce an extremely rapid current change, snap-off diodes are ideal for producing and shaping fast pulses. They are also excellent for the generation of high-order harmonics from an input reference signal.

of minority current carriers on both sides of the junction, in its immediate vicinity.

If the external voltage applied to the diode is now suddenly reversed, the current will not fall immediately to its usual near-zero reverse-bias value. The reason for this is that a rapid reversal of applied voltage leaves the areas on each side of the junction with their high concentrations of minority carriers—and to minority carriers, the reverse-biased junction is an inviting "downhill" potential gradient.

The minority carriers thus proceed to stream back across the junction, and in doing so they constitute an appreciable reverse current flow.

The reverse current remains at a high value determined mainly by the external circuit resistance until the minority carrier concentrations in the vicinity of the junction fall to their zero-bias values. The time taken for this to occur is called the **storage time** of the diode.

When the near-junction concentrations have fallen to their zero-bias values, the current then commences to fall to its static reverse-bias value. The time which it takes to fall to this value depends upon the number of minority carriers which were present in the bulk of the crystal, and also upon the displacement required to set up the depletion layer.

Using the 'FET' in an Audio Preamp

Field-effect transistors are now freely available at low cost. This article explains how they work and shows how they can be used in audio preamp circuits.

by Anthony Leo



The field effect transistor is one of the more recent developments in semiconductor technology, although the device was originally proposed as early as 1952 by W. Shockley in a paper to the American Institute of Radio Engineers. In his paper, Shockley predicted the behaviour of the device and made mathematical derivations of some of its parameters, although at that time the device had never been made.

It was not until some time later, when the device was made, that Shockley's predictions were found to be remarkably accurate, although the device itself was still not a practical proposition. Following further development the device was subsequently made available to industry.

Until recently high manufacturing costs had restricted their use to industrial and military applications, but with improved quantity production techniques it has become possible to introduce them to the consumer market.

Fairchild Australia Pty. Ltd. have just released type 2N4360, an economy p-channel device at a very attractive unit price of \$1.05.

The field effect transistor, or simply

"FET," is a semiconductor device which differs markedly from the more familiar injection type transistor. For those more conversant with semiconductor theory the FET is a majority current carrier device while the injection type is a minority current carrier device. Both are three terminal devices, although some FETs can be made as a four terminal device analogous to a tetrode type valve. Corresponding to the two types of transistor structure (nnp and pnp) there are two types of FET structure described as n-channel and p-channel.

Clearly the most significant difference between the FET and the injection transistor is the high input resistance of the FET, to the order of 10,000Mohms. The input of the FET is basically a reverse biased diode, whereas the input of the injection transistor is a forward biased diode, with an input resistance of a few thousand ohms, in the case of small signal devices, and down to a few ohms for a power transistor.

As the FET is a voltage-controlled device and has a high input impedance

it is somewhat more suited to radio frequency circuitry than the injection transistor, which requires more elaborate impedance matching. However, the FETs available currently tend to have larger feedback capacities than silicon injection transistors and therefore would require more elaborate neutralisation than the latter.

The FET and injection transistors are both constant current devices and exhibit a pentode type output characteristic of high impedance. The FET tends toward a higher output impedance, although manufacturing techniques can produce a FET of relatively low output impedance.

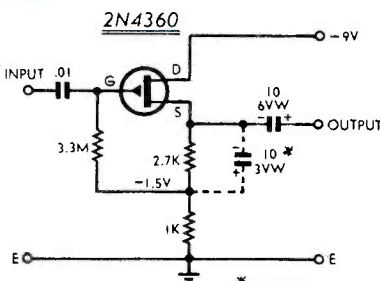
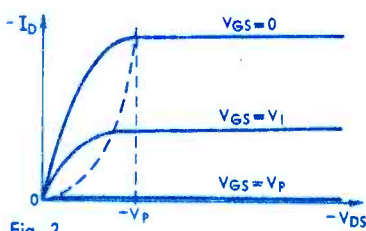
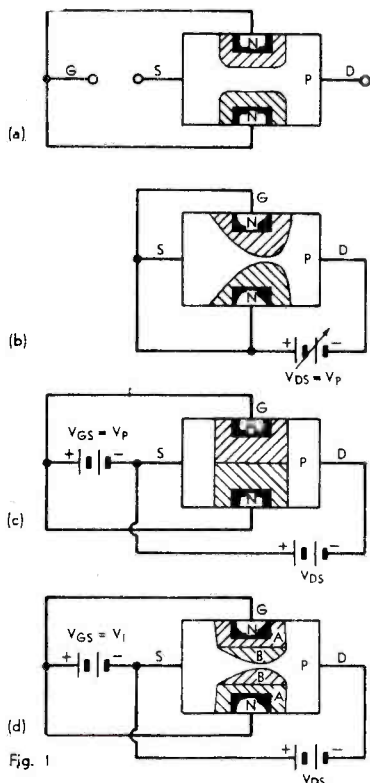
The three terminals of the FET are referred to as the "source," the "gate" and the "drain" corresponding to the emitter, base and collector of the injection transistor respectively, or in vacuum tube terminology, to the cathode, grid and anode respectively.

Figure 1 (a) shows the cross section of a P-type bar of silicon which has had N-type impurities introduced into opposite sides, forming two P-N junctions. The extent of the depletion region on either side of the junction is that of an unbiased diode. The N-regions constitute the gate and the area between the N-regions is termed the channel.

Consider the configuration of figure 1(b); the gate is externally connected to the source with a variable potential between the source-gate and the drain. At small values of this potential the channel between the drain and source behaves as a linear resistor but, as current increases, the parts of the channel near the junctions become significantly negative with respect to the source terminal. Since the N gate is connected externally to the source, the junctions are reverse biased and the depletion layers extend into the channel, lowering the channel conductance.

At some potential which we will designate V_p , a balance between the current limiting depletion layer and the channel current will cause the channel current to become constant and independent of any further increase of potential between the drain and source. At the point of current limiting the channel is said to be "pinched off" and the potential V_p is termed the pinch off voltage. The curve $V_{GS}=0$ of figure 2 is divided into two regions; the ohmic region where V_{DS} is less than V_p and the pinch off or constant current region where V_{DS} is greater than V_p .

If a bias between gate and drain is equal to V_p , as in figure 1 (c), then



At left are diagrams used to explain the operation of the FET, while at top above are the static characteristics. Immediately above is the circuit of a source follower, which may be used as a unity gain impedance matching device.

the depletion layers extend across the channel and meet, so as to cancel the potential gradient due to the voltage V_{ds} . Under these conditions no channel current flows, as represented by the $V_{gs}=V_p$ curve in figure 2.

Consider an applied bias intermediate between $V_{gs}=0$ and $V_{gs}=V_p$, which we shall designate V_i as in figure 1 (d).

The depletion layer will be the resultant of the two phenomena mentioned above, as shown in figure 1 (d). The section of the depletion layer which is shaped as a rectangle and labelled "A" is proportional to the gate bias V_{gs} .

As the drain source voltage is increased the drain current will increase to the point where the extension of the depletion region, the area labelled "B₁", will cause the channel current to become constant and independent of the drain source voltage V_{ds} . The current is represented by the $V_{gs}=V_i$ curve of figure 2, where the pinch off current is less than that of the $V_{gs}=0$ curve by an amount proportional to the applied gate bias V_{gs} .

Having followed the process thus far one might be tempted to say "so what!" Well, having attempted to point out and explain the various features of the FET, a summary of these ideas might be of advantage.

Firstly the device is analogous to a pentode valve in so far as it is a voltage controlled device of high input resistance and displays a constant current output characteristic. Biasing techniques are similar to those of valves, but the FET is available in two polarity types. It might be said that the FET has the best of both worlds as it were, being superior to valves in certain applications, particularly where third harmonic distortion and noise problems predominate.

The FET is a symmetrical device in the electrical sense, that is to say, theoretically, the drain and source are interchangeable. However, it is not symmetrical physically and the connections specified by the manufacturer must be adhered to. The existence of two polarity types necessitates the use of two symbols to differentiate between them. As the arrow on a transistor symbol indicates conventional current flow and we are using a p-channel device, the arrow on the gate points away from the schematic silicon bar. If the device was n-channel the arrow would point towards the gate junction.

When considering some of the possible applications of the FET we were mindful of audio applications which would be suited specifically to FET characteristics. Of these, a high input impedance low noise preamplifier was one logical choice.

Due to the many and varied requirements, in terms of crystal and ceramic transducers, we have endeavoured to make our design as flexible as possible. We have included details of a source follower, using the p-channel FET, for those applications where the transducer output level is high and it is to be followed by an amplifier of high gain.

At the outset, it may be of advantage to consider the relative impedance

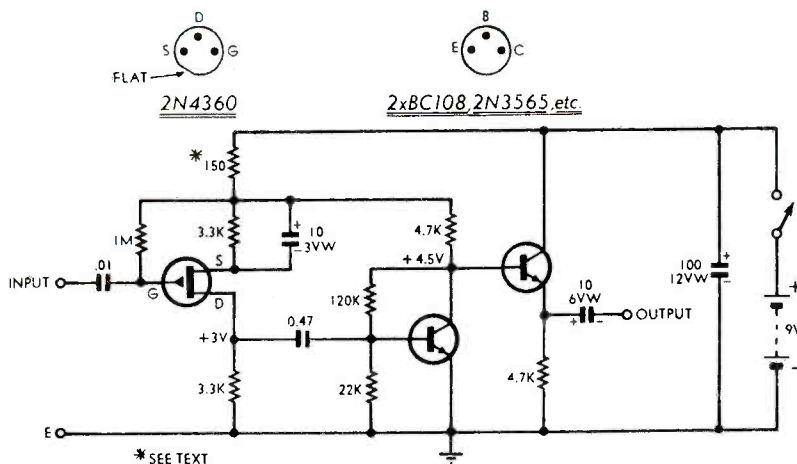


Fig. 4

FET HIGH-Z PREAMPLIFIER

COMPONENTS LIST

THREE TRANSISTOR PREAMP.

- 1 Case 4in x 4in x 2½in.
- 1 9v battery with connector lead.
- 1 Slide or toggle switch.

Components for one preamplifier channel:

TRANSISTORS

- 1 Type 2N4360 FET.
- 2 Type BC108, 2N4360 or similar.

RESISTORS ½-WATT 5 PER CENT

- 1 150 ohms (see text)
- 2 3.3K.
- 2 4.7K.
- 1 22K.
- 1 120K.
- 1 1M.

CAPACITORS

- 1 .01uF plastic or paper.

- 1 0.47uF disc ceramic.
- 1 10uF 3VW electrolytic.
- 1 10uF 6VW electrolytic.
- 1 100uF 12VW electrolytic.

MISCELLANEOUS

- 4 x audio connectors; 12-tag length of miniature resistor panel; scrap of aluminium for battery clamp; nuts, bolts, washers, connecting wire, solder, etc.

SOURCE FOLLOWER

- 1 Type 2N4360 FET.
- 1 1K ½ watt 5pc resistor.
- 1 2.7K ½ watt 5pc resistor.
- 1 3.3M ½ watt 5pc resistor.
- 1 .01uF plastic or paper capacitor.
- 1 10uF electrolytic.
- 1 10uF electrolytic (see text).

NOTE: Type 2N4360 field effect transistors are available by mail order, from Messrs Fairchild Australia Pty. Ltd., at either P.O. Box 151, Croydon, Victoria or Suite 22 A.M.P. Building, Parramatta, New South Wales.

and signal output levels for, say, crystal and ceramic pickups and crystal microphones. The transducer may be represented as a voltage source in series with a capacitor of a value depending upon the type of transducer. Crystal pickups generally work into an impedance of about 1M ohms with an output signal level of 200 to 400mV; while ceramic pickups have an output level of 80 to 100mV into about 2Mohms. Crystal microphones have an output voltage level of 15 to 30mV and require a load of about 5Mohms.

When such low signal levels are followed by high gain amplification, noise generated at the input presents a problem. A major source of noise is the gate resistor which must of necessity be a large value. To ensure sufficient input impedance without excessive values of gate resistor, negative feedback is provided by means of a "source follower" circuit. (Figure 3.) This is analogous to the emitter follower in injection transistor circuits, or the cathode follower in valve circuits.

The gain of the source follower is always less than unity, the exact value being determined by the value of the source resistor and the transconductance of the transistor. In the case of the

circuit shown the gain is about 0.9 where the source resistor is 3.7Kohms.

The effective input resistance is determined by the value of gate resistor and the position of the tap on the source resistor. However, the tap on the source resistor is determined by the DC bias requirements of the FET. In this circuit the input impedance of the amplifier is about 5M ohms.

Those experimenters who desire to increase the input impedance, or maintain the present impedance and reduce the gate resistor, may bypass the 2.7K resistor with an electrolytic of 10uF. This makes the effective source load 1K ohms which reduces the voltage gain to about 0.65. However, the input impedance is increased from 5M to 8M ohms.

When we constructed the unit we decided that the increased input impedance did not justify the additional electrolytic with the attendant reduction of gain. The output impedance of the source follower is about 1.8K ohms and the harmonic distortion is 0.1% at an output level of 1V RMS.

With a source follower as the basis of an impedance matching device there are several disadvantages. Not only is the gain less than unity but the major

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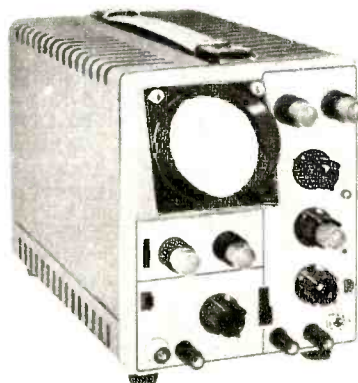
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limitation is the degree of impedance magnification at the input. These features thus led us to develop the high-Z preamplifier (figure 4) which we shall now consider in detail.

At first sight the FET might appear to be in a source follower configuration but, in fact, this is not the case. Because the FET is a P channel type, as we have already stated, its polarity in the transistor sense is opposite that of the two NPN injection transistors. Hence for simplicity it is drawn upside down.

The FET is connected in a conventional configuration with the 3.3K resistor in the source circuit providing source automatic bias. The transistor load is also 3.3K ohms, connected to the drain and returned to the negative supply. The signal coupling is via the 0.47uF ceramic capacitor into the base of the second transistor.

There is no degeneration in the source circuit due to the 3.3K bias resistor because it is bypassed by the 10uF electrolytic capacitor. However, to obtain magnification of the IM gate resistor and stabilise the gain, negative feedback or degeneration is applied via the 150 ohm resistor in the source circuit.

Negative feedback applied to the FET source is proportional to the AC component of collector current of the second transistor, because its collector load is returned to the positive supply through the 150 ohm resistor. Furthermore, the amount of negative feedback applied is determined by the value of the feedback resistor, in this case 150 ohms. Hence the input impedance and gain can be controlled by the value of feedback resistor.

The 150 ohm resistor in this case was chosen on the basis of a minimum input impedance of 5M ohms and a stable overall gain of about 30. However, where gain is a premium the feedback resistor may be 100 ohms. This increases the voltage gain to 40 but the input impedance is reduced to a little more than 4M ohms and the total harmonic distortion is 0.15 per cent. For values of 150 ohms and greater the total harmonic distortion is less than 0.1 per cent at an output level of 1V RMS.

We increased the resistor to as high as 470 ohms, at which point the voltage gain was only 10 but the input impedance was measured at 10M ohms.

With a feedback resistor of 150 ohms the frequency response was: -3dB at 35KHz and -3dB at 20Hz with 1dB rise at 30Hz. However, increasing the feedback with 470 ohms only extended the upper response to -3dB at 40KHz although the lower end was flat to 50Hz, rising to a peak of 2.5dB at 18Hz, beyond which we were unable to measure. By bypassing the source bias resistor with 50uF, instead of only 10uF, a smooth roll off was obtained which was 1dB down at 18Hz.

To obtain the requirement of low output impedance the addition of the emitter follower was necessary. However, by using DC coupling there is a saving of two resistors and one electrolytic capacitor. The output impedance is sufficiently low to operate into the majority of transistor amplifiers and over long signal leads without degradation of the response at high frequencies.

So much for the circuit operation. Let us now consider some of the constructional aspects of the preamplifier, for example such things as the type of wiring board and case, and the inclusion of

At right is an inside photograph of the pre-amplifier showing the mounting panel for a single channel. Most of the components are clearly visible, except those in the vicinity of the 100uF electrolytic and the two under panel resistors.

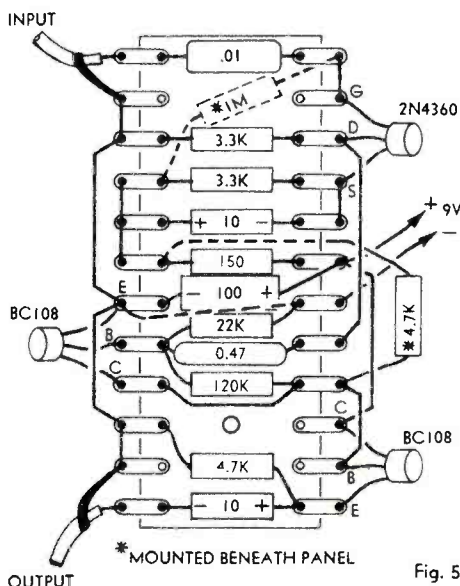
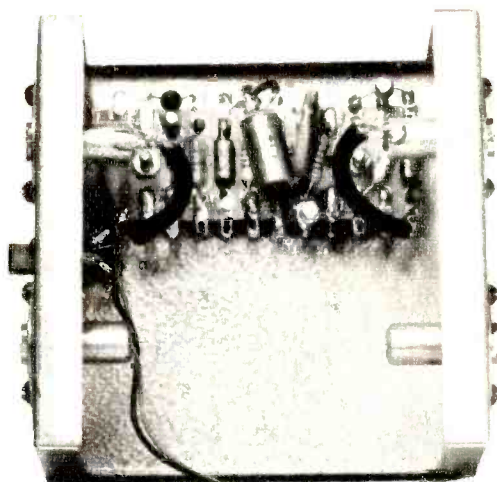


Fig. 5

Shown at the left is the wiring diagram for a single channel, using miniature resistor panel. There are two resistors under the panel which are clearly indicated. The 1M resistor at the input is arranged to clear the mounting screw beneath it.

it in an existing amplifier. Due to the high input impedance and possibly high gain, stray pickup of hum could be a problem. For this reason adequate shielding is essential.

As an enclosure for the unit we selected a small metal box measuring 4in x 4in x 2½in which has ample room to mount two wiring boards and the battery. Although we constructed only one preamplifier board, provision was made for a stereo unit by the addition of two extra cable connectors. The on-off slide switch was mounted on the front of the box, although a more functional position may be at the top. However, we decided to keep the number of projecting surfaces to a minimum.

The wiring board we used was a length of "miniature resistor board" which proved convenient for mounting. On a length of 12 tags the layout is such that the input terminals are at one end and the output terminals are at the other. Mounting was secured by two screws and two ½in spacers. Matrix board may well prove just as convenient as the two amplifiers could be built on a single piece of board.

As may be seen from the wiring diagram (figure 5) the layout is fairly straightforward and should not be difficult to follow. A point worthy of mention is the lead length of resistors and capacitors. If the leads are too short excessive heat, when soldering,

may cause these components to alter their values.

It is always good practice to solder the transistors into the circuit last of all, and avoid the use of excessive heat. Apart from the normal respect due a silicon transistor, added care should be taken when handling the FET, although this particular device is one of the more robust types as FETs go. When soldering the transistors hold their leads in the jaws of a pair of long nosed pliers to absorb the heat transmitted along the leads.

For our preamplifier we used a small 9 volt battery supply but this is largely dependant upon individual requirements, as some may wish to incorporate this in a permanent set up. The battery drain is quite modest—about 3mA—so there should be no hesitation in using a battery, notwithstanding that the drain is doubled for a stereo unit. The battery was clamped to the inside of the top cover of the box by a small bracket bent from a strip of aluminium.

We have endeavoured to make the design as flexible as possible without making the component requirements uncertain or critical. At the outset we stated possible applications of the pre-amplifier in conjunction with various transducers so, for those who are fiddlers at heart, the preamplifier and the FET, in particular, have numerous possibilities.

DESIGN FOR AN SSB TRANSMITTER

Last month, we introduced the new SSB transmitter by going over the block diagram and described the functions in broad outline. In this part, we are presenting a more detailed description of the various stages, together with the complete circuit diagram and parts list.

By Ian Pogson

In the previous article, we discussed the overall system up to the block diagram stage. The system of frequency changing was touched on, with particular emphasis on the requirements of the mixing processes. In point of fact, the block diagram was gone over twice, once briefly, then a second time, with the idea that it would make the system clearer in the mind of the reader.

Having thus cleared the way, it is proposed to go through the circuit diagram, dealing with each stage and covering the functions in enough detail to bring those readers into the picture who have not ventured before into the field of SSB transmitters. We would like to repeat that, although there seems to be a lot in one of these transmitters, if taken in "bite sizes," this one is not difficult to understand.

The input to the first audio amplifier is suitable for use with a crystal microphone but, if a dynamic microphone is to be used, it may be found desirable to make some changes if the bass response is too high. We tried a crystal microphone and the quality could be considered such that it is well balanced for SSB operation. On the other hand, we tried a dynamic made by "Primo" and the bass was too heavy. The 27K resistor was removed and a high-pass filter fitted as shown in figure 1. This gave the desired result and more will be said

comparing microphones under the discussion on the VOX circuit.

An alternative and simpler high-pass filter was tried, replacing the 27K resistor with a 220K and shunting it with a .0027 capacitor. This proved to be satisfactory but was not as effective as the filter in figure 1.

The first stage of the audio amplifier is conventional and we used a type BC108 transistor. This has proved to be satisfactory but, as mentioned in the first article, should a low level microphone be used, it would be better to use a low noise type, such as the BC109. Near equivalents to the BC108 and BC109 are the 2N3565 and SE4010, respectively.

The output of this stage feeds into the audio gain control and input to the VOX amplifier is also taken from this point. The second audio amplifier is conventional and a BC108 or 2N3565 transistor is suitable. The 100uF electrolytic capacitor in the supply line is a "must" if hum is to be avoided.

The coupling capacitors between stages may be any low voltage type — we used "Redcaps" which are small and easy to fit on to the wiring board. An exception is C7, the .022uF between the output of the second stage and the balanced modulator. It is better not to use a Redcap or similar type and a low voltage plastic will do the job. This will

minimise the possibility of leakage, with DC finding its way into the balanced modulator. The 50uF electrolytic capacitor C9, connected to a pair of relay contacts, is for muting purposes and will be covered later.

The balanced modulator uses a pair (preferably matched) of OA91 germanium diodes. The balancing potentiometer has been cut to 500 ohms and this value is increased by adding a resistor each side, of 820 ohms. The idea is to make the balancing adjustment easier by giving a certain amount of "bandsread." The capacitors shown on one side are for balancing out capacitive imbalance in the modulator circuit and the values given are those as used in the prototype. It is possible that these may need to be changed somewhat in subsequent models. More will be said about this on the subject of alignment.

The 455KHz carrier oscillator is virtually as recommended by Pye Pty. Ltd. The oscillator was only slightly changed so that we could use silicon NPN transistors and, instead of including a trimmer for small adjustment of carrier frequency, we have substituted a 33pF NPO ceramic. The frequency of the crystal must be correct for the mechanical filter used.

The oscillator is followed by an amplifier, with two outputs. The principal output is from the collector, through an IF transformer. The type used is a modified 178, made by R.C.S. Other makes should be suitable, although none has been tried — the prime requirement being that it is tuned with 330pF. The 455KHz signal from the IF transformer must be fed into the balanced modulator from a low impedance source. The secondary winding has been disconnected and 24 turns of approximately 33 SWG enamelled wire are wound over the top of the primary winding. This winding is critical and the number of turns should be adhered to.

The second output is taken from the emitter of the same amplifier and it is used for carrier reinsertion. The signal is taken via a 47pF capacitor to the 50K potentiometer, the rotor of which injects the signal into the base circuit of the 455KHz amplifier. Shielded leads are used to and from the potentiometer.

The transistor types for these two stages are not critical but recommended types are the BC108 and 2N3565.

Before leaving the 455KHz carrier generator circuits, we mentioned earlier that it would be possible to use a self-excited oscillator here. A suitable oscillator was described in the magazine for October, 1966, on page 52. However, for readers who do not have ready access to this issue, we are reproducing the circuit in figure 2.

As mentioned previously, we have used a Kokusai mechanical filter, which is readily available from Wagner Industries Pty. Ltd. The unit in our transmitter is the type MF-455-10K, which has minimum bandwidth at minus 6dB of 2KHz. This will occupy a minimum of spectrum space and still give quite acceptable speech quality. The next type with a minimum bandwidth of 3KHz is



The dial for the VFO tuning was made up specially, the basic unit being a dual-ratio planetary drive. A description as to how the rest of the unit was made will be given later on. The knob is from an Eddystone 898 dial assembly but other suitable knobs are readily available for this and all other positions on the front panel.

the MF-455-15K; this will naturally give a wider range of speech frequencies, at the expense of greater occupancy of the band in use.

In the 455KHz IF amplifier TR3, we found it necessary to take precautions against instability. To this end, we used a BF115 transistor in this position, having somewhat less gain than the BC108. In addition, the BF115 has a fourth lead for shielding purposes.

Still on the subject of stability, we also used a low gain IF transformer immediately following the amplifier, — actually an RCS type 178, with primary winding shunted with a 47K resistor. This transformer has two windings, each shunted with a 330pF capacitor; other makes similar to this should be suitable.

The first mixer must also be considered carefully, with respect to the type of transistor used. We used a BC108 in the finished transmitter but it is possible to use other types. Some checks which we made, however, showed that it was necessary to alter the emitter resistor value for optimum results, according to the transistor type.

For builders who may wish to use another transistor type in this position, we give these figures as a guide only: The BF115 appeared to give optimum mixing with 330 ohms in the emitter circuit; an SE1002 required 220 ohms, while a 2N3566 needed a value as low as 27 ohms. Possibly the best course would be to use a BC108 as in the prototype.

In the sideband switching crystal oscillator, the transistor type is not critical and the BC108, 2N3565, or similar types should be satisfactory. The switching diode for the 2.455MHz crystal is not critical, such types as OA91, 1N60A, etc., being suitable. However, it appears

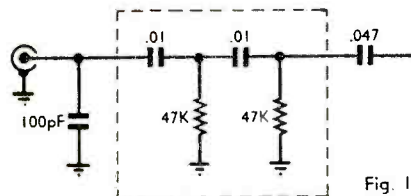


Fig. 1

This filter may not be strictly necessary. Details are given in the text, however.

that the 1.545MHz crystal is more critical with respect to diode switching. Gold bonded types, such as OA47 or OA7, are satisfactory and we suggest that you use one of these in this position.

We have already mentioned that two sideband switching crystals must tie in with the carrier crystal which, in turn, must be suited to the individual mechanical filter used. These three and indeed, all the rest of the crystals for this unit were obtained from Pye Pty. Ltd., who supplied the crystals to the frequencies which we specified. Similar high grade crystals may also be obtained from other suppliers but we would suggest that if you intend to use some older type crystals, they should be checked for activity in the circuits which we have specified. To this end and in the case of the sideband switching oscillator, the value of the 820pF capacitor may have to be changed.

The capacitor C35, which is used to inject the sideband switching oscillator output into the emitter of the first mixer,

is a miniature variable trimmer of 2-10pF. The large Philips or similar type would be suitable and it may even be possible to substitute a fixed capacitor instead. The value required will be of the order of 4.7pF, but this can only be ascertained on alignment.

The second mixer is for all practical purposes, the same as the balanced modulator. A pair of germanium diodes, preferably matched, are needed and type OA91 or other similar types will be satisfactory. The 3-30pF trimmer may be any good quality air dielectric type, such as the Philips.

Injection for the second mixer is from the VFO, which is a vital section of the transmitter. A brief description of this VFO was given in the article on Transistor Oscillators, in the issue for October, 1966. For readers who did not see this description and for the purposes of covering some changes, we will go over it again.

As mentioned before, we have used the "Synthetic Rock" oscillator and this has been adapted to our purpose. A fixed mica capacitor of 100pF and a 3-60pF Oxley variable air trimmer in parallel, are connected in series with a standard Roblan 10-415pF variable capacitor. This is done so that a good degree of tuning linearity may be obtained. This has worked out about as successfully as one could expect; the scale is opened out somewhat at each end, being slightly cramped around the centre scale.

A 47pF mica and a 3-60pF Oxley variable air trimmer are shunted across the tuned circuit and the trimmer is used to set the high frequency tuning limit of the oscillator. Strictly, the other trimmer in series with the main tuning capacitor is for making adjustments to the linearity law. The idea is to set the centre frequency approximately to mid-scale. The coil should be adjusted in inductance, so that the lower frequency limit of the oscillator is correct. In practice, we have found it convenient to adjust the inductance as closely as possible and then use the series and shunt trimmers to set the low frequency and high frequency limits, respectively. This makes only a slight alteration to the linearity.

A valuable refinement, which has been added since the October article, is provision for a "Calibration" control on the front panel. A silicon diode type BA102, which is a voltage dependent capacitor, is connected in series with a 33pF mica capacitor being, in turn, connected across the tuned circuit. A variable DC voltage is fed in the reverse bias polarity with respect to the BA102 and this arrangement gives a frequency variation of plus and minus about 7KHz. This can be used to compensate for any drift, differences in crystal frequencies when changing from one band to another and for setting the dial so that it is correct for upper or lower sideband transmission. When checked against a 100KHz crystal, the dial calibrations can be very accurate indeed.

The output of the oscillator is fed into an emitter-follower which, in turn, drives an amplifier. A tuned circuit in the collector of the amplifier is set to the mid frequency of the VFO tuning range. A low impedance secondary on the tuned circuit transformer provides the injection for the second mixer.

The transistors for the VFO unit are not critical and we have used such types as BC108, BF115, 2N3565 and 2N706

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 †Sensitivity : -52 dB \pm 3 dB,
 Dimensions : 148 \times 48 \times 34.5 mm without stand
 Cable : 4 ϕ mm, 3 m
 Weight : 1 $\frac{1}{4}$ lbs (525 g)



DF-1DE

SPECIFICATIONS
 Impedance : 50 k Ω
 Frequency Response : 150~10,000 c/s \pm 8 dB
 †Sensitivity : -57 dB \pm 3 dB,
 Dimensions : 385.5 mm high
 21 mm diameter, microphone
 128 mm diameter, stand
 Cable : 4 ϕ mm, 1.5 m
 Weight : 1 $\frac{3}{8}$ lbs (840 g) with cable



*DF-14B

SPECIFICATIONS
 Impedance : 50 k Ω Variable
 Frequency Response : 100~10,000 c/s \pm 8 dB
 †Sensitivity : -48 dB \pm 3 dB,
 Dimensions : 136 \times 75 \times 47 mm
 Cable : 6 ϕ mm, 4 m
 Weight : 2 lbs (900 g)



*DF-22B

SPECIFICATIONS
 Impedance : 50 k Ω
 Frequency Response : 50~12,000 c/s \pm 7 dB
 †Sensitivity : -57 dB \pm 3 dB,
 Dimensions : 32.5 mm diameter, 220 mm long
 Cable : 6 ϕ mm, 4 m
 Weight : 1 $\frac{1}{4}$ lbs (575 g)



DF-1/*DF-1B

SPECIFICATIONS
 Impedance : 50 k Ω
 Frequency Response : 100~10,000 c/s \pm 8 dB
 †Sensitivity : -57 dB \pm 3 dB,
 Dimensions : 21 mm diameter, 82.7 mm long
 Cable : 3 ϕ mm, 1.5 m
 Weight : 3.9 oz (110 g) with cable



DF-3

SPECIFICATIONS
 Impedance : 50 k Ω
 Frequency Response : 50~12,000 c/s \pm 8 dB
 †Sensitivity : -56 dB \pm 3 dB,
 Dimensions : 33.5 mm diameter, 133 mm long
 Cable : 4 ϕ mm, 1.5 m
 Weight : 9.0 oz (255 g) with cable



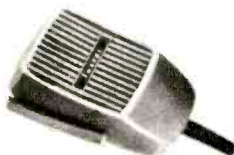
DF-12/*DF-12B

SPECIFICATIONS
 Impedance : 50 k Ω
 Frequency Response : 80~12,000 c/s \pm 8 dB
 †Sensitivity : -57 dB \pm 3 dB,
 Dimensions : 23 mm diameter, 158 mm long
 Cable : 3 ϕ mm, 1.5 m
 Weight : 6.3 oz (180 g) with cable



*DF-2B

SPECIFICATIONS
 Impedance : 50 k Ω
 Frequency Response : 100~10,000 c/s \pm 10 dB
 †Sensitivity : -56 dB \pm 3 dB,
 Dimensions : 75 \times 53 \times 30 mm
 Cable : 3 ϕ mm, 1.5 m
 Weight : 4.8 oz (136 g) with cable



*DF-51B

SPECIFICATIONS
 Impedance : 50 k Ω
 Frequency Response : 150~8,000 c/s \pm 7 dB
 †Sensitivity : -57 dB \pm 3 dB,
 Dimensions : 98 \times 58 \times 36 mm
 Cable : 6 ϕ mm, 1.6 m, Coiled
 Weight : 7.3 oz (207 g) with cable

* with switch :

† at 1,000 c/s, 0 dB = 1 V/ μ bar

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The third mixer which follows is in the form of a ring modulator and the reasons for its use have already been given. The diodes for this mixer must be a matched quad and Messrs Mullard have undertaken to provide sets of OA91s for this purpose. The price is a little higher than that for four individual diodes but it is very worth while. Do not attempt to use random diodes, as they will not give anywhere near as much attenuation of the unwanted responses.

In order to get the best possible balance, in addition to the 1K potentiometer, capacitive balancing is also necessary. The amount of capacitance required is quite small and, so that it may be made easier to balance, a small amount of fixed capacitance (10pF) is added to one side, with an adjustable trimmer on the other side.

The crystal oscillator is virtually the equivalent of the valve-type Pierce and details of this oscillator were given in the magazine for September, 1966, on page 57. We have shown a fixed capacitor of 27pF, from collector to earth, whereas the original showed a 3-30pF trimmer. If it is found that the crystals are all slightly off frequency, in the same direction, then the value of the 27pF capacitor could be changed to reduce the error. On the other hand, the error is only small and it may be considered not worthwhile to make any such adjustments.

The transistors, as used in our model in each of these stages, are type BF115. The 2N3691 is a near equivalent and should also be suitable.

Keying facilities are provided in the emitter and bias return circuits. The collector's load is tuned to the signal frequency, the requisite coil being selected by the band-change switch. The individual coils are shunted with a resistor of sufficient value to broaden the bandwidth where necessary. These details are given in the coil table.

Fig. 2

both wound on the one former. Besides saving space, this method also helps in keeping leads to the switch as short as possible. The former and cans are made by Neosid and these are distributed by Messrs Watkin Wynne Pty. Ltd.

Coils in the plate circuit are substantially the same as those already described for the collector of the BF115. Some variations exist regarding the values of shunt capacitance and resistance and these are also given in the coil table. The signal voltage appearing at the plate is more than ample to drive the final linear amplifier. A drive control, consisting of a 1K wire-wound potentiometer, is connected in series with the 150 ohm resistor which establishes the minimum bias for the valve. The 1K potentiometer gives sufficient control under all conditions which we have encountered. Should it be found necessary to reduce the drive still further, the potentiometer can be increased in value.

Although we have specified a 6EH7 valve for the driver, we have also tried types 6EJ7, 6BY7 and 6BX6. All appear to function satisfactorily, but a slight drop in output is evident in the cases of the 6BY7 and 6BX6, which is what could be expected, anyway.

The valve chosen for the final is a 6DQ6B, which has a plate dissipation of 18 watts, is easy to drive and available at a reasonable price. For those who already have a 6DQ6A, we can see no reason why it should not be used. The plate dissipation is lower, at 15 watts, but this really is no problem, as the valve is normally operated within this rating. The price of the latter type is also less.

The loading capacitor is a two-gang 10-415pF capacitor made by Roblan; any other similar unit would suffice, provided it will fit physically and has sufficient capacitance.

High tension to the final plate is fed in series with the tank coil, via an RF choke. Series feed was chosen on this occasion because the voltage is not high and, more important, demands on the RF choke are rendered less critical. The RF choke which we used is made by Telecomponents, Part No. 8331. For readers who may wish to wind their own, it is a straight winding of 200 turns of 32 B. and S. enamel wire, close wound on a bakelised cardboard former, 7/16in OD and 2½in long.

A parasitic suppressor R77 is connected in series with, and right at, the plate connection of the 6DQ6B. We did not find it necessary but it is included as a precaution. The suppressor consists of 2½ turns of 16 gauge tinned copper wire over a 100 ohm ¼ watt resistor.

Neutralisation is effected by the series-

Continued on page 63.
The complete parts
list appears overleaf.



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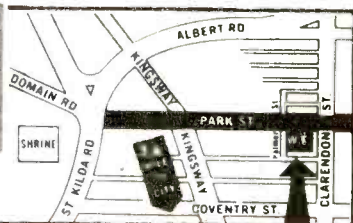


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- 1 6in 1/2in dia. steel or brass rod.
- 1 Meter 1mA FSD.
- 1 Power transformer 230-240-250V. HT sec. 120-110-100V. LT sec. 6.3V-4A.
- 1 Filter choke 6H 100mA.
- 1 Pi-network coil and switch.
- 1 Relay, 500 ohms, 4 sets change-over springs.
- 1 Diecast metal box 4-5/8in x 3-5/8in x 2-3/16in.
- 1 455KHz mechanical filter.
- 1 455KHz crystal (see text).
- 1 2455KHz crystal (see text).
- 1 1545KHz crystal (see text).
- 1 6250KHz crystal.
- 1 8000KHz crystal.
- 1 9000KHz crystal.
- 1 11500KHz crystal.
- 1 11750KHz crystal.
- 8 Sockets for crystals.
- 1 Rotary switch, 1-wafer, 1-pole 2-position.
- 1 Rotary switch, 1-wafer, 2pole 4-position (non-shorting).
- 1 Rotary switch, 4-wafer 1-pole 6-position (see text).
- 1 Toggle switch, SPST.
- 1 Jack (microphone).
- 1 Closed circuit jack (key).
- 1 Octal valve socket.

VALVES

- 1 6EH7.
- 1 6DQ6B.
- 1 Voltage regulator, VR150.

TRANSISTORS

- 1 BC108 or 2N3565 or BC109 or SE4010 (TR1).
- 15 BC108 or 2N3565 (TR2, TR4, TR5, TR7, TR8, TR9, TR10, TR11, TR13, TR14, TR15, TR16, TR17, TR18, TR20).
- 4 BF115 or 2N3694 (TR3, TR6, TR12, TR19).
- 1 AC128 or 2N3638 (both with heat sink) (TR21).

DIODES

- 10 OA91 or 1N60A (D1, D2, D3, D4, D10, D11, D12, D16, D17, D24).
- 1 OA47 or OA7 (D9).
- 4 OA91 matched quad (D5, D6, D7, D8).
- 1 OAZ208 zener diode (D13).
- 1 OAZ213 zener (heat sink) (D23).
- 1 BA100 silicon diode (D14).
- 1 BA102 voltage dep. cap. (D15).
- 3 OA210, 1N3194 (D18, D19, D20).
- 2 1N3193 (D21, D22).

RESISTORS

- (All resistors $\frac{1}{2}$ watt, 10% tolerance, unless stated otherwise.)
- 1 1.011 ohms (see text) (R79).
 - 1 4.17 ohms (see text) (R78).
 - 1 27 ohms 1 watt (R106).
 - 2 47 ohms (R19a, R41).
 - 2 100 ohms (R10, R65).
 - 1 100 ohms (see text) (R77).
 - 1 120 ohms (R29).
 - 1 150 ohms (R72).
 - 1 220 ohms (R105).
 - 1 500 ohms lin. pot. (preset) (R13).
 - 1 500 ohms linear pot. (R94).

- 1 Ceramic octal valve socket.
- 1 Ceramic 9-pin valve socket.
- 1 5-pin miniature socket.
- 4 Coax sockets.
- 1 Fuse holder.
- 1 1-amp fuse.
- 1 1in flexible coupling.
- 2 455KHz IF transformers (low gain transistor type).
- 3 2.5mH RF chokes.
- 1 100uH RF choke (see text).
- 6 Coil formers, 2 1/2in x 5/16in.
- 6 Cans to suit formers.
- 5 Coil formers, 1 1/2in x 5/16in.
- 5 Cans to suit formers.
- 14 Slugs to suit formers (see coil details).
- 1 Ferrite toroidal former, Q2 material 23/32in OD x 15/32in ID x 1in thick.
- 2 Ferrite tubes Type FX1193 or FX1243.
- 12 Rubber grommets to suit.
- 1 3-tag strip.
- 3 4-tag strips.
- 3 5-tag strips.
- 3 8-tag strips, two mtg. feet.
- 1 13-tag strip, two mtg. feet.
- 1 Mini. tag board, 8 prs.
- 1 Mini. tag board, 13 prs.
- 1 Min. tag board, 14 prs.
- 1 Min. tag board, 15 prs.
- 1 Min. tag board, 22 prs.
- 13 Knobs for front panel (other knobs as required).
- 1 Clip (6DQ6B valve plate). Coaxial cable and plugs as required. 3-core flex and 3-pin plug. Hookup wire, screws, nuts, lugs, solder.

- 13 470 ohms (R9, R24, R26, R30, R33, R37, R42, R49, R60, R62, R66, R69, R70).
- 2 820 ohms (R12, R14).
- 1 1K (R7).
- 3 1K linear pots. (R38 and R57 preset, R73 variable).
- 2 1.5K (R11, R64).
- 7 2.2K (R19, R35, R36, R46, R54, R82, R93).
- 1 2.5K linear pot. (R52).
- 3 3.3K (R16, R48, R92).
- 11 4.7K (R4, R31, R32, R51, R53, R55, R61b, R61c, R76, R86, R97).
- 1 4.7K 1 watt (R75a).
- 1 5K linear pot. (R88).
- 1 5K 5 watt wire wound (R104).
- 2 5.6K (R2, R34).
- 1 6.8K (R80).
- 13 10K (R6, R8, R27, R39, R44, R47, R59, R61a, R68, R74a, R74b, R74c, R81).
- 1 10K linear pot. (R83).
- 3 15K (R18, R56, R101).
- 4 22K (R22, R45, R67, R75).
- 2 27K (R1, R43).
- 2 39K (R40, R58).
- 1 39K (see text) (R90).
- 6 47K (R17, R25, R71, R84, R95, R100).
- 1 50K linear pot. (R20).
- 1 68K (R91).
- 7 100K (R3, R15, R21, R50, R87, R98, R99).
- 1 100K 1 watt (R102).
- 1 100K linear pot. (R5).
- 2 220K (R28, R63).
- 1 220K 1 watt (R103).
- 1 270K (R23).
- 2 470K (R85, R96).
- 1 500K linear pot. (R107).
- 1 1M (R89).

CAPACITORS

(All low voltage types unless stated otherwise.)

- 1 2.2pF ceramic (C89).
- 4 10pF NPO ceramic (C31, C57, C62e, C73).
- 4 2-10pF air trimmer (C33, C34, C35, C40).
- 2 27pF NPO ceramic (C67, C77d).
- 6 3-30pF air trimmer (C36, C58, C69, C70, C72, C83).
- 2 33pF plastic or NPO ceramic (C14, C71).
- 1 33pF silver mica (C52).
- 1 39pF plastic or NPO cer. (C62d).
- 3 47pF plastic or NPO ceramic (C18, C63, C65).
- 1 47pF silver mica (C50).
- 1 5-55pF mica trimmer (C27).
- 2 56pF plastic or NPO ceramic (C62c, C77c).
- 3 3-60pF air trimmer (C10, C48, C51).
- 1 82pF plastic or NPO cer. (C68).
- 4 100pF plastic (C38, C41, C43, C45).
- 1 100pF silver mica (C47).
- 1 100pF ceramic (C1).
- 1 120pF plastic (C28).
- 1 150pF polystyrene (C53).
- 3 150pF plastic (C62b, C66, C77b).
- 1 150pF mica or 400V plastic (C80).
- 2 220pF plastic (C62a, C77a).
- 1 270pF plastic (see text) (C11).
- 1 10-270pF variable (see text) (C84).
- 3 330pF polystyrene (normally part of transformer) (C17, C22, C25).
- 1 390pF plastic (C15).
- 1 10-415pF variable (single) (C49).
- 1 10-415pF variable (2-gang) (C87a, C87b).
- 1 470pF mica (C76).
- 1 470pF plastic (C16).
- 2 820pF cer. or plastic (C13, C32).
- 1 .001uF plastic (C42).
- 1 .001uF polystyrene (C55).
- 1 .001uF mica or 200V cer. (C82).
- 1 .001uF mica or plastic (C90).
- 1 .0022uF mica or 400V ceramic (see text) (C86).
- 1 .0033uF polystyrene (C54).
- 1 .0033uF ceramic or mica (C88).
- 2 .0047uF plastic (C8, C29).
- 1 .0047uF mica or 400V plastic (C85).
- 1 .01uF plastic (C37).
- 1 .01uF 400V plastic (C79).
- 5 .01uF ceramic (C78, C104, C105, C106, C107).
- 1 .022uF 100V plastic (C81).
- 2 .047uF cer. or plastic (C2, C21).
- 17 0.1uF ceramic (C12, C19, C20, C23, C24, C26, C30, C39, C44, C46, C56, C59, C60, C61, C64, C74, C75).
- 1 0.15uF plastic (C97).
- 1 0.22uF plastic (C7).
- 4 0.22uF ceramic or plastic (C3, C4, C91, C95).
- 1 4uF electrolytic (if required, see text) (C94).
- 1 4uF 500VW electrolytic (C98).
- 1 8uF 200VW electrolytic (C99).
- 2 25uF 12VW electro. (C92, C96).
- 1 32uF 200VW electrolytic (C100).
- 1 32uF 300VW electrolytic (C103).
- 2 50uF 6VW electrolytic (C9, C93).
- 1 100uF 3VW electrolytic (C5).
- 2 100uF 200VW electrolytic (insulated) (C101, C102).
- 4 1000uF 12VW electrolytic (C6, C108, C109, C111).
- 1 1000uF 18VW electrolytic (C110).
- 1 2000uF 12VW electrolytic (C112).

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SSB TRANSMITTER—Cont.

capacitance method. The 3-30pF neutralising capacitor C83, is connected back to a 470pF capacitor C76, at the cold end of the driver valve plate circuit. The variable capacitor which we used is made by Oxley. Alternatively, any good air trimmer would be satisfactory. The 470pF capacitor is a silvered mica.

Neutralising is correct when the ratio of the neutralising capacitance to the 470pF is equal to the ratio of plate-to-grid capacitance to the input capacitance at the grid. The latter includes the input capacitance of the 6DQ6B, the output capacitance of the 6EH7, plus strays.

The screen by-pass capacitor C82 should be a non-inductive type and a ceramic or mica will be suitable. We used a silvered mica.

Metering of this stage is of considerable importance. Grid current, screen current, plate current and RF output are all covered and selection is by a 2-pole, 4-position, non-shorting switch, to a common meter. The meter used has a 1-milliamp movement, with an internal resistance of 100 ohms. The one which we used is a type VT4 of Electronics Supplies and it is available through Messrs. Watkin Wynne.

The grid circuit should be metered to ensure that it is NOT being run into grid current and more will be said about this on alignment and adjustment. Screen current should be metered, in that it is possible to tune to resonance more accurately than by checking against plate current; screen current also gives a very good idea of loading and overall operating conditions of the stage.

Plate current metering also has its place in checking operating conditions.

Finally, RF metering also helps in setting up and adjustment of the output stage.

In all cases, except that for metering RF output, the meter is switched across shunt resistors of suitable value, which are left permanently in circuit. As the need in the grid circuit is to check for small quantities of grid current, a shunt resistor is used which is large compared with the internal resistance of the meter. The value of 4.7K has little effect on the meter and it still has a virtual sensitivity of 1-milliamp FSD.

A convenient range for measuring screen current is 0-25 milliamps and, assuming a meter resistance of 100 ohms, a shunt resistor of 4.17 ohms is needed. This value can be closely approximated by connecting in parallel 4.7 and 33 ohms, 5 per cent tolerance resistors.

As the plate current is normally run somewhere between 70 and 90 milliamps, a range of 0-100 milliamps has been selected. This calls for a shunt value of 1.011 ohms. However, for all practical purposes, we have found a 1-ohm resistor, with a 5 per cent tolerance, to be quite satisfactory.

RF metering is relative only and no attempt has been made to calibrate this function. It will be noted, however, that a 2.2pF capacitor has been shunted across the 6.8K resistor. This assists in offsetting a fall-off in reading at the higher frequencies.

The RF output is terminated independently in a coaxial socket. Another coaxial socket looks into the "make" side of a set of changeover

contacts on the aerial changeover relay. This is done so that the output of this transmitter can be patched into the grid circuit of a high power linear, or straight into the relay contacts. This will be the normal procedure when the transmitter is used "barefoot." Coaxial sockets are also provided for the aerial and receiver connections. The receiver input is shorted out when the transmitter is activated.

Muting of the transmitter is done at three points. In the circuit, the muting contacts of the relay are shown in the "receive" position, with the transmitter muted. The -90 volt bias supply, besides being used for fixed bias on the final stage, is also used to bias both the driver and final beyond cut-off for muting purposes. The 500K potentiometer is used to set the working bias on the final to the correct value.

Even with the last two stages cut off, sound into the microphone was sufficient to generate a signal that found its way into the receiver, resulting in feedback. Various methods of muting the audio amplifier were tried, each having some disadvantage. The idea of short-circuiting the audio output with an electrolytic capacitor did not suffer from any disadvantages or problems and is the method which has been adopted.

One relay, with four sets of change-over contacts, performs the functions of muting and aerial changeover. The relay winding is energised from the 16 volt unregulated supply and in conjunction with the VOX circuit. If the VOX is not to be used, then the relay may be connected across the 16 volt supply, in series with a push-to-talk switch.

The power transformer which we used is type PVD 102, made by Ferguson. It is designed for voltage doubling and the secondary winding is rated at 120 volts AC, at 100 milliamps. The winding is also tapped at 110 and 100 volts AC. By using the full winding, we obtained between 300 and 310 volts DC. The primary is wound for 250 volts and is tapped at 240 and 230 volts. There is only one 6.3 volt winding, which is centre tapped and rated at 4 amps. Equivalent transformers should be suitable, provided they fit into the available space.

Two OA210 silicon rectifiers or their equivalent, are used with two 100uF 200VW electrolytics for voltage-doubler service. The filter choke is rated at 6H at 100mA. The Ferguson type which we used is F6/100, but any other similar unit should be suitable, again provided it will fit into the rather limited space available for it. The last part of the filter is a 32uF 300VW electrolytic.

The 300 volts DC is used to supply the plate of the 6DQ6B and the plate and screen of the 6EH7. A 5K 5W wire wound resistor is used in series with a 150 volt gaseous regulator tube, to provide the 150 volts regulated to the screen of the 6DQ6B. We used a type VR150 but, unless you happen to have one on hand, it might be better to use the miniature 150C4.

Bias of -90 volts is also obtained from the same winding of the transformer. An OA210 or equivalent is used as a shunt rectifier with a two-section filter consisting of a 47K resistor and an 8uF capacitor, followed by a 15K resistor and a 32uF capacitor. A 100K

bleeder resistor is shunted across the filter.

Since the 6.3V AC winding is used to supply the heaters of the two valves, as well as being the source for the DC supply to the transistors, it is not possible to connect either side of the winding directly to earth. In this respect, it is left floating, but each side is earthed to RF, in that it is by-passed at each valve socket with two .01uF ceramic capacitors.

As only 6.3V AC are available for the transistor supply, we used a voltage doubler again, with two 1N3193 or equivalent type silicon diodes, with a pair of 1000uF electrolytics. A further 1000uF electrolytic is shunted across this output for extra filtering. At this point, 16 volts of DC are available which is used to operate the relay either with, or without, the VOX circuit.

A nominally 12 volt OAZ213 zener diode is used to stabilise the voltage on the base of an AC128 transistor shunt regulator. This system is simple and effective, as well as being self-protecting against short-circuiting of the output. A 2000uF electrolytic is shunted across the output to provide sufficient filtering of the supply to all transistors.

(To be continued)

For complete circuit diagram, see overleaf

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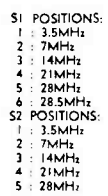
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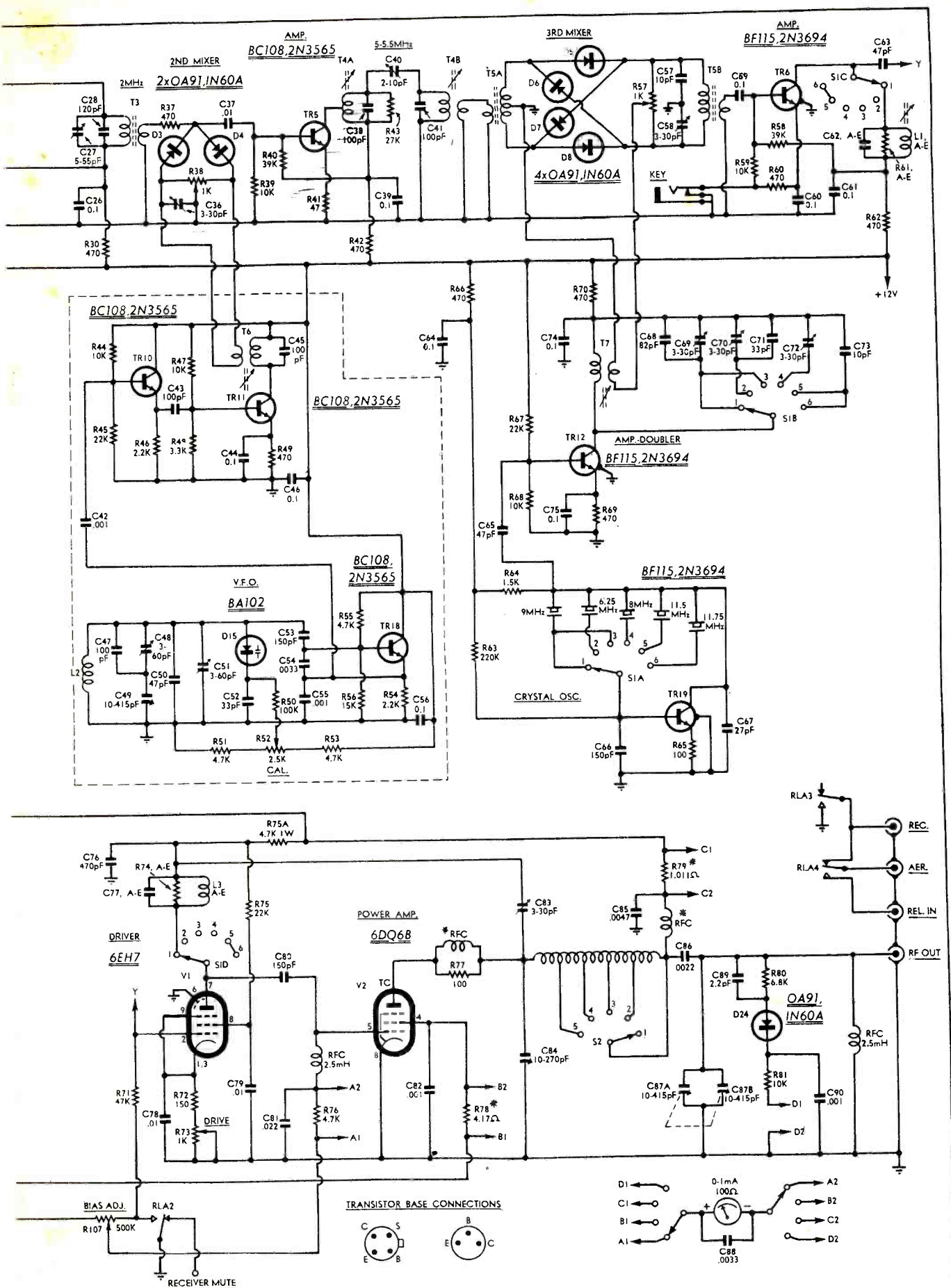
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A READER BUILT IT!

Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

TRANSISTORISED RESONANCE METER

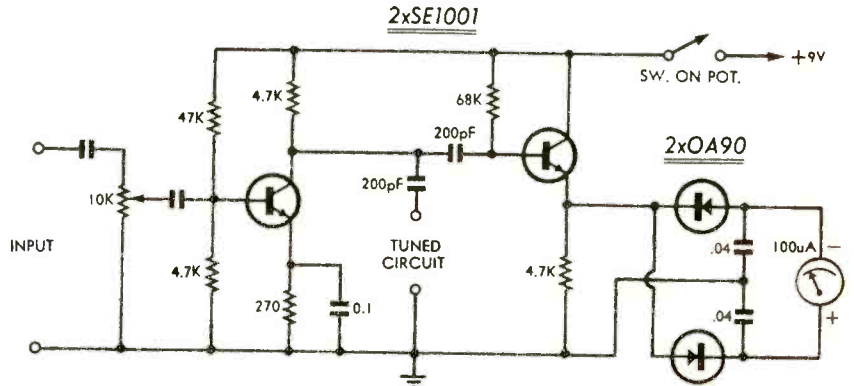
From Mr C. Horwitz, 81 Prospect Rd, Summer Hill, N.S.W., comes this description of a resonance meter, inspired by our own resonance meter of November 1965.

"Here are details of a transistorised version of your 'Resonance Meter'; a light compact meter that is very easy to use. It serves two purposes; as an RF indicator, and to check the resonance of tuned circuits and crystals. I have found the meter invaluable when, without a CRO, I have had to check and adjust the level of an oscillator or IF stage.

"No attempt has been made to make the scale linear with frequency, or to temperature stabilise the circuit. These are complicating factors, and my aim was simplicity with maximum usefulness. With a signal generator at the input, and a tuned circuit or crystal at the 'tuned circuit' terminals, the resonance point is found by watching for a dip or peak. This is only an approximate reading, because the unit has some capacitance (about 5pF) which will affect the circuit with low capacitance, say 50pF or less.

"The original used a 100uA meter from an exposure meter. Any movement up to 500uA could be used by changing the voltage doubler capacitors. To measure the resonance of high Q circuits, a sharp acting movement is necessary, or the dip or peak may not be noticed even when using the vernier on the signal generator. It should be possible to use other transistors by altering the bias resistors, although I have not tried this.

Below: The circuit of the time base and amplifier.



"My unit gave good performance over the range 100KHz to 10MHz. The gain fell off after that, but it was still quite useful at 30MHz. The circuit was assembled on a piece of 'Veroboard,' and the

unit was built into a small box not much larger than a multimeter, making it compact and handy to use. The circuit draws only 1mA and is very economical on battery power."

SIMPLE TIME BASE AND X AMPLIFIER

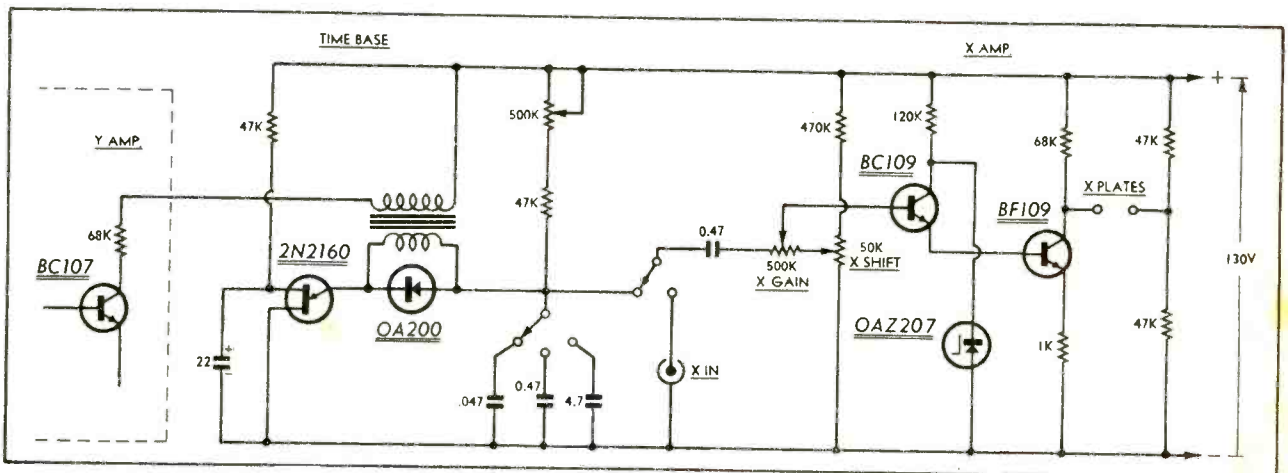
Mr P. G. Tassicker, 1 Godfrey Court, Surrey Hills, E.10, Victoria, sends us this description of a saw tooth generator based on the unijunction transistor.

"Following your recent articles on unijunction transistors (UJT's), this circuit using a UJT as a high-quality saw-tooth generator might be of interest for your 'Reader Built It' column.

"The oscillator in your February, 1966 magazine had the same voltage across both the resistor - capacitor net-

work and the UJT. The UJT will conduct when the capacitor has charged to about half the battery voltage. As the capacitor charges, the charging current decreases, and thus the time rate of change of voltage across the capacitor is curved.

"If, however, we put a much higher voltage across the resistor and capacitor than across the UJT, the time rate of change of voltage across the capacitor will be linear up to the point at which



the UJT conducts, so that the waveform is not curved, but saw-tooth. High sweep amplitudes can be obtained using a high input impedance, high voltage gain amplifier.

"There are, of course, limitations on the frequency range, which varies with different transistors. The UJT used gave good waveforms from about 5Hz to 100KHz. While this frequency range is not suitable for many CRO's, it is adequate for simple CRO's used mainly for audio work, such as the one in your August 1965 magazine.

"The circuit uses a simple method of synchronisation. A miniature driver transformer, connected as shown, with the high impedance coil in the collector circuit of the Y amplifier output transistor, will synchronise a signal from 10Hz to 100KHz, although this falls off sharply above 50KHz.

"The method of operation is very simple. When the capacitor is charged almost to conduction point, a change in voltage on the Y amplifier collector will produce a small corresponding change across the secondary coil, and this will initiate the conduction of the UJT, thus achieving synchronisation. The diode is placed across the secondary coil so that it conducts when the capacitor is discharging, thus removing the effect of the coil impedance on the time of discharge.

"An alternative arrangement would be B2 synchronisation, achieved by fitting a 1K resistor directly in series with the B2 electrode. The synchronising signals (negative - going) could then be fed via a capacitor to the electrode, obviating the need for a transformer. There are, however, several objections to this method.

"The main objection is that the UJT is a low impedance device, and if placed across the Y amplifier output transistor via a capacitor, would load this stage greatly. Hence, to use this method of synchronisation, a power amplifier stage must be provided which would be more complex than the transformer.

"Also, when the UJT conducts, its effective B1-B2 resistance is changed so that the current through it alters. Since it is fed through a resistor, this current change causes a voltage change on B2, which would send a pulse through the capacitor to the Y plates and hence appear on the tube display. In the present circuit, there is a capacitor across the UJT to prevent any sudden change on B2. However, with the alternative method of synchronisation, this capacitor would have to be removed.

"The X amplifier is also simple, using high gain BC109 and low gain, high voltage BF109 silicon NPN transistors in an emitter follower configuration to give high input impedance and high voltage gain. This amplifier may be used separately from the time base and the whole unit forms a compact time base and X amplifier. It is particularly suitable for use with highly sensitive post deflection acceleration tubes, but is also suitable for tubes which require X sweep voltages up to 130V."

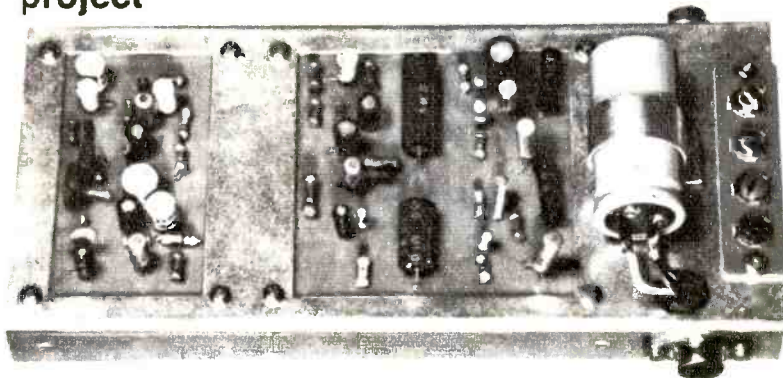
IRON PRESERVER

Mr N. Kukulka, 1 Sunhill Avenue, Burwood E.13, Victoria, suggests a simple scheme to minimise overheating a soldering iron when used intermittently.

"It is sometimes necessary to use a
(Continued overleaf)

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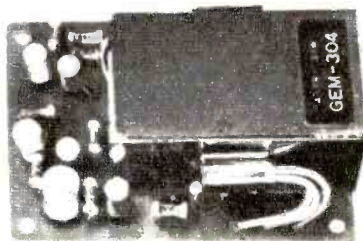
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Model 304 is a 3 watt (4 transistor) audio amplifier. Power requirements 9 V. D.C. Frequency response 150-10,000 Hz.

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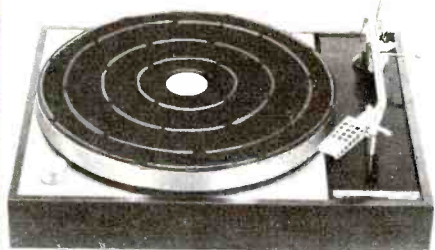
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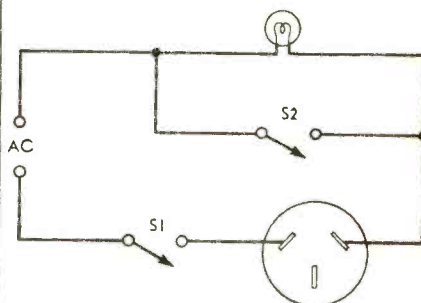
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large soldering iron, but after a few minutes of heating, there is a tendency for the soldering 'tint' to be burned off the iron. If a lamp is put in series with the iron, it cools sufficiently not to burn while not in use.

"In the circuit, S1 switches the com-



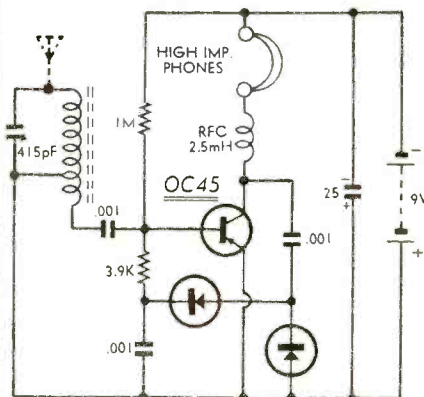
plete unit on and off. S2 switches the lamp in or out of circuit, by shorting it when the iron is required to work at full heat. Different wattage lamps can be used to vary the temperature of the iron."

REFLEX PORTABLE

From a reader, L.T., in Bendigo, Victoria, comes this circuit for a simple reflex set.

"Will you please publish this one transistor reflex portable on your 'Reader Built It' page. The set performs very well with the ferrite rod aerial on the local stations, and receives other stations if a short aerial is attached.

"The coil is wound on a 4 1/2in piece of ferrite rod with 30 B&S wire, and consists of 52 turns with a tap 7 turns from the earth end. I used OA90's but



any germanium diode may be employed. Although high impedance phones are shown, a crystal earpiece may be substituted with the primary of an output transformer in parallel.

"The current consumption is low so the battery should last a few months. An XA101 transistor will give higher gain than the OC45 and is also cheaper. The original circuit was built on a piece of 'Veroboard,' and housed in a wood case 4 1/2in x 2 1/2in x 1 1/2in, with plywood panel and lid."

(This reader submitted his full name and address but specifically requested that it not be published. He would not be in a position to enter into any correspondence concerning the circuit.)

AUDIO TOPICS

ELECTRONICS IN THE MUSIC CLASSROOM

Electronics have come to the music classroom through the Electronic Music Laboratory developed by the Wurlitzer Company. The new system permits the teacher to instruct students at various levels of proficiency in the same room at the same time.

The heart of the system is the new Wurlitzer Electronic Communication Centre, a compact instrument panel that permits the teacher to control various activities simultaneously.

"With the electronic communication centre, students may be involved with four different activities at the same time without distracting classmates or those in surrounding classrooms," said Mrs Fay Templeton Frisch, Wurlitzer music education consultant.

Mrs Frisch has travelled throughout the United States visiting schools and universities in her role as music education consultant.

"The ideas and specifications of hundreds of music educators have been incorporated in the Wurlitzer Electronic Communication Centre," she said.

Among other suggestions, educators requested a system that:

— permits them to maintain control while standing and walking around the classroom;



One instructor can carry on four separate activities simultaneously. For example, in a group of students, the teacher may monitor one group of 6 pianos in an ensemble rehearsal; instruct an individual student in a second group; feed music from a phonograph disc to a third and material from tape to a fourth.

With a push of a button, she can give personal attention to each student, to individual groups or to the entire class, demonstrate a passage of music on her own piano or discuss a point of technique through her microphone. She may use instructional tapes and records by throwing separate levers or listen to individuals or groups "aloud."

Thus, the system makes possible the optimum in piano instruction — a combination of group and individual instruction that takes place in the same time interval.

Many varied activities for learning the fundamentals of music are possible through group instruction. This stimulates group enthusiasm and speeds the learning process. Lessons often open with rhythmic activities; flash card drills; board work on transposition of melodies; relation of melody to harmony, and similar activities.

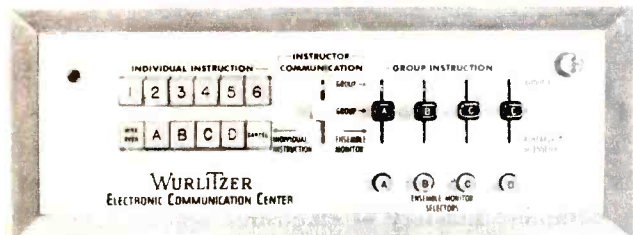
In the group experience, these basic exercises become games and challenges. To one child alone they would be academic drills.

However, differences among youngsters in hand-and-eye co-ordination, concentration, perseverance and similar physical and mental skills mean that some will progress faster than others. Private practice sessions monitored by the classroom teacher and varied composition assignments permit students to progress at their own pace.

Due to the size of the equipment in the electronic music laboratory, more instruments can be placed within a given class area. This results in a lower space cost per pupil. Instruction cost per pupil is also decreased as one teacher can easily handle more students in the electronic laboratory situation. Additional advantages to schools and institutions are reductions in equipment and maintenance costs.

The electronic pianos used in the system have 64 notes, and the majority of all music for piano instruction may be played on the instrument.

From the keyboard through the hammer that strikes the tone-producing element, the electronic piano is similar to the conventional piano. Both have approximately the same touch characteristics. A volume control on the electronic piano permits sound to be adjusted. It can be turned up to fill the largest room or down to a soft whisper of music.



The control panel is divided into three basic sections: Individual instruction (2 sets of buttons on left of panel); instructor communication (white lever in middle of panel); group instruction (four black levers on right of panel). The four round buttons at the bottom right of the control panel are Ensemble Monitor Selectors.

- includes an outlet for tape recorder and phonograph;
- allows for various classroom activities;
- has uses for non-musical courses of study;
- permits ensemble, individual and smaller group performances.

"These and other specifications were presented to A. Donald Arsem, vice-president of research for Wurlitzer, and he included them in the design of the electronic communication centre," Mrs Frisch said.

The communication centre has outlets for as many as 24 electronic pianos. The pianos, communication centre and auxiliary tape recorder player may be used for language and science instruction, among other studies.

Classrooms using the electronic music laboratory need not be specially soundproofed or isolated from other school facilities. Each student hears only his own playing when earphones are in use.

The teacher sits at the communication centre with leads from all electronic pianos connected to her control panel.

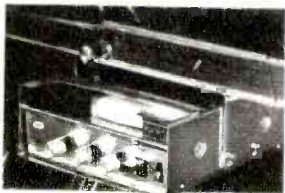
Craig

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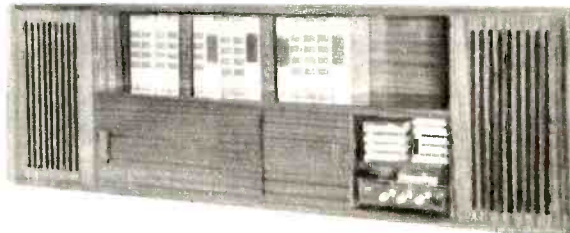
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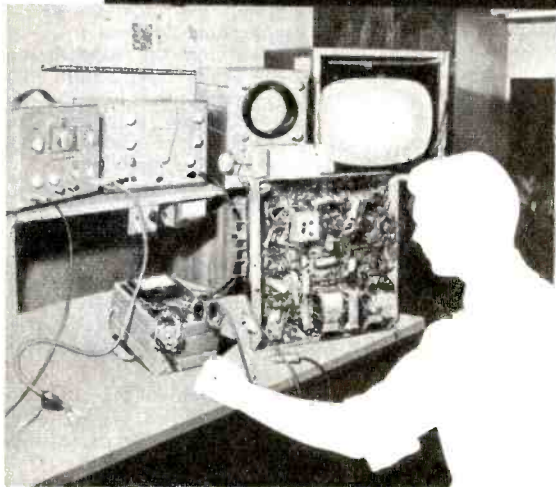


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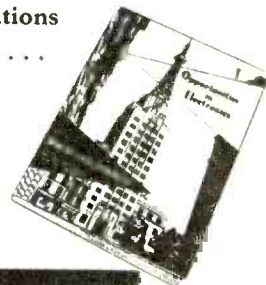
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KNOW YOUR GRAMOPHONE*

A plain man's guide to records and reproducers

By JOHN BORWICK, B.Sc.

PART SIX — GRAMOPHONE STYLI

Following our general discussions of pickup types and mechanics, we now come to the point—or rather the stylus.

Gramophone records continue to be relatively expensive and indeed subsequent catalogue deletion may make some recordings impossible to replace. Therefore we must demand of our gramophone not just a high standard of reproduction, but also a low degree of record wear.

Since the stylus, or needle, comes in direct contact with the grooves, its characteristics are of primary importance for both criteria—quality and wear. And, as we shall see, a quite different philosophy has to be applied to today's soft vinyl records compared with the old, abrasive shellac discs.

Looking back, it comes as something of a surprise to find that the ball-pointed styli used to play the early Bell and Tainter wax cylinders of 70 years ago were made of sapphire or ruby. Notice that the wax was soft and the jewel stylus could be regarded as "permanent," i.e., keeping its original shape for many playings.

With the advent of the gramophone and disc records as we now know them, from around 1897, the records were pressed in a hard thermoplastic material. These used a shellac binding and contained slate dust and carbon black so that the groove surface was rough and abrasive. It also varied a great deal in shape to begin with and called for a type of stylus which would grind itself to fit the groove during the first few turns of the record.

Tapered steel needles were the rule and were sold in different thicknesses, the thicker ones giving "loud" tone and the thinner, more flexible ones giving "soft" or "fine" tone.

Ideally, the user was supposed to throw each needle away after it had played one record but this counsel of perfection was frequently ignored, in spite of the sometimes dreadful increase in needle "scratch" and consequent damage to the records.

Record lovers who valued their collections then adopted the use of fibre or thorn needles. The former certainly gave less surface noise, due mainly to their being compliant and steeply attenuating the higher frequencies. They also bedded down into the whole groove profile and effectively spread the load of early, heavy pickups over a greater area and damped the pickup resonance.

There was evidence, however, that abrasive particles from the record could

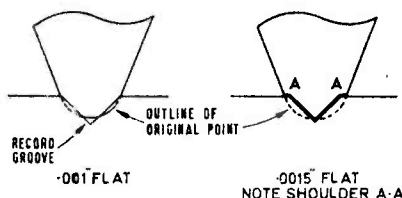


Figure 1: Showing the effect of 0.001 and 0.0015 in flat worn on stylus.

become embedded in the fibre and so damage the groove.

Thorn needles were harder than fibre (perhaps I should have used the present tense, because a small body of enthusiasts continue to employ fibres and thorns) and could play up to six records before wearing out. Sharpening on fine glasspaper was possible (I still have my old wheel-and-chuck sharpener) but it seems that here too there was the possibility of glass dust becoming embedded in the needle.

Nothing in the gramophone business stays put for long, however, and the changeover from acoustical to electrical recording and reproduction (around 1925) was followed by a progress towards standardisation of the groove dimensions and the development of lighter pickups (with playing weights measured in grammes instead of ounces).

This permitted the amount of abrasive material in records to be reduced, with a

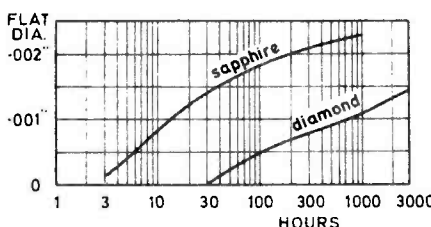


Figure 2: Comparing the diameters of flat worn on sapphire and diamond styli with increased playing time.

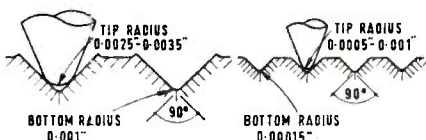


Figure 3: Showing maximum bottom radius of groove and stylus tip radius for 78rpm (left) and microgroove discs.

beneficial reduction in surface noise to accompany the spectacular widening of the frequency range. (The range on acoustic reproducers was originally about 160 to 2000Hz: by 1945 the best electrical gramophones could almost cope with the full audible range of 30 to over 15000Hz.)

Around 1950 came the introduction of unfilled vinyl and Geon, etc., for discs. No abrasive filler was incorporated and, once again, as with the wax cylinders of 70 years ago, the best stylus was seen to be a jewel tip. Sapphire, ruby or diamond are preferred and can be manufactured to fine tolerances and given a high degree of polish.

All 33-1/3 and 45rpm records are made of these soft materials and so the steel needle can be forgotten: the question of choice can be reduced to a decision between sapphire or diamond.

Sapphire styli are virtually never natural gems, but are synthetically manufactured and for the quantities required (several millions per year in the U.K. alone) the processes have been automated and the price per stylus can be as low as a few shillings.

The final radiusing and polishing of the sapphire tip, for example, is performed by tumbling thousands of the coned rondels along with grinding powders. Statistically it can be established that, after tumbling for a certain period of time, the pointed end will have assumed a perfectly hemispherical shape and the radius of this tip will be determined by the mass of the rondel.

Natural and artificial diamonds are both used for styli, but the much greater hardness of diamond means that both types are more expensive to produce than sapphire — costing from 25/ to several pounds.

However, the relatively higher cost of diamond against sapphire, and of the better grade diamonds against the cheaper ones, can be considered a worthwhile investment. Besides the factor of greater precision, there is the all-important question of playing life.

Researches by Stanley Kelly have established the type of relationship which exists between the number of hours playing and the diameter of "flat" worn on typical sapphire and diamond styli. Figures 1 and 2 are based on results published by Mr Kelly. Figure 1 illustrates the deeper seating of the stylus in the groove as the "flat" becomes increasingly greater with wear.

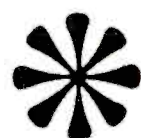
It will be seen from figure 2 that, taking a "flat" of 1 thousandth of an inch as being just acceptable, the sapphire in question should be discarded after about 15 hours playing time. The diamond, however, would last for 750 hours under the same conditions.

In round figures, we can deduce that after about 40 LP sides the sapphire is due for renewal and the diamond after 2,000 sides.

Of course these figures should be regarded as a guide only. Variable factors which would greatly influence the playing life of any stylus include the playing weight and general "goodness" of the pickup and the type and state of cleanliness of the records being played.

Note that a "flat" of one thou. requires a powerful microscope for its detection; so if you can see any such imperfections on your stylus — even through a magnifying glass — it must already be inflicting serious damage to

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10D5	900' 1.0 Mil Acetate	3.96	1.98	10C3M*	225' 1.0 Mil Polyester	1.76	0.88
10D5M	900' 1.0 Mil Polyester	5.32	2.66	5C3M*	300' .5 Mil Polyester	1.98	0.99
5D5M	1200' .5 Mil Polyester	5.70	2.85	CORRESPONDENCE TAPE ON 3 1/2" REELS			
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your records. Replacing the stylus in good time is obviously cheaper than replacing valuable gramophone records.

You may be able to give yourself a time bonus by using an ultra-lightweight pickup and a Dust Bug on good quality records: otherwise, play safe and renew your stylus within the timings given above.

The dimensions of gramophone styli

Figure 4, kindly supplied to me by Dr Dutton of E.M.I. takes a typical section of a groove modulated, on the right hand wall only, with a simple sine wave. Whereas the 0.0005in stylus remains safely in the groove, a standard 0.001in stylus is seen to be too large at C-C' where the groove width has narrowed to 0.001in (the minimum laid down by international standards).

Figure 4: Illustrating the inability of a 0.001 inch radius stylus to track a stereo groove where a minimum groove width of 0.001 in is permitted.

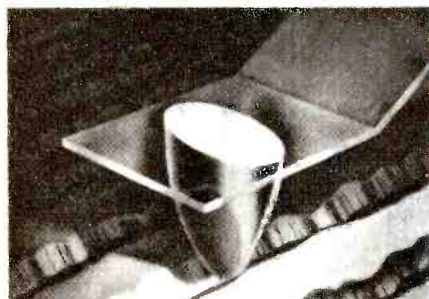
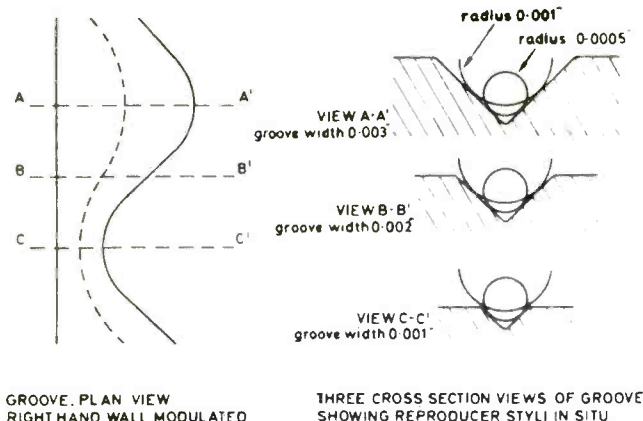


Figure 5: Artist's impression of elliptical stylus in stereo groove. (Courtesy Shure Bros.)

are quoted by reference to the radius of the hemispherical tip. The optimum stylus for any given groove will have a tip which preserves a two-point contact with the groove walls at all times. If too large, it will tend to ride on the 'hedge' of the groove; if too small, it will 'bottom' in the groove.

The groove walls present an included angle of approximately 90 deg. on all types of record. This is shown in figure 3 and, since clearly a sharp V-shape is impossible, the actual groove bottom has a specified maximum radius of about 0.001in and 0.00015in on standard and microgroove discs respectively.

For 78rpm records, a gradual reduction has taken place in the optimum stylus size over the years. For late 78rpm issues, say from 1945 onwards, 0.0025 to 0.003in is recommended. Earlier records had larger bottom radii and may require to be played with a 0.0035 to 0.004in stylus if the needle is not to scalp the groove bottom and give "groove skating."

The recommended stylus radius for mono LP records is between 0.0005in and 0.001in.

The situation is complicated on stereo discs since, as was effectively shown by the photo-micrograph of stereo grooves in figure 3 last month, the groove width and depth are continually changing. Recommended stylus tip radii for stereo discs are from 0.0005in to 0.0007in.

In practice, most users of high fidelity equipment have become used to using a single 0.0005in "stereo" stylus for stereo and mono microgroove records. As an alternative, particularly on American pickups, a compromise 0.0007in tip radius has become popular as coping better with mono discs, which had perhaps become worn by frequent playing with a mono stylus. Indeed, most replacement

styli sold in shops appear to be of this dimension.

More recently, though not really a new idea, there have emerged oval or elliptical styli with a minor axis radius of about 0.0003in and a major axis radius of about 0.0007 to 0.0009in. With the major axis aligned at right angles to the groove (see figure 5) the elliptical stylus is claimed to avoid "bottoming" on mono records. More important, the smaller minor axis tip radius should theoretically reduce tracing distortion.

Tracing distortion is a purely geometric effect and is inherent in a system which uses a spherical stylus to reproduce records cut with a sharp V-edged tip. Research by N. S. Corrington has shown that very high degrees of distortion can be introduced due to this cause.

Since the effect is due to failure of the round stylus to follow the fine recorded waveform, distortion increases at the higher frequencies and towards the inner grooves of the record — where the waveform is progressively more cramped. Tracing distortion also increases with stylus radius and will be just about halved by a reduction from, say, 0.0006in to 0.0003in.

Elliptical styli are gradually gaining acceptance, though it seems that the earlier ideas of using a major axis radius of 0.0009in were too optimistic. A major dimension of around 0.0007in now seems to be preferred.

Correct mounting of the stylus in its cartridge, and the cartridge in its shell/arm is of paramount importance. Practical matters of this type will be discussed after the section on pickup arms which forms our next instalment.



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Classical reviews

By JULIAN RUSSELL

STRAUSS — "Last Four Songs"

STRAUSS—Four Last Songs, and Five Other Songs with Orchestra. Elisabeth Schwarzkopf and the Berlin Radio Symphony Orchestra conducted by George Szell. Columbia Stereo SAX5258.

The Four Last Songs written when the composer was 84 are in a rich autumnal mood, which is not surprising. What does surprise is that at this great age Strauss's invention showed no signs of flagging, and the passion is still that of a man in his prime. The accompaniments are rich both harmonically and in the composer's gorgeous scoring. Szell serves Strauss well in his realisation of the subtle beauties of these orchestrations, always restrained when the singer has to be considered, but brought to incandescence in climaxes where he has the orchestra on its own.

There are a few bars in which the voice is perhaps recorded just a little bit too favourably to hear all the accompaniment, but these are very few, and Schwarzkopf is in such wonderful voice throughout that, to me, they didn't matter a bit. The Four Last Songs were, of course, recorded admirably by Lisa della Casa some five years ago in a voice that many might think a trifle

fresher in quality than Schwarzkopf's. But the latter makes up for this in the maturity of her interpretations and the undeniable manifestation of greater technical skill.

On this disc another fact that might cause surprise among those to whom the early songs are unfamiliar is the quite wonderful maturity of these younger pieces. All five are given here with beautiful orchestral accompaniments, four of them by Strauss himself, the fifth by Robert Heger in true Straussian style. But it must be remembered that at the period these earlier songs were written Strauss had already behind him the great series of tone poems which had established him as one of the greatest composer's for orchestra of all time. For the record, the five early songs include "Muttertändelei," "Waldseligkeit," "Zueignung," "Freundliche Vision," and "Die Heiligen Drei Könige."

This is a record I can recommend with the greatest enthusiasm to all admirers of the late Romantic school on every count—the beautiful singing, the luscious orchestral playing, and engineering, except for the tiny, almost negligible scruples of balance mentioned above, in every way worthy of the enchanting performances.

BRAHMS—Double Concerto in A Minor

BRAHMS—Double Concerto, in A Minor, Op. 102. David Oistrakh (violin); Pierre Fournier (cello). Tragic Overture, Op. 81. Philharmonia Orchestra conducted by Alceo Galliera. World Record Club T/4085.

There have been slightly better engineered performances of this concerto since the one under review was first issued in 1959. This, however, is still my favourite reading for many reasons. Oistrakh and Fournier are matched, both in tone and temperament, in a manner that is not always equalled and never excelled in the other available versions. The same might be said of

the soloists' technique, which here is so secure that the concerto's difficulties cannot even be guessed. Their interpretation, too, is massive — as befits the work—and impassioned, yet full of musicianly restraint. There is no fervour.

To support all these features with the utmost sympathy and generosity Alceo Galliera provides an exemplary orchestral part. As to the engineering mentioned in my first sentence, I should be misleading if I allowed you to think that it has not fine presence. It has. All that worries me is a slight thickening of textures in the inner voices in the tuttis that produce what some con-

sider characteristic Brahms sound. Not all conductors choose to balance Brahms' dynamic markings in a way that clarifies these inner voices and makes the sound a little more transparent. Galliera may or may not try to do so, but there is no denying a very slight denseness throughout the middle register of the orchestra.

But I must emphasise that this is only slight and can, when the superb performances of the soloists are remembered, be easily ignored. If, in the heavier climaxes, the soloists tend to be overwhelmed by the orchestra that is what almost invariably happens in any concert hall, so it is not surprising to meet the problem here. Everywhere else throughout the concerto the soloists merge quite admirably into their surroundings save in those places where they are called upon to emerge, when they do so nobly.

An occasional woodwind solo sounds as if it had been recorded a little too close to the mike for normal concert hall balance. But these intrusions, too, are few and, on the whole, all the minor defects are easily outweighed by the many virtues to be found in this admirable performance put out attractively at an economy price. A spirited, dramatic account of Brahms' "Tragic" Overture makes a generous fill on Side 2.

★ ★ ★

STRAVINSKY.—The Rite of Spring. Complete Ballet. Philharmonia Orchestra conducted by Igor Markevitch. World Record Club, Stereo TE250.

I am less happy with his performance, also issued under the World Record Club label. That it is immensely exciting few would be willing to deny. Markevitch takes full advantage of the unusually wide dynamic range provided by the sound engineer. He gets much real urgency into the composer's deliberately disturbing rhythms. His climaxes are craglike in their rises and falls. And he uses these parts of the score to belabour the listener in the way the composer intended.

But in the more delicate passages. Markevitch's performance lacks some of the refinement to be found in alternative versions by Ansermet, Monteux and Stravinsky himself. However, these last three have not, so far as I know, yet been reissued at the price at which you can buy the Markevitch, and if you are not prepared to pay the higher price the last-named should suit quite well.

★ ★ ★

WALTON.—Facade Suites Nos. 1 and 2. Johannesburg Festival Overture; Portsmouth Point Overture; Crown Imperial March; Orb and Sceptre March. Philharmonia Orchestra conducted by William Walton. H.M.V. Mono HQM1006.

The two Facade suites wear wonderfully well for music that was the latest word in chic back in the early-1920s. Their tunes remain as fresh as ever, the wit as cutting, the many parodies and burlesques as brilliant. Walton has chosen 12 items in all, and in my opinion, they are the best. The absence of an occasional favourite may be regretted, but a generous supply of bright entertainment remains.

All are played without the recital of the Edith Sitwell poems they were originally designed to illuminate. I think this is all to the good because I have never yet heard these poems delivered at the speed they must go to fit the music

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without the words become hopelessly gabbled and their reciter left breathless. Orchestra and conductor are in merry mood throughout and the playing is superlatively good.

The two overtures also come off very well. Both are jolly, ingenious, and colourfully scored, though the Johannesburg piece wears better than Portsmouth Point nowadays. The two marches have become very well known since the time they were commissioned, "Crown Imperial" for the coronation of George VI in 1937, "Orb and Sceptre" for that of Elizabeth II in 1953. It is safe to say that Walton has proved himself, in these, to be the finest composer of marches since Elgar.

★ ★ ★

YEHUDI MENUHIN at 50. A violinist tells the story of his musical life. HMV Mono HQM1018.

This is a fairly complete musical biography but tells us little about the man. A pity this, because although Menuhin keeps his private life private, the little personal knowledge one has of him whets the appetite for more.

But as an example of the difficult transition from child prodigy to mature musician this disc is without rival. It starts with an example of his earliest recording, "La Romanesca" back in 1928, and progresses through a series of short but brilliant trivia, all played with marvellous facility and glowing tone, to the famous Elgar Violin Concerto recording—an excerpt only, of course—right up to his most recent issues which include Stravinsky's "Dumbarton Oaks" and Mozart's C Major Sonata (K.303).

Although in the earlier recordings some of the sound is on the primitive side they still give a good idea of the breathtaking brilliance of the boy violinist in his early teens. His progress toward maturity was not steady. I should place the turning-point in his career at about the time he recorded the Caesar Franck Violin Sonata with his sister Hepzibah in 1936. On the evidence offered here this seems to be when he discarded the instinctive genius of the prodigy in favour of the more conscious processes of discerning musicianship.

Menuhin supplies the commentary himself with becoming and characteristic modesty in an accent that wavers between American and English, which is not surprising since he has spent so much of his life in England, a country he loves with an abiding affection. A slight peep at his extra-musical activities is revealed in the fact that royalties from the sale of this record will be paid to the Yehudi Menuhin school for brilliant children at Stoke d'Abernon, Surrey, England.

★ ★ ★

BEETHOVEN—The Two Piano Trios, Op. 70. Yehudi Menuhin; Hepzibah Menuhin; Maurice Gendron. HMV Stereo AS2D2 258.

I am quite sure that Beethoven intended the piano parts in these trios to be given more prominence than they receive here. I am also convinced that Hepzibah Menuhin could have awarded them the necessary prominence had she been allowed to. As it is, the piano, though it never recedes into complete inaudibility, is treated as a purely accompanying instrument to fine performances by the violinist and cellist.

It will surprise no one that all three musicians play splendidly most of the time and that their sense of style is pretty well faultless. The slow move-

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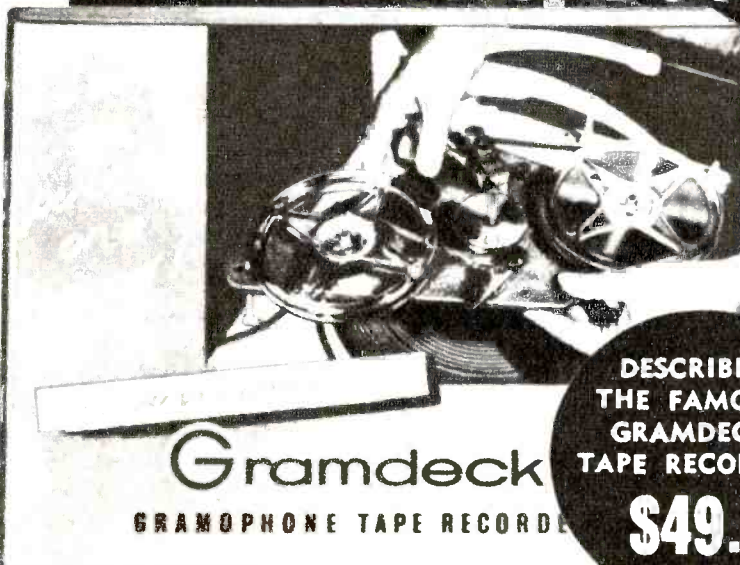
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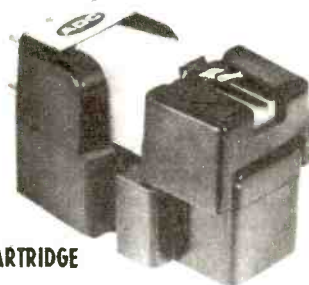
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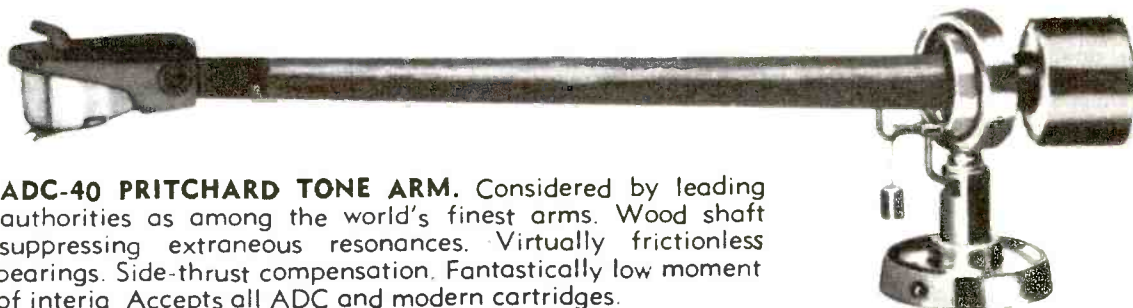
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ments in particular stand out in the beauty of their controlled passion, especially where the piano is treated with more generosity than elsewhere. Now and again, in a faster one, the playing gives the impression of being a trifle hard-driven, though this never degenerates into clumsiness.

Although I doubt if these performances will ever be considered the last word on the subject, they are at present the best available. Indeed, so far as I can trace, this is the only disc to couple the two Trios of this opus.

★ ★ ★

MOZART. Piano Concertos—No. 12 in A Major (K414); No. 18 in B Flat Major (K456); No. 20 in D Minor (K466); No. 23 in A Major (K488); No. 24 in C Minor (K491); No. 26 in D Major (K537). Lili Kraus and the Vienna Festival Orchestra conducted by Stephen Simon. Epic Stereo BSC154 (three discs).

This is the first set of what will eventually be Lili Kraus' integral recording of Mozart's Piano Concertos. She has for many years enjoyed an enviable reputation as an interpreter of Mozart's music. I still have some of her prewar 78s, and it is interesting to trace how her readings have changed over the years. Her style is still faultless and her technique unimpaired, which means that all such problems are so securely solved that the mechanics of the performances can be ignored.

What can be detected is a slightly more aggressive approach in some of the faster movements. I do not mean by this that Madame Kraus' style has become pugnacious. Her added vigour remains well within the limits of 18th-century dynamics and her expression is always decorously classical. Her tone, too, despite an increase in volume, remains admirably limpid.

Sometimes, too, a momentary accelerating give the impression of slight impatience as if the player had in mind the desire to convince rather than charm. But all these occasions are rare and some will even find approval among the most diligent Mozartian purists. No one can expect an enterprise of this magnitude to please everybody throughout its entire length. There are bound to be bars, even movements, in which another reading might be preferred to Madame Kraus'.

But I can assure any potential buyer that they are unlikely, on the strength of this first set, to find anything violently opposed to good taste in Madame Kraus's performances. The orchestra is extremely competent if seldom inspired and if the balance now and again favours the piano ever so slightly, that instrument is not allowed to make important orchestral passages inaudible. Otherwise the sound is clear and of good quality.

★ ★ ★

MOZART—Symphony No. 40 in G Minor (K.550).

HAYDN — Symphony No. 88 in G Major. Columbia Symphony Orchestra conducted by Bruno Walter. CBS Stereo SBR235165.

This is a handy coupling for anyone who wants two popular 18th century symphonies, but I am afraid I can recommend only the Mozart with any real enthusiasm. This offers Walter at his best, suave, sensitive, yet weighty where necessary, the nuancing phrased with infinite care—and love. The orchestra re-

sponds with the utmost flexibility to his slightest wish. I know of no performance of this great symphony I like better.

But I cannot say the same about the Haydn. Walter's performance here can best be summed up by one word—flat. The first movement lacks the wonderful vitality present in the two outside movements of the Mozart. The adagio, though phrased with all Walter's customary care, goes so slowly that most of the tension gets lost. The other two movements are better. The Minuet is full of merry pomp and the Finale gossips away with beguiling garrulity. But generally speaking the playing is nowhere up to the very high standard Walter sets in the Mozart.

★ ★ ★

VAUGHAN WILLIAMS — Symphony No. 8 in D Minor. Partita for Double String Orchestra. London Philharmonic Orchestra, conducted by Sir Adrian Boult. World Record Club, Stereo T/4126.

I think Vaughan Williams' Fourth, Fifth and Sixth Symphonies are far and away his best. The eighth, though admirably argued and well set out on a large frame, is much less attractive. Boult keeps the first movement pleasingly relaxed and is always alert to the subtleties in the composer's scoring.

The most effective movement is the second, a scherzo for wind, in turn grotesque, a la Mahler, and impertinent, a la Shostakovich. The playing in this is never less than brilliant. The following Cavatina for strings is pleasing, though Williams did better in similar movements in other symphonies.

Tuned percussion in the Finale give the movement a strong Chinese flavour unusual in this composer's work, though his characteristic modalism is only thinly disguised.

The Partita for Double String Orchestra is a revision of his Double String Trio. Its present arrangement, much in the manner of a concerto grosso, is much more effective than the original. Here, too, Williams' modalism is seldom absent, though this particular work displays more rhythmic interest than is usually found in his works. I can't imagine the disc having much general appeal and Vaughan Williams is nowadays suffering the eclipse that usually follows hard on the death of a composer and which, in his case, I hope will only be temporary.

★ ★ ★

SCHUBERT—Lachen und Weinen; Dass Sie Hier Gewesen; Sei Mir Gegrusst; Du Bist die Ruh; Waldesnacht; Seligkeit; Heiden Roslein; Standchen; Des Fischers Liebesgluck; Fischerweise; Der Jungling an der Quelle; An die Laute; Die Forelle; Auf der Riesenkoppe. Fischer-Dieskau (baritone) and Gerald Moore (piano). HMV Mono ALP2263.

It is amazing to think that, despite the popularity of many of the songs offered here, and with seven "mixed" Schubert recitals already on disc this is the first time Fischer-Dieskau has recorded any of these. The only explanation resides in the fact that Schubert wrote more than 600 songs, so that several still remain for Fischer-Dieskau's future attention.

Although the selection here covers Schubert's most popular lieder, they are none the less welcome, for there is nothing jaded in the manner in which the singer, and his incomparable accompan-



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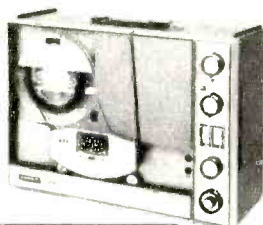
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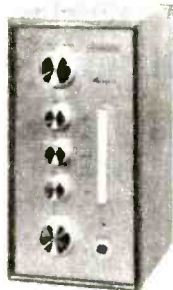
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ist, Gerald Moore, offer them. They all sound perennially fresh, almost as if they had been specially learned for the occasion. When I write that both artists are at the very top of their form, it can be taken to mean that I can think of no other combination to excel them.

In addition to the "popular" items, two are likely to be unfamiliar to all but Schubert students—"Waldesnacht" and "Auf der Riesenkoppe." The record, is issued under the title of "Fischer-Dieskau Sings Popular Schubert Songs."

★ ★ ★

MOZART—Requiem Mass in D Minor (K.626). Elly Ameling (soprano), Marilyn Horne (mezzo-soprano), Ugo Benelli (tenor), Tugomir Franc (bass), Vienna State Opera Chorus and Vienna Philharmonic Orchestra conducted by Istvan Kertesz, Decca Stereo SET 302.

Much as I admire Istvan Kertesz as a conductor I feel it necessary to write that I don't think this work suits him. The Requiem is a dramatic work, to be sure, but it suffers badly under Kertesz' over-dramatic treatment. He uses a dynamic range quite unsuited to eighteenth century compositions and an operatic style that, while eminently welcome in Verdi's wonderful "Manzoni" Requiem, is out of place here.

Moreover, Kertesz seems unable, or at any rate reluctant, to introduce any feeling of mystery into the Mass. And when it is remembered that Decca are the producers, one is surprised to find that the chorus sometimes overwhelms the orchestra and that though the soloists all work accurately and musically, the tone of the chorus often degenerates into coarseness and the ensemble is anything but tidy. There are better versions available today and more are bound to turn up in the not too far distant future.

★ ★ ★

IN MEMORIAM. Kathleen Ferrier (contralto). Decca Mono LXTA-7512.

Songs and arias featured in this disc are: Ye Banks and Braes (Quilter-Burns); O, Waly, Waly (Sharp-Britten); Now Sleeps the Crimson Petal (Quilter-Tennyson); Drink To Me Only With Thine Eyes (Quilter-Jonson); I will Walk With My Love (Hughes); Willow, Willow (Elizabethan Song arr. Warlock); Ma Bonny Lad (Trad.); Geistliches Wiegenlied, Op. 91 (Brahms); Mad Bess of Bedlam (Purcell-Britten); Grief for Sin (Mass in B Minor) (Bach); Art Thou Troubled? ("Rodelinda," Handel); Che Puro Ciel ("Orpheo ed Euridice," Gluck). Some have piano, others have orchestral accompaniments.

This disc will be welcomed by all those to whom the ill-fated Kathleen Ferrier gave so much pleasure some 20 years ago. I found myself enjoying as much as ever her beautiful rich, magnificently produced contralto voice. Some of the folk-song type of items she sings on Side 1 are accompanied in the very simplest fashion. In others the accompaniments have been arranged by a number of composers, and include the polite drawing-room exercises of Roger Quilter and the much more sophisticated settings of Warlock and Britten.

The second side is devoted to arias, with orchestral accompaniments, by Bach, Handel and Gluck and demonstrate that the late Kathleen Ferrier could switch from the unaffected simplicity of the "ditties" to the majestic grandeur of the others without damage to the alluring personality that made her so beloved during her brief lifetime. ■

DOCUMENTARY RECORDS

Reviewed by Glen Menzies

BIBLE STORIES FOR CHILDREN told by Claude Rains. Produced by Alan Livington. CAPITOL MONO ENC 9207.

This record has already been reviewed by W.N.W. in the Devotional Records section. Personally, I approached it with some trepidation for, when Hollywood actors or actresses read material with a religious background, what is meant to be awe-struck reverence only too often gives way to readings unequalled for their unctuously nauseating sentimentality. It is therefore a pleasure to report that Mr Claude Rains avoids all of these pitfalls and gives highly professional readings, with just the right touch of dramatisation.

The three shorter works adapted by Axel Gruenberg occupy one side of the disc and of the three, "Joseph and His Coat of Many Colours" comes across very well with vigour and feeling. I didn't find Nathaniel Shilkret's music particularly ingratiating; it is far too busy, rather like the interminable background music in some television programs.

"The Story of Jesus" occupies all of Side one, and although naturally compressed, Charles Palmer in his adaptation has achieved a great deal in avoiding archaisms of speech without adding any cute or objectionable modern day phrases which always sound so out of place in this context. The telling of the story is simple and direct with an acceptable musical score from that man of many parts, Mr Billy May.

This is a record well worth its reissue in the Encore series. The Capitol sound recording is good. The somewhat cavernous acoustic from which the reader's voice emerges is a little disconcerting at first, but I must add that it did nothing to disturb my six-year-old's rapt attention when listening to the stories. Sound effects, as always with Capitol, are well contrived and not over emphasised.

★ ★ ★

THE FOLKSONGS OF BRITAIN, VOL. 8. "A Soldier's Life for Me." Collected and Edited by Alan Lomax and Peter Kennedy. CAED- MON MONO TC 1164.

Without professing to be a connoisseur of the folksinger's art, I found this a fascinating collection to listen to. Alan Lomax, the well known American collector, and several others gathered this material in faraway corners of the British Isles. There they recorded these songs which, in the way of the folk tradition, have been handed on from one generation to the next, undergoing changes and modifications in the process. Selected from the thousands collected, there are 22 songs in this album, all of them about the soldiers who willingly or otherwise marched off to war.

The songs tell of lovers lost in war, of women who dressed as soldiers to be near them, of death in battle and the simple soldier's hatred of his officers. I must add that they are not all grim; some are amusingly irreverent whilst

others have a touching sadness. These are folksongs with a difference, not sung by polished professionals or the would-be "folkies" who have been such a bore these last few years, with their unmusical strummings. The singers on this disc have voices often cracked with age, rough in texture but completely sincere, singing in most cases without any kind of accompaniment.

A splendid booklet goes with the album which gives the words and history of each song, and a brief note on the singer. The recording of the artists has been done with complete professionalism, not only from the point of view of sound, but also in the way the collector has gained the confidence of these people in remote places, far away from recording studios.

This is the final volume in the Folksongs of Britain series and, although it seems a somewhat back-to-front way to do it, one could do worse than find out what the other seven volumes are all about.

★ ★ ★

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There are people who spend so much of their time, beside, on, or in the sea, for whom its recorded sounds would have little fascination; yet who has not responded nostalgically to the sound — for example—of seagulls in full cry? And this is only one of the various stimulating yet soothing sounds heard on this record—much of which could be used to induce a mood of relaxation (to say nothing of its possibilities as background music for your private showing of slides of that holiday at the beach).

In fact, deeply interesting—even mov-

ing—as they are, the sounds of the sea itself on this record, once heard, become the background for such incidental effects as the seabirds' cries, the foghorn piercing the white mist over the sea at strict intervals, and the music of the pebbles on the beach as they roll back with each receding wave (the recordings were made in English waters). Other tracks take in a foggy night on Merseyside and life on a steamship in fair weather and foul (the latter almost realistic enough to make you reach for the seasickness pills.)

For the record (as they say) the sounds heard on board ship were taped on a Birkenhead-Liverpool ferry and on an Admiralty tug; the gentler sounds of the lapping surf on beaches in Dorset; the wild ones on the rocky coast of Cornwall, beautifully portrayed on the cover.

But for me the main attraction is the last part of the record made at Whitby Harbour, in Yorkshire, in the twilight of an autumn evening. Children are heard playing on a nearby jetty while seagulls wheel and cry overhead. In the distance church bells begin to chime and the fishing boats chug out towards the open sea to begin their evening trawl. Here, surely, is the stuff that dreams are made on!

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VARIETY FARE

"ELECTRONICS Australia"

Staff Review Panel

Devotional

GREAT MOMENTS OF SACRED MUSIC. Jerome Hines with Orchestra arranged and conducted by Kurt Kaiser. Stereo, Word WST-8337-LP (Gospel Film Ministry). Also available in mono.

Interest: Outstanding soloist.
Performance: Yes, outstanding.
Quality: Excellent.
Stereo: Normal.

From an un auspicious beginning, according to the jacket notes, Jerome Hines moved up the musical ladder to appear as a soloist with the Hollywood Bowl Orchestra and the Los Angeles Philharmonic.

Winning the Caruso Award at the New York Met. in 1946, he has since appeared there in thirty leading basso roles, appearing also in the famous opera houses of Europe. In 1962, he made a very successful appearance in Moscow, and was entertained socially by Nikita Krushchev. Currently, Jerome Hines, "a deeply committed Christian" is kept busy singing the Gospel message in contexts varying as widely as national radio programs and Salvation Army meetings on skid row.

In the face of all this, I was vaguely disappointed with his first number, "How Great Thou Art," which was good but not that good!

But the rest dispelled any possible doubts: Let Us Break Bread Together—Largo—The Lord's Prayer—I'd Rather Have Jesus—He's Got The Whole World In His Hands—The Old Rugged Cross—Eternal Father, Strong To Save—Blessed Assurance—In The Image Of God—The Day That I Met Jesus—The Lost Chord.

A magnificent voice and an album that deserves a place in any collection of Gospel music. (W.N.W.)

★ ★ ★

NAT COLE SINGS HYMNS AND SPIRITUALS. With the First Church Of Deliverance Choir conducted by Gordon Jenkins. Stereo, Capitol/EMI ST-2454. Also available in mono T-2454.

Interest: Gospel with a beat.
Performance: Very good.
Quality: Very clean.
Stereo: Outstanding.

In May, 1960, I reviewed this same album under the title "Every Time I Feel The Spirit." Capitol have re-released it now, following the singer's death, as his only album of hymns and spirituals.

Summing it up on the previous occasion I said "... when the hymn tunes are predominantly negro spirituals, the singer is the negro son of a minister and he is backed by a church choir and a rhythm group, the result is something of an enigma. It is debateable what is negro, what is spiritual and what is pop."

Perhaps, during the intervening years, I've grown more accustomed to the idiom and I found myself, on this hearing, much less concerned with the reservations and much more impressed by the sheer musicianship of the presentation. And, if many of the hymns have a full share of beat, others have a strong emotional impact: Every Time I Feel The Spirit—I Want To Be Ready—Sweet Hour Of Prayer—Ain't Gonna Study War No More—I Found The Answer—Standin' In The Need Of Prayer—Oh, Mary Don't You Weep—Go Down, Moses—Nobody Knows The Trouble I've Seen—In The Sweet By And By—I Couldn't Hear Nobody Pray—Steal Away.

As noted above the quality is excellent, with diction and stereo quite outstanding, even by the standards of 1967. In fact, well worth a hearing if the type of material appeals. (W.N.W.)

★ ★ ★

HALLELUJAH. Clara Ward, vocal with piano, organ and percussion. Mono, Universal UM-660.

Interest: Negro gospel.
Performance: Negro style.
Quality: Good.

Perhaps I was conditioned by the Nat Cole album reviewed above, but I liked this one by Clara Ward a lot better than I originally expected. Actually the two have a lot in common: A basic negro idiom, with Hammond organ, percussion and chorus and alternating between uninhibited rhythm and the deeply soulful. The main difference is that, whereas Clara Ward's voice is hard and passionate, Nat Cole works close-up on mic. with a voice that is whisper smooth.

Clara Ward's numbers: Walk With Me—All God's Chillun Got Shoes—Peace In The Valley—Swing Low, Sweet Chariot—Goodnight, God—When We

Get Up There—Silver Wings—Deep River—Oh Glory Hallelujah—The Lord Will Understand—Take My Hand, Precious Lord—I Am So Happy.

Technically not as outstanding as the Nat Cole disc, this is nevertheless a good one, if you like this kind of music. (W.N.W.)

★ ★ ★

BIBLE STORIES FOR CHILDREN.

Told by Claude Rains, Music by Nathaniel Shilkret. Mono, Capitol, Encore Series ENC 9207.

Interest: Bible stories.
Performance: Well told.
Quality: Good.

In meeting up with a record like this, one has to make a conscious effort to dissociate the narrator from some of the roles in which he has appeared in theatre and television—a problem that will not confront the children who might listen to these Bible stories. To them it will be the voice of a story-teller, neither patronising nor artificial, just friendly, natural and clear.

Side 1 carries "The Story Of Jesus," from the shepherds to the ascension. Side 2 carries three stories: Noah And The Ark—Moses In The Bullrushes—Joseph And His Coat Of Many Colours.

Excellent for children of kindergarten age, in school or in the home. (W.N.W.)

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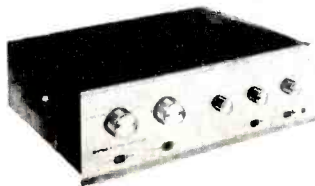
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- Output 8 watts per channel (16 watts).
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• Valves used 6AN7 6N8, 12AU7 or 12AX7, 2—6GW8 and 2—0A210 rectifiers.

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I LIKE BEETHOVEN. Various artists and orchestras. Capital (E.M.I.) Stereo SP 8635. Also available in Mono.

Interest: Classics for beginners.

Performance: Standard.

Quality: Mostly very good.

Stereo: Mostly normal spread, some electronically reprocessed.

A more apt title for this disc might be "I wonder if I'll like Beethoven," since it obviously intended as a sampler for people with only a slight knowledge of classical music. It is easy to be patronising about this type of record, and I acknowledge that the idea of playing single movements from Symphonies and Sonatas is about as logical as reading one chapter from a novel. However, when I think back to the days when I myself was just beginning to like classical music, I remember how I played to death a single record from a 78rpm set of Beethoven's fifth symphony—not even a complete movement! If newcomers to classical music can capture from this disc the rapture I found in that single disc, their money will be well spent.

Strangely, the popular first movement of the Fifth Symphony is not included in the selection, which consists of: Adagio from "Moonlight" Sonata—Egmont Overture—Allegretto from 7th Symphony—Minuet in G and Fur Elise (piano solos)—Turkish March from "The Ruins of Athens"—Coriolan Overture—Adagio from "Pathétique" Sonata—Finale from Symphony No. 3.

The performances themselves are all quite standard with the exception of the two movements from the piano sonatas, which have been arranged for piano and orchestra. While the slow movement from the "Moonlight" sonata comes off fairly well, with the orchestra doing little other than reinforcing the bass line, the Adagio from the "Pathétique" sonata is far less successful; in my opinion, it does not lend itself to this type of treatment.

Technically, the disc is never less than adequate, and in some tracks, the sound is excellent. The stereo spread is noticeable without being particularly wide. (H.A.T.)

★ ★ ★

ESPANA. The Hollywood Bowl Symphony Orchestra conducted by Felix Slatkin. Encore (E.M.I.) Stereo SENC 9232. Also available in mono

Interest: Spanish classics.

Performance: Excellent.

Stereo: Normal spread.

Spain has had to rely largely on foreign composers to present its musical idiom to the world. Very few Spanish composers have achieved lasting fame, and the few that have are not usually regarded as being in the front rank of composers. Fortunately the unique colour and character of Spanish music has fascinated many great composers of other nationalities, so we find in this selection two works by a Frenchman, one by a Russian and only one by a Spaniard. These are "Capriccio Espagnol" by Rimsky Korsakov, "Bolero" and "Alborado del Gracioso" by Ravel and "Triana" by Albeniz.

"Capriccio Espagnol" was described by Tchaikowsky as "a colossal masterpiece of instrumentation," and is a great favourite with concert goers and performers alike because of the brilliance of its orchestration and the changing moods, varying from dreamy nostalgia to blazing passion. The Hollywood Bowl Symphony Orchestra provides a colourful and exciting rendering of this work and exhibits excellent instrumental work by individual performers.

Ravel's "Bolero" has been subjected to much ridicule, because of its repetition of the main theme. There is the story of the critic who dreamt he was listening to this piece, and woke up to find he was. However, when played as it is here there is no risk of boredom. The theme is superbly presented by the various instrumentalists, and the tension is built up in masterly fashion by Slatkin to the final thundering climax. The other piece by Ravel, his "Alborado del Gracioso," an exquisite masterpiece in miniature, is also beautifully played.

The Albeniz item is from his "Iberia" suite of 12 short tone poems depicting in music various districts of Spain. Triana is a district close to Madrid, and for those who are interested, Iberia is the old Roman name for the Spanish peninsula. Although this is a pleasant enough piece, it is not particularly Spanish in flavour, and cannot compare with the other pieces on the disc as an orchestral masterpiece. (H.A.T.)

★ ★ ★

THERE'S MAGIC IN MUSIC. Eric Jupp, His Piano and His Orchestra. Mono, Universal Record Club U-779.

Interest: Popular local orchestra.

Performance: Very pleasant.

Quality: Entirely clean.

My reaction to "Frenesi", the first track on side 1, was that this was an album I was not going to like! But "Deep Purple", which followed, made me doubt my first reaction. After that, well, I had to admit that the sound was just about as clean, bright and melodic as one could wish for.

In fact, Eric Jupp is well known in this country, having come here first in 1960 as a guest conductor for the A.B.C., only to stay on as Director of Light Music for the Sydney studios, and a featured musician on A.B.C. radio and television.

Other than the numbers mentioned earlier, he presents: You Belong To My Heart — Anna — Big City Blues — Amor — Poinciana — Why Do I Love You — By The Light Of Your Eyes — Yesterdays — Toy Piano — Adios Mariquita Linda. And Eric Jupp's own solo piano? He need defer to no one. (W.N.W.)

★ ★ ★

CLASSICAL MINIATURES. Frank Pourcel and his Orchestra. H.M.V. (E.M.I.) Stereo OCSD 7656. Also available in mono.

Interest: "Palm Court" music.

Performance: Competent.

Quality: Very good.

Stereo: Normal spread.

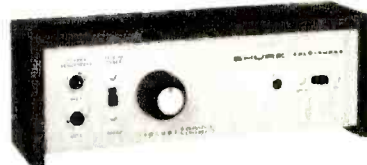
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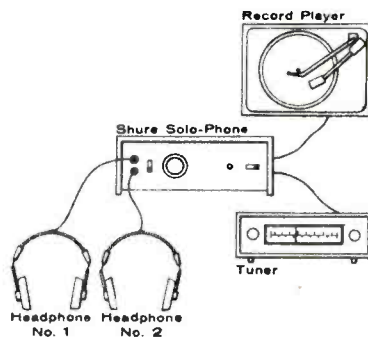
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the Hollywood Bowl, to mention only a few. Notwithstanding this, there seems to be a ready sale for records of discs featuring light classics played by light orchestras, judging by the large numbers of such records put out, so I assume that many people prefer the more restful type of "Palm Court" performance offered by these orchestras.

If you are one of this group, this disc by Frank Pourcel and his orchestra should please you, as it is very good of its type, featuring a good selection of popular tunes and competent performances, while the technical quality is above reproach. On the other hand, if you like the full weight of a symphony orchestra, there are plenty of alternatives to choose from.

The titles: Waltz of the Flowers from the "Nutcracker" (Tchaikowsky)—Melody in F (Rubinstein)—Obertass Mazurka (Wieniaski)—Serenade (Toselli)—Reverie (Schumann)—Czardas (Monti)—The Swan from "Carnaval of the Animals" (Saint Saens)—La Czarine (Ganne)—Meditation from "Thais" (Massenet)—Barcarolle from "Tales of Hoffman" (Offenbach). (H.A.T.)

★ ★ ★

NOREEN HENNESSY Plays The Academy Award Winners at the Hammond Organ. Stereo, Festival SFL-932,039. Also available in mono FL-32,039.

Interest: Undying favourites.

Performance: Capable.

Quality: Normal.

Stereo: Mild.

In this, her third album to be reviewed recently, Noreen Hennessy switches to a selection of film favourites and a Hammond organ.

That she is completely at home playing such tunes is never in doubt, evident the theatre-style phrasing, counter-melodies and footwork. But, despite loads of organ reverberation and vibrato, there is too much of a sameness about the voicing to make one want to play the album straight through. Even a re-arrangement of the numbers would have improved matters, with "Gigi" providing much needed variation in the middle of side 1, as does "High Noon" on side 2.

Order notwithstanding, however, the numbers will have their individual appeal: Que Sera, Sera—Chim Chim Cheree—Lullaby Of Broadway—The Way You Look Tonight—Over the Rainbow—When You Wish Upon A Star—The Last Time I Saw Paris—Mona Lisa—High Noon—The Continental—Three Coins In The Fountain—Gigi.

Technically, the recording quality is okay apart from "When You Wish Upon A Star", which puts a lot of level right where it shouldn't be—on the inside track. (W.N.W.)

★ ★ ★

A TRIBUTE TO KREISLER. Ruggiero Ricci, violin, with Brooks Smith, piano. Universal Record Club, in Stereo DL 10052. Also available in Mono.

Interest: Violin music of Kreisler.

Performance: Rather intense.

Quality: Good.

Stereo: Unimportant.

The Kreisler "salon pieces" presented in this recital by Ruggiero Ricci are standard items in every violinist's repertoire, and must be some of the most played pieces ever composed for the instrument. Literally hundreds of versions of "Liebesleid" and "Schon Ros-

marin" have been recorded in recent years, yet these and other Kreisler pieces remain as popular as ever. So far these beautiful swaying melodies have escaped the attention of popular song writers, no doubt because the copyright has been carefully guarded.

Now Mr Ricci is a very good fiddle player, and opinions will no doubt differ about the right way to play these pieces, but to my mind his rather fierce attack at the beginning of phrases tends to disturb the legato flow of the melodies. I have always regarded these Kreisler pieces as essentially gentle in character and prefer the smooth approach adopted by some other violinists. However, I admit that this is purely a subjective opinion, and others may prefer the more unrestrained approach adopted by Ricci.

It must, however, not be overlooked that this disc is very good value for money, for besides being available at the economy club price, it also contains no fewer than 14 tracks: Praeludium and Allegro—Sicilienne and Rigaudon—Chanson Louis XIII and Pavane—Rondino on a theme of Beethoven—Variations on a theme by Corelli (Tartini-Kreisler)—Recitativo and Scherzo-Caprice—Caprice Viennois—Tambourin Chinois—Liebesfreud—Liebesleid—Schoen Rosmarin—La Gitana—The Old Refrain—La Chasse. (H.A.T.)

★ ★ ★

THE "IN" HARMONICA. Larry Nelson, Harmonica with Group. Stereo, Festival SFL-932,083. Also available in mono.

Interest: Rock style harmonica.

Performance: Virtuoso.

Quality: Crystal clean.

Stereo: Plenty of separation.

If you're an old-fashioned Larry Adler fan, this isn't the kind of sound you'll hear from this album. Nor will you hear from it anything like the fullsome rhythms of the Harmonicas.

Rather is the performance built largely on a driving rock-style beat, with electronic organ, guitar and percussion and with Larry Nelson out front, straining the harmonica reeds to their limits. In its class, it's quite a performance but, before you pay out your dollars, make sure it's the kind of sound you go for.

The tracks: You Were On My Mind—Mr Jones—Baby Don't Go—Early Morning Rain—But You're Mine—The "In" Crowd—Where Do You Go—Universal Soldier—Just You—Try To Remember—All I Really Want To Do—She Belongs To Me.

Originally recorded for the American World Pacific—Liberty label, the sound quality of this local Festival pressing is tops. (W.N.W.)

★ ★ ★

FLAMENCO. Dave Parker. Monument (Festival) Stereo SPL-932120. Also in Mono PL-31120.

Interest: Virtuoso guitar.

Performance: Skilled.

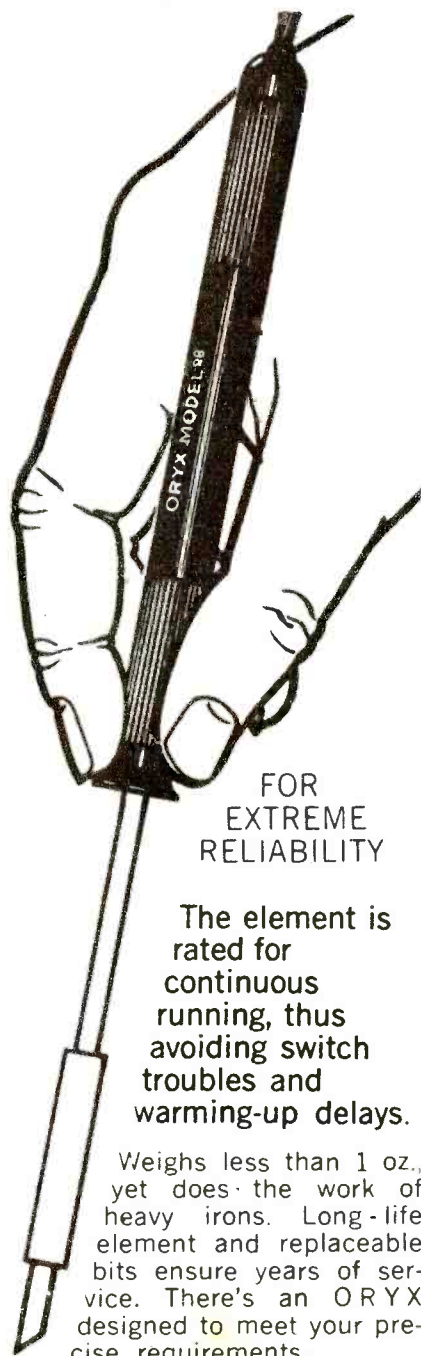
Quality: Excellent.

Stereo: Not significant.

Let me point out at the start that this is not flamenco playing at all, notwithstanding the title. Dave Parker does not play here in the flamenco style, with the traditional chord structures and rhythms. Instead, he gives us some well-known tunes arranged for guitar solo and some of his own compositions specially written for the instrument. Possibly the sales organisation of record companies find it difficult at times to suggest a suitable title for a disc, but

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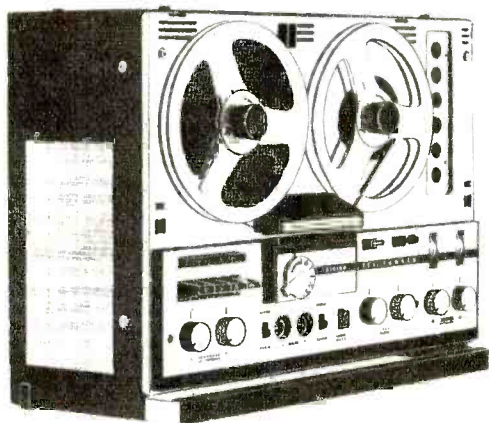
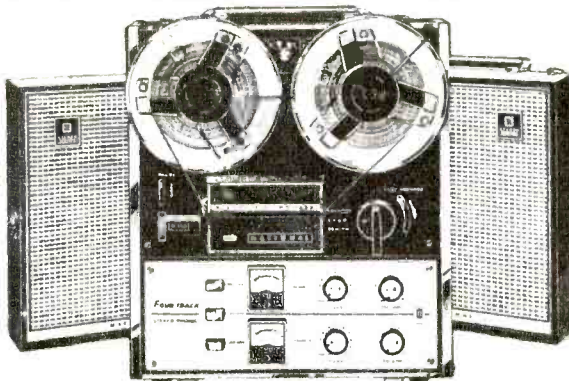
(Right)

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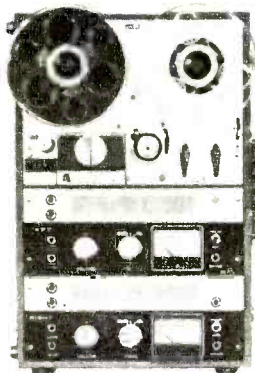
(Left)

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one as inappropriate as this could be positively misleading to purchasers.

However, it would be wrong to allow the sins of the sales personnel to detract from Dave Parker's performance, which is skilful and enjoyable. His program includes April in Portugal — Carnaval — Malaguena — Cavaquincho — Third Man Theme — La Comparsa — Bells of Sao Paulo — Bay of Monterey — Poinciana — Mirage — Southern Star — Romanza.

If you want the traditional flamenco, stick to the playing of such performers as Montoya, Escuderos and Sabicas, but for something with a more modern touch, this one is worth a try. It is well recorded, with bright clear sound, and with none of the disturbing squeaks and clicks which mar some recorded performances of guitar music. (H.A.T.)

★ ★ ★

CONTINENTAL ZITHER, Ruth Welcome with Dominic Cortese, Accordion. Mono, EMI-Capitol T-2472.
Interest: Gentle zither harmonies.
Performance: Pleasant.
Quality: Flawless.

With a sound that could oftentimes be mistaken for a gently played Hawaiian steel guitar, Ruth Welcome moves from scene to scene on her musical continental tour. And with her goes Dominic Cortese and his accordion, which he plays with easy virtuosity. The sound is interwoven delicately but is marred to my ear, by imperfect pitch from the zither in some numbers.

The titles: The Poor People Of Paris — Be Mine Tonight — The Cabby — Al Di La — The Happy Wanderer — Come Back To Sorrento — April In Portugal — Oh My Papa — Jalousie — Until Then — Scusami.

Gently, pleasant — but for that reservation about pitch. (W.N.W.)

★ ★ ★

BLOND ON BLOND. Bob Dylan. Two disc set in folding album. CBS Stereo. S2BP 220019. Also available in mono.

Interest: Folk singer.

Performance: Typical

Quality: Excellent.

Stereo: Normal spread.

This two-disc set, in a folding album which opens out to give a 25in long three quarter length portrait of the artist in colour, is sure to be enthusiastically received by Bob Dylan's many fans. Not a word of copy or title is allowed to deface the whole cover area, while the inside faces of the album contain large pictures of Dylan and, presumably, some of his fans! A close inspection will reveal the track titles in small type above and below the pictures. Otherwise, there is no word of text about either Dylan or the music in the set.

In my opinion, Dylan is not a good performer of his own music. His diction is often slurred, so that the lyrics, often difficult to understand anyway, become incomprehensible. This makes the absence of a sleeve note on this set a matter for special regret. Nevertheless, I count this as a good example of Dylan's work. The sound quality and stereo are of good modern standard, so if you have Dylan discs, and want more, take a look at this set.

Many people, especially those with an interest in folk music, will know some of Dylan's better songs, since these are often performed by other artists, and they may well wonder whether they will

find enjoyment in a Dylan performance. However, I doubt whether a two-disc set is a wise purchase to make on the grounds of curiosity. There are quite a few single discs with which to experiment.

The tracks on these discs are:

Rainy Day Women — Pledging My Time — One of Us Must Know — I Want You — Memphis Blues Again — Leopard Skin Pill Box Hat — Just Like A Woman — Most Likely You'll Go Your Way and I'll Go Mine — Temporarily Like Achilles — Absolutely Sweet Marie — 4th Time Round — Obviously Five Believers — Sad Eyed Lady of the Lowlands. (H.A.T.)

★ ★ ★

ONE OF THOSE SONGS. The Ray Charles Singers. Command (Festival) Stereo SNDL-931,987. Also available in Mono.

Interest: Popular songs.

Performance: Slick.

Quality: Excellent.

Stereo: Exaggerated.

Not just one of those tunes — there are 12 of them in this selection. The sort of tune that you hear at breakfast on the radio and that runs through your head all day, with no apparent reason, other than that it is catchy or soulful — it depends on the mood you are in!

Here they are: One of Those Songs — Someone to Light Up My Life — Little Orphan Annie — Yesterday — My World — Dream Along With Me — The Shadow of Your Smile — Bells — Blue Roses — Yo Te Amo — Scarlet Ribbons — Put Your Dreams Away.

The Ray Charles Singers deliver these in their usual smooth and competent manner, the male and female voices blending harmoniously together and the instrumental accompaniment providing just the right level of unobtrusive support. As in previous recordings by this group, the female singers are arranged on the left and the males on the right, while the "centre channel" is filled by the instrumentalists.

The technical quality of the disc is excellent, but the stereo separation tends to be somewhat exaggerated by the grouping mentioned above. (H.A.T.)

★ ★ ★

SPOTLIGHT ON JIMMY ROGERS. Universal Record Club, Stereo U-793 Also available in Mono.

Interest: Popular singer.

Performance: Lively.

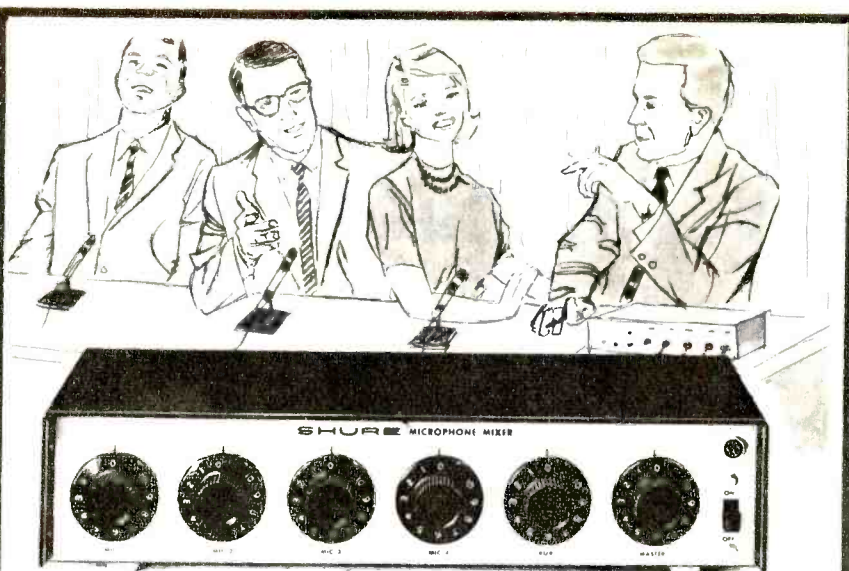
Quality: Very good.

Stereo: Restricted.

This is my first close encounter with Jimmy Rodgers, and I must admit I did not know quite what to expect; in the event, I was pleasantly surprised. Jimmy has a good resonant voice and engaging manner, as well as a naturally easy style of delivery. On this disc, he has the support of a very competent group of instrumentalists and singers, too. All in all, this adds up to very good entertainment.

The songs included in this selection consist of a mixed bag, comprising folk songs, negro spirituals and ballads: Estrellita — Casey Jones — One More River to Cross — I Almost Lost My Mind — Dry Bones — A Wonderful Time up There — Water Boy — Come Along Julie — Town and Country — Mighty Big Ways — Mama Was a Cotton Picker — Hootenany Saturday Night.

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- A high impedance auxiliary output.
- A DC power supply jack. This supplies 28 volts DC for use with accessories such as the Model A68P Phono Preamplifier or it may be used as power input in conjunction with the Model A68B Battery Power Supply (Accessory).
- A facility for connecting two or more mixers together to obtain additional microphone inputs. For example, two mixers connected together will give a total of eight microphone inputs and one auxiliary input.

SPECIFICATIONS

Gain: At 1,000 HZ (cps).

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	Low Imp. Mic.	High Imp. Mic.	High Imp. Aux.
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High Imp. Mic. 5 mv produces	-13 db 1.1 mv	+11 db 18 mv	+38 db 400 mv
AUX. 50 m. produces	-35 db 0.9 mv	-11 db 14 mv	+16 db 320 mv

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Distortion: Less than 1 per cent total Harmonic Distortion when low impedance microphone output is at 20 mv level, high impedance microphone output is at 200 mv level and Aux. high impedance output is at 2.0 volt level.

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Output Min. Clipping Level
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Mic. High Impd. 85 volts

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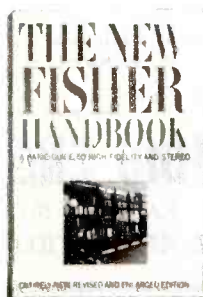
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ADDRESS

singing seriously may frown at some of the modernised arrangements, those who do not mind a more lively style of presentation should find much to enjoy in this disc. Listen, for example, to the clever arrangement of "Come Along Julie," which I thought one of the best tracks on the disc. (H.A.T.)

★ ★ ★
DANCE AND SING ALONG WITH MITCH. Mitch Miller And The Gang. Stereo, Festival SDL-932,053. Also available in Mono. DL-32,053. Interest: Sing-a-long, dance-a-long. Performance: Characteristically competent. Quality: Flawless. Stereo: Nicely spread.

It is customary to make disdainful remarks about Mitch Miller and his gang and to summon laughs by mimicking his well-known mannerisms. But let's face it: Not too many groups can produce sound which is so effortless, so smooth and so downright infectious.

And that's the kind of sound it is here—listenable, singable, danceable. And, as you might expect, the songs are hand-picked for the occasion: Yes, Sir, That's My Baby—Heartaches—Someday You'll Want Me to Want You—Get Me To The Church On Time—On The Sunny Side Of The Street—Silver Dollar—Wedding Bells—Into Each Life Some Rain Must Fall—I'm Gonna Sit Right Down And Write Myself A Letter—You Always Hurt The One You Love—Red Wing.

The sound quality? Absolutely clean. (W.N.W.)

★ ★ ★
LIGHTLY LATIN — Perry Como. Arranged and conducted by Nick Perito. Choral Director Ray Charles. RCA 12-inch stereo, LSP-3552. (Also in mono, on LPM-3552.) Interest: Como, bossa nova. Performance: Smooth, relaxing. Recording: Excellent. Stereo: Effective.

A relaxed and relaxing recording, with Perry Como sauntering smoothly through a dozen bossa-nova style tunes written by Antonio Jobim, Luis Bonfá and others. There's even the beautiful McCartney-Lennon piece "Yesterday." For smooth and relaxed listening, it's a disc that would be very hard to beat.

The tracks are entitled: How In-sensitive — Stay With Me — The Shadow Of Your Smile — Meditation — And Roses and Roses — Yesterday — Coo Coo Roo Coo Coo Paloma — Dindi — Baia — Once I Loved — Manha de Carnaval — Quiet Nights of Quiet Stars. The last-but-one is the haunting theme from Camus' famous film "Black Orpheus," and makes particularly beautiful listening.

With splendid Dynagroove recording, a disc that can be warmly recommended. (J.R.)

★ ★ ★
A CHILD'S GARDEN OF FREBERG — "A rather witty bouquet of Mr Freberg's best-selling albums." Capitol 12-inch "Encore Series," mono ENC 9235.

Interest: Freberg re-issue. Performance: Authentic! Recording: Very good.

For those who missed out on Stan Freberg's zany songs in their heyday,

an economy LP anthology of the best-sellers. Some of the musical styles and performers lampooned are no longer with us, but despite this the songs have stood the test of time rather well. Perhaps the time is ripe for Freberg to take another rest from his advertising work and have a lash at some of our more recent musical "art forms" . . .

The tracks are entitled — St. George and the Dragonet — C'est Si Bon — Try — Wide-Screen Mama Blues — Heartbreak Hotel — Rock Around Stephen Foster — The Yellow Rose of Texas — John and Marsha — The Great Pretender — That's My Boy — Rock Island Line — Sh-Boom. I think the one which still seems funniest is the Yellow Rose of Texas; it's a real gem. The recording is very good. (J.R.)

★ ★ ★
THE TWILITERS IN CONCERT. The Twiliters with Ed Gaston, recorded live at concerts at the University of Sydney and the University of New South Wales. RCA Camden 12-inch stereo, CAMS-117. Interest: Australian folkies. Performance: Polished, happy. Recording: Excellent. Stereo: Smooth.

I remember hearing the Twiliters soon after they had arrived in Sydney, at the Copperfield restaurant. Although lacking a little in polish, they certainly lacked nothing in warmth or enthusiasm. Their recent concerts and this recording both testify that they have now gained adequate polish, while retaining all of their original vivacity. They sure make highly entertaining listening.

The tunes on this disc are all fairly familiar: The Oxdriver — In The Evening — Chickens — Where I'm Bound — The Albury Ram — Ella Speed — Me and My Uncle — Where Have All The Flowers Gone — Coal Tattoo — Dark As A Dungeon — Creamsleeves — San Francisco Bay Blues.

The recording is of excellent quality in most songs, although the level is a little variable. The warmth of the concert atmosphere is captured admirably.

For folkie fans, well worth a listen. (J.R.)

★ ★ ★
THE VERY BEST OF JIMMY DURANTE. With orchestra conducted by Roy Bary. Mono, MGM Encore Series VO2 9198. Interest: Famous old timer. Performance: Still sounds good. Quality: Excellent.

Maybe it's just the generation I belong to, but some of these old timers still sound pretty good to me. Fast tempo, abrupt changes in tempo, remarks, interpolations, "ad libs" flow from Jimmy Durante and orchestra with a precision that must have necessitated painstaking rehearsal, yet without sacrificing its apparent spontaneity.

The jacket notes do not identify the source or the age of the tracks. Sufficient to say that they are old enough to have captured the real Durante, yet not so old as to have suffered from poor recording techniques: Bill Bailey Won't You Please Come Home — What You Goin' To Do When the Rent Comes Round — A-Rass-A-Ma-Tazz — I'm a Vulture for

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Very effective in a 2½ or 3 cubic ft. enclosure, overall frequency response is 30-18,000 Hz. Power handling capacity is 20 watts RMS. Flux density—17,000 gauss. Total flux 180,000 maxwells. The tweeter is co-axially mounted and an electrical cross-over provides smooth transition. Inter-modulation is negligible. **\$59**

STANDARD CX 1512 12"

Very similar to the CX 2012, frequency response is 30-15,000 Hz, and power handling capacity 15 watts RMS. Crossover frequency is 4 kHz. Impedance 15-16 ohms. Flux density is 13,000 gauss, total flux 88,000 maxwells. An outstanding, low priced high fidelity speaker. **\$39.50**

SPEAKER ENCLOSURES

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The Lux Corporation is recognised as one of Japan's leading electronics manufacturers being contractors for the Olympic Games Stadium in Tokyo and suppliers to the NHK Broadcasting Network. Encel price (£94/10/-) **\$189**

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As Australian Agents Encel Electronics are proud to be associated with these famous American amplifiers, considered to be the finest in the world. The first two Acoustech shipments were sold out within two days of arrival in Australia! Of particular interest is the Acoustech Model V, an integrated solid state stereo amplifier with an output of 45 watts RMS per channel — a rating applicable throughout the extended frequency range. This model is priced at **\$350**

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FIRST RELEASE OF CELESTION "POWER RANGE" LOUDSPEAKERS!

Two mighty new speakers are now available from Encel Electronics. These rugged and powerful units are particularly suitable for public address, guitar and organ applications; in Europe both are extremely popular.

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Just released! Model SAQ-202B. 6 watts RMS per channel, separate bass and treble controls, input sensitivity is 100 mV for pick-up, turn and auxiliary. In attractive metal case. Frequency response is 30-20,000 Hz, plus or minus 3 db. 12 transistors. Encel price **\$49**

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Although our range of tape recorders is wide, Encel prices have assured speedy turnover. . . . and Encel sales are at an all time high. Stock now includes: TRUVOX R44, R102-104, PD102-104; REVOX G36, two and four track — TANDBERG Series 12; AKAI M8, X4, 355, 1710, X100D — NATIONAL 703S, 705, 755S, and many more. Save much more at Encel Electronics!

SEE ENCEL STEREO CENTRES FOR REDUCED PRICES ON THE FAMOUS LEAK SANDWICH SPEAKER SYSTEM

Music lovers owe it to themselves to compare the Leak Sandwich with any other speaker system. . . . in performance and price. The new reduced price makes the Leak Sandwich better value than ever!

THE COMPACT CELESTION "DITTON 10"

Measuring only 12" x 6½" x 8½", the "Ditton 10" is regarded as the most advanced compact high fidelity system available. Read the reviews in "Hi-Fi News", page 433, October 1965 and the "Gramophone", page 41, June 1965. The latest models of this proven miniature enclosure are better than ever! Power handling capacity is 10 watts RMS. Separate bass and treble units. **\$59** Available in wanut or teak

THE NEW PLANET MG-1504 STEREO AMPLIFIER

This extremely well finished stereo amplifier is also a fine performer. . . . with a total power output of 15 watts (1.H.F.M.) and a frequency response of 30-20,000 Hz, plus or minus 2db. Speaker matching for 4, 8 or 16 ohms. Valve complement 2 x 12AX7, 1 x 6AQ8, 1 x 6CA4, 2 x 6BQ5. **\$59** Encel price is only . . .

THE REVOX G36 PROFESSIONAL 2 OR 4 TRACK STEREO AND MONO TAPE RECORDER

Encel Electronics recommend this famous Swiss recorder. Three motors are featured in this versatile two-speed professional quality recorder which takes 10½" spools; ask for an EMQ or a trade-in valuation on your old unit. See Encel Stereo Centres for a Revox demonstration. . . . the price will pleasantly surprise you!

SPEEDY MAIL ORDER SERVICE

Please give us your name and address in BLOCK LETTERS when ordering. All Encel equipment is BRAND NEW and Sales Tax is included in Encel prices. We care-pack and freight anywhere. Service is available at the Encel Service Centre in Melbourne and also at the Encel Stereo Centre, 257 Clarence Street, Sydney.

EXCLUSIVE ENCEL OFFERS FOR JANUARY!

1. The solid state Sound 202B stereo amplifier, Connoisseur turntable and Connoisseur SAU-1 tone arm w/lift and Connoisseur cartridge with diamond stylus, two Wharfedale 10" wide range loud-speakers **\$128**

2. Encel CSM-40 stereo amplifier (over 15 watts RMS per channel), Connoisseur Craftsman II transcription turntable, Decca FFSS tone arm and cartridge, two Leak Sandwich speaker systems **\$475**

EARLY ENCEL SPECIALS AVAILABLE!

The special offers made from time to time by Encel Electronics in "Electronics Australia" are often kept open for several months. In many cases, the prices quoted are still applicable. Please check with us!

Encel Electronics Pty. Ltd.

Head Office: 431 Bridge Rd., Richmond, Vic. Tel. 42 3762

City Branch: 18 Bourke St., Melbourne Tel. 32 2672

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High-Fidelity Organ

THE ORGAN PLAYS MUSIC FOR A MERRY CHRISTMAS. With chorus and soloists. Stereo, Reader's Digest/RCA Dynagroove, 4-record boxed set. Also available in mono.

Interest: Organ music.

Performances: Outstanding.

Quality: Superb.

Stereo: Good.

Arriving much too late for review in our last issue, this new Reader's Digest set came within an ace of being put aside with two or three other Christmas releases which had "missed the boat," as far as we were concerned. But curiosity caused us to listen to one or two tracks—and how glad are we that we did. Christmas or no Christmas, this is a set that anyone interested in the pipe organ should not miss hearing.

Record 1 of the set is presented by the seemingly timeless Reginald Dixon at the Tower Ballroom Wurlitzer in Blackpool, England. And what a performance it is—and how superbly recorded! Dixon puts to good use the impressive equipment of the organ as a solo instrument and, in addition, demonstrates his skill as an accompanist to a soloist and chorus. All of this is light fare—Santa, sleighbells and carols.

Then comes record 2, played by Virgil Fox on the Royal Festival Hall Organ, London. On the jacket, it looks like an innocuous collection of carols but don't let that mislead you. In the act of playing them, Virgil Fox releases some of the most massive organ sound that I've ever heard on record and, while I didn't have time for this review to play every

track in full, those that I did play remained clean and well defined. Whether a routine crystal pickup could sit the grooves, I wouldn't know; I have no intention of subjecting my own pressing to such a test!

Record 3, recorded in America by Dick Leibert at the Radio City Music Hall organ, impressed me less than the previous two. The largest Wurlitzer ever assembled, in one of the biggest theatres with one of the biggest echoes, it seems to lay claim to inclusion on this score. More carols, it's not by any means a poor record—just outshone by the others.

Back to England for record 4, this is recorded by William Davies, at the Church of St. Gabriel the Archangel, Cricklewood, London. Again, it is a magnificent example of modern recording with soloist, chorus and a brass chorus perfectly blended and distributed. Included on this disc are tracks such as: A Mighty Fortress — The Holy City — Evening Prayer — Alleluiah — Mary's Little Boy Child — Jesu, Joy of Man's Desiring and six others. Perhaps a rather mixed selection but one which, again, allows the organist to display the moods and tones of a 3-manual Walker organ, designed primarily for liturgical music.

A characteristic of the whole album is the heavy, rolling organ bass which had my whole listening room throbbing, yet without any suggestion of break-up or intermodulation.

Christmas is eleven months away I know, but if you're an organ enthusiast, try to hear this album. (W.N.W.)

Horticulture — It's my Nose's Birthday — I'll Do the Strut-Away In My Cut-Away — I'm the Guy Who Found the Lost Chord — The Day I Read a Book — Fugitive from Esquire — Chidabee-Ch-Ch — The State of Arkansas — Dollar a Year Man.

If you don't have a Jimmy Durante album in your collection, this is your opportunity to add a good one at the Encore price. (W.N.W.)

POPULAR JAZZ

by GRAEME BELL

RECORDED IN NEW ORLEANS, VOLUME I. Good Time Jazz, Mono. M12019.

Interest: New Orleans Jazz.

Performance: Varied.

Quality: Fair.

These recordings were made in 1956 in New Orleans under the supervision of Dr Souchon for the New Orleans Jazz Club.

There are four different groups, under the leadership of Sharkey Bonano, Paul Barbarin, Bill Matthews and George Girard.

Sharkey, veteran trumpeter and vocalist, has Pete Fountain on clarinet, and Paul Barbarin, one of the best known New Orleans musicians, has Dr Souchon on banjo and guitar.

Bill Matthews has been blowing trombone for over fifty years, and has a pianist in his group who is either drunk or an outright imposter.

Best thing for my money on this very interesting and worthwhile album is the trumpet playing of the late George Girard on Liszt's "Liebestraum." He died of cancer at the age of 26, less than a year after this record session.

The most merciful thing about these New Orleans musicians recorded on their home ground is that they sound nothing like the bleatings of their British and Australian copyists.

★ ★ ★

MY SON THE JAZZ DRUMMER.

Shelley Manne, drums; Shorty Rogers, flugelhorn and trumpet; Teddy Edwards, tenor sax; Victor Feldman, piano and vibes; Al Viola, guitar; Monty Budwig, bass. Contemporary Stereo S3609. Also available in Mono.

Interest: Modern jazz.

Performance: Excellent.

Quality: Very good.

Stereo: Normal.

Noted for his explorations in all sorts of directions concerning jazz, Shelley Manne has now come up with versions of ten very expressive Jewish and Israeli songs, including "Hava Na Gila," "Bei Mir Bistu Shein," "Yussell! Yussell!" "Orchah Bambidbar," "Tzena," "Exodus" and "My Yiddishe Momme."

(Continued on Page 99)

CLASSIC TAPE RECORDERS

MAGNETIC TAPE DIRECT

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GUARANTEED QUALITY

Money back if not satisfied.

LOWEST PRICED

tape in Australia.

ALL POLYESTER BASE

Except 7in 1200ft which is available in both. Acetate and Polyester.

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7in 1200ft Polyester	2.25
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7in 1800ft Polyester	3.50
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5 1/2in 1200ft Polyester	3.30
5 1/2in 1800ft Polyester	3.90
5in 600ft Polyester	1.60
5in 900ft Polyester	2.00
5in 1200ft Polyester	2.80
3 1/2in 600 Polyester	1.80
3in 150ft Polyester	.56
3in 225ft Polyester	.60
3in 300ft Polyester	.96
2 1/2in 300ft Polyester	.96
7in Empty spool, boxed	.75
5in Empty spool, boxed	.55
3in Empty spool, boxed	.25

Leader tape 1 cent per foot

SPECIAL OFFER

When buying 10 reels of 7in or 5in tape you will receive one 3in

FREQUENCY TEST TAPE FREE

40-14000 cps. for tape head alignment and frequency response test.

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500V "UNIMEG" INSULATION TESTER

RANGE. .25 to 50 megohms at 500 volts test potential, with centre scale at 3.5 megohms.

One of the most common faults causing the malfunction or failure of electrical equipment is **insulation breakdown**.

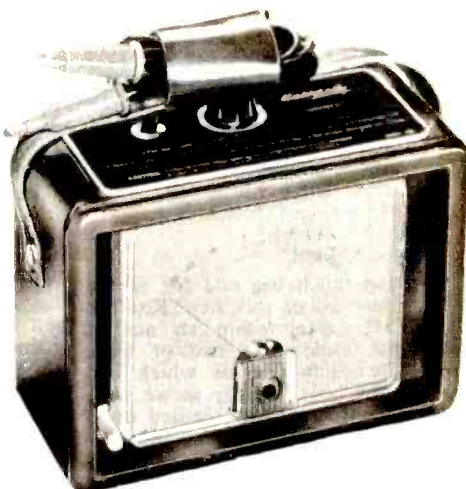
The gradual deterioration of insulation over a period of time can be detected by regular inspection and testing.

A quick and efficient test of electrical equipment, appliances and electrical wiring can be made by using University Graham's "UNIMEG."

This ruggedised portable transistorised insulation tester used regularly will detect failures in their early stages thus preventing expensive breakdowns which could occur at inconvenient times. The unit consists of a stable transistorised oscillator the output voltage of which is then stepped up by a transformer and in turn converted to 500 volts DC by high voltage rectifiers.

The power is supplied by a 9 volt transistor radio battery and by the nature of the unit's intermittent operation and its reserve voltage, long battery life can be expected.

For more information on "UNIMEG" or any electrical measuring problem consult:—



106 BELMORE ROAD, RIVERWOOD, N.S.W.

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AUSTRALIA'S LEADING MANUFACTURER OF ELECTRICAL INSTRUMENTS (A UNIT OF INSTROL)

THE "UNIMEG" IS QUICK AND SIMPLE TO USE.

1. "Short" the test leads, press the push switch, and adjust the potentiometer, to indicate full scale on meter.

Note: (The 500 volt potential is present only when switch is depressed.)

2. Connect test leads to circuit under test, and press push switch.
 3. Read resistance directly off scale.
- Solid leather carrying case, with combined shoulder and hand strap, available as an extra.

REPRESENTATIVES:

W.A.: Atkins (W.A.) Ltd.,
894 Hay Street, Perth, W.A.

S.A.: George Procter,
52 Gawler Place, Adelaide, S.A.

VIC.: Eastern Instrument Services
Pty. Ltd.,
38 Milton Parade, Malvern, SE4.

QLD.: Keith Percy & Co. Pty. Ltd.,
Box 1478V, G.P.O., Brisbane, Qld.

TAS.: W. P. Martin and Company,
188 Collins Street Hobart,
and 134 Cambridge Street,
Launceston.

STEREOPHONIC HI-FI AMPLIFIER plus TAPE RECORDER combined

AS A HI-FI STEREO AMPLIFIER . . .

Freq. response 20-20,000 cps. Separate treble and bass, giving boost and cut (+12 Db, —14 Db.). 10W music power per channel. (6W RMS per channel). Input for mic and ceramic P.U. Output impedance 7-15 ohms.

AS A STEREO/MONO TAPE RECORDER

- 3 speeds.
- Response 35-18,000 c.p.s.
- Separate treble and bass.
- Push-button operation.
- Wow, flutter less than .15%.



- 7in spools.
- Beautifully styled timber cabinet.
- Meter level indicator.
- Position for 3rd head.
- Monitoring through speakers.

Model TR9 Stereo

PRICE \$216.00 Price includes two dynamic mics, tape and spool.

Fully transistorised, transformerless output. Two built-in speakers. Price with two bookshelf speakers is \$268.00. Garrard changer fitted with ceramic cartridge in matching portable cabinet, \$57.00. Call in and hear, before you decide to buy anything else.

MODEL TR9 MONO 2 Track \$149.00 4 Track \$157.00

CLASSIC TAPE RECORDERS

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Telephone 79-2618**

TRADE REVIEWS AND RELEASES

Sony TA-1120 Stereo Amplifier

Pictured is the Sony TA-1120 silicon transistorised stereo amplifier, a very high performance unit recently released in this country by Sony agents Jacoby Mitchell and Company Pty. Ltd. Featuring high power output with very low distortion, its performance should convince even the diehards that transistor audio amplifiers have finally "made it" in the high-fidelity field.



Measuring a compact 15in x 5in x 12in and weighing about 24 pounds, the TA-1120 has a sturdy grey finished case and extruded alloy front panel. Both inside and outside the case it shows ample evidence of good design and meticulous workmanship.

The front panel presents six rotary controls with comfortable-sized turned metal knobs, six smoothly operating tab switches and two indicators. The rotary controls select volume, balance, bass, treble, mode and input selection — the last-named working in conjunction with one of the tab switches. The remaining five tabs are along the lower half of the panel and control power, rumble filter, tone control cancel, scratch filter and tape/source monitoring. The indicators are a mains pilot and a "safety" light which operates in conjunction with the overload protection circuitry.

Note that the tone controls are of the switched variety rather than the more usual dual potentiometers — a feature which provides for accurate adjustments without upsetting channel balance. The effect of the tone controls may be negated at any time by the "cancel" switch, which instantly restores the response to a "flat" curve when this is desired.

The TA-1120 provides rear-panel inputs for tape head, tape deck, two magnetic pickups, radio tuner, microphone and auxiliary. It has rear-panel outlets for tape recording, 8-16-ohm loads, together with three mains outlets for associated equipment. Pre-set level controls are provided for the tuner and auxiliary inputs, while there are also pre-set adjustments provided for the treble characteristic of the tape head preamps.

Preamp outputs are connected to the main amplifier inputs via links on the rear panel, allowing either section to be used externally. There is also a "DIN" connector for single-cord interconnection to a tape recorder, and an earth terminal to facilitate earthing of associated equipment.

Containing no less than 46 transistors and 23 diodes, the unit is rated at 50 watts per channel into 8-ohm loads at less than 0.1 per cent T.H. distortion over the range 10-100,000Hz (+0, -1dB), using the "Tuner" or "Aux." inputs or the main amplifiers alone. Damping factor is quoted at more than 70 for 8-ohm loads, and at more than 140 for 16-ohm loads — phenomenal figures indeed.

The tone controls are specified as in-

dependent and producing 2dB variations per step at 100Hz and 10KHz respectively. The two switched filters are 12dB/octave types, with rated corner frequencies of 50Hz and 9KHz respectively. Signal-to-noise figures for shorted inputs range from 65-90dB, although these are specified as being measured with a weighting network. Input sensitivities for all channels are quoted at figures likely to be adequate for all transducers.

Tested in our laboratory, the TA-1120 gave a most impressive performance indeed, and in almost every case equalled or exceeded the specifications.

Power output before clipping was 55 watts RMS per channel into 8-ohm loads, and close to 39 watts RMS into 16-ohm loads. Overall THD at 50W into 8-ohms at 2KHz was below the 0.1 per cent figure, an excellent performance. Crosstalk was a low -50dB; S/N figures were very commendable, although we couldn't obtain figures which seemed likely to correspond with the weighted readings.

Frequency response was virtually unchanging up to 50W output, and was measured at 10-30,000Hz for the main amplifiers and 30-30,000Hz for the overall flat response — not quite as good as

claimed, but certainly a very good performance. The square-wave response was very good also and the stability excellent. The overload characteristic tends to be smooth before the protection circuitry operates.

In short, the performance as indicated by instruments is of a very high order indeed.

Listening tests performed with a high-quality magnetic cartridge and a pair of high-performance speaker enclosures confirmed that the measured performance applied equally to musical reproduction. All staff members who heard our reference discs played through the unit agreed that

the reproduction was exceptionally smooth and clear.

The TA-1120 comes complete with a handsomely-printed owner's manual which includes a quality control certificate and a set of (typical) curves showing the claimed performance in various modes. The price is quoted as \$400.

Enquiries should be directed to Jacoby Mitchell and Co., Pty. Ltd., at 469-475 Kent Street, Sydney (J.R.).

BASIC RADIO COURSE

Did you know that our well-known introduction to basic radio and electronics is now available in 128-page book form? It can be obtained either direct from our offices, or by mail order. For complete details of price and availability, please refer to the full-page advertisement on page 89 of the December issue.

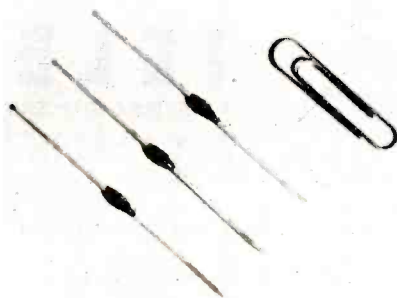
MINIATURE RECTIFIERS WITH 4A RATING

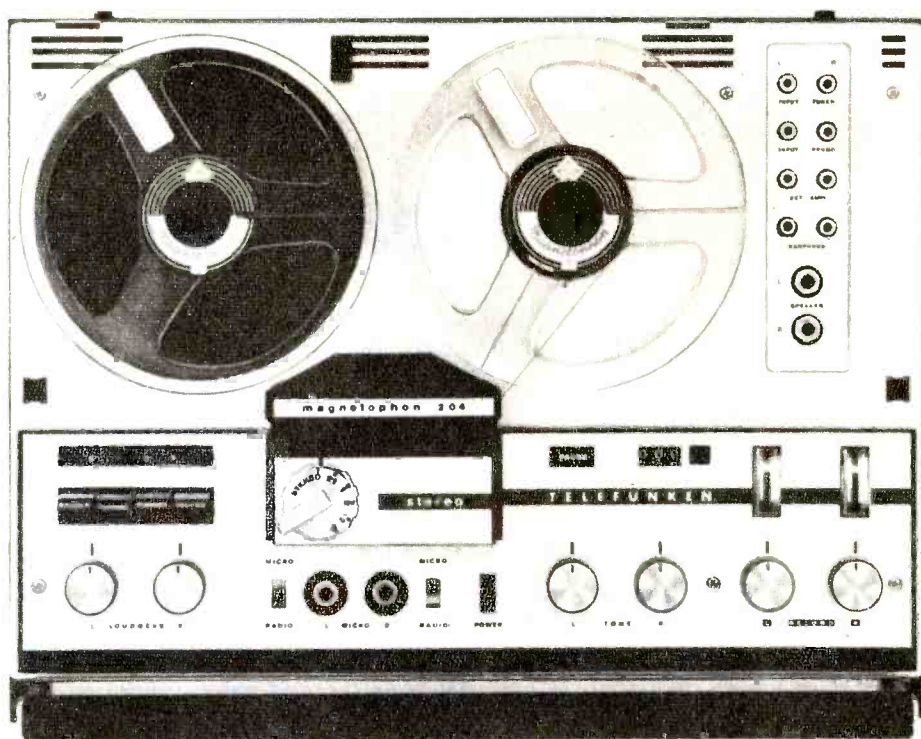
Miniature axial lead "Unitrode" rectifiers with a rating of 4 amps yet as small as .145in diameter are now available from Cema (Australia) Pty. Ltd., whose head office is located at 33 Market Street, Adelaide. Surge currents of 100A can be handled with leakages typically of 0.5uA at 25°C. Cema says this is the first time that recti-

fiers as small as this have been available with this rating. Similar units are available with current ratings down to 750mA and with physical size as small as .085in diameter.

The units are available at peak inverse voltages from 50 to 800 volts. Since they are controlled avalanche diodes, they are said to be ideally suitable for ultra-reliable assemblies. The construction is the same as that used for the entire "Unitrode" range and features metallurgically bonded pins and dice of identical diameter. Over this, a sleeve of hard glass is fused, forming a void-free monolithic structure. The resultant glass-fused junction and low thermal resistance ensures that electrical characteristics are stable and do not change even under overload and environmental extremes.

Prices range from 29c to \$8.95, according to specification. Further details can be obtained from the Cema head office given above, or state offices at 41 The Broadway, Wahroonga, N.S.W., and 129 Clarendon Street, South Melbourne, Vic.





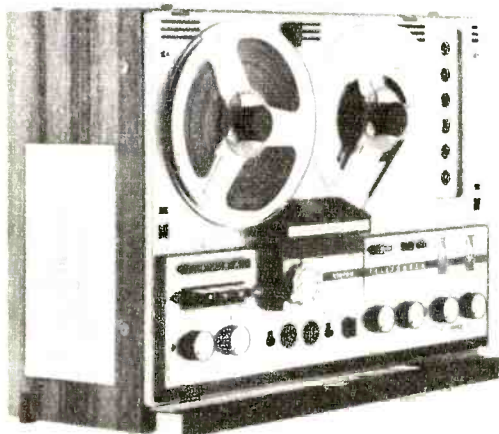
Take it from the top, Mac..

Stand this new Telefunken model 204E on its head — and that's about the only time you're in trouble. Otherwise, you can build it into that avant-garde 'entertainment shelf' standing up-ways, sideways or front-end, because every control and socket is on the deck. The other attributes of a great tape-recorder — it's got those, too. Separate and individual volume, tone and record-level controls. Track selector, multi and synchro-play on the one easy dial. Two speeds, $7\frac{1}{2}$

and $3\frac{3}{4}$ — at $7\frac{1}{2}$, your response is 40-18,000 C.P.S. Output? That's big — 12 watt push-pull, fully transistorised, push button operation.

We could get a whole lot more technical — but then we guess you'd rather hear it on our fantastic — and we do mean fantastic — demonstration tape that fully explains and pinpoints every remarkable feature of the M204E. (You like it — it's yours, dubbed on the free tape that goes with every recorder. In fact, this demonstration tape no sound enthusiast should miss hearing — it's a rare entertainment piece in itself.)

One final thing — bring her along when you come to look. She'll tell you this Telefunken M204E model is just beautiful. And for once, she's right — that Scandinavian oiled cabinet with satin-finish metal top deck looks pretty good. Price **\$490** (£245)



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TRADE RELEASES IN BRIEF

AUSTRALIAN GENERAL ELECTRIC PTY. LTD., of 103 York Street, Sydney, N.S.W., has sent information on the following new General Electric devices.

The F16H1 (formerly known as D16H1) is an economy silicon voltage reference diode designed for general purpose voltage reference and voltage regulator applications at currents up to 15mA. The device consists of two diodes connected in series opposition to provide a reference voltage with a low temperature coefficient. A single pellet structure is used to minimise temperature differentials between the junctions. The availability of a third lead at the common point between the diodes opens the possibility for new applications.

The MPD200, MPD300 and MPD400 are multi-pellet diodes which have a tightly controlled conductance, controlled stored charge and low leakage. They consist of 2, 3 or 4 planar passivated epitaxial diode pellets in series, respectively, mounted in a subminiature double heat sink package. They can be used as low voltage regulator diodes, amplifier non-linear bias elements, signal limiters or level shifting diodes in logic circuits, etc.

Technical literature describing these devices is available on request from the head office of Australian General Electric given above.

STANDARD TELEPHONES AND CABLES PTY. LTD. has appointed Mr A. T. Deegan Deputy Managing Director and a member of the Board of Directors. Mr Deegan, an Associate Fellow of the Australian Institute of Management, has been with the Company for 27 years. Prior to his new appointment, he held the administrative positions of Sales Superintendent, Commercial Manager, Manager (Telephone and Telegraph Division) and, from 1964, Assistant Managing Director. In this latter post, he was responsible for the engineering, sales, manufacturing and installation departments at the Company's Alexandria plant.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD., announces the availability of the following transistor types from RCA.

RCA 2N4036, 2N4037 and 2N4314 are double diffused, epitaxial planar silicon PNP transistors. These are the former development types with numbers TA2651, TA2670 and TA2670A respectively. These transistors are intended for a wide variety of small signal, medium power applications. With a minimum gain-bandwidth product (ft) of 60MHz, these types will provide useful gain at frequencies in the HF region. In addition, the 2N4036 is useful in high-speed saturated switching applications. The 2N4036 and 2N4037 are the PNP complements of 2N2102 and 2N3053 respectively.

RCA developmental type TA2500E is an epitaxial planar transistor of the silicon NPN type for AF amplifier applications. It is particularly suitable for use with its PNP counterpart the RCA 40253 in moderate power complementary-symmetry output amplifier stages.

RCA developmental types TA2669 and TA2669A are epitaxial silicon NPN power transistors employing a new overlay structure with a number of separate emitter sites. The high current handling capability of these transistors in conjunction with fast switching speeds makes them especially suitable for switching control amplifiers, power gates, etc.

RCA developmental types TA2849, TA2850, TA2851, TA2853 and TA2854 are silicon NPN transistors specifically designed for use in "front-end" and IF amplifier stages of FM and AM/FM receivers operating at frequencies up to approximately 110MHz. The intended functions of the types are TA2849—RF amplifier, TA2850—mixer, TA2851—HF oscillator, TA2853

BURGLAR ALARM FROM R. H. CUNNINGHAM

Recently submitted for our appraisal was a packaged burglar alarm kit manufactured by the well known English firm of Bulgin. It is intended for installation by the average handyman in a house, flat, or small business premises.

The kit consists of a 4in underdome bell, battery magazine, key switch control box, pressure pad switch, two latching type door switches, 75ft of twin bell wire, security alarm plaque, screws, tacks, spare key, etc. Additional door and window contacts are available in a wide range to suit most likely situations.

This packaging is probably the best arrangement, since the exact number or type of contacts likely to be needed will vary with each individual. The kit as it stands would conceivably suit the minimum requirement, such as a flat or home unit with only one or two doors and no windows accessible from the ground.

The circuit employs a latching relay so that, once started, the bell will continue to ring even if the door or window involved is closed immediately. The batteries supplied are intended to operate the bell for at least 15 minutes.

The latching door switches are ingeniously designed so that they are operated only when a door is opened, but not when it is closed. This enables the alarm to be set before the occupant leaves the building, and while one door is open, but prevents the door from being opened again without tripping the alarm.

The key switch control box is intended to provide for legitimate re-entry. This is small metal box, fitted with a key operated switch, and which serves to switch off the system. The householder carries the key along with his door keys.

The makers suggest that the key switch may be mounted either inside the dwelling, or in some concealed spot outside. When mounted inside, it is necessary to trip the alarm when entering, then switch it off immediately. If mounted outside, the system may be switched off without being tripped.

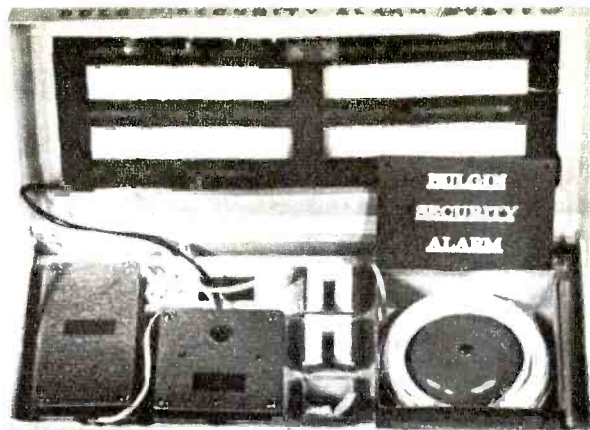
The security alarm plaque is intended for prominent display outside the building, as a deterrent to would-be intruders.

The kit, as demonstrated to us, is well made and nicely finished. It appears to work quite reliably and as it is intended to. It would doubtless form the basis for a satisfactory alarm system in many instances.

However, we feel that there are some points of criticism which should be considered.

A major one concerns the provision for legitimate re-entry. While it is true that locating the key switch inside the protected

area provides maximum protection, the need to sound the alarm every time the householder enters the house — is bound to prove irksome — even to the point of discouraging the use of the alarm just when it is likely to be needed!



Locating the key switch control box outside the protected area overcomes this, but has the disadvantage that the box cover is secured by means of four large screws, the heads of which are plainly visible and readily accessible to any would-be intruder who cares to remove them. In addition, the key is of such a simple, and standard, design as to be wholly inadequate in such a role.

Another point concerns the size of the bell. While it is capable of making quite a lot of noise in a confined space — and, therefore, supposedly, will scare off any intruder—the system relies heavily on the psychology of convincing the intruder that this can be heard by neighbours and passers-by when, in fact, there may be considerable doubt about this.

Finally, the mere presence of a kit of this kind on the market tends to make the burglar as wise as the householder in regard to its workings and weaknesses, and is a major reason why it should be good enough to act as a deterrent, even to those who know how it works. As it is, the publication of the fact by means of the plaque that the particular alarm system is installed, may serve only to advise the burglar how to go about circumventing it.

Further details, price etc., may be obtained from the Australian distributors, R. H. Cunningham Pty. Ltd., 8 Bromham Place, Richmond, Victoria, or their branches in other capital cities. (P.G.W.)

and TA2854—IF amplifiers. These devices feature very low feedback capacitance, low noise, and high useful power gains in their recommended applications, as well as the high temperature capability of silicon.

RCA developmental types TA2918 and TA2919 are gate-controlled full-wave AC silicon switches designed to switch from a blocking state to a conducting state for either polarity of applied voltage with positive or negative gate triggering. They are intended primarily for the phase control of AC loads in applications such as light dimming, universal and induction motor control, and heater control.

Further details of these RCA transistors can be obtained from the AWW head office at 348 Victoria Road, Rydalmere, N.S.W.

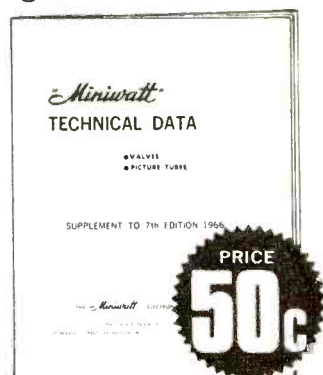
R. H. CUNNINGHAM PTY. LTD., announces the formation in Melbourne of Andrew Antenna (Aust.) Pty. Ltd., a wholly owned subsidiary of Andrew Corporation, of Chicago, U.S.A. The Andrew Corporation has been a manufacturer of aerial systems and Heliac co-axial cables for a number of years. R. H. Cunningham Pty. Ltd., exclusively represented Andrews in Australia from 1960 to March, 1966 when, by mutual arrangement, a sales office in St. Kilda Road, Melbourne was set up by Andrews. This arrangement also provided for a stockist-distributorship basis for R. H. Cunningham Pty. Ltd., to carry on the stocking and sales of Andrews co-axial cables and accessories in their Melbourne head office warehouse at 8 Bromham Place, Richmond, Victoria.

the 7th edition 3rd printing of the "Miniwatt" TECHNICAL DATA Book is now on sale!



This volume retains all reference data for valves, television picture tubes and semi-conductors from the 2nd printing and now includes a 20-page supplement containing the latest valve and picture tube types available in Australia up to the present time. In addition, an updated valve cross reference index is provided. Price \$3.00.

NOTE: If you already have a 7th edition of this manual and do not wish to purchase a new book, you may bring it up to date with the purchase of the supplement only, at a cost of 50 cents. Data includes physical outlines, basing connections, typical operating conditions, maximum ratings.



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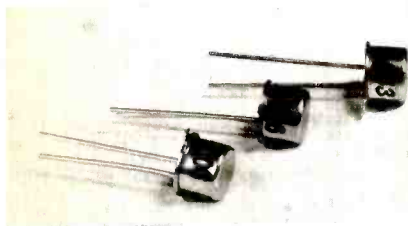
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ELECTRONICS DIVISION OF PHILIPS ELECTRICAL PTY. LIMITED

Miniwatt Electronic Products for use in the field of entertainment; communications; industry; commerce; medicine; scientific research and defence—Valves for Radio and TV; Valves for Transmitting, Industrial and Special Applications; TV Picture Tubes; Semi-Conductors; TV Components; Foil Capacitors; Electrolytic Capacitors; Ceramic Capacitors; Trimmer Capacitors; Carbon Resistors; Potentiometers; Negative Temperature Coefficient Resistors (N.T.C.); Voltage Dependent Resistors (V.D.R.); Light Dependent Resistors (L.D.R.); High Fidelity "Master Range" Loudspeakers; Valve Sockets and Shields; Ferrites; Computer and Specialised Prof. Componentry; Small Synchronous Stepping Motors; Electro Mechanical Components; Variable Transformers; Peltier Batteries; Piezoxide; Wire.

FAIRCHILD AUSTRALIA PTY. LTD., has extended the range of its locally manufactured semiconductors. With the release of new types announced recently by the company, field effect transistors and zener diodes are available for the first time in Australia at an economy price.

Type 2N4360 is an epoxy TO-18 packaged P-channel diffused silicon planar field effect transistor featuring low noise voltage, and



a high Y_f of 2,000micromhos minimum. These are available at a price as low as 59c each in lots of 1,000 pieces.

Fairchild also announces release of the first Australian-made zener diodes. Indicated features of these include low leakages at biases approaching the zener voltage, very low dynamic resistance and planar construction — a rarity for zeners. These show a substantial price drop on existing prices, being available for 30c in lots of 1,000.

Further details and technical literature can be obtained from the Fairchild Australia head office at 420 Mt. Dandenong Road, Croydon, Victoria.

DR W. A. S. BUTEMENT, C.B.E., who in the past 17 years has pioneered the development of Australia's defence science, will retire as Chief Scientist of the Department of Supply on January 1, 1967. He will become Director of Research with the Plessey group of companies in Australia based at North Melbourne.

The Minister for Supply has paid tribute to Dr Butement's leadership and initiative. Senator Henty said: "His departure will leave a gap that will be extremely hard to fill. It was largely due to Dr Butement that internationally renowned guided weapons systems were developed. He played an important part in the establishment of the Woomera Rocket Range."

Dr Butement was born in New Zealand. He graduated from London University as a Bachelor of Science in 1926. From



1928-1946, he was active in the development of special radio and radar equipment for the Armed Services in Britain.

In 1931, four years before Watson-Watt began to develop radar, Dr Butement and Mr P. E. Pollard made the world's first radar proposal. In 1938-39, Dr Butement was attached to the Radar Research and Development Establishment in Britain, where he developed the first operational beamed radar. From 1940-46, he was Assistant Director of Scientific Research in England.

Dr Butement came to Australia in 1947, as Deputy Chief Scientific Officer of the team under General Evetts to develop the rocket range at Woomera. He later became

Amplion (A'sia) Pty. Ltd. has forwarded samples of the new Acos "90 Series" of crystal and ceramic cartridges. They advise that, with the release of these cartridges, the manufacturers have implemented a policy of fitting diamond styli for L.P. playing instead of sapphires, at no extra cost.

The cartridges are direct substitutes for existing types and, while the makers make no extravagant claims for high fidelity performance, they do point to a long history of reliability in their products.

All types in this range are fitted with turnover stylus with a diamond stylus for playing LP discs (6-7mil for stereo and 7-8mil for mono) and a 25-30mil sapphire stylus for 78rpm. They are also supplied with a plastic or metal mounting bracket which can be fixed into the head shell either by a single centrally located hole, tapped for 6BA, or by two slots with 3in centres, allowing overhang adjustment. The cartridge clips into the bracket, and is easily removed and replaced, when necessary (for changing stylus, for example).



One of the new Acos mono cartridges, the medium output GP97-1 crystal.

Apart from the use of a diamond stylus, the new units exhibit somewhat better compliance and frequency response, and reduced playing weight when compared with earlier equivalents. The following data has been extracted from the maker's specification sheets.

The GP91 Series mono crystal cartridges: These are available in two versions, GP91-1 medium output types and GP91-2 high output type. Frequency response curves in the maker's specification sheets suggest a response from 50 to 18,000Hz with a 10dB total variation over the range, for the type GP91-1. Other data for this type are given below.

Compliance: 4×10^{-6} cm/dyne.

Tracking weight: 3-6gms.

Output at 1KHz—14dB (200mV) average with recorded velocity 1.2cm/sec.

Vertical output: Better than — 18dB on hor. output at 1KHz.

The GP91-2 delivers about twice the output of the GP91-1 but has a somewhat less smooth frequency response, about half the compliance and needs about double the tracking weight.

The GP92-1 mono ceramic cartridge: This is a ceramic version of the GP91 series, intended for conditions of high ambient temperature and humidity. Published curves indicate a frequency response similar to that of the 91-1, but with a trifle less bass for the same output load. Other data quoted are:

the first Chief Superintendent of the Long Kanee Weapons Establishment, now part of the Weapons Research Establishment, and for two years continued to co-ordinate the planning of the range.

In 1949, he was appointed Chief Scientist of the Department of Supply and put in charge of defence science in Australia. For his work in coast defence radar and communications in England before and during the war, Dr Butement was awarded the O.B.E. For his work in Australia, he was awarded the C.B.E.

Compliance: 2.5×10^{-6} cm/dyne.

Tracking weight: 5-10gms.

Tip mass: 3.2mG dynamic.

Output: —17dB (104mV) average at 1KHz recorded velocity of 1.2cm/sec.

The GP93 Stereo crystal cartridge has been designed for high output with acceptable average characteristics and operates at the now recommended 15 degrees tracking angle.

Frequency response: 40-18,000Hz (plus 2, minus 6dB.)

Compliance: 2.2×10^{-6} cm/dyne. (hor. and vert.).

Tracking weight: 4-8gms.

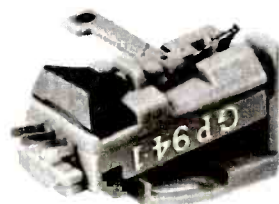
Tip mass: 3mG dynamic.

Output: —12dB (250mV) at 1KHz, recorded velocity 1cm/sec.

Channel separation: 15dB minimum at 1KHz.

The GP94 stereo ceramic cartridge: This is the most expensive of the GP90 series (although it is still moderately priced) and as may be expected, has the best all-round performance. Compliance is good at 5×10^{-6} cm/dyne and recommended tracking weights are 3-6gms. Channel separation is shown as 18dB minimum at 1KHz. This cartridge also operates with 15 degrees tracking angle.

We tested the GP94 cartridge as the one most likely to be of interest to our readers. The channel separation did not quite reach the specification, being 15dB down at about 1KHz. Frequency response in the left channel was within plus or minus 2dB from 200-10,000Hz (reference 1000Hz) rolling off to



The GP94-1 stereo ceramic cartridge.

-3dB at 100Hz and to -4dB at 12,000Hz. In the right channel, response was within plus or minus 2dB from 200-12,000Hz, falling to -4dB at 100Hz and 14,000Hz.

On tracking tests the unit showed up well, with no obvious distortion on the track modulated at 6dB above standard recording level, when the tracking weight was adjusted to 4gms. The cartridge should therefore be able to cope quite well with heavily modulated discs.

On subjective listening tests, playing a variety of music styles, the cartridge sounded very pleasant though not unexpectedly lacking the ultimate brightness of the more specialised high fidelity cartridges, characterised by lower output higher price and, probably, less robust mechanics.

In short, it belongs logically to a range of cartridges aimed at the domestic new-equipment and replacement markets, offering the claimed reliability of Acos products and the obvious attraction of a diamond stylus for no increase in cost.

Retail prices of the five units are: GP91-1, \$5.95; GP91-2, \$5.95; GP92, \$6.55; GP94-1, \$7.95; GP94-2, \$8.95. Normal trade discounts apply. Further details may be obtained from the importers, Amplion (A'sia.) Pty. Ltd., Majors Rd., Concord, N.S.W.



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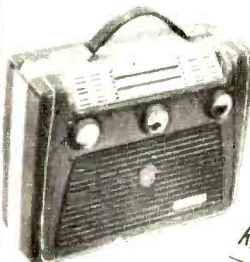
STEREO

MULLARD 12 TRANSISTOR

5 watt x 5 watt.
Distortion 1/2 of 1%. Frequency response 30 cycles to 18Kc. Output 15 ohm speaker
12in lg. x 7in d x 4in h.
Pre-Amplifier kit No. 616C \$26.00
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1—5w Power supply No. 681C \$16.00
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COMPLETE KITS, nuts, screws, etc. No. 471C \$78.50
Wired and tested, No. 471D, extra \$5.00. Freight extra. Write for blueprint list of parts.

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From your drawings. Price: \$10 set up charge plus 30c for each print 5 sq. in. and under. For prints over 5 sq. in., add 2c per sq. in. Drilling, plating, coding, price on application.



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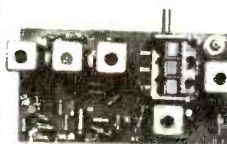
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● No expensive test equipment ● Everything fits.
1964 RF Transports 7. Complete kit—No. 640: \$43.50.
Portable car radio, identical to 640 above, plus extra switch and car coil, etc. No. 642: \$46.
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Small size: cabinet 3" x 2" x 1" plastic. Suitable crystal P.I. up. Intercom., microphone rad., etc. (9 volt)
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CONTACT Mk-1



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The best 100 m.w. unit we've heard. 9 Transistors. All metal with leather case. Separate speaker and microphone. Good value at \$49.50 each.

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This ultra powerful 5-Watt Transceiver is suited for ham operation in the 26 to 28 m.c. region. Either from 12 volts D.C. or 240 volts A.C. Crystal locked and turnable receiver. The finest available today. Price \$213 each.

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FORUM — continued

sively more out of harmony with emerging technical terminology.

To use his own phraseology, it is in no sense a "dirty" word.

In simple fact, the term "cycles per second" has been singled out for special definition because of its enormous usage, its clumsiness when expressed in full and its inaccuracy when abbreviated.

To take up R.A.'s own illustration: Having rejected the simple, monosyllabic term 50 "Hertz" current, he has the choice left of the two-syllable and inaccurate 50 "cycle" current or the accurate and still valid mouthful 50 "cycle-per-second" current.

Of course, 50 Hertz sounds peculiar—because we're not used to it in Australia. But it also takes a while, after marriage, to get adjusted to our partner having a new surname!

As have so many other correspondents, R.A. apparently fails to appreciate that the move to Hertz is an international one, and not just an affectation by Yanks, Aussies, or technical journals—including "Electronics Australia."

The basic decision in favour of Hertz dates back quite a few years and has taken the intervening time to implement.

However, it has the backing of the Technical Committee on Quantities, Units and Symbols of the International Organisation for Standardisation. Closely associated with it is the International Electrotechnical Commission and the International Bureau of Weights and Measures.

The roll-call of nations and countries involved includes at least 50, which are classified as "industrial," plus others classified as "emergent." These individual nations are involved through their own internal Bureaux of Standards, Standards Associations, etc.

In the U.S.A., the National Bureau of Standards has officially adopted Hertz, along with most of the electronics industry and most of the associated technical Press.

In Australia, the Standards Association has adopted the term as standard.

What about amplifier response and piano tuning, R.A. asks. The answer is straightforward. After the electronic and electrical sciences, the acoustic science probably ranks next in its usage of cycles per second. The intention is to encourage the use of the term here also.

In fact, as far as I can gather, the Australian Standards Association draws no hard lines in the matter. To them, the term Hertz means cycles per second and qualifies for consideration in any technical context.

However, the usage of cycles per second or Hertz tends to concentrate in the electronic, electrical and acoustic fields. In other fields, cyclic phenomena are commonly equated to other time periods, rpm, G forces and so on, and the need for a special term is not so apparent. But, as I pointed out earlier, cycles per second is still as valid in such context as cycles per minute or cycles per anything else. ■

POPULAR JAZZ, etc. — continued

The material assembled is excellent as is the line-up of star musicians — all obviously sympathetic to the idea of recording Jewish music.

The oriental influence in some of the Israeli songs is strong and most of it is so beautiful that it makes one wish to hear the original versions without the jazz solos!

These tracks were recorded in 1962 in Los Angeles and the sound is first class.

★ ★ ★

JAZZ BAND BALL. Kenny Ball and his Jazzmen. Astor Mono PLP1139. Interest: Dixieland jazz. Performance: Excellent. Quality: Excellent.

The success of the Kenny Ball Jazzmen has continued undiminished since they topped the World Hit Parades with "Midnight in Moscow." The main reasons for the constant popularity are his first class musicianship and the vigorous manner in which they attack every note they play.

This English band never appear to be tired or bored, which is quite an achievement when one considers that Dixieland, of all the jazz styles, is the one in which the players are most likely to become stale, when almost constantly performing one-nighters.

The personnel is still the same as that which toured Australia, and, although it is difficult to single out any of these excellent instrumentalists, mention must be made of the remarkably fresh approach given to his solo in "New Orleans" by trombonist John Bennett.

Some of the other titles are: Memphis Blues — Temptation Rag — Steamboat Stomp — Jazz Me Blues — There Ain't No Sweet Man Worth the Salt of My Tears.

This is no rehashed Dixieland — this is fresh creative music and the sound quality is all that you could wish for.

★ ★ ★

SUGAR 'N' SPICE. John Robertson and his Multi-Trumpets with orchestra directed by Thomas Tycho. RCA Stereo SL 101726. Also available in Mono.

Interest: Virtuoso trumpet.

Performance: Masterly.

Quality: First class.

Stereo: Normal Spread.

Here is yet another great album by the best exponent of the trumpet that Australia has produced. Only a virtuoso brass player would dream of tackling Zes Confrey's pianistic tour-de-force, "Dizzy Fingers," but Robertson goes even further by playing three trumpets in a unique display of dexterity.

Other exciting renditions include "La Danza" and "Boliviana," while Robertson's feeling for a beautiful ballad is displayed in "Sunrise Sunset" from the musical, "Fiddler on the Roof," which has not yet been staged in Australia.

The trumpet as an instrument is "in" throughout the world at the moment, so this record will have universal appeal.

Production is by Ron Wills, the arrangements are by Thomas Tycho and Laurie Napier was responsible for the good quality sound. ■

"OXFORD"

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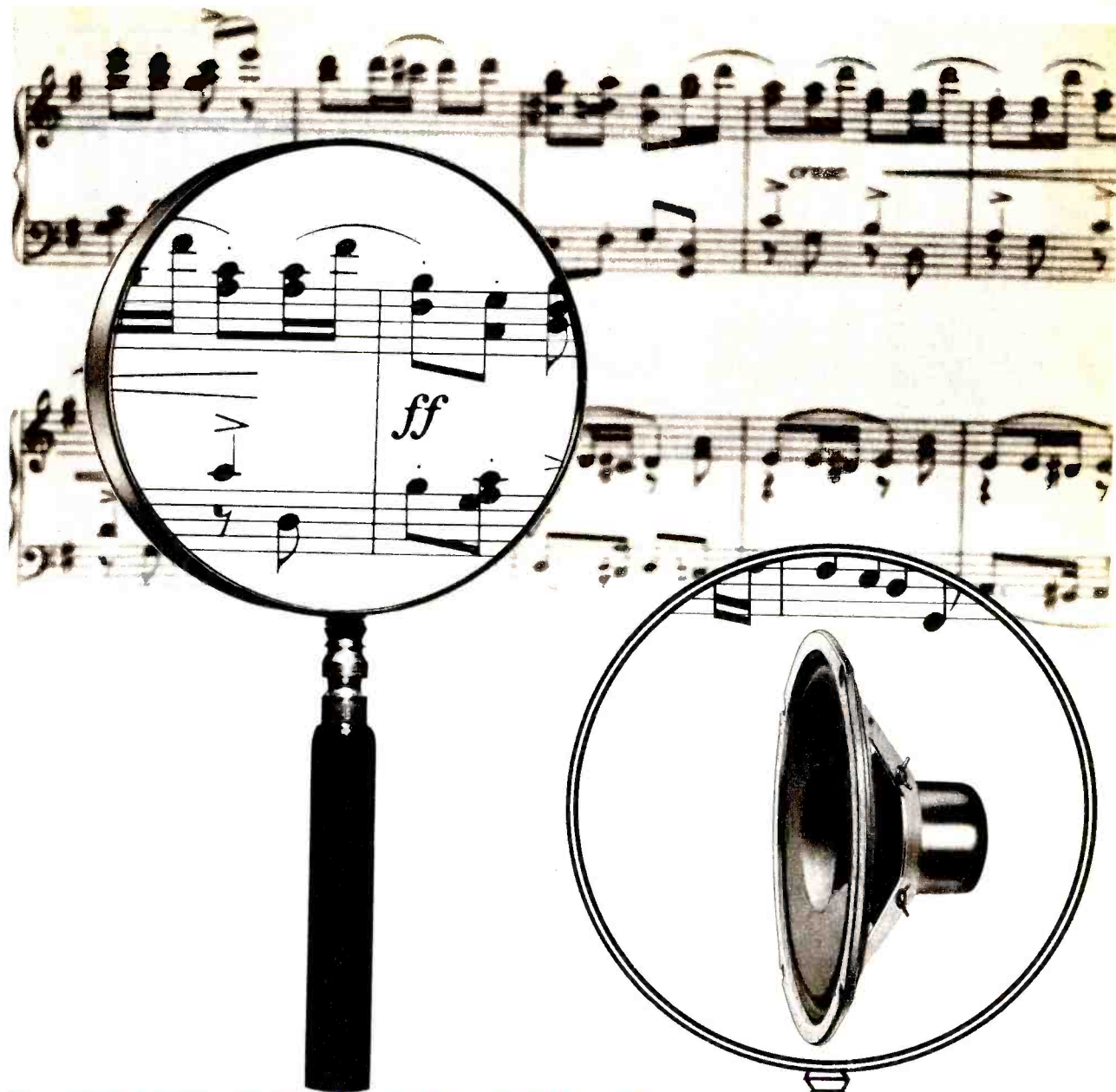
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2KM	Kempsey, N.S.W.	530	2000	3UZ	Melbourne, Vic.	930	5000
3UL	Warragul, Vic.	530	*2000	4QY	Cairns, Qld.	940	2000
4QL	Longreach, Qld.	540	10000	7ZR	Hobart, Tas.	940	10000
7SD	Scottsdale, Tas.	540	2000	2UE	Sydney, N.S.W.	950	5000
2CR	Orange, N.S.W.	550	50000	3BO	Bendigo, Vic.	960	2000
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6WA	Wagin, W.A.	560	50000	5DN	Adelaide, S.A.	970	2000
3WV	Horsham, Vic.	580	50000	6KG	Kalgoorlie, W.A.	980	2000
4QR	Brisbane, Qld.	590	50000	2GZ	Orange, N.S.W.	990	2000
7ZL	Hobart, Tas.	600	10000	3HA	Hamilton, Vic.	1000	2000
4AT	Atherton, Qld.	600	2000	6PM	Perth, W.A.	1000	2000
6NM	Northam, W.A.	600	200	4RO	Rockhampton, Qld	1000	2000
+6PH	Port Hedland, W.A.	600	2000	4CA	Cairns, Qld.	1010	2000
2FC	Sydney, N.S.W.	610	50000	6GE	Geraldton, W.A.	1010	2000
3AR	Melbourne, Vic.	620	50000	4IP	Ipswich, Qld.	1010	2000
4QN	Townsville, Qld.	630	50000	7EX	Launceston, Tas.	1010	2000
7QN	Queenstown, Tas.	630	200	2KY	Sydney, N.S.W.	1020	5000
5CK	Port Pirie, S.A.	640	10000	3DB	Melbourne, Vic.	1030	5000
6AL	Albany, W.A.	650	400	2UH	M'wellbrook, N.S.W.	1040	1000
8DR	Darwin, N.T.	650	2000	5PI	Crystal Brook, S.A.	1040	2000
2NU	Tamworth, N.S.W.	650	10000	2CA	Canberra, A.C.T.	1050	2000
2BH	Broken Hill, N.S.W.	660	200	4SB	Kingaroy, Qld.	1060	2000
6GF	Kalgoorlie, W.A.	660	2000	2RG	Griffith, N.S.W.	1070	*2000
2CO	Albury, N.S.W.	670	10000	6WB	Katanning, W.A.	1070	2000
8KN	Katherine, N.T.	670	50	2MO	Gunnedah, N.S.W.	1080	*2000
+6BE	Broome, W.A.	670	50	4MI	Mount Isa, Qld.	1080	200
8TC	Tennant Creek, N.T.	680	50	6IX	Perth, W.A.	1080	2000
2KP	Kempsey, N.S.W.	680	10000	7HT	Hobart, Tas.	1080	2000
4KQ	Brisbane, Qld.	690	2000	3LK	Lubeck, Vic.	1090	2000
6WF	Perth, W.A.	690	50000	4LG	Longreach, Qld.	1100	2000
2NR	Grafton, N.S.W.	700	50000	6MD	Merredin, W.A.	1100	2000
7NT	Launceston, Tas.	710	10000	7LA	Launceston, Tas.	1100	2000
4QW	St. George, Qld.	710	10000	2UW	Sydney, N.S.W.	1110	*5000
7QT	Queenstown, Tas.	720	500	4BC	Brisbane, Qld.	1120	2000
2TR	Taree, N.S.W.	720	200	2AD	Armidale, N.S.W.	1130	2000
4QA	Mackay, Qld.	720	2000	6CI	Collie, W.A.	1130	2000
6CA	Carnarvon, W.A.	720	200	3CS	Colac, Vic.	1130	2000
5CL	Adelaide, S.A.	730	50000	2HD	Newcastle, N.S.W.	1140	2000
2BL	Sydney, N.S.W.	740	50000	2WG	Wagga N.S.W.	1150	2000
4QS	Toowoomba, Qld.	750	10000	4MB	Maryborough, Qld.	1160	2000
2NB	Broken Hill, N.S.W.	760	1000	5PA	Penola, S.A.	1160	2000
2AN	Armidale, N.S.W.	760	50	2CH	Sydney, N.S.W.	1170	5000
+6BS	Busselton, W.A.	760	2000	3KZ	Melbourne, Vic.	1180	5000
3LO	Melbourne, Vic.	770	50000	2NZ	Inverell, N.S.W.	1190	2000
6VA	Albany, W.A.	780	2000	5KA	Adelaide, S.A.	1200	2000
2KA	Katoomba, N.S.W.	780	2000	2GF	Grafton, N.S.W.	1210	2000
4TO	Townsville, Qld.	780	2000	6KY	Perth, W.A.	1210	2000
4QG	Brisbane, Qld.	790	10000	3YB	Warrnambool, Vic.	1210	2000
5RM	Renmark, S.A.	800	2000	4AK	Oakey, Qld.	1220	2000
9RB	Rabaul, N.G.	810	2000	2NC	Newcastle, N.S.W.	1230	10000
6WN	Perth, W.A.	810	10000	3TR	Sale, Vic.	1240	2000
2BA	Bega, N.S.W.	810	10000	8DN	Darwin, N.T.	1240	2000
2GL	Glen Innes, N.S.W.	820	10000	2DU	Dubbo, N.S.W.	1250	2000
3GI	Sale, Vic.	830	10000	9PA	Port Moresby, N.G.	1250	2000
6GN	Geraldton, W.A.	830	2000	3SR	Shepparton, Vic.	1260	2000
4RK	Rockhampton, Qld	840	10000	2SM	Sydney, N.S.W.	1270	5000
6ED	Esperance, W.A.	840	1000	3AW	Melbourne, Vic.	1280	5000
2CY	Canberra, A.C.T.	850	10000	2TM	Tamworth, N.S.W.	1290	2000
4GR	Toowoomba, Qld.	860	2000	4BK	Brisbane, Qld.	1300	2000
7HO	Hobart, Tas.	860	2000	5AD	Adelaide, S.A.	1310	2000
6AM	Northam, W.A.	860	2000	3BA	Ballarat, Vic.	1320	2000
2GB	Sydney, N.S.W.	870	5000	4NA	Nambour, Qld.	1320	2000
6DB	Derby, W.A.	870	2000	3SH	Swan Hill, Vic.	1330	2000
4WK	Warwick, Qld.	880	*2000	4BU	Bundaberg, Qld.	1330	2000
6PR	Perth, W.A.	880	2000	2LF	Young, N.S.W.	1340	2000
5AN	Adelaide, S.A.	890	10000	3GL	Geelong, Vic.	1350	2000
2LM	Lismore, N.S.W.	900	2000	4GY	Gympie, Qld.	1350	2000
7AD	Devonport, Tas.	900	*2000	2NX	Bolwarra, N.S.W.	1360	2000
6BY	Bridgetown, W.A.	900	2000	5SE	Mount Gambier, S.A.	1370	500
4QB	Maryborough, Qld.	910	10000	4LM	Mount Isa, Qld.	1370	2000
4QO	Eidsvoll, Qld.	910	10000	2LT	Lithgow, N.S.W.	1370	500
2XL	Cooma, N.S.W.	920	*2000	2GN	Goulburn, N.S.W.	1380	2000
4VL	Charleville, Qld.	920	*2000				

(Continued on Page 103)

foster

hi-fi speakers

High Compliance tweeters

FT-502



SPECIFICATIONS
 Size: 50 mm (2 in.)
 *Impedance: 8 or 16 Ω
 Frequency Range: 2,000 ~ 20,000 c/s
 Sensitivity: 100 dB
 Power: 30 W max., 8 W nom.
 Dimensions: 82 x 82 mm, 29 mm depth
 Magnet Weight: 193 g (6.81 oz), Ceramic
 Weight: 615 g (1 $\frac{1}{4}$ lbs)

High Compliance woofers

FW-162



SPECIFICATIONS
 Size: 160 mm (6 $\frac{1}{2}$ in.)
 *Impedance: 8 or 16 Ω
 Resonant Frequency (f_0): 40 ~ 50 c/s
 Frequency Range: f_0 ~ 2,000 c/s
 Sensitivity: 97 dB
 Power: 30 W max., 10 W nom.
 Dimensions: 166 x 166 mm
 81.6 mm depth
 Magnet Weight: 500 g (1 $\frac{1}{4}$ lbs), Ceramic
 Weight: 1,660 g (3 $\frac{1}{2}$ lbs)

FW-202



SPECIFICATIONS
 Size: 200 mm (8 in.)
 *Impedance: 8 or 16 Ω
 Resonant Frequency (f_0): 30 ~ 40 c/s
 Frequency Range: f_0 ~ 2,000 c/s
 Sensitivity: 98 dB
 Power: 45 W max., 15 W nom.
 Dimensions: 208 x 208 mm
 90.8 mm depth
 Magnet Weight: 830 g (1 $\frac{3}{4}$ lbs), Ceramic
 Weight: 2,760 g (6 $\frac{1}{4}$ lbs)

Double-cone speakers

PW-65A



Size: 160 mm (6 $\frac{1}{2}$ in.)
 *Impedance: 8 Ω
 Resonant Frequency (f_0): 70 ~ 100 c/s
 Frequency Range: f_0 ~ 15,000 c/s
 Sensitivity: 97 dB
 Power: 6 W max., 5 W nom.
 Dimensions: 164.9 mm, 86.2 mm depth
 Magnet Weight: 77.6 g (2.73 oz)
 Weight: 476 g (1 $\frac{1}{4}$ lbs)

*at 400 c/s: *at 3,000 c/s

High Compliance wide range speakers

FE-103



Size: 100 mm (4 in.)
 *Impedance: 8 or 16 Ω
 Resonant Frequency (f_0): 65 ~ 95 c/s
 Frequency Range: f_0 ~ 18,000 c/s
 Sensitivity: 96 dB
 Power: 5 W max., 3 W nom.
 Dimensions: 105 x 105 mm, 46.6 mm depth
 Magnet Weight: 193 g (6.81 oz), Ceramic
 Weight: 630 g (1 $\frac{1}{4}$ lbs)

FE-163



Size: 160 mm (6 $\frac{1}{2}$ in.)
 *Impedance: 8 or 16 Ω
 Resonant Frequency (f_0): 40 ~ 60 c/s
 Frequency Range: f_0 ~ 20,000 c/s
 Sensitivity: 98 dB
 Power: 10 W max., 5 W nom.
 Dimensions: 166 x 166 mm, 73.7 mm depth
 Magnet Weight: 398 g (14.04 oz), Ceramic
 Weight: 1,260 g (2 $\frac{3}{4}$ lbs)

Coaxial speakers

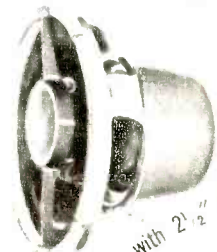
FX-201



with horn tweeter

Size: 200 mm (8 in.)
 *Impedance: 16 Ω
 Resonant Frequency (f_0): 45 ~ 75 c/s
 Frequency Range: f_0 ~ 18,000 c/s
 Sensitivity: 101 dB
 Power: 10 W max., 5 W nom.
 Dimensions: 206 mm, 137.5 mm depth
 Magnet Weight: 240 g (8.46 oz)
 Weight: 2,200 g (4 $\frac{7}{8}$ lbs)

FX-200 G2



with 2 $\frac{1}{2}$ " tweeter

Size: 200 mm (8 in.)
 *Impedance: 16 Ω
 Resonant Frequency (f_0): 45 ~ 75 c/s
 Frequency Range: f_0 ~ 18,000 c/s
 Sensitivity: 101 dB
 Power: 10 W max., 5 W nom.
 Dimensions: 206 mm, 140.7 mm depth
 Magnet Weight: 234 g (8.21 oz)
 Weight: 2,200 g (4 $\frac{7}{8}$ lbs)

2-way network



LC-100

Crossover Freq.: 2,500 or 3,500 c/s
 Impedance: 16 Ω
 Attenuation: 6 dB/oct.
 Dimensions: 63.1 mm, 69 mm height
 Weight: 280 g (9.88 oz)

2 or 3-way network



LC-300

Crossover Freq.: 350 or 700 c/s, 2,500 or 5,000 c/s
 Impedance: 8 or 16 Ω
 Attenuation: 6 dB/oct.
 Dimensions: 83 H x 200 W x 134 mm D
 Weight: 1,430 g (3 $\frac{1}{8}$ lbs)

tweeter



FHT-1

*Impedance: 16 Ω
 Frequency Range: 2,500 ~ 16,000 c/s
 Sensitivity: 100 dB
 Power: 10 W max., 5 W nom.
 Dimensions: 110 mm height, 95 mm depth
 Weight: 330 g (11.75 oz)

(SOLE AGENT)



ZEPHYR PRODUCTS PTY. LTD.

70 BATESFORD ROAD, CHADSTONE, VICTORIA

4MK	Mackay, Qld.	1380	2000
4BH	Brisbane, Qld.	1390	2000
2PK	Parkes, N.S.W.	1400	2000
2KO	Newcastle, N.S.W. ..	1410	2000
3XY	Melbourne, Vic.	1420	5000
2WL	Wollongong, N.S.W. ..	1430	2000
2MW	M'will'bah, N.S.W. ..	1440	2000
3CV	Maryborough, Vic.	1440	2000
5AU	Port Augusta, S.A.	1450	2000
2MG	Mudgee, N.S.W.	1450	2000
5MU	Murray Bridge, S.A.	1460	*2000
2NM	M'wellbrook, N.S.W. ..	1460	*2000
3MA	Mildura, Vic.	1470	2000
2BE	Bega, N.S.W.	1480	1000
4ZR	Roma, Qld.	1480	*2000
2AY	Albury, N.S.W.	1490	2000
2BS	Bathurst, N.S.W.	1500	2000
3AK	Melbourne, Vic.	1500	5000
2NA	Newcastle, N.S.W.	1510	10000
2QN	Deniliquin, N.S.W.	1520	2000

5LN	Port Lincoln, S.A.	1530	200
8AL	Alice Springs, N.T.	1530	50
2VM	Moree, N.S.W.	1530	*2000
2CN	Canberra, A.C.T.	1540	2000
4QD	Emerald, Qld.	1550	50000
2RE	Taree, N.S.W.	1560	2000
2CP	Cooma, N.S.W.	1570	50
2LG	Lithgow, N.S.W.	1570	200
3WL	Warrnambool, Vic.	1570	200
4GM	Gympie, Qld.	1570	200
5WM	Woomera, S.A.	1580	50
2WN	Wollongong, N.S.W.	1580	2000
5MG	Mt Gambier, S.A.	1580	200
4SO	Southport, Qld.	1590	200
5MV	Renmark, S.A.	1590	2000
3NE	Wangaratta, Vic.	1600	*2000

* Operates at night or during specified periods on reduced (usually half) power.

† Projected transmitters.

TV CHANNELS & STATIONS

Channel 0	45-52MHz	Channel 6	174-181MHz
Channel 1	56-63MHz	Channel 7	181-188MHz
Channel 2	63-70MHz	Channel 8	188-195MHz
Channel 3	85-92MHz	Channel 9	195-202MHz
Channel 4	94-101MHz	Channel 10	208-215MHz
Channel 5	101-108MHz	Channel 11	215-222MHz
Channel 5A	137-144MHz		

A.C.T.

Location	Station	Polarity	Channel
Canberra	ABC (Nat.)	Vert.	3
	CTC (Com.)	Vert.	7

N.S.W.

Sydney	ABN (Nat.)	Hor.	2
	ATN (Com.)	Hor.	7
	TCN (Com.)	Hor.	9
	TEN (Com.)	Hor.	10
Newcastle	ABHN (Nat.)	Hor.	5
	NBN (Com.)	Hor.	3
Illawarra	ABWN (Nat.)	Hor.	5A
	WIN (Com.)	Hor.	4
Central T'lands	ABCN (Nat.)	Vert.	1
	CBN (Com.)	Vert.	8
Richmond-Tweed	ABRN (Nat.)	Hor.	6
	RTN (Com.)	Hor.	8
Bega	ABSN (Nat.)	Vert.	0
Broken Hill	ABLN (Nat.)	Vert.	2
	*BKN (Com.)	Vert.	7
Coffs Harb.	ABDN (Nat.)	Hor.	2
	NRN (Com.)	Hor.	11
Dubbo	ABQN (Nat.)	Vert.	5
	CWN (Com.)	Vert.	6
Griffith	ABGN (Nat.)	Hor.	7
	MTN (Com.)	Hor.	9
Tamworth	ABUN (Nat.)	Hor.	7
	NEN (Com.)	Hor.	9
Taree	ABTN (Nat.)	Vert.	1
	ECN (Com.)	Vert.	8
Wagga	ABMN (Nat.)	Hor.	0
	RVN (Com.)	Hor.	2

VICTORIA

Melbourne	ATV (Com.)	Hor.	0
	ABV (Nat.)	Hor.	2
	HSV (Com.)	Hor.	7
	GTV (Com.)	Hor.	9
Ballarat	ABRV (Nat.)	Hor.	3
	BTV (Com.)	Hor.	6
Bendigo	ABEV (Nat.)	Vert.	1
	BCV (Com.)	Vert.	8
Latrobe Valley	ABLV (Nat.)	Hor.	4
	GLV (Com.)	Hor.	10
Goulburn Valley	ABGV (Nat.)	Vert.	3
	GMV (Com.)	Vert.	6

Location	Station	Polarity	Channel
Albury	ABAV (Nat.)	Hor.	1
	AMV (Com.)	Hor.	4
Mildura	ABMV (Nat.)	Hor.	4
	STV (Com.)	Hor.	8
Swan Hill	ABSV (Nat.)	Vert.	2

QUEENSLAND

Brisbane	TVQ (Com.)	Hor.	0
	ABQ (Nat.)	Hor.	2
	BTQ (Com.)	Hor.	7
	QTQ (Com.)	Hor.	9
Darling Downs	ABDQ (Nat.)	Hor.	3
	DDQ (Com.)	Hor.	10
Rockhampton	ABRQ (Nat.)	Hor.	3
	RTQ (Com.)	Hor.	7
Townsville	ABTQ (Nat.)	Hor.	3
	TNQ (Com.)	Hor.	7
Cairns	ABNQ (Nat.)	Hor.	9
	FNQ (Com.)	Hor.	10
Mackay	*ABMQ (Nat.)	Hor.	4
	*MVQ (Com.)	Hor.	6
Maryborough	ABWQ (Nat.)	Vert.	6
	WBQ (Com.)	Vert.	8
Warwick	ABSQ (Nat.)	Hor.	1
	SDQ (Com.)	Hor.	4

SOUTH AUSTRALIA

Adelaide	ABS (Nat.)	Hor.	2
	ADS (Com.)	Hor.	7
	NWS (Com.)	Hor.	9
	SAS (Com.)	Hor.	10
Mt. Gambier	ABGS (Nat.)	Hor.	1
	SES (Com.)	Hor.	8
Pt. Pirie	ABNS (Nat.)	Vert.	1
	*GTS (Com.)	Vert.	4

WEST AUSTRALIA

Perth	ABW (Nat.)	Hor.	2
	TVW (Com.)	Hor.	7
	STW (Com.)	Hor.	9
Bunbury	ABSW (Nat.)	Hor.	5
	*BTW (Com.)	Hor.	3
Albany	ABAW (Nat.)	Vert.	2
	*GSW (Com.)	Vert.	9
Northam York	ABCW (Nat.)	Hor.	4

TASMANIA

Hobart	ABT (Nat.)	Hor.	2
	TVT (Com.)	Hor.	6
Launceston	ABNT (Nat.)	Hor.	3
	TNT (Com.)	Hor.	9

* Not yet in operation.

Aust. TV, shortwave services continued page 105.

ELECTRONIC DEVELOPMENTS PTY. LTD.

KITSETS - - BUILD IT YOURSELF SAVE \$\$\$s

AMPLIFIERS

GUITAR

Golden Series, 12 Watt.
Std. Series, 20 Watt.
Std. Series, 10 Watt.
Std. Series, 25 Watt.
Std. Series, 35 Watt.
Std. Series, 50 Watt.
Playmaster 102.
Playmaster 103.

HI-FI MONAURAL

Hi-Fi 3
Mullard 3-3
Mullard 5-10
Mullard 5-20

HI-FI STEREO

Basic 2
Mullard 2-2
Mullard 3-3
Mullard 10-10
Philips Twin Valve 10
Playmaster Twin 10
Playmaster Twin 17
Playmaster 113
Playmaster Unit 2
Playmaster Unit 3
Playmaster Unit 4
Playmaster 101
Playmaster 105

P/A UNITS

Standard 10W

Standard
Standard
Standard
Standard
Transistor
Transistor

25W
35W
50W
100W
10W
30W

144 MC/S
50-144 MC/S
X'Tal Locked
D.C.-D.C.
D.C.-D.C.
D.C.-A.C.

40W
60W
40W

TAPE UNITS

Stereo
Stereo Adapter
Stereo Phone Amp

PREAMPLIFIERS

Transistor Mono
Transistor Stereo

CONTROL UNITS

Playmaster No. 8
Playmaster No. 9
Playmaster No. 10
Playmaster No. 104
3-Channel Mixer
Philips Magnetic
Mullard
Mullard
Transistor Mono
Transistor Stereo

3V
2V
3V

CONVERTERS

S/W Batt.
S/W Batt.
S/W A.C.
S/W A.C.
50 MC/S

1
2
1
2

INSTRUMENTS

3in. C.R.O.
5in Wide Range C.R.O.
Wide Band C.R.O.
Preamplifier
R/C Bridge
V.T.V.M.
Electronic Stethoscope
Sweep Generator
Sweep Marker
Generator
Pattern Generator
Diode Noise Generator
G.D.O.
Transistor Wave Meter
Transistor Signal Tracer
Transistor Pattern Generator
Valve and Transistor Tester
Millivoltmeter
Distortion Noise and
Millivoltmeter
Mullard Tachometer
Electronic C.R.C. Switch
Geiger Counter

RECEIVERS

DXERS (Batt.)

1

DXERS (Batt.)

DXERS A.C.

DXERS A.C.

DXERS, 3 Band

Interstate

Fremodyne

Amateur RX

Transistor

Transistor

Transistor

Transistor

Transistor (R.F.)

Transistor

Transistor 3 Band

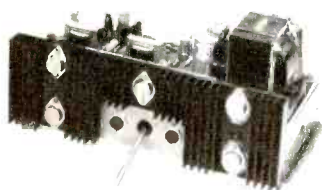
TRANSMITTERS

V.F.O. 1962
Remote V.F.O. 1963
144 MC/S A.M. TX
144 MC/S S.S.B. TX
1962 S.S.B. TX
144 MC/S Linear Final

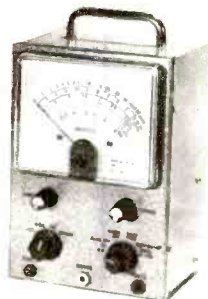
MISCELLANEOUS

Light Beam Relay
Flasher Unit
Regulated 9V D.C. Supply
Universal Battery Charger
Intercomm. Unit
Metronome Unit
Porta Player
TV Hearing Aid

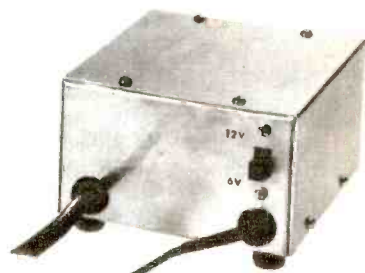
If you cannot see your project listed—write for a quote, we have many other units available or in development.



Playmaster 113



1966 VTVM



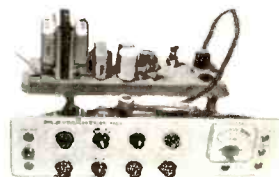
Battery Charger



Mullard Stereo 3.3



103 Guitar Amp.



Playmaster 110 Tape Amp.

ELECTRONIC DEVELOPMENTS PTY. LTD.

Phones 63-3596
63-5973

232 FLINDERS LANE
MELBOURNE VICTORIA

Phones 63-3596
63-5973

TRANSLATOR STATIONS

National TV Service

Area served	Parent Station	Channel
Armidale, N.S.W.	ABUN-7	4
Bonalbo, N.S.W.	ABRN-6	3
Kyogle, N.S.W.	ABRN-6	3
Lithgow, N.S.W.	ABCN-1	5
Warrnambool-Port Fairy, Vic.	ABRV-3	2
Queenstown-Zeehan, Tas.	ABT-2	4
Rosebery-Renison Bell, Tas.	ABT-2	1
Smithton-Stanley, Tas.	ABNT-3	1

Commercial TV Service

Armidale, N.S.W.	NEN-9	1
Batemans Bay-Moruya, N.S.W.	WIN-4	11
Bonalbo, N.S.W.	RTN-8	5
Cooma, N.S.W.	CTC-7	10
Kyogle, N.S.W.	RTN-8	5
Lithgow, N.S.W.	CBN-8	6 mod. (-1000KHz)
Mudgee, N.S.W.	CWN-6	11
Murwillumbah, N.S.W.	RTN-8	5
Snowy Mountains (Khancoban), N.S.W.	AMV-4	10
Warrnambool-Port Fairy, Vic.	BTV-6	9
Cardstone Village, Qld.	TNQ-7	5
Queenstown-Zeehan, Tas.	TVT-6	8
Rosebery-Renison Bell, Tas.	TVT-6	10
Swansea-Bicheno, Tas.	TVT-6	8
Taroona, Tas.	TVT-6	8
Gowrie Park, Tas.	TNT-9	1
Smithton-Stanley, Tas.	TNT-9	6
St. Mary's-Fingal Valley, Tas.	TNT-9	11

"Electronics Australia" does not publish, nor do we have available, list of overseas stations, frequencies, broadcast times, etc. The only information of this type is as compiled by our DX correspondent, Mr Art Cushen, and published each month on "Listening Around The World" page.

For general information on shortwave and other stations, reference can be made to the "World Radio Handbook," available through most large technical booksellers.

SHORT-WAVE SERVICES

The following stations provide a domestic and overseas service in the 49, 42, 31, 25, 19, 16, 13 and 11 metre bands:

Call Sign	Location	Power (watts)
VLG	Melbourne, Victoria	10,000
VLH	Melbourne, Victoria	10,000
VLJ	Sydney, N.S.W.	2,000
VLK	Port Moresby, Papua	10,000
VLM	Brisbane, Queensland	10,000
VLQ	Brisbane, Queensland	10,000
VLR	Melbourne, Victoria	10,000
VLT	Port Moresby, Papua	10,000
VLW	Perth, Western Australia	10,000
VLX	Perth, Western Australia	50,000

Transmitters for the overseas service of Radio Australia are located at Shepparton, Victoria. They comprise four 100,000-watt transmitters, two 50,000-watt transmitters and one 10,000-watt transmitter. A 10,000-watt transmitter at Lyndhurst, Victoria, is also used on occasions. These use a variety of frequencies and aerials as required to give best reception in the selected areas.

Mullard MINI SPEAKER UNITS

8 or 15 Ohms
\$27.00 (£13/10/).
Plus Post.



PLAYMASTER No. 106 Stereo Amplifier Tuner

Built and tested, \$114.50. (£57/5/-)
De Luxe with Timber Cabinet, \$129.50 (£64/15/-)



Palace 8-Watt Stereo Amplifier

● Output Power: 8 Watts, 4 Watts per channel. ● Frequency Response: 60 to 15,000 cps \pm 1db. ● Sensitivity: Phono (Crystal) 100mV 250K ohm Tuner 100mV. ● Dimensions: 9 1/2 in x 6 1/2 in x 3 in. ● Weight: 5.1lb. Price \$32.50.



TRANSISTOR MODULES



Unit 1. Model 10/20 Amplifier 10 Watt into 1.5 Ohms 20-20 kc/s 12V Suppl. \$15.
£7/10/ plus Tax.
3 Watt £4/10/ \$9 plus Tax.

Unit 13. 10 Watt RMS Continuous 15 Ohms, 40V Supply. £10/10/, \$21.00. Also 35W, 50W, 75W RMS Amplifiers, 8 Ohms. From £22, \$44.00, plus Tax.



Unit 10A. Transistorised Tuners—Bandwidth, 12 kc/s. With Power Supply, £11/10/ \$23 plus Tax.
With RF stage, £16/10/ \$33.

TAPE RECORDER KITS

UNIT 14. TAPE PRE-AMPLIFIER
Unit 15. 60 kc/s, Push/pull Transistorised Bias Oscillator Module. £8. \$16 plus Tax.
Unit 16. Transistor Tape Recording Amplifier Module. Used with Unit 14. 12 volt Transistorised P.A. Amplifiers from 3 watt to 50 watt. £4/15/ \$9.50 plus Tax.

TRANSISTORS AND DIODES AT SPECIAL PRICES

BC107	\$1.00	AF114	95c	AF117	90c	AC125	90c	2N301	\$2.50
BC108	90c	AF115	95c	OC44	90c	AC127	\$1.00	OC74	95c
BC109	\$1.30	AF116	90c	OC45	90c	AC132	\$1.05	AA119	30c

ALSO COMPONENTS, TAPE, FILM, ETC. LISTS AVAILABLE.

SEND STAMPED ADDRESSED ENVELOPE FOR DETAILS

Please specify section in which you are interested.

60 SIMPLE ELECTRONIC PROJECTS YOU CAN BUILD NOW!

How would you like to make a 2-transistor Radio, an Intercom Unit, a Burglar Alarm, Electronic Thermometer, Stereo Headphone Amplifier, Short Wave Radio, Electric Fence or any one of 60 exciting, easy-to-build projects?

IT'S EASY THE S.E.W. KIT WAY

*No technical background needed, just screwdriver, pliers and soldering iron.
* All kits transistorised.

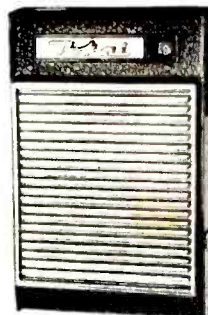
IDEAL FOR BEGINNERS OF ALL AGES

Kits use special printed Circuit Boards.

NEW RELEASE

6 Transistor Radio Kit, complete to last details. Incl. instruction manual.

£8/10/
\$17.
incl. tax.



S. E. WILLIS TRADING CO. 38 RIVERSDALE RD., CAMBERWELL, E.6, VIC. 82-5787



RADIO SUPPLIERS

5a MELVILLE ST., HAWTHORN, VIC.
8 PARK STREET, GLENFERRIE, VIC.

Phone: 86-6465

Phone: 81-1935

ESTABLISHED 1947

JUST ARRIVED CITIZEN'S BAND CRYSTALS

SUIT JAP WALKIE TALKIES

Available in Standard HC 6/u holders, or HC 18/u miniature solderin type holder.

27.240 m/c \$3.00

26.785 m/c \$3.00

or \$5.50 per pair. Either type.

MULTIMETER MODEL 200H

20,000 ohms per V d.c. 10,000 ohms per V a.c.



Specifications:
DC volts: 0-5, 25, 50, 250, 500, 2,500.
AC volts: 0-10, 50, 100, 500, 1,000.
DC current: 0-50 uA, 25, 250 mA.
Resistance: 0-60 K ohms, 0-6 meg.
Capacity: 0.01, 0.3 uF, 5V; 0.0001, 0.01 uF, 50V; 250V.
Decibel: Minus 20 dB, plus 22 dB.
Output range: 0-10, 50, 100, 500, 1,000.
Battery used: UM3 1.5s, 1-piece. Dimensions: 3.4 x 4.2 x 1.5 in.
Complete with internal battery, testing-leads and prods.

Price \$10.75 inc. tax

Post 25c

HI-FI LOUDSPEAKERS

6 in twin cone, rated 5 watt, 60-16 Kc, 8 or 16 ohm available \$5.00, £2/10/0
8 in twin cone, rated 10 watt, 60 to 16 Kc, 8 or 16 ohm available \$7.50, £3/15/0
12 inch twin cone, rated 10 watt, Ferrite Magnet, 10 watt, 60 to 16 Kc, 8 or 16 ohm available \$10.00, £5/0/0
6 inch Coaxial, rated 8 watt, 60 to 16 Kc, 8 or 16 ohm available \$11.00, £5/10/0
8 inch Coaxial, rated 10 watt (40-16 Kc) 8 or 16 ohm available \$15.00, £7/10/0
12 inch twin cone, rated 20 watt (30-13 Kc) 8 or 16 ohm available \$19.00, £9/10/0

SPEAKER ENCLOSURES FOR ABOVE SPEAKERS AVAILABLE TO ORDER P.O.A.

MULLARD MAGNAVOX MINI BOOKSHELF SPEAKER BOX

(Mullard outlook, April, 1966, edition). Built by Approved Magnavox Manufacturer. Completely built and polished maple, walnut or teak.

With Speakers, each \$27.00, £13/10/0 F.O.R.

MICROPHONES

LM1, Crystal Lapel Type \$1.00, 10/-
BM3, Crystal Pencil, Type w. on-off switch \$5.00, 50/-
CM30, Crystal Small Tape Rec. Type \$1.95, 19/6
DF2, Dynamic Tape Recorder Type 500HM or 50K available \$5.00, 50/-
DF3, Dynamic Pencil Type 500HM or 50K available \$9.00, 90/-
B1051, Dynamic Thin Pencil Type, polished aluminium finish, Response, 15-15KC 50K OHM only \$7.50, 75/-
B1052, Dynamic Dual Impedance Pencil Type (600 ohm and 50K) (Response 15-15KC) \$11.50, £5/15/-
B1053, Uni Directional Slim Pencil Type Dual Impedance (500-50K) \$18.00, £9/0/0
B1401, Microphone Stand, Desk Type \$1.80, 18/-

SEMICONDUCTORS TRANSISTORS

Germanium and Silicon

AC107	\$1.90	BC108	.90
AC125/OC70	.90	BC109	\$1.30
AC126/OC75	.90	BF115	.90
AC127	\$1.00	OC26 AD149	\$2.25
AC128	.95	OC30	\$4.10
2-AC128	\$1.90	OC35 AT1138A	\$3.25
AD149 OC26	\$2.25	OC44N	.90
AF114N OC171	.95	OC45N	.90
AF115N	.95	OC70	\$1.16
AF116N OC170	.90	OC71 2N215	.75
AF117N OC169	.90	OK 3 for	\$2.00
AF118N	\$2.00	OC71	\$1.25
ASZ20 2N370	.90	OC72	\$1.25
AT126 AC126	.90	OC74N AC128	.95
AT310 Silicon	.95	OC75 AC126	.95
AT311 Silicon	.95	OC202	\$3.00
AT312 Silicon	.98	2N217 S	.95
AT313 Silicon	\$1.00	2N217 S	.95
AT314 Silicon	.90	2N370 ASZ20	.95
AT315 Silicon	.95	2N372	\$1.75
AT316 Silicon	.95	2N410	.85
AT1138A OC35	\$3.25	26278 Delco	\$3.00
BC107	\$1.00	2N301 AWW	\$2.30

Germanium, Silicon and Zener Diodes

BA100	.45	OAZ205	\$1.50
BY100	\$1.55	OAZ208	\$1.25
OA5	.70	OAZ212	\$1.25
OA79	.30	OAZ213	\$1.25
OA90 OA80	.30	OAZ222/BZZ14	\$2.00
IN34A	.30	OAZ224/BZZ16	\$2.00
OA91/OA81	.30	OAZ225	\$2.00
OA200	.70	OAP-12 Light/sens	.85
OA202	.75	IN3194/OA210	.85
OA210/IN1763/		IN3193/OA605	.55
IN3194 HR25,		IN3491	.95
400PIV, 400MA	.85	IN3491R	.95
OA211/BY100/S1AR2		IN3492 100PIV	.95
1000PIV 1 amp.		18A	\$1.20
	\$1.60	IN3492R	\$1.20
AO605 IN3193	.55	IN3493 200PIV	\$1.30
OA650	\$1.10	18A	
OAZ200	\$1.50	IN3660 100PIV	
OAZ202	\$1.50	25A	
OAZ203	\$1.50	IN3660R	\$1.55

ALSO MANY OTHERS TO ORDER.

SPECIALS

CV448/OA81 Germanium Diodes.
22c each or 12 for \$2.00.
2SA29/OC44, 75c or 3 for \$2.00.

SPECIAL

NEW VALVES IN STOCK TO CLEAR

6AC7	50c each or 5 for \$2
6AG5	25c each or 10 for \$2
12SR7	50c each or 5 for \$2
12AT7	75c each or 3 for \$2
7E6	35c each or 8 for \$2
7A8	35c each or 8 for \$2
6SH7	50c each or 5 for \$2
7C5	50c each or 5 for \$2
84	50c each or 5 for \$2
7W7	35c each or 8 for \$2
6H6G7	20c each or 12 for \$2
954	50c each or 5 for \$2
6J7	50c each or 5 for \$2
EA50	10c each or 12 for \$1
958A	50c each or 5 for \$2
6U7G	50c each or 5 for \$2
2C26	50c each or 5 for \$2
6J6	75c each or 3 for \$2
RL18	75c each or 3 for \$2
1625	50c each or 5 for \$2
6SJ7	75c each or 3 for \$2
866A	\$1.25 each or 3 for \$3
100TH	53 each
500 Kc Crystals DC	\$5
807 Valves	\$1.75

C. R. TUBES

902 2in CRT	\$7
5BP1 5in CRT	\$5
VCR 97 7in CRT	\$5

Please allow for Postage and Packing.

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(This Month Only.)

Scotch brand, 1800 ft on 7 inch reel lubricated Acetate \$3.50, 35/-
Scotch brand, 300 ft on 3 inch reel polyester base \$1.20, 12/-
Lafayette Brand, 1800 ft, on 7 inch reel polyester base \$3.95, 39/6
Lafayette Brand, 2400 ft, on 7 inch reel polyester base \$5.00, 50/-
Lafayette Brand, 1200 ft on 5 inch reel polyester base \$3.25, 32/6

POST 10c per Reel.



Scoop Insurance Purchase

NUOVO FARO NF-20
TAPE RECORDER Upright Type

2 Speed 1 1/2-3 1/4 i.p.s. 2 Track. 2 Motors. Takes 5 1/2 in. Reels. A.C. operated. Complete fast forward and rewind with Microphone and B.A.S.F. 1200ft tape. Brand new but slightly damaged Case.

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Packing 50c. F.O.R.

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24 WATT STEREO AMPLIFIER

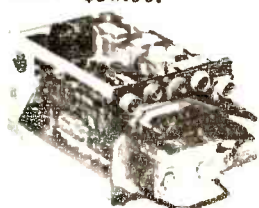
and Pre-amp (Similar Star SA30)

12 watts per channel, 8 and 16 ohm outputs. Rumble Filter, etc. Few only at this price \$80.00, £40/0/0



STEREO AMP. 10 WATT

Model ST-100 Stereo Amplifier, 5 watts per channel, valve type. Response 15-15Kc. 4, 8, 16 ohm output, \$38.00.



V.H.F. TRANSCEIVERS

TR1935 (TR1934) Supersedes SCR522, FREQ. RANGE 115-145 M.C. Crystal Locked, 21 valves comprising 6CQ5, 6AM6, EB91, 6AM5, TT15, QVO4 7. Suitable for conversion to 144 M.C. Band. (Still current for aircraft bands.) Brand new condition less crystals. \$30.00 (£15). CIRCUITS, 10/ EACH.

NEW ZEALAND RADIO, TELEVISION

Medium-Wave Broadcast Stations

Call	Location	Frequency KHz	Authorised Power Watts	Call	Location	Frequency KHz	Authorised Power Watts
2YA	Wellington	570	10000	1ZB	Auckland	1070	10000
2YZ	Napier	630	20000	3ZB	Christchurch	1100	10000
4YX	Alexandra	640	2000	2YD	Wellington	1130	2000
2YC	Wellington	660	60000	1YW	Hamilton	1140	2000
3YA	Christchurch	690	20000	3XC	Timaru	1160	2000
4YZ	Invercargill	720	20000	2YW	Gisborne	1180	2000
3ZA	Greymouth	750	2000	2XA	Wanganui	1200	2000
1YA	Auckland	760	20000	1XE	Kaikohe	1220	2000
4YA	Dunedin	780	20000	1YD	Auckland	1250	2000
2YB	Wellington	800	20000	2ZC	Hawkes Bay	1280	2000
4ZA	Invercargill	820	10000	1XH	Hamilton	1310	2000
1YX	Whangarei	830	2000	2XN	Nelson	1340	2000
2XB	Masterton	840	2000	1ZC	Rotorua	1350	2000
1YZ	Rotorua	860	10000	2XP	New Plymouth	1370	2000
1YC	Auckland	880	10000	3YD	Christchurch	1400	2000
4YC	Dunedin	900	10000	1ZO	Tokoroa	1420	2000
3YZ	Greymouth	920	10000	4XD	Dunedin	1430	250
2ZA	Palmerston North	940	2000	1XA	Kaitia	1440	2000
3YC	Christchurch	960	10000	3YW	Westport	1460	2000
1XN	Whangarei	970	2000	—	R. Hauraki (international waters)	1480	2000
2ZB	Wellington	980	20000	1ZA	Taupo	1500	2000
1ZD	Tauranga	1000	10000	1ZU	Taumarunui	1520	1000
4ZB	Dunedin	1040	10000	2ZE	Blenheim	1540	1000
2XG	Gisborne	1060	2000	2ZH	Hawera	1560	1000

Television Channels and Stations

Channel 1	44-51MHz	Channel 6	188-195MHz
Channel 2	54-61MHz	Channel 7	195-202MHz
Channel 3	61-68MHz	Channel 8	202-209MHz
Channel 4	174-181MHz	Channel 9	209-216MHz
Channel 5	181-188MHz		

MAIN STATIONS

Location	Call sign	Channel
Wellington	WNTV-1	1
Auckland	AKTV-2	2
Dunedin	DNTV-2	2
Christchurch	CHTV-3	3

REPEATER STATIONS

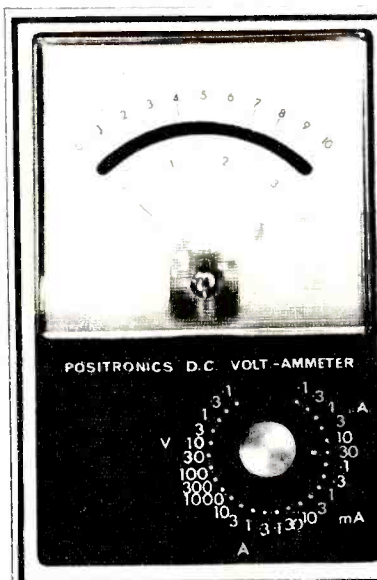
Location	Parent station	Channel
Mt. Te Aroha (Waikato)	AKTV-2	1
Hedgehope (Invercargill)	DNTV-2	1
Wharite	WNTV-1	2
Hikurangi	AKTV-2	3
Mt. Studholme	CHTV-3	4
Horokaka	AKTV-2	5
Kuriwao	DNTV-2	5
Mt. Erin	WNTV-1	6
Blenheim	WNTV-1	6
Masterton	WNTV-1	7
Whangarei	AKTV-2	7

Radio New Zealand Short-Wave Service

The New Zealand Broadcasting Corporation operates New Zealand's short-wave service over Radio New Zealand with two 7500W transmitters and has programs beamed to the Pacific and Australia. The schedule is: to the Pacific, 1700-1945, 2000-0545, 0600-0845; to Australia, 2000-2230, 2245-0545, 0900-1145.

The calls and frequencies assigned are:

ZL20	6020KHz
ZL7	6080
ZL18	9520
ZL2	9540
ZL8	9620
ZL3	11780
ZL22	11820
ZL21	15110
ZL4	15280



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Announces a superb Australian electronic voltmeter-ammeter

Voltage and current ranges follow a 1,3,10, . . . sequence, from 100 mV to 1 KV and 100 nA to 10 A full scale. Input resistance on voltage ranges rises from 1.0 megohms on the 100 mV range to 10 megohms on the 1.0 V and higher ranges. Voltage drop, at full scale deflection, on the current ranges is nominally 100 mV.

Age will not affect the accuracy—3% of full scale. Resolution and repeatability are 0.1% of full scale deflection. Drift is so low that no external zero controls are required. Current consumption is so low that no on-off switch is required.

The instrument is extremely robust—overload on the more sensitive ranges is harmless.

. . . and this is only the beginning.

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CHELTENHAM, VICTORIA
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AMATEUR BAND NEWS AND NOTES

Guide For Prospective Y.R.S. Clubs

Those associated with the Wireless Institute of Australia Youth Radio Scheme, anticipate that 1967 will see a substantial increase in the number of students participating in radio club activities.

By Pierce Healy, VK2APQ*

From time to time specific aspects of the W.I.A. Youth Radio Scheme have been recorded in these notes. From inquiries received it would appear that more detailed information should be published before the actual commencement of the academic year.

For information, and as an introduction of the scheme to parents, educationists and in general for those who have vaguely heard of the Y.R.S., an outline of the origin, objectives and administration of the scheme is given which will enable those interested in starting a club, to acquaint themselves with some of the details and maybe do some preliminary planning prior to the commencement of the school year.

ORIGIN

The Youth Radio Scheme was developed by the New South Wales Division of the Wireless Institute of Australia, and submitted as a working project to the Federal Council of the Institute, at the Annual Convention 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."

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 Executives 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 of 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 instructors(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.

YOUTH RADIO SCHEME ACTIVITIES

The Youth Radio Club Scheme in Victoria has been allotted the Call Sign, VK2ANE and the official operator appointed is Don Reid, VK3EI. At the end of 1966 there were 22 clubs and three Non-Club Participants enrolled in the division.

As at the end of November, 1966, the following clubs have gained Certificates:—

Macleod Radio Club. 6 Elementary and 8 Junior Certificates.

Essendon Grammar School. 7 Elementary and 10 Junior Certificates.

Gowrie Park State School. 10 Elementary, 2 Junior and 4 Intermediate Certificates.

Camberwell Grammar School. 9 Elementary Certificates.

This impressive list will be supplemented by those awarded to successful students who were sitting for their exams when these notes were being compiled.

On Friday evening 18th November, what has become an annual function of presentation of Certificates was made at the Gowrie Park State School. The Headmaster officiated at the function which was attended by the boys and their parents, Mr Oxman of the P.M.G. Radio Branch, Don Reid, VK3EI representing the Y.R.Cs., and several other Club Leaders. The District Inspector made the presentation of certificates.

New South Wales

Activity in the postal groups has been of a high order, there being a further ten members joining the groups during November last. Because of his call-up for Citizen Military Forces camps, Roger Davis, VK1RD, has had to curtail his Y.R.S. work. However, Susan Brown, VK2BSB, the first school girl to obtain her amateur licence, and currently doing a University Arts course, will be combining both her own and Roger's Postal Groups. This is an excellent example of the "Amateur Spirit" by two former members of Youth Radio Clubs.

Australian Capital Territory

For the past five months the Canberra Youth Radio Club has been guided by Roger Davis, VK1RD, there being eighteen active members. Of this number, eleven recently gained Y.R.S. Certificates.

Now that Roger has C.M.F. commitments, the Club will continue under the joint leadership of Len Whyte and David Brown.

Western Australia

The latest group to join the Y.R.S. in Western Australia is the Bunbury High School Radio Club. Ten members under the guidance of Tom Tuffin are busy with several projects.

The Principal of the School has agreed to present radio "pockets" to any of the students passing the Y.R.S. examinations.

*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.

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 applicants 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 Clubs.

(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.

JAMBOREE-ON-THE-AIR

The interest in the annual Scout Jamboree-on-the-Air has spread to other community organisations. The Headquarters of the Penrith City Civil Defence Organisation was placed at the disposal of the Neapean District Amateur Radio Club by Penrith City Council.

This gesture enabled some 170 boys and girls to participate in the weekend activities. The group included Scouts from the 1st East St. Mary's, 1st Cambridge Park, 1st and 2nd Penrith, and Guides from 1st Bennett Rd.

Senior Scouts from the 1st East St. Mary's and Scouts from Penrith were quartered in the Civil Defence Headquarters overnight.

Amateurs who assisted during the weekend were Dennis Wheaton, VK2AWW, Roy Lopez, VK2ZCL, Noel Walker, VK2ZNS and Roland Gravas, VK2AQX. Rescue personnel from the Civil Defence Organisation assisted in erecting the VHF and HF aeriels.

The equipment used and operated under the Call Signs VK2AWW and VK2ZCL included a Swan 240, Heathkit HW22, SCR522, and home built six metre gear. The bands used were 80, 40, 20 and 2 metres.

Contacts were plentiful and included one with DP1BSP, the official headquarters station of the Boy Scouts of the Philippines, during which senior scouts spoke to guides from Group 78 in the Philippines. Another interesting contact was with 9M2AU, the radio club station of the Butterworth R.A.A.F. Base in Malaysia.

Other overseas stations worked were KR6LL, CE6CA, FK8BK and 9V1ND which proved very interesting contacts for the scouts.

LAFAYETTE New Equipment



HA-520 \$119.50

2-BAND FM RECEIVER 30-50 Mc and 152-174 Mc

A de luxe FM Communications Receiver for Office or Home.

- 10 Tubes plus Silicon Diode.
- Nuistor RF Amplifier (152-174 Mc).
- 3 IF Stages and Fully Tuned RF Stage.
- Excellent Sensitivity of 3 uV for 20 db quieting.
- Variable Squelch for Dependable All-Day Monitoring.
- Built-in 4in Speaker.
- Power Requirements 220/240 V AC.



LRE-80 \$199.50

Lafayette's latest Hi-Fi Stereo Amplifier with performance and facilities to satisfy the most discriminating music lover.

80-WATT SOLID STATE STEREO AMPLIFIER

A superb amplifier combining excellent musical reproduction with handsome low-silhouette styling.

- Advanced 29 Semiconductor Circuit.
- Tape Monitoring Facilities.
- Response plus or minus 1 db 20-24,000 cps.
- Output 80 watts IHFM to drive any Speaker System to Full Capacity.

Controls: Bass, Treble, Dual Volume, 5-position Mode, 5-position Input, 4-position Output, Low Filter, High Filter, Loudness, Tape Monitor, Special.



Criterion 50 \$45.50

"CRITERION 50" TRUE 2-WAY BOOKSHELF SPEAKER SYSTEM

A system that offers impressive sound yet measures only 19w x 8 1/2d x 10 3/4in h. An acoustically tuned enclosure, fully lined, assures smooth resonant free sound with extended bass response.

- 8in Woofer plus 4in Tweeter.
- Response 35 to 18,000 cps.
- Handles 20 Watts but efficient at Low Power.
- Handsome hand-rubbed oiled walnut veneer, tastefully framed in ebony and gold moulding.



LA-340A \$146.50

A medium priced amplifier of high performance. Sounds really good when used with two "Criterion 50" speakers.

40-WATT SOLID STATE STEREO AMPLIFIER

Enjoy the thrilling sound of transistor amplification with the Lafayette LA-340A.

- 5 Input Pairs accommodate all Program Sources including Magnetic and Ceramic (Crystal) Cartridges.
- Response plus or minus 1 db 30-20,000 cps.
- Output 40 watts IHFM.

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TAPE RECORDERS — AMPLIFIERS — TURN-
TABLES — SPEAKERS — CONNECTED AND
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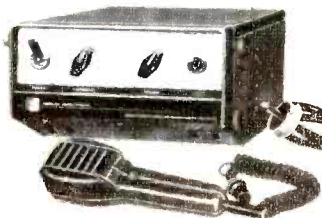
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100yds to 100 miles.

V.H.F. BASE STATIONS.
50 WATTS MOBILES
FROM 15 watts. FULLY
LICENSED. \$370 each.



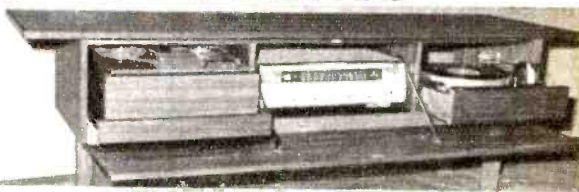
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FOR SOUND SATISFACTION

W.I.A. Activities

All members of the W.I.A. have been urged by their divisional councils to give some consideration to agenda items for the Federal Convention scheduled to be held at Easter in Hobart.

The work of preparing and circulating the agenda draws very heavily on the spare time of the officers responsible. If there is some subject that it is considered should be discussed for the benefit of the Institute and the advancement of the amateur service, then send in your ideas to the secretary of your division.

The Federal Secretary of the W.I.A. has tendered his resignation to Federal Executive becoming effective as from December 31.

Peter Williams, VK3IZ, has capably filled the position of secretary for the past two years and retires with an expression of sincere thanks from all members of the Institute for a job well done.

NEW SOUTH WALES

The library recently installed at the Wireless Institute Centre, 14 Atcheson Street, Crow's Nest is now fully operational, and in addition to being available to members attending general meetings, members may obtain the loan of magazines by writing to the librarian. This is a service to country members and members unable to attend meetings.

With the exception of postage, there is no charge made for this service.

Rules:

1. Maximum loan period is four weeks. If a magazine is still needed, contact the librarian and if no other member wishes to borrow the same magazine, then the loan period can be extended.

2. When requesting magazines by mail, they will be sent by certified mail to members and must be returned by certified mail. The member must pay for all mailing charges. When applying for magazines, include postage stamps for mailing by certified mail, of approximately \$0.15 for each. Refunds of postage stamps will be made if magazine is not in stock.

3. If magazines are returned by ordinary mail, then no magazines will in future be made available to that member. Magazines must be returned to: Librarian, W.I.A., P.O. Box 154, Crow's Nest, N.S.W.

4. In the case of loss of a magazine by a member, he (or she) will be expected to replace the lost magazine as quickly as possible. Please notify the librarian in case of loss.

5. Handbooks and reference books are not available for borrowing. These can be read at Wireless Institute Centre only.

Magazines available for borrowing include: "QST"; "CQ"; "Break-In"; "Amateur Radio"; "Radio ZS"; "Short Wave Magazine"; "ELECTRONICS Australia"; "Radiotronics"; "Mullard Outlook" as well as some trade publications. The librarian, Keith De Haan, VK2UE, will supply all details on the service and availability of issues of magazines, on receipt of a self addressed stamped envelope.

The Council of the N.S.W. Division have announced the appointment of Roger Hanley, VK2ZIG, as QSL Bureau Officer. Roger succeeds Sid Molen, VK2SG, who relinquished the office at the end of November. The appreciation of a job well done over the past seven years has been extended to Sid by council and members.

Ted Whiting, VK2ACD, will continue to handle outward cards and in association with Roger Hanley the bureau will continue to operate under the existing rules. The address of the N.S.W. Division, QSL Bureau is Box 1734, G.P.O., Sydney.

STATE CONVENTION

The New South Wales Division State Convention will be held over the Holiday weekend January 27th, 28th, 29th. It is hoped that there will be a number of country members present.

The monthly general meeting will be held at Wireless Institute Centre, 14 Atcheson Street, Crow's Nest, on Friday evening commencing at 8 p.m.

An interesting lecture has been arranged

and the business for the evening will include the election of the Federal Council for the ensuing year.

On Saturday evening 28th January, the Convention Dinner will be held at Wireless Institute Centre. Members, their wives, friends and associates are invited to attend. The cost will be \$2.25 per person. Following the dinner an organised program of entertainment will be provided. Reservations should be made in advance and be sent to Bill Lewis, VK2YB, Phone 31-4967.

On Sunday January 29th the Convention Field Day will be held at the VK2WI transmitting station, Quarry Road, Dural. Activities will commence at 9.30 a.m. Registration fee will be \$1.00.

The first event will be the Bob Winch Memorial Mobile All Band Scramble. The contest commences at 9.30 a.m. and each contestant must be at least 15 miles air line from Dural at this time. The contest finishes at the turn into Quarry Rd., Dural, and logs must be handed in at the convention site by 10.45 a.m.

During the day there will be 7MHz and 144MHz events and entertainment for the ladies.

Refreshments of all varieties will be available. Wives and children will be admitted free.

Country members or interstate visitors requiring accommodation for the weekend should contact Tom O'Donnell, VK2OD, either on the air or telephone 48-2776.

There will also be displays of professional, commercial and amateur built equipment.

NORTH WEST ZONE CONVENTION

The second Annual Convention held in the North West Zone of the New South Wales Division will be held at Tamworth over the Australia Day holiday weekend.

Activities are scheduled to commence on Saturday, January 28, with registrations and a tour of points of interest in the town. This will be followed by a buffet dinner in the evening, after which there will be a construction competition and a 144MHz transmitter hunt.

On Sunday 29 there will be the usual events, including an all band scramble, a 7MHz hidden transmitter hunt, 144MHz hidden transmitter hunts for both mobile and pedestrians, and ladies and gents quizzes.

Light refreshments, soft drinks, and ice cream will be provided, while pies and sandwiches will be available at the grounds.

Accommodation can be booked and inquiries for this and other information should be directed to the Zone Officer, Max Francis, VK2BMK, 93 Kingdon Street, Scone, N.S.W. or Noel Taylor, VK2ASQ, 40 Diane Street, South Tamworth.

The organisers suggest that the first holiday weekend trip in 1967 should be to take the family to the North West Zone Convention at Tamworth.

CENTRAL COAST BRANCH

Members attending the November meeting of the Central Coast Branch on Friday

18 in the School of Arts, Gosford had the good fortune to hear a most interesting and informative lecture.

The lecturer was John Featherstone, K7JUP, from Tucson, Arizona who, in the capacity as consultant, is associated with electronic research at the Sydney University. The subject of the lecture was "New thoughts in Communications."

In his talk he referred to the galloping progress of radio in its various forms and expressed the opinion that only the fringe of possibilities had been touched upon. He praised the work of the radio amateur in experimental fields and also the capacity of the Australian technicians.

The next meeting will be held on January 20. Visitors are welcome to attend.

The date set down for the very popular Central Coast Field Day is Sunday, February 26. A full program of events is being planned and details will be included in these notes next month.

The committee and members of the branch extend a very hearty invitation to amateurs and their families to attend this event.

BLUE MOUNTAINS FIELD DAY

The Annual Field Day of the Blue Mountains Branch of the New South Wales Division was held at the Lawson Swimming Pool grounds on Sunday, November 20.

The weather was good and fifty amateurs and associates registered, this number being supplemented by the families and friends of those present.

The winners of the various events were:—

144MHz Hidden Transmitter Hunt for Pedestrians:

Harold Burtoft, VK2AAH, 1st.

G. L. Wilson, VK2ZGW, 2nd.

144MHz Hidden Transmitter Hunt for Mobiles:

Harold Burtoft, VK2AAH, 1st.

No other competitor located the transmitter and second place was awarded to Bob Lear, VK2ASZ who so successfully hid the transmitter.

144MHz Scramble:

S. K. McCarthy, VK2ZMQ, 1st.

Dave Andrews, VK2AWZ, 2nd.

7MHz Scramble:

Pierce Healy, VK2APQ, 1st.

Dennis Wheaton, VK2AWW, 2nd.

Treasure Hunt:

Treasures were very difficult to locate and Dave Andrews, VK2AWZ, was the only successful competitor.

Various lucky number prizes were also won by the ladies and amateurs present. The day concluded with a general gathering for the presentation of prizes by the New South Wales Division president Tom O'Donnell, VK2OD. The Branch president Dr Derick Boyd, VK2NR, thanked those present for making the day a success and the secretary, Bill Moore VK2HZ, on behalf of Branch members thanked the following commercial organisations for their support:—

International Resistance Company (Australia) Pty. Ltd., \$10 open order. Ducon Condenser Pty. Ltd., a wide selection of

ROSS HULL MEMORIAL CONTEST

A revised scoring table for the 1966-67 contest came to hand after the copy for the December issue of these notes had been finalised. The scoring table for the contest as set down by the Federal Contest Committee of the W.I.A. is:

Distance between stations (miles)	25 MHz	144 MHz	432 MHz	576 MHz	Higher bands
Up to 25	1	1	2	10	20
26 to 50	1	1	10	25	50
51 to 100	2	5	25	75	100
101 to 200	5	10	50	100	200
201 to 300	15	15	75	200	
301 to 500	10	20	100		
501 to 1000	5	25	200		
1001 to 1500	10	50			
1501 to 2500	20	100			
2501 to 3500	35	200			
3501 to 5000	50				
5001 to 8000	100				
8001 and over	200				

It should also be noted that the points claimed in the example logs should be corrected to this new scoring table.

It is understood that the revision is an attempt to incorporate a more equitable basis of scoring, by taking into account propagation characteristics on the 52MHz band, amateur population in various areas and possible interstate and DX contacts on the 144MHz and 432MHz bands.



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MODEL EC10 550 kc/s to 30 Mc/s TRANSISTORISED

The Eddystone Model "EC10" is a fully transistorised communications receiver of reasonably small size and giving an excellent performance over the range 550 kc/s to 30 Mc/s, covered in five bands and without any break. The receiver accepts CW and AM signals and, although not designed specifically for reception of SSB, it operates well in this mode also. Power is derived from dry cells housed in a box within the cabinet and easily changed when required. A speaker is fitted and the receiver is self contained other than for an aerial, the input connections allowing the use of different types, including a short rod or whip.

Frequency Coverage

Range 1-18.0 Mc/s to 30.0 Mc/s—Range 2-8.5 Mc/s to 18.0 Mc/s—Range 3-3.5 Mc/s to 8.5 Mc/s — Range 4-1.5 Mc/s to 3.5 Mc/s — Range 5-550 kc/s to 1500 kc/s

A brochure is available upon request. Now available ex stock.

Price: \$191.98 plus sales tax \$48.00



VIC.: 8 Bromham Place, Richmond—42-1614.

N.S.W.: 64 Alfred St., Milson's Point—929-8066.

QLD.: L. E. Boughen & Co., 95 Central Ave., Sherwood—79-2207.

W.A.: H. J. McQuillan Pty. Ltd., 1017 Wellington St., Perth—21-8911.

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Kit of Parts \$47.00
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Kit of Parts \$73.00
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Kit of parts \$69.80
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No. 110 TAPE AMPLIFIER
Kit of parts only \$63.00
Tape Amp Unit \$53.00
Adaptor Power Unit \$31.50

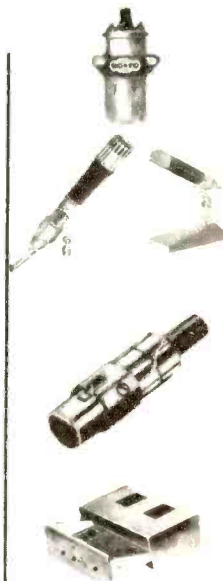
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their components. Amalgamated Wireless Valve Co. Pty. Ltd., technical literature. Also the N.S.W. Division, for providing a soldering iron as a prize.

WAGGA DISTRICT RADIO CLUB

There will be ten members commencing the A.O.C.P. classes which start in mid January at the club's headquarters in the Civil Defence Hall, Wagga. The course will be based on the N.S.W. Divisions Correspondence Course and as those attending have already had some instruction, the aim will be to complete the series of lectures in time for the P.M.G. August examination.

Morse code training will also be included and as the practical work part of the club activities it is proposed to build the club station VK2WG.

It is the aim of the club to assist in the communications section of the Wagga Civil Defence organisation. Then at a later date, when members have obtained their licence, help in the formation of Youth Radio Clubs at the local schools.

Further details can be obtained by contacting the President, Sid Ward, VK2SW, White Avenue Koorlingal, or the Secretary, Jim Edge, VK2AJO, Wallace Street Coolmon.

Stan Mitchell, VK2AID, 41 Fernleigh Road Wagga will be the morse code instructor.

VICTORIA

The Council of the Victorian Division have announced the details of their Amateur Operators Certificate of Proficiency classes for 1967.

Commencing on Tuesday, February 20, the classes are designed to prepare students for the P.M.G., A.O.C.P. exam in February 1968.

Applications for enrolment should be sent to the Secretary, W.I.A., Victorian Division, P.O. Box 36, East Melbourne, C2.

A deposit of \$5, not refundable, must accompany applications for enrolment. The full fee is \$25 and must be finalised at the commencement of the classes.

QUEENSLAND

Nominations are being called for election to the Council of the Queensland Division for 1967-1968. Nomination forms duly completed and signed must reach the Hon. Secretary, W.I.A., Queensland Division, Box 638J, G.P.O. Brisbane on or before NOON, Thursday, February 2, 1967.

If more than twelve nominations (the number of members for Council) are received, an election will be held at the Annual General Meeting on Friday, March 3, 1967.

A sub-committee consisting of five members has been elected to investigate the practicability of the proposal to establish

a permanent headquarters for the Queensland Division of the W.I.A. The scheme envisages that the headquarters building would also serve as a memorial to those amateurs who lost their lives during World War II.

Members of the sub-committee are:-

A. R. Bradley, VK4BA.

A. H. Davies, VK4SJ.

A. M. Simpson, VK4ZAE.

A. Williams, VK4AI.

L. Blagbrough, VK4ZGL. (Chairman)

Morse practice sessions are conducted three nights each week under the auspices of the Queensland Division. The times scheduled for these transmissions are:-

Time: 2030 hours to 2100 hours each Monday.

Frequency: 7020KHz (40 metre band).
Operator: G. W. Fox, VK4FK (Rockhampton).

Time: 1900 hours to 2015 hours each Tuesday and Friday.

Frequency: 3580KHz (80 metre band).

Operator: Tuesday — J. Thompson,

VK4XP. Friday — C. F. Wade, VK4QW.

Those persons making use of these transmissions are asked to report on reception, conditions, etc., either direct to the operators or via the Institute at Box 638J, G.P.O., Brisbane.

WESTERN AUSTRALIA

The November bulletin of the Western Australian Division gives the total membership of the division as 289. Although one of the numerically smaller divisions of the W.I.A. the members have shown a particular interest in the future of amateur radio in relation to representation at I.T.U. Conventions.

A levy of \$0.50 has been added to annual subscriptions of both grades of membership. For those wishing to join the division, subscription rates are:

Full members, \$4.50, including I.T.U. levy; Country and Associate members, \$4.00, including I.T.U. levy. Full details and application forms can be obtained by writing to the Secretary, Box N. 1002, G.P.O., Perth.

JOHN MOYLE MEMORIAL FIELD DAY

The John Moyle Memorial National Field Day will be held over the weekend February 11-12, 1967.

The Federal Contest Committee of the Wireless Institute of Australia invites all Australian Amateurs and Short Wave Listeners to participate in this annual contest which is held to perpetuate the memory of John Moyle, whose efforts advanced the Amateur Radio Service.

There will be two divisions of this Contest one of 24 hours duration and the other of six hours duration. The six-hour period is for the benefit of the operator who is unable to participate for the full 24-hour period.

Operators using 25 watts or less input to the final stage of the transmitter in each section of the Contest will be considered for a certificate where the activity warrants its issue.

It will be seen that the Federal Contest Committee has, in accordance with comments and suggestions received, made changes to the rules. In the hope that the alterations will increase activity and operators will again make an effort to participate in this Contest.

DATE: From 0800 hours Greenwich Mean Time, February 11, to 0800 hours GMT February 12, 1967.

OBJECTS:

The operators of portable and mobile stations within all VK call areas will endeavour to contact other portable, mobile and fixed stations in Australia and in overseas call areas.

RULES:

1. There are two divisions, one of six (6) hour and one of twenty-four (24) hour duration. In each division there are six sections:-

- (a) Portable/Mobile Transmitting, phone.
- (b) Portable/Mobile Transmitting, C.W.
- (c) Portable/Mobile Transmitting, Open.
- (d) Portable/Mobile Transmitting Multiple Operation, open only.
- (e) Fixed Transmitting Stations working Portable/Mobile Stations, open only.
- (f) Reception of Portable/Mobile Stations.

2. All Australian amateurs are encouraged to take part, portable/mobile operators and operators of fixed stations working mobile or portable stations will be eligible for certificates. Operators will be limited to their licensed power. This power shall be derived from a self-contained and fully portable source.

(a) Portable/mobile stations shall not be situated in any occupied dwelling or building. Portable/mobile may be moved from place to place during the contest.

No apparatus shall be set up on the site earlier than 24 hours prior to the commencement of the contest.

All amateur bands may be used. Cross mode operation is permitted, and will count for scoring purposes.

Entrants in Section (d) for Multiple Operator Stations can set up separate transmitters to work on different bands at the same time. All such units of a Multiple Operator Station must be located within an area that can be encompassed by a circle not greater than half-mile diameter.

For each transmitter of a Multiple Operator Station a separate log shall be kept with serial numbers starting at 001 and increasing by one for each successive contact.

All Logs of a Multiple Operator Station shall be submitted by the operator under whose call sign the transmitters are working. No two transmitters of a Multiple Operator Station are permitted to operate on the same band at any time.

3. Amateurs may enter for any section in the portable/mobile sections.

4. One contact per station for phone to phone, C.W. to C.W. also cross mode per band is permitted.

5. Entrants must operate within the terms of their licences and in particular observe the regulations with regard to portable operation.

6. Serial numbers consisting of RS or RST

report plus three figures commencing with 001 and increasing by one for each successive contact shall be exchanged.

7. SCORING:

(a) Portable/Mobile Stations:

For contacts with Portable/Mobile Stations outside the entrant's Call Area, 15 points.

For contacts with Portable/Mobile Stations within the entrant's Call Area, 10 points.

For contacts with Fixed Stations outside the entrant's Call Area, 5 points.

For contacts with Fixed Stations within the entrant's Call Area, 2 points.

(b) Fixed Stations:

For contacts with Portable/Mobile Stations outside entrant's Call Area, 15 points.

For contacts with Portable/Mobile Stations within entrant's Call Area, 10 points.

8. The following shall constitute Call Areas: VK1, VK2, VK3, VK4, VK5, VK6, VK7, VK8, VK9, and VK0.

9. All logs shall be set out under the following headings: Date/Time (GMT) Band; Emission Call Sign; RST number sent; RST number received; Points Claimed. Contacts must be listed in numerical order.

In addition, there shall be a front sheet showing the following information:-

Name
Address
Call Sign (6 hour or 24 hour)
Division
Section
Call Sign of other operator(s) (if any)

Location of Portable/Mobile Station hours.

A brief description of equipment used, bands used, and points claimed, followed by the declaration:-

"I hereby certify that I have operated in accordance with the rules and spirit of the contest."

Signed
Date

10. The right is reserved to disqualify any entrant who, during the contest, has not observed the regulations and rules of this contest, or has consistently departed from the accepted code of operating ethics.

11. The decision of the Federal Contest Manager of the Wireless Institute of Australia is final and no disputes will be entered into.

12. Certificates will be awarded to the highest scorer of each section of each division. Additional certificates may be awarded at the discretion of the F.C.C. Fixed Stations working Mobile/Portable will be eligible for Certificates.

13. Comments concerning the Contest, with particular reference to: Duration of contest, points scoring system, rules of the contest, would be appreciated by the Federal Contest Manager.

RETURN OF LOGS.

All entries must be postmarked not later than February 28, 1967, and be clearly marked "John Moyle Memorial National Field Day Contest, 1967," and addressed to:

Federal Contest Manager,

Wireless Institute of Australia,

B1002, G.P.O., Perth.

RECEIVING SECTION

15. This section is open to all short wave listeners in VK Call Areas. The rules shall be the same as for the transmitting stations. Logs shall take the same form as for transmitting stations, but may omit the serial numbers received.

Logs must show the Call Sign of the station heard, the serial number sent by it and the Call Sign of the station being worked.

Scoring will be on the same basis as for transmitting stations. It will not be sufficient to log a station calling CQ. A station may be logged once only for phone and once for C.W. in each band.

Awards:- Certificates will be awarded for the highest scorer in each Call Area.

ALWAYS RELY ON R.D.S.

SPECIAL FOR JANUARY

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1. Transistorized Variable DC Power Supply SE100 0.20v variable £8/15/ plus 12½% tax equals £9/16/10 \$19.68.

2. Transistorized Signal Injector SE250. Frequency 400-700 C/S and Harmonics £2/5/ plus 12½% tax equals £2/10/8 \$5.07.

3. 3 stage "Gem" intercom. unit, £6/11/8 or \$13.17.

4. Audio Generator TE22 Frequency Range Sine Wave 20-200,000 CPS in 4 bands £17/8/6 plus 12½% tax equals £19/12/1 \$39.21.

5. Stereo amplifier 5 watts per channel £18/15/ or \$37.50 complete.

6. Slimline Teak Cabinets. Take 8MX or 8WR plus Tweeter Speakers. £8/11/ plus 25% tax equals £10/13/9 \$21.38.

Suppliers of all Radio and TV Components
Meter and Multimeters £5/12/6 Net \$11.25
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SPECIAL PURCHASE



Car FANS from West Germany, with plastic blades and suction cup fitting.

6 Volt \$3.00

12 Volt \$3.95

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Key Ring

Actual Size

"KEY LITE" \$3.95

Free. One spare mercury cell.

With fob keyring, attractive gold finish case. Simply squeeze. Illuminates car and house locks, etc.

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MULTIMETER TESTERS

Model RH-50

Modern Design, 33 Micro Amp Meter.

30,000 Ohms per Volt D.C.

13,000 Ohms per Volt A.C.

1 p.c. Multipliers and Shunts used. Printed circuit.

Clear Scale, rugged moulded case.

SPECIFICATIONS

DC Voltages: 0-0.3-1.2-3-12-30-120-300-600-1,200 V at 30,000 Ohms per volt.

AC Voltages: 0-3-12-30-120-300-600-1,200 V at 13,000 Ohms per volt.

DC Current: 0-0.06-6-60-600 mA, 0-12 A.

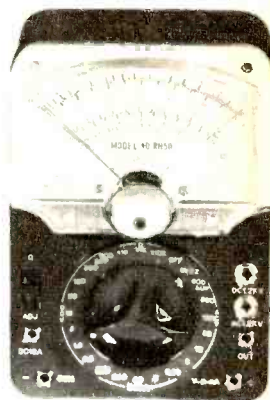
Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).

Decibels: minus 20 to plus 57 dB (0 dB equals 1 mW, 600 ohms).

Audio Out: Capacitor in series with AC volt ranges.

Short Test: Internal buzzer.

Accessory: 1 pr. heavy test leads.



Price \$31 (£15/10/-)

Postage 50c to \$1 extra.

Batteries: 1 (1.5V), 1 (15V).

Size: 3 5-16" x 6 5-16" x 2 1/2"

Weight: 1.4lb approx.

LIMITED STOCK ONLY

Model RH-10

RANGES:

DC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.

AC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.

DC Current: 0-500uA 0-500 mA.

Resistance: 0-10K-1Meg: 60 ohms, 6K ohms at centre scale.

Capacitance: 250uuF to 1uF, in two ranges.

Decibels: -20 to plus 36db, two ranges.

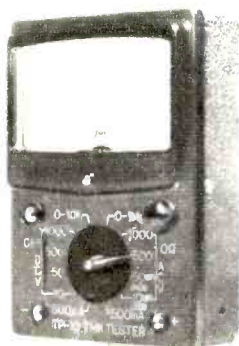
Output: 0-1,000 V in four ranges.

Size: 5in x 3 1/2in x 1 1/2in.

Weight: 13oz approx.

Price \$10.75 (£5/7/6)

Postage 50c to \$1 extra.



Model RH-31

Model RH-31

- 20,000 Ohms per Volt on DC.
- 10,000 Ohms per Volt on AC.
- 3 1/2" Meter.
- 18 position selector.

SPECIFICATIONS

DC Voltages: 0-5-25-100-500-1000-5000 (20,000 Ohms/V).

AC Voltages: 0-5-25-100-500-1000 V (10,000 Ohms/Volt).

DC Current: 0-50 uA, 0-5-50-500mA.

Resistance: 0-6K-600K, 0-6Meg-60Meg.

(30) Ohms, 3K, 30K, 440K at centre scale.

Capacitance: 100uuF-0.01uF, 0.002uF-0.3uF.

Inductance: 20 H to 2000 H.

Decibels: minus 20db to plus 30db in 2 ranges.

Output Jack: for Audio measurements.

Dimensions: (3 3/4" x 5 3/4" x 2 3-8").

Weight: (23oz approx.)

Complete with internal battery and testing leads with prods.

\$24.50

Postage 50c to \$1 extra.



TRANSISTOR HEARING AID

First Phone Model 3 Transistors
This Hearing Aid is an ultra-modern unit. It incorporates the following outstanding features:

Ample power and clear tone.
Compact, smaller than a packet of cigarettes.

Precision printed circuit design.

Magnetic earphone.

Separate Tone and Volume Controls.

Standard size torch cell.

Packed in a presentation case.

New Model \$31.50

Replacement Battery only 12c.

Postage 50c extra.

Model RH-5

- High sensitivity-20,000 Ohms/V DC, 10,000 Ohms/V AC.
- 3in Meter.
- Handy pocketable size.

SPECIFICATIONS

DC Voltages: 0-10-50-250-500-1000 V (20,000 Ohms/V).

AC Voltages: 0-10-50-250-500-1000 V (10,000 Ohms/V).

DC Current: 0-50uA, 0-5-50-500mA.

Resistance: 0-10K, 0-100K, 0-1Meg, 0-10 Meg.

(62 Ohms, 620 Ohms, 6.2K, 62K at centre scale).

Capacitance: 0.0001uF, 0.005uF, 0.05uF-1uF.

Decibels: minus 20db to plus 36db in 2 ranges.

Dimensions: (3 1/2in x 5 1/4in x 1 3/4in).

Weight: 15oz approx.

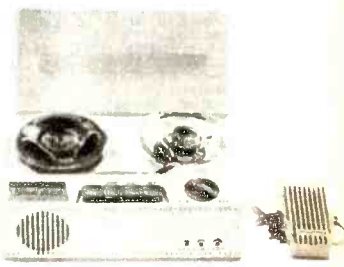


Price \$18 (£9/-/-)

Postage 50c to \$1 extra.

Complete with internal battery, testing leads with prods.

PORTABLE TRANSISTOR TAPE RECORDER



"SUNACE" PD 401

\$21.00 (£10/10/-)

Postage 75c (7/6)

Complete with Mike, Battery and Tape.

WANTED

SALESMAN FOR OUR RADIO ELECTRICAL COUNTER

Enquiries phone 61-3832 or write to 306 PITT STREET, SYDNEY

AN EYE ON THE WEATHER

Amateur interest in the weather satellites now in orbit appears to be growing. In a bulletin of the West Australian VHF Group, it was mentioned that two members, D. E. Graham, VK6HK and W. Jacobs, VK6WJ, would be attempting to receive pictures from the weather satellite Nimbus II.

For some time now, cloud cover pictures have been received at the Melbourne University by members of the University Amateur Radio Club.

Around the world there are 150 official stations receiving pictures from Nimbus II. Details of a station at the Vienna Polytechnicum in Austria, were given in "Electronics," June 13, 1966.

The station was constructed by a graduate student, Helmut Kindl, who had the support of the Institute of High-Frequency Technology.

The station receives weather pictures which are then beamed by television to some 10 million central Europeans, including four million people in Hungary, Czechoslovakia and Yugoslavia.

The \$US300 station consists of antenna, preamplifier, tape recorder, signal conversion unit, modified television receiver and camera.

The 139.95MHz transmitted signals from the five-watt Nimbus II transmitter are picked up and converted into a TV image that is photographed and then retransmitted by the government-run television network.

The Nimbus II signal is frequency modulated over a bandwidth from 0-1600Hz with a 2.4KHz subcarrier.

The receiving antenna is a helical-coil type with six windings. It has a wire mesh reflector that measures 4.92ft square. Gain is 7dB. The signal from the antenna is fed over a 60ohm cable to a transistorised 136-138MHz preamplifier followed by a normal FM/IF stage with optimum bandwidth of 30KHz.

Both the 2.4KHz carrier frequency and a 200Hz reference frequency are recorded on tape. The reference frequency is used to compensate for variations in the tape speed.

The signal conversion unit was built at the Vienna Institute. The two recorded frequencies (2.4KHz and 200Hz) are separated in a frequency divider since the 2.4KHz sub-carrier is amplitude modulated. After amplification, the signal is fed into a rectifier to separate the sidebands. The demodulated signal is fed to a video amplifier and then displayed on a 14-inch screen.

The horizontal deflection for the video circuits is derived from the 200Hz reference frequency, which is clipped and converted to a signal of four pulses per second. The vertical deflection comes from a monostable multivibrator that has a period of 208 seconds. Because of the low frequencies involved all the power amplifiers are DC.

DM DX AWARD

The DM DX Club has issued the DM-DX-Certificate for working members of the DM-DX-Club after May 1st 1965.

To obtain the certificate—
Overseas stations need 3 QSOs with different members.

European Stations need 5 QSOs with different members.

DL and DJ Stations need 10 QSOs with different members. The award is issued for CW, CW/Phone or SSB contacts.

To obtain the certificate send GCR-list plus six IRCs to:—

Radio Club of the GDR,

Awards Manager,

P.O. Box 30, GDR 1055 Berlin,

German Democratic Republic.

Short wave listeners may also obtain the award by reporting on stations heard.

SBE MODEL 34 SSB TRANSCEIVER

Last month mention was made of the evaluation of a SBE model 34 Single Side Band transceiver, and a few technical details were given. Since then, the unit has been used under various conditions of fixed station operation using basic dipole antennas and from both AC mains and 12 volt DC power sources.

1966 REMEMBRANCE DAY CONTEST RESULTS

The results of the 1966 Remembrance Day Contest just released by the Federal Contest Committee of the Wireless Institute of Australia shows the VK6 Division, Western Australia, the winner, followed by VK5 Division, South Australia, in second position.

The scores of all States with the exception of New South Wales were higher than those for 1965. The number of logs submitted was also greater in 1966, New South Wales being the only State to submit a lower number.

The placings of all States were:—

Western Australia	1st	Victoria	4th
South Australia	2nd	Tasmania	5th
Queensland	3rd	New South Wales	6th

The final score for each State is obtained from a formula which takes into account the number of logs submitted, number of licences and the total points scored.

In 1967 a new method, approved by the Federal Convention of the W.I.A. held in 1966, for determination of the State score, in addition to the inclusion of Limited Licensees, will be adopted.

DETAILS OF STATE SCORES

STATE	LOG ENTRY	LIC'S	%	Total State Score	Average Top Six Logs	STATE Points
New South Wales	100	1296	7.7	19,286	778	2264
Victoria	74	1101	6.7	21,619	897	3239
Queensland	90	444	20.3	18,510	996	4754
South Australia	97	474	20.5	20,539	832	5043
Western Australia	74	266	27.8	15,405	944	5228
Tasmania	39	128	30.5	8,093	840	3108

In addition to the trophy awarded to the winning State, certificates are awarded to the highest scorers of the various sections in each State.

The Award Winners were:—

Receiving Section:

VK1	J. Hurren	375 pts
VK2	A. Nutley	1083 pts
VK3	P. Forbes	784 pts
VK4	D. Clark	1042 pts
VK5	J. Ross	252 pts
VK6	F. Price	675 pts
VK7	G. Johnston	1305 pts
Club Entry: Victorian Amateur Listeners Club:		954 Points

Phone Section:

VK1QL	610 pts	VK6RY	999 pts
VK2XA	675 pts	VK7TX	873 pts
VK3MO	1273 pts	VK8DI	173 pts
VK4BQ	1013 pts	VK9DJ	1539 pts
VK5EF	916 pts		

C. W. Section:

VK2QL	493 pts	VK6WT	392 pts
VK3AXK	481 pts	VK7G	252 pts
VK4XW	305 pts	VK8HA	273 pts
VK5FO	365 pts	VK9CJ	165 pts

Open Section:

VK1DA	433 pts	VK5BI	588 pts
VK2AHM	1304 pts	VK6RU	1365 pts
VK3AKS	693 pts	VK7SM	1290 pts
VK4RH	1369 pts	VK9AG	828 pts

VHF/UHF Sect.:

VK2ZCF	84 pts	VK5ZDX	53 pts
VK3ZCK	60 pts	VK6ZER	6 pts
VK4ZEP	8 pts	VK7ZJG	26 pts

TOP SIX LOGS

New South Wales:

VK2AHM	1304 pts	VK2BGF	266 pts
VK2BO	888 pts	VK2ATT	572 pts
VK2XA	675 pts	VK2AKF	524 pts

Victoria:

VK3MO	1273 pts	VK3EG	789 pts
VK3ARD	935 pts	VK3WK	733 pts
VK3DF	930 pts	VK3LW	721 pts

Queensland:

VK4RH	1369 pts	VK4WW	886 pts
VK4LT	1066 pts	VK4AL	875 pts
VK4BQ	1013 pts	VK4AK	768 pts

South Australia:

VK5EF	916 pts	VK5KM	814 pts
VK5IZ	861 pts	VK5EK	779 pts
VK5NY	845 pts	VK5GZ	773 pts

Western Aust.:

VK6RU	1365 pts	VK6PH	954 pts
VK6RY	999 pts	VK6CW	687 pts
VK6XX	987 pts	VK6LR	673 pts

Tasmania:

VK7SM	1290 pts	VK7AI	620 pts
VK7DK	1286 pts	VK7ZZ	515 pts
VK7TX	873 pts	VK7XL	454 pts

A.C.T.:

VK1QL	610 pts	VK1JG	312 pts
VK1DA	433 pts	VK1VK	210 pts
VK1VP	389 pts	VK1JL	206 pts

The unit created quite a deal of interest at the South West Zone Convention at Wagga, where it was used for some time as the convention base station, VK2WG.

During the Jamboree-on-the-Air it was in operation for about 14 hours during the weekend when all Australian call areas were worked on the 80, 40, 20 and 15 metre bands.

By simply changing one crystal, it now operates on the 80-metre Australian band without interfering with the operation on the other bands.

Reports have all been very good in regard to the quality of the transmission and although no special effort has been made some good contacts have been logged. These included OA3ON in Peru on 7MHz, OH7PI in Finland on 14MHz.

(Continued on page 126)

WE SPECIALISE IN TAPE RECORDERS SALES AND SERVICE

P. CARTER RADIO & TV SERVICE

79 NEW ILLAWARRA ROAD,
BEXLEY NORTH, N.S.W.
50-3150



NEW TRANSISTOR SIX PORTABLE KIT AT LESS THAN HALF PRICE

(DESIGNED TO SELL AT OVER £30/-/-)

Excellent fidelity is obtained in this new kit set by the use of large speaker and polished timber case with attractive gold metal front panel. By using heavy duty batteries it is economical to operate and is ideal for portable use or that second set. Complete kit of parts is supplied with full instructions. CAN BE SUPPLIED WIRED AND TESTED AT £2/10/- EXTRA. Post and packing N.S.W., \$1.25 — Interstate, \$1.75.

\$23.75 (£11/17/6)

RESISTORS, CONDENSERS AND POTENTIOMETERS

We have purchased the resistor and condenser stock of manufacturers including S.T.C. and Stromberg-Carlson who have ceased the manufacture of television and radio receivers and can offer the same at less than 25 per cent of list price. The resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg. in 1/2, 1 and 2 watt ratings and include some wire wound resistors.

List price, \$9.00 per 100. Our price, \$2.00 per 100.

Post and packing 25c extra.

The condensers are in most popular makes and include mica, ceramic, paper, and electrolytic in standard values.

List price, \$11 per 100. Our price, \$2.06 per 100.

Post and packing, 35c extra.

The potentiometers are all current types and include switch pots, dual concentric and T.A.B. pots.

List price, \$12 per dozen. Our price, \$2.50 per dozen.

Post and packing, 25c extra.

FREE For a limited period with each lot of resistors, condensers or potentiometers purchased we will supply free: One New Type Valve Type 6U7G, 6X5GT or 1T4.

SPECIAL — OFFER

Complete KIT for TRANSISTOR 6 PORTABLE \$17.50

The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. Set is housed in attractive plastic case as illustrated.

Dials available for all States. Post and Pack: extra. N.S.W., \$1.00, Inter., \$1.30.



NEW ENGLISH MAZDA TRANSISTORS

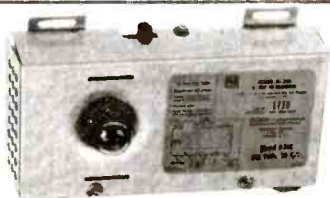
TYPE	EQUIVALENT			
XA101	OC45	R.F. Transistor	55c	Ducon type SFT 123 equiv, OC74 75c ea.
XA102	OC44	Osc. Transistor	75c ea.	Available in matched pairs at \$1.50 pair
XB103	OC75	AUDIO general purpose	75c	AUDIO OUTPUT
				Post and packing on transistors 15c any quantity.

A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturers stock E.H.T. units \$5.00. Deflection yokes \$5.00. Post free

NEW VALVES AT BARGAIN PRICES

807	\$1.75	3Q4	75c	6H6G	35c	6SJ7	95c	12AT7	\$1.00
1A7GT	95c	3S4	\$1.00	6K7G	45c	6SN7GT	95c	1L6G	95c
1C7G	30c	5V4G	\$1.00	6K8G	68c	655 equiv. 6SK7	85c	12A6	60c
1D8GT	95c	6B8	\$1.00	6Q7G equiv. 6B6G	\$1.00	6U7G	45c	12SK7	50c
1K5G	40c	6C6G	50c	6SA7GT	95c	6X5GT	75c	12SK8	50c
1K7G	49c	6F6	\$1.00	6SH7	55c	7C7	35c	12SH7	50c
1M5G	40c							866	1.50
1P5G	25c							954	25c
1Q5G	25c							955	25c
1T4	45c							EK32	68c

Please add postage on all valves.



NEW AMERICAN TV POWER BOOSTER UNIT AT LESS THAN HALF PRICE

(EX LIQUIDATION STOCK H. G. PALMER)

These TV POW-R boosters can be used in two ways. Firstly as a "straight-thru" circuit giving extra boost to the TV signal for improved performance on one receiver.

Secondly to boost signal strength to two or three TV receivers coupled to the one aerial.

\$9.75 (£4/17/6) POST FREE

Full instructions supplied with each unit. 240 volt A.C. operation.

A PREAMP FOR MAGNETIC PICK-UP OR TAPE HEADS

SUITABLE FOR USE WITH THE COLLARO OR B.S.R. TAPE DECKS

Using 3 silicon transistors as featured in October. Electronics Australia complete with kit of parts including transistors mono \$7.50, stereo \$13.00, 240 power supply for above \$7.00.



NEW 17 & 25 WATT P.A. AMPLIFIERS

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.

All amplifiers are fitted with Ferguson output transformers with voice coil tapings of 2 to 15 ohms. The 25 watt amplifier can be supplied with line output transformer tapped from 100 to 600 ohms if required at 20/extra.

Inputs provided for microphone, pick-up, and radio with mixing facilities and tone control.

The 15 watt is as above but using two 6BQ5 valves in push-pull output.

12in speaker for above (10 watt) \$6.75 .. 67/6

Crystal Microphones for amplifier \$4.75 .. 47/6

25 WATT .. \$53.75, £26/17/6
17 WATT .. \$43.75, £21/17/6
Post Extra on 15 Watt
N.S.W., 10/-; Interstate, 15/-
25 Watt by Rail or Air.
Too Heavy for Post.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.



LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

New B.B.C. Relay on Aldabra Island

The tiny island of Aldabra in the Indian Ocean, 300 miles north of Madagascar, is being considered as a possible site for a new B.B.C. relay base to put a stronger and more consistent signal into East Africa.

The tiny atoll, east of Tanzania and north of Madagascar, is a British possession and comes under the Seychelles administration. It is roughly 21 miles long and 8 miles wide and is strategically placed to beam relays of programs from London to all parts of Africa. The necessity to build a new base has arisen following the granting of independence to Bechuanaland, the present site of the B.B.C.'s Central Africa relay at Francistown, near the Rhodesian border.

The B.B.C. also lost its other relay base in British Somaliland some months ago. This station closed when the former colony became the new Somali Republic. This area of the Near East is now being covered by a relay base on Perim Island, in the Gulf of Aden.

On the other side of Africa, in the South Atlantic, the B.B.C. relay station at Ascension Island is now firmly established. The second of the projected four 250KW transmitters is now on the air on a test basis with programs beamed to Africa and Latin America.

11 METRE BAND SIGNALS

The increase in sunspots has been so rapid that the predicted maximum is expected to be April 1968. This has resulted in the greater use of the 11 metre band, and Britain, Norway and the United States now have transmissions in this band.

The B.B.C. in London has a program of the World Service on 25650KHz from 0900, while the frequency of 25670KHz is used for the service to Africa. This program includes English at 1000GMT. Another channel, 25750KHz, which has been on the air on a test basis for several months, is now used in the service to the Far East and has been noted at 1100GMT.

Radio Norway in Oslo uses an 11M band channel, 25900KHz, for its service to the Pacific, Africa and Asia from 1100GMT, and is also using 9610, 11855, 21655 and 21730KHz. The best reception is on 21730KHz which opens well at 1100GMT when it has the usual English announcement. The new channel of 21655KHz replaces 21670, which has been withdrawn due to interference from VOA in Monrovia on the same frequency, but the 21655KHz channel is only poorly received.

The Voice of America is also using 11M, with the Greenville station in North Carolina broadcasting on 26040KHz with the power of 50KW. The station has normal VOA programming to Africa and Europe from 1300 to 1545GMT.

BONAIRE ON 11785KHz

A frequency change which has resulted in much stronger signals has been noted from Radio Bonaire of Trans World Radio in the Netherlands Antilles. The station is now heard opening in Russian at 2000GMT on 11785KHz, and at 2030 carries a pro-

gram in German to 2100GMT. At this time they commence the English program. This includes listeners' requests on Thursday, and on Friday the DX Special, the T.W.R. DX session, which is carried in the 2100-2130 program. The DX Special is also heard on Sunday at 0335GMT on 11815KHz in the service which is directed to North America.

Trans World Radio is offering to its listeners who report reception a booklet on the short-wave listening hobby which discusses reception, the ionosphere and other broadcasting factors which affect short-wave transmission and reception.

VATICAN CHANGES IN FREQUENCIES

In common with all broadcasters, the Vatican Radio in its services to Australia and New Zealand has made some frequency changes. The session at 2200GMT continues on the two frequencies of 11740 and 9560KHz. The session at 1130GMT has been on 9695 and 11785KHz for some weeks, but tests carried out recently were on 21525 and 17820KHz. Higher frequencies will probably be used during our summer.

The station requested our observations on the matter of suitable frequencies, and we have recommended 21485KHz and 17820KHz for the 1130GMT service. Both these frequencies are clear, and the use of 21525KHz does not result in good reception due to severe sideband interference from the B.B.C. with V.O.A. relays on 21530KHz.

These transmissions from the Vatican Radio are in English and are on the air daily.

The other transmissions in English from the Vatican Radio are as follows:

Central Africa	
1020 weekdays	17840, 21485KHz
1740 daily	11705, 15135
East Africa	
1000 weekdays	17840, 21485
1700 daily	11705, 15135
North America	
0050 daily	7250, 9645, 11770
Asia	
1440 weekdays	11825, 15135
Philippines	
1155 Tue. Thurs. Sat.	11705, 15210
2230 Mon. Wed. Fri.	9450, 11740
Australasia	
1130 daily	9695, 11785
2200 daily	9560, 11740

DEUTSCHE WELLE CHANGES

Recent changes in the transmission schedule and frequencies in use by "The Voice of Germany" at Cologne are now in service till early March and are summarized as follows:

To North America in English and French, 0130-0250GMT, 9735 replaces 9640KHz. English from 2050-2100 is now carried on 6145, 9735, 11925KHz.

Frequency in use to South America is

15410KHz, which replaces 15405; Portuguese is carried 2140-2240, and Spanish 2240-2350.

For the English broadcasts to South Asia 1550-1620 the frequencies are 9535 and 11765KHz. The additional English transmission to South Asia from 0300-0340 is now on 7165KHz, replacing 11945KHz.

The German program for Europe has been retimed and can be heard from 1600-1855 and is on 6075KHz.

In the service to Southern Europe, times and frequencies have been altered, Spanish is now 1940-2030 on 6120, 9605; Portuguese 2040-2130 on 6120; Italian 1020-1050 on 9675; Greek 1000-1030 on 9640; Turkish 1725-1755 on 9640, 11925KHz.

AFRICAN SIGNALS

Angola station CR6RZ located at Luanda is being heard on 9535KHz by Barry Williams of Auckland, N.Z., at 1700GMT. The station is at fair level but with good readability, at 1715, when a news bulletin in English is broadcast. The station gives full identification at 1720 and 1725, but is blocked by the Berne transmissions of the Swiss Broadcasting Corporation which opens on the frequency at 1730GMT.

Addis Ababa station Voice of Ethiopia has verified with a card and it gives the following schedule: To West Africa, 13500KHz 1810-1850; to Europe 11925KHz 1510-1550; to Middle East 11875KHz 2010-2050; to East and Central Africa, on 7290KHz 0430-0500, on 6185 and 9610KHz, 0400-0530. The station uses the same frequencies 1600-2000 and 1000-1300. The address is P.O. Box 1364, Addis Ababa, Ethiopia.

NEW CHANNELS FROM BERNE

As a result of the use of higher frequencies by some stations, many new channels have been received during the summer reception period. The Swiss Broadcasting Corporation at Berne has included several higher frequencies in its transmissions to its overseas audiences.

The frequency of 5965KHz is used to North America and gives very good reception in English 0500-0615 daily. The sign off is at 0645GMT and the last 30 minute period is devoted to broadcasts in Italian, French and Swiss-German. Another new frequency is 6045KHz and this one is on the air in English from 1845 to 2100GMT. The frequency of 9695KHz operates 2300-2400. The frequency 11810KHz is used, 1800 to 2300 in a program for Swiss nationals overseas, then for reception in Europe. The channel of 11880KHz is used 1730-1815 for programs in Arabic and French, beamed to the Middle East. The frequency of 11965KHz is operating 2300-2400 in Portuguese.

Transmissions from Berne carried on the new 15130KHz outlet 1500 to 1700 are in English and the "Swiss Abroad" program. The transmission on 17845KHz is on the air 1300 to 1445 in English, with the last

WIRELESS INSTITUTE OF AUSTRALIA VICTORIAN DIVISION A. O. C. P. CLASS

A new Theory class, to be held on Tuesdays from 8-10 p.m., will commence on the 21st February, 1967.

Persons desirous of being enrolled should communicate with:—

Secretary, W.I.A., Victorian Division, P.O. Box 36, East Melbourne.

Phone 41-3535

TUDOR RADIO

L. E. CHAPMAN

ESTABLISHED 1940

103 ENMORE ROAD, ENMORE, N.S.W.
PHONE 51-1011



Steel speaker baffle unit 6 x 9, 7 x 5 speaker, 10/.
Pack and post 1/6.

Transistor speaker and drive transformers, large and midget type... 10 0

Speaker transformers 15,000 and 25,000 to 3 ohms 6 watts 15/ each

5,000 to 3 and 15 ohms 12/6 each

Transistor speaker chokes .. 15/ each

Here's value in pots.

Pots, single log and linear:

3K, 7½K, 10K, W.W., 20K, 25K, 50K, 100K, 200K, 250K, 500K, 1 Meg, 2 Meg. 5/ each

1.5 Meg. Dual Concentric .. 10/ Pack and post 50c.

Pots dual ganged 10K. 5/. 1 Meg. 12/6

Pots concentric. 100K + 50K, 100K + 24K, 100K + 10K, 250K + 250K, 500K + 500K, 1 Meg + 1 Meg., 1 Meg. + 500K. Various others 5/ each

TV power Transformers 300 mill 225v a side, suit amplifiers up to 50 watts voltage doublers available.. £4 each

TV safety glass per sheet £1 15 0

Garrard plug in stereo heads £2 0 0

TV masks, 17, 21, 23in 15/ each

Tuning condensers 2 and 3 gang 10 0



STEREO AMPLIFIER KIT SETS

TU 10, 3.5. watt per channel, £12.

TU 11, 3.5 watt per channel has facilities for tape and microphone channels, £14.

TU 12, 5 watt per channel, £13/10/-.

TU 13 5 watt per channel with TU 11 facilities, £16.

Each kit set includes valves, speakers and all components.

Single stage amplifier kit set:

5 watt per channel, £11.

2 stage of I.F.T. tuner, £7/10/.

Large dial BC SW, £11.

Ideal to use with the above amplifiers.

Transistor ear plugs, 3 for 10/.

Tag strips, mixed types. Dozen, 6/.

Switches, oak 4 position, 4/ each. 2 position, 2/6 each.

Knobs long shaft, push on. Dozen 12/. Knobs for concentric shaft. Dozen 12/. 250 mixed screws. BA, Whit., self-tapper bolts, nuts, etc. 10/ bag plus 2/6 post. Crystal microphones, good quality, ideal tape recorders, etc. £1/8/.

Transistor speaker transformers, single ended, 5 watt, 15/.

Dutch Philips 3 pin flexible jacks 4/ ea.

STEREO RADIOGRAM CHASSIS. New well-known make. Complete with every component, no dial or valves £7.

ZEPHYR —CRYSTAL MICROPHONE



£2/5/, pack and post 2/.

MSP line output transformer 90 deg., £2/10/-.

SPEAKERS

MSP 20928 mod 12 PQ £6 15 0

MSP 6 x 9 15 ohm £2 15 0

MSP 8in twin cone 15 ohm £2 15 0

MSP 12in twin cone 15 ohm £3 15 0

MSP 7 x 5, 3 and 15 ohm .. £1 15 0

MSP 3½ inch £1 0 0

Rola 5 x 4, 3 and 15 ohm .. £1 5 0

Rola 4 x 3, 10, 15, 27 ohms £1 0 0

Rola 5 B 3 ohms £1 0 0

Rola 8 x 4 15 ohm £1 15 0

6 x 9 single cone 15 ohm .. £1 15 0

8 inch single cone 15 ohm £2 2 0

3½ inch 47 ohm £1 0 0

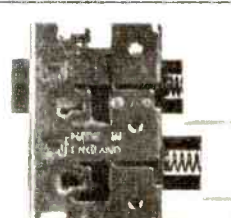
6 x 4 33 ohm £1 5 0

2 x 4, 15 ohm £1 0 0

5 x 3, 47 ohm £1 0 0

5 x 3, 27 ohm £1 0 0

10 x 3, 15 ohm £1 10 0



English push-button on/off switches, 7/6 each. Pack and post 1/.

Mini cable, 4 strand shielded, lots of uses, including microphone cable, extension speakers, etc. 1/ yard

Radio knobs, push on 5/ doz.

Miniature valve sockets 7 and 9 pin 1/ each

Octal valve sockets 1/ each

Picture tubes, all sizes, new in cartons. £12/10/. With your dud. Bonded extra.

Philips IFT'S 455KC .. 7/6 each

Aerial and oscillator coils .. 5/ each

Scope soldering iron, standard; mini scope. Scope De Luxe. Vibra scope; National scope transformer.

TV AERIALS

Famous Make

All types £1/15/ to £10 plus post.

TV aerial lead in 9d yard

TV aerial chimney mount kits £1 15 0

Wall stand-off brackets, pair 19 0

PUBLIC ADDRESS SPEAKER HOUSING



For 4, 5, or 6in speakers. £2, post 5/.

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12AU7 .. 12/6

12AX7 .. 12/6

6SA7 .. 12/6

6V4 9/

6BU8 .. 12/6

6M5 .. 12/6

6AN7 .. 12/6

6N8 .. 12/6

6BM8 .. 15/

1S5 10/

1T4 5/

6CJ6 15/

12BH7 .. 12/6

6L18 10/

ECL85 .. 12/6

SP61 10/

UU9 10/

6BL8 .. 15/

30 minutes being for Swiss Abroad. The 21460KHz channel is used for a service to Africa, and this is on the air from 0900 to 1300GMT with an English period 0900-1015, and the remainder of the transmissions in other languages. The frequency of 21560KHz is also listed for operation, but it is not scheduled at present.

VQ03 NOW ON 7115KHz

The Solomon Islands Broadcasting service has moved its VQ03 outlet from 3205KHz to the new channel of 7115KHz in common with the trend to move to higher frequencies with the increased sunspot activity. The new channel is well received from 0725GMT, and has news and market reports in English after opening. The other outlet VQ04 remains on 3995KHz and is now not received so early in the transmission. The new 7115KHz station, being in the 41M amateur band, suffers some interference from amateur station, but its signal level in the early part of its transmission is much stronger than VQ04 on 3995KHz. These two stations are located at Honiara, and are scheduled 0725-1130 daily, except that on Saturday, sign on is 0800-1130, and Sunday sign on is 0800-1120.

FLASHES FROM EVERYWHERE

DAKAR in Senegal which has long operated an International Service, but has seldom been reported from the Pacific area, has made a frequency change allowing for better reception. The station is now operating on 11895KHz and opens in French at 1800GMT. At 1830 a program in English is presented for 30 minutes. Dakar's home program is best received at 0600GMT when opening on 5965KHz at good level.

TANZANIA is now testing a new 250KW transmitter from Dar-es-Salaam, and the station is reported from Europe as being received on both 21600KHz and 15435-KHz from 0800-1030GMT. 1000-1300 has also been reported as another time on which tests have been noted on 15435KHz. The station has a relay of home service news in Swahili at 1000 and 1300GMT, and at 1500GMT, when tests have continued, news in English is broadcast. The station requests reports to Radio Tanzania, P.O. Box 9191 Dar-es-Salaam, Tanzania.

AFGHANISTAN is now reported to be operating from Kabul on the channels on 7200 and 9735KHz, with a German program at 1830GMT. The station has a program in English at 1900GMT.

ASCENSION ISLAND relay station of the B.B.C. is now testing the second of its four 250 KW transmitters. It has been observed at 2000GMT on 17790KHz, reports "Sweden Calling DXers". Another frequency, 15105KHz, is reported to be in use 1745-1945GMT with a relay of the World Service, and this seems to replace 15350KHz. A service 2300-0016 on 15375-KHz in Portuguese is beamed to Brazil.

CEYLON with broadcasts from the studios in Colombo is expected to make some changes in its Overseas Service beamed to Europe and the Middle East, which starts at 0700GMT on 1533KHz. The transmission at 0915GMT to South Asia is on 17820KHz. The station is interested to know if the times of broadcastings are of value to listeners, and listeners should send their comments to: Listener Research Officer, Overseas service, Radio Ceylon, P.O. Box 574, Colombo 7, Ceylon.

SOUTH AFRICA is now reported in the 13M band when the signals of Radio South Africa have been observed using 21495KHz. The station opens at 0950 with its identification signal, the call of

(Continued overleaf)

BROADCAST STATION SCHEDULE CHANGES

The new schedule for the English programs from Radio Sweden, in Stockholm, shows 13 transmissions are now carried each day.

GMT	KHz.	Primary Area.
0900-0930	6065, 21690	Europe and Middle East.
1100-1130	6065, 9705	Europe-Far East.
1230-1300	9705, 21690	Africa-Far East.
1400-1430	11810, 17840	East Asia and North America.
1600-1630	11705, 17840	West Coast North America.
1900-1930	11705, 11810	Africa-Middle East.
2015-2045	6065, 11705	Europe and North America.
2245-2315	7270, 11705	Far East-South America.
2330-2400	1178	Europe.
0030-0100	5990	East North America.
0200-0230	5990	East North America.
0330-0400	5990	West North America.
0515-0545	11705	South Asia.

Radio Sweden's mailing address is P.O. Box 955, Stockholm, Sweden.

SCHEDULE FROM PRAGUE

The present English transmissions from Prague over Radio Prague, Czechoslovakia, show some frequency alterations for our summer reception period. Present schedule is:

	1200-1230	9560, 11960, 15285 KHz.
Europe	1900-1930	5930, 7345.
Africa	1530-1630	6055, 7345, 9550, 11990, 15285.
	1730-1830	5930, 7285, 7345, 9795, 11990.
North America	1400-1500	15285, 15448, 17825 (Sun. only)
	0100-0200	5930, 7115, 7345, 9550, 11990.
	0330-0430	6095, 7115, 7345, 9550, 11990.
Far East-Australasia	0700-0800	6055, 9550, 15310, 15285, 21450.

RADIO NEW ZEALAND

Transmissions from Radio New Zealand is Wellington have, as is the custom, with the higher sunspot count, moved to higher frequencies, and the following schedule is now effective.

To Pacific	1700-1945	ZL8 9620, ZL22 11820.
	2000-0545	ZL4 15280.
	0600-0845	ZL2 9540, ZL22 11820.
Australia	2000-2230	ZL22 11820
	2245-0545	ZL21 15110
	0900-1145	ZL18 9520, ZL22 11820.

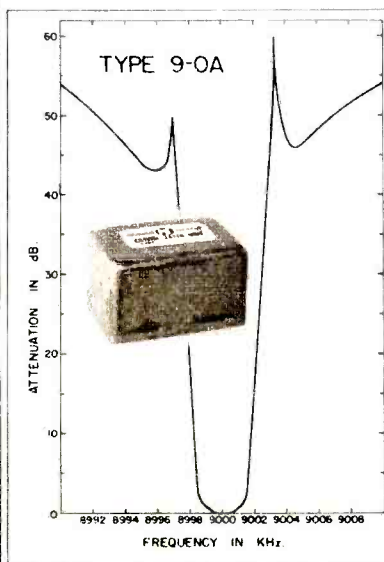
On Sundays the service to Antarctica 0815-0845GMT is on ZL18 9520KHz.

RADIO PYONGYANG ENGLISH SERVICES

The English transmission from Radio Pyongyang, Pyongyang is now on the air as follows:

Near East	1900-2000	6540, 7580KHz.
East Africa	0400-0500	6540, 15520
South Asia	0800-0900	6540, 15520
	1100-1200	6480, 7580
South Asia	1400-1500	6480, 7580.

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40 dB Bandwidth: 6 kHz. max.
Pass Band Ripple: 2dB max.
Insertion Loss 4.5 dB max.
Input Termination: 150 ohm plus 150 pF.
Output Termination: 150 ohm plus 120 pF.
Physical Dimensions: 2" x 1.375" x 1.125".
Recommended Oscillator Crystals: 8998.0 9002.0 kHz.

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Quantity discounts will be negotiated.

For further information contact:—

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Perth: 151-155 Brisbane St. Perth 28-4338
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a native bird, and folk song music is presented till 0955 when the station gives its program preview. The station opens its service at 1000GMT, and has some interference from Lisbon, Portugal, which is also using the same frequency at this time. Radio South Africa is reported to be carrying the same program on 17805-KHz at the same time. 15220 and 11900-KHz also relay the program, the target area being Africa. On Sunday the station opens at 0800 with a church service in Afrikaans on these same four frequencies.

MAURITIUS Broadcasting Corporation continues to be heard on 4850KHz and we have been hearing the station at Forest Side with B.B.C. news at 1800-GMT at good level. The station generally has a program of uninterrupted music to 1830 when station identification is given in French and then the station's sign off is with "God Save the Queen".

BROADCAST BAND NEWS

NEW ZEALAND.—Considerable extension of transmission has been made by the N.Z.B.C. on the YD Network, the country's light and popular music service, and plans are now being announced for the stations to accept private programming under contract.

The stations 1YD Auckland (1250), 2YD Wellington (1130) and 3YD Christchurch (1400) are now on the air from 1800 to 1200 daily except Sunday when the operation time is 2100 to 1000GMT. In addition, the new stations 1ZO (1420) and 1ZU (1520) now open at 1700 instead of 1800GMT with an early morning program called "Country Roundabout," directed at the dairyfarmers.

Dunedin is the only major city with no YD station, but the privately owned 4XD, operated by the Otago Radio Association, has been in service since 1922 and provides limited programming. 4XD is on 1430KHz and operated Wednesday, Thursday 0600-1030, Saturday 0800-1000 and 2130-2400GMT, this being Sunday morning in New Zealand. The station is a private broadcaster, is non-commercial and broadcasts mainly gospel programs. It is the only private radio station left in New Zealand from those which operated in the late 1930s, the others having been bought out by the Government and absorbed into what is now the New Zealand Broadcasting Corporation. Some areas which were served by private radio stations at Cromwell, Balclutha, Hastings, Manurewa and other towns in the early 1930 period, are now covered by the nearest N.Z.B.C. network stations.

AUSTRALIA.—Recent power increases which have been approved by the Broadcasting Control Board are: 2LM (900) 2KW Day and Night; 2NM (1460) 2KW Day 1KW Night; 5MU (1460) 2KW Day 1KW Night; 7AD (900) 2KW Day 1KW Night; 7BU (560) 2KW Day 1KW night; 5PA (1160) to increase power to 10KW from a new site further north still to be selected.

Radio 3UL at Warragul, Victoria, operating on 530KHz has recently extended its schedule and is now on the air 1900-1400 GMT from Monday to Friday; on Saturday they operate 1700 (Friday) to 1500; and on Sunday from 2100 Saturday to 1300 GMT. Converted to Australian time this is Monday to Friday 5 a.m. to midnight, Saturday 5 a.m. to 1 a.m. Sunday, and Sunday 7 a.m. to 11 p.m.

The station is printing new verification cards which show the antenna towers of 3UL, and these will be sent to listeners who report the reception of 3 UL on 530KHz. The station manager, Colin McL. Cameron, gives this news in a recent letter, following the reception of an all-night promotional program we heard on 3UL. ■

TECHNICAL BOOKS AND PUBLICATIONS

Feedback System Analysis

FEEDBACK CONTROL SYSTEM ANALYSIS AND SYNTHESIS, by John J. D'Azzo and Constantine H. Houpis. 2nd Edition, 1966. Published by the McGraw-Hill Book Co., Inc., New York. Hard covers, 6in x 9in, 824pp., many circuits and diagrams. Price in Australia \$15.20.

It would be hard to conceive of a more comprehensive or more thoroughgoing text on feedback control system engineering than this volume by D'Azzo and Houpis, now in its second edition. It is surely destined to become a classic, or at least as close to a classic as a book can become in this fast-moving field.

The authors are associate Professors of Electrical Engineering at the U.S. Air Force Institute of Technology, and their book is intended both for the undergraduate student and for the graduate control engineer. For the former it would certainly make an excellent text, while for the latter it will make a most worthy reference. University and college lecturers should find it very suitable for use as a text.

The heading list for the 21 chapters should give a good idea both of the scope and the treatment: 1. Introduction; 2. Methods of Writing Differential Equations; 3. Solution of Differential Equations; 4. Laplace Transforms; 5. Block Diagrams, Transfer Functions and Flow Graphs; 6. Basic Servo Characteristics; 7. Root Locus; 8. Specialised Pole-Zero Topics;

9. Frequency Response; 10. Nyquist's Stability Criterion; 11. F.C.S. Performance Based on the Frequency Response; 12. Cascade Compensation: Root Locus; 13. Cascade Compensation: Frequency-Response Plots; 14. Feedback Compensation; 15. Complex Control Systems; 16. AC Feedback Control Systems; 17. Optimum Response; 18. Nonlinearities and Describing Functions; 19. Analog Computers; 20. Experimental and Design Procedures; 21. State of the Art.

Throughout the text seems lucid, concise and well illustrated with diagrams, graphs, data tables and examples. It combines a high degree of mathematical rigour with a commendable level of explanation and qualitative discussion, and takes considerable care in defining terms and concepts where they are first introduced. Each chapter ends with a bibliography for those interested in further reading, while the book ends with no less than 10 appendices, some 215 problems, answers to selected problems and a comprehensive index.

To reiterate, a book which may be warmly recommended to the undergraduate student, control engineer and academic as a most comprehensive treatise on feedback control system engineering.

Our copy came direct from the publishers, but we understand that the book should already be in stock at major technical book sellers. (J.R.)

Comprehensive Relay Handbook

ENGINEERS' RELAY HANDBOOK, produced by a Board of Editors under H. D. Steinback, and sponsored by the National Association of Relay Manufacturers. Published by Hayden Book Co. Inc., New York, 1966. Hard covers, 7-3/8in x 10in, 300pp., many illustrations, charts and graphs. No Australian price is quoted, but the American price is \$11.95. Our review copy was supplied by the publishers.

Although many articles on different aspects of relays have appeared in various technical publications, this is probably the first really comprehensive presentation of relay technology. This book is intended primarily for engineers and others who may be concerned with specifying relays to be used in equipments. Previous works in this field have been aimed mainly at the designer and manufacturer of relays.

The first chapter deals with relay terminology and includes an introduction to relay designations, symbols and diagrams for general switching purposes. The chapter also includes a section of relay terms and definitions, which includes a 22-page glossary and 12 pages of standard circuit symbols. The glossary, in particular, is very comprehensive and includes non preferred terms which are used extensively as well the preferred terms.

The second chapter is a short one, listing classes of relay service for commercial, industrial and military applications. The description of each area of application is brief and is intended for a user who may have had little experience with relays.

The third chapter is concerned with relay classification, and includes a detailed listing

of about 60 different types of relays. There is also a cross reference from non-preferred terms to the preferred ones to allow any relay to be found. The types of relays include delay slug relays, mercury plunger relays, radiation resistant relays, and telephone type relays. The section also includes very comprehensive articles on reed relays, and stepping relays and switches. Finally, the chapter includes sections on contact combinations, enclosures, mountings and terminals.

The following chapter covers the principles of relay operation as they concern a user or a circuit designer faced with the selection and specification of a relay. The section includes DC and AC relay actuator systems, polarised relays, and finally contact performance and protection, including the switching of AC inductive loads.

The fifth chapter deals with relay application considerations, explaining how the suitability of a design can be evaluated. The topics discussed in the chapter are DC and AC armature type relays, power relays or contactors, mercury-wetted and dry reed contact relays, rotary stepping switches and thermal relays. The chapter concludes with 16 pages of simple circuits that are basic to the art of relay circuit design. The designs include polar relay circuits, current and voltage sensing circuits, time delay relay circuits and typical power relay circuits.

The sixth chapter concerns itself with reliability at some length, and includes a discussion on the theory of probability and statistics, and the application of statistical principles to reliability.

How to specify a relay is discussed in

the seventh chapter. A number of basic rules are explained; these include environmental requirements, operational specifications, electrical characteristics and contact specifications. This is followed by five specification check lists, each of which is followed by a sample specification.

The eighth chapter covers the testing procedures for relays. Each test listed includes the purpose, definition and requirements of the test, the procedure and how to record the data for the test, and precautions and possible trouble areas to guard against. The tests given include contact bounce and chatter, operating characteristics (DC and AC), vibration and corrosion tests, and contact life. The final chapter will have only limited application to Australian users as it is devoted to American Government specifications for relays.

The book concludes with three appendices and a bibliography. The first appendix covers the wire used for winding the relay magnet. This gives comprehensive tables on wire data and includes a section on the different insulating materials used for the wires. The second appendix is a short one on wire for leads. The final appendix is a large collection of useful reference tables, charts and graphs, including a seven-page list of general conversion factors.

The bibliography is very complete, occupying 24 pages and listing references under 61 different headings.

In conclusion, I can recommend this book to any engineer who is concerned in any way with using or specifying relays. While it gives a thorough description of

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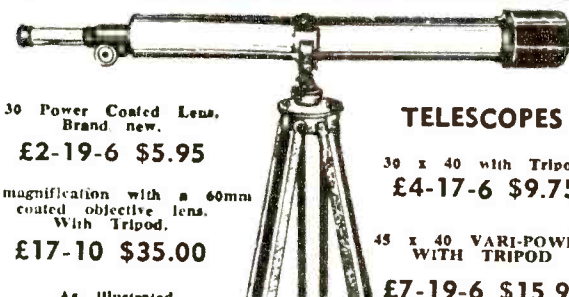
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41	\$1.25	6F13	75c
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77	\$1.00	6X4	\$1.00
VR150-30	\$1.00	6F8	75c
5CPI	\$3.95	6N7	\$1.00
EF50	35c	12SK7	50c
6U7	75c	VR1120	50c
V1103	\$1.00	VR118	75c
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relay technology, the main emphasis of the book is practical and it provides a reference book for all users of relays. The work will also be of value to students because of the coverage of the many aspects of relay types and applications. (J.H.)

Suitable Mainly For Revision

QUESTIONS AND ANSWERS ON RADIO AND TELEVISION, by H. W. Hellyer. Hard covers, 4½in x 6½in, 128 pages, 70 line diagrams.

QUESTIONS AND ANSWERS ON AUDIO, by Clement Brown, Assoc. I.R.E. Hard covers, 4½in x 6½in, 104 pages, 57 line diagrams.

QUESTIONS AND ANSWERS ON TRANSISTORS, by Clement Brown, Assoc. I.R.E. Hard covers, 4½in x 6½in, 96 pages, 60 line diagrams.

QUESTIONS AND ANSWERS ON ELECTRONICS, by Clement Brown, Assoc. I.R.E. Hard covers, 4½in x 6½in, 112 pages, 80 line diagrams. Published by George Newnes Ltd., London, U.K. Price 8/6 each. Our copies direct from the publisher.

These four small handbooks all suffer from the same faults—they try to cover far too much ground in limited space. They are too technical for the layman, but not technical enough for those with electronic training to technician level and beyond.

For example, in the "Radio and Television" volume, the whole subject of oscillators is treated in some 200 words, while the explanation of the Hartley oscillator takes three lines of type. Despite such obvious inadequacies, the jacket note claims that the reader will be taken to the stage where he will have a thorough grasp of the subject.

The "Audio" book could conceivably be intended for the high fidelity enthusiast who wants to know more about the equipment he uses, to judge by some of the questions and explanations.

Typical questions posed are "What is meant by wow and flutter?" and "What types of speaker systems are used?" It is hard to reconcile this type of material with complete circuit diagrams of stereo amplifiers and receivers, which would certainly be incomprehensible to persons asking the questions mentioned above; yet a section entitled "Amplifiers and Receivers" devotes a large part of its space to such circuits. On the other hand, the technically trained are unlikely to be looking for this type of circuit in a small handbook such as this.

A better case could conceivably be made out for the transistor book since, even today, there are many technicians and servicemen who have only a limited knowledge and experience with solid state devices. However, even here, too, much of the material is pitched at too low a technical level. (Example: "What is printed wiring and how is it used?")

The author of the "Electronics" volume obviously had the hardest task, since he had to cover a tremendous amount of ground within just over 100 small format pages. It just can't be done.

Nevertheless, these handy sized books could fulfil at least one useful purpose. The material they contain seems ideal for revision by students approaching exams. In the relevant subjects, since the concise explanations could be easily absorbed. Provided the student has prior knowledge of the subject, the explanations offered should be a useful aid in his revision, and may even help him to understand certain points which had not previously been clear. (H.A.T.)

LITERATURE — in brief

MULLARD-AUSTRALIA PTY. LTD. has published a four-page brochure listing its range of numerical and character indicator tubes. In addition to brief descriptive and technical data, it has base diagrams and photographs illustrating the various types of tubes. This brochure is available free from the Mullard head office at 35-43 Clarence Street, Sydney. Requests should be accompanied by a stamped, self-addressed envelope not smaller than foolscap size, endorsed "Indicator Tubes."

INTERNATIONAL ELECTRONICS CONFERENCE, to be held at Toronto, Canada, in September, 1967, under the sponsorship of the Canadian Region of the I.E.E.E., is calling for papers on electronics and related subjects, of about 20 minutes duration. The title and a 100-word abstract, including the name of the author, his company affiliation and telephone number, should be submitted not later than March 15. A 500-word summary is also required by the same date. These should be sent to Dr Rudi de Buda, Technical Program Chairman, International Electronics Conference, 1819 Yonge Street, Toronto 7, Canada.

EMERSON AND CUMING INC., of Canton, Massachusetts, U.S.A., has published a ready reference guide to its line of casting resins, adhesives, coatings, foams, silicones and controlled dielectrics, in the form of a three-leaf fold-out pamphlet.

Products of each group are listed together with two or three of the important characteristics given for each composition. Illustrations are included showing the form and use of the products listed.

Inquiries should be addressed to the company's Australian agents, Wm. J. McLelland and Co. Pty. Ltd., The Crescent, Kingsgrove, N.S.W.

STANDARDS ASSOCIATION OF AUSTRALIA is seeking comment on the following draft standards:

Pressurised enclosures for electrical equipment, issued as Doc. 1100. This establishes design, construction and marking requirements for the form of enclosure for electrical equipment which permit its use in flammable or explosive atmospheres.

Non-wirewound potentiometers, type II, issued as Doc. 1103. This specifies requirements for the electrical, mechanical, and climatic properties of non-wirewound potentiometers for telecommunications and electronic equipment.

Intensity levels of sound, issued as Doc. 1104. The draft gives methods for expressing power levels and intensity levels of sound or noise, and recommends the universal adoption of particular reference levels.

Fixed capacitors for DC using impregnated paper or paper/plastic film dielectric, issued as Doc. 1105, which relates to fixed capacitors designed essentially for DC with a rated voltage not exceeding 6300V.

Fixed metallised paper dielectric capacitors for DC, issued as Doc. 1106, which

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ADELAIDE: T. & G. Building, King William St. Tele.: W-4148.

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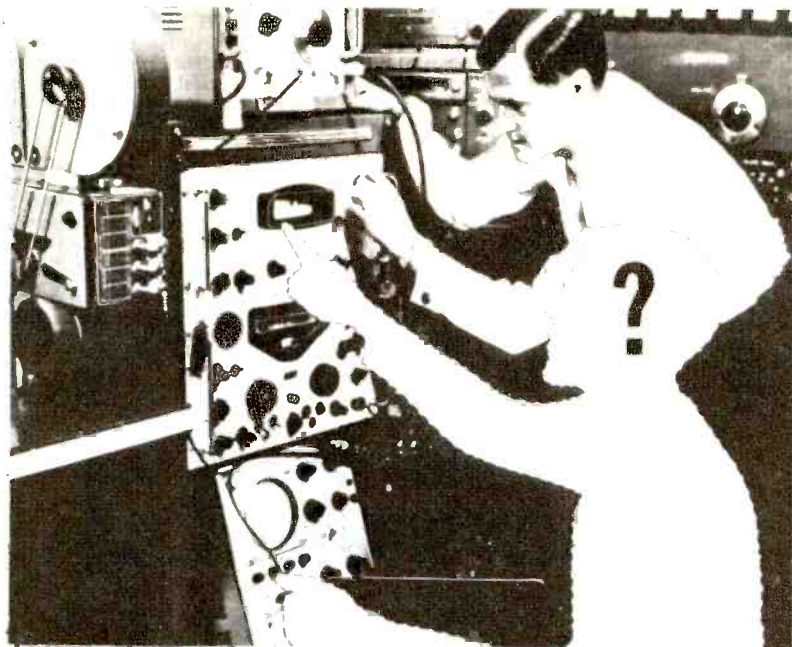
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relates to fixed capacitors with self-healing properties with a rated voltage not exceeding 6300V.

Ceramic dielectric capacitors, type II, issued as Doc. 1107, which relates to capacitors of this type intended for use in equipment for telecommunications and electronic equipment, but excluding capacitors for RF current exceeding 1A or for a reactive power exceeding 10VAR.

Polyester film dielectric capacitors for DC, issued as Doc. 1108, which relates to fixed capacitors designed essentially for DC with a rated voltage not exceeding 6300V, using as a dielectric either polyethylene terephthalate or similar material.

Copies of these documents may be obtained from the association's headquarters at 157 Gloucester Street, Sydney, or from branch offices in capital cities and Newcastle, N.S.W. Comments should reach the association not later than January 31, 1967.

FAIRCHILD AUSTRALIA PTY. LTD., 420 Mt. Dandenong Road, Croydon, Victoria, has produced a revised edition of its semiconductor price list, showing prices of single units and batch lots up to 1000 units. Printed on heavy quality paper in a striking design of black and reversed white type on green background, the list is obtainable on request to the company's office at the address shown above.

FEEDBACK CIRCUIT ANALYSIS, by Hakim, reviewed in our November issue, showed the wrong price, advises the Technical Book and Magazine Company Pty. Ltd., of Melbourne, who supplied the review copy. The correct price is \$14.80, not \$16.80 as shown in the review.

MULLARD AUTOMATION REVIEW, Vol. 1, No. 1, is the first issue of a new Mullard publication which the company says presents a new concept in industrial electronics by dealing with system design in modular form, in a language readily understood by electrical, mechanical and production engineers. The publication will be distributed free of charge to senior personnel in industry, and may be obtained by applying on company letterhead to the Publications Distribution Officer, Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney.

This first issue contains articles entitled: The Applications Engineering Laboratory; Automation . . . The Way to Increased Productivity; Industrial Communications Systems; A Telemetering System for High Power Electricity Distribution. Subjects to be discussed in forthcoming issues are: Remote supervision and control; plant alarm systems; instrumentation; batch sorting and counting; variable speed drives.

MULLARD OUTLOOK, Vol. 9, No. 6, (November-December, 1966) contains the second part of an article "Dynamic Display Means Sales" intended as a summary of display principles for radio and electrical retail establishments. Part 2, entitled "Display in Action," progresses to the more practical aspects of display and gives some suggested schemes.

Also in this issue of "Outlook" is an item by Mullard-Australia chief engineer Harry Watson describing a possible design for a hybrid television receiver. A block schematic diagram of a typical hybrid receiver is included.

Other items are: "Integrated Logic Circuits" describing new Mullard types which will be available soon in quantity at competitive prices; "Magnetic Matrices for Low-cost Data Storage" describing a new series of inexpensive single plane matrices; "Mullard Colour TV Picture Tubes;" "M-O-S Transistors" giving details of new metal oxide semiconductors for impedance conversion and chopping.

"Mullard Outlook" is available from Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney. Subscription rate is \$2 a year.

ANSWERS TO CORRESPONDENTS

When writing to us:—

- Please give your name and full postal address, including the State . . . N.S.W. &c.
- Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.

AMATEUR PROJECTS

D.W.S. (Elizabeth East, S.A.) mentions that he has been reading our magazine for some time and would like to see a variety of subjects covered. These include the construction of a Heterodyne Frequency Meter, Add-on SSB Adapter for receivers, and design details for phased array antennas.

In August, 1949 edition of "Radio Television and Hobbies" an amateur band frequency meter of the heterodyne type was described. This circuit may still be used with the possible substitution of modern valves. We do not have any immediate plans for describing another frequency meter, but would lean toward a type using interpolation methods rather than the straight heterodyne type. We have not described an add-on SSB adapter as many of the product-detector/BFO circuits published in our communication receivers could be used for this purpose. The best place for an intermediate frequency filter is directly after the mixer stage, not in an add-on unit such as suggested in your letter. In regard to antennas, a lot of useful information may be obtained from the normal antenna manuals such as published by the A.R.R.L. The ground-plane antenna is free from ground effects as it virtually has its own ground in the form of the radials. However a vertical Yagi antenna would still suffer from ground effects. The ground-plane antenna gets its main DX advantage from its low angle of radiation and not from any electrical gain built into the antenna.

240V AC INVERTER

L.H. (Carnegie, Vic.) wants to know where he might be able to obtain the circuit for a transistor inverter to produce 240V AC at 1A minimum, operating from a 12V battery.

Sorry, but we cannot help you on this one. L.H. In point of fact, inverters for low voltage DC to high voltage 50Hz AC seem to be rather few and far between. What you are actually asking for is an oscillator or oscillator/amplifier capable of producing a minimum of 80 watts sine wave at 50Hz — which is quite an order on its own, without taking into consideration the normally attendant requirement for good frequency and voltage regulation.

READER BUILT IT

N.K. (Burwood, Vic.) sends in an idea for keeping a soldering iron at less than full temperature for possible use in "Reader Built It."

It's a simple idea and an old idea but may be worth publishing again for those who haven't come across it. Many thanks.

COST OF PROJECTS

H.T. (Launceston, Tas.) wonders whether it would be practical to publish the estimated cost of various projects.

Apparently you missed earlier discussion in these columns about this problem. It is quite

difficult to arrive at any kind of "Universal" price estimate, having regard to retail and discounted figures, various brands and quality of components, interstate differences, etc. If estimates are too high, they are unreal and unattractive; if too low, they cause arguments about brands and margins. We therefore leave it to our advertisers to do their own quoting. A reader recently pointed out that an overseas magazine, which used to give estimates, had to cease doing so because they provoked too many arguments.

CRO FROM TV SET

N.M. (Warradale, S.A.) suggests that there is long overdue in the pages of our magazine an article on the conversion of a TV receiver to a cathode-ray oscilloscope.

This is one to which we can plead "not guilty." A quite long article on the subject appeared in our March, 1963, issue, which is still available from our stock of back numbers. We must say, however, that the scheme is likely to appear better than it actually is, and attractive only in the limited number of cases where a "demonstration" instrument is required or one to fill in some fixed requirement. If the requirement is for a general-purpose oscilloscope, the conventional approach is likely to be much the better one in the long run.

SWITCHED COILS

B.J. (Elizabeth, S.A.) plans to build the ABC-Three receiver featured in February, 1966, and asks whether it would be possible to switch the coils rather than plug them in individually.

In general terms, B.J., there is no reason why coils cannot be switched. To do this for best results, however, it is necessary to arrange the coils so that the highest frequency one has the shortest leads. Make sure also that the coils are separated by at least their diameter. On the drawing forwarded with your letter we note that the aerial connections for the coils have all been joined together. This is incorrect, as the aerial input should be switched to the coil selected, by another section of the switch.

BUDGET-PRICED QUALITY

A. A. (Melbourne, Vic.) says that he has made up some record playing equipment around a player, amplifier and loudspeakers, which he bought second hand. He says that he would have to pay twice as much to match the performance with items bought new.

That could well be so, A. A. Enthusiasts who care to shop around and don't mind the work can do very well by collecting and associating odd bits and pieces, bought at quite keen prices. But, of course, it is necessary to know enough to pick the bargain from the junk and to put it all together into a workable whole. We are glad to note that you have obtained reasonable results from your parallel-connected loudspeakers, although your reservations indicate that you have discovered some of the limitations of the idea. For example, the limited power output probably represents the power limitation imposed by the 5-inch unit.

LOGIC AND COUNTING

G.M. (Blayney, N.S.W.) writes to say that he enjoys reading the articles on Logic and Counting Circuits. He would also like to build up the demonstrator unit as described. With this in mind, he also asks if we intend to publish the complete circuit.

We are pleased to learn that you like reading the series on Logic and Counting Circuits. We are also mindful of the desirability to correlate all the constructional material which has been presented, possibly in an article at the conclusion of the series. This is only a thought on the matter at this stage. However, it is being given careful consideration and we will do whatever is considered best when the time arrives.

DEAD LETTER

A letter addressed to Mr Dennis Bridgeman, 551 Dandenong Road, Malvern, Victoria, has been returned unclaimed, with the advice that Mr Bridgeman is no longer at this address. Would he please advise us of his new address.

"ELECTRONICS Australia" INFORMATION SERVICE

To assist readers, ELECTRONICS Australia, conducts a technical information service. Conditions governing this service are set out below:

- (1) Address letters to Assistant Editor, "ELECTRONICS Australia," Box 2728, G.P.O., Sydney.
- (2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of \$0.20 (2/-). Queries not accompanied by a fee will be answered in rotation on these pages.
- (3) For the \$0.20 fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information 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 circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel. Where articles are not on file we can usually provide a photostat copy at \$0.20 PER PAGE.
- (4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.
- (5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.
- (6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost \$0.50 (5/-) each. Original photographs of most projects are also available, from \$0.50 for a 6in x 8in glossy print, postage \$0.08 (9d).
- (7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.
- (8) Technical queries are not answered by telephone.
- (9) We have no file of circuits for commercial radio or TV sets, etc.
- (10) A fairly good range of back numbers is available. On issues up to 6 months old there is a surcharge of 5c (6d). On issues from 7 to 12 months old the surcharge is 10c (1/-). Over 12 months, it is 20c (2/-).

STEREO EQUIPMENT CABINETS

New 1966 models are now available. Can be supplied in "make it yourself" kits.



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AMATEUR BAND NOTES — cont.

MORSE PRACTICE SESSIONS

To assist those interested in obtaining the full amateur operator's certificate most divisions of the Wireless Institute of Australia provide Morse practice sessions over the air on specified frequencies in the 40 metre and 80 metre amateur bands. In New South Wales this service is provided nightly on a frequency of 3550KHz commencing at 7.30 p.m.

The main object of the session is to provide training in receiving Morse code from 5 words per minute to 16 words per

minute in order that listeners will be able to pass the P.M.G. test at 14 words per minute as required for the Amateur Operators Certificate of Proficiency.

The sessions are constantly under review and in order that a satisfactory service may be provided the comments of listeners would be appreciated.

Address your letters to D. G. Courtney, VK2AUC, 5 Tanang Street, Bomaderry, New South Wales.

Opinions on the type of script to be used, E.G., extracts from text books or



East St. Mary's scouts and guides participate in Jamboree-on-the-Air. (See story page 109.) Left to right: Edward Little (11), Mr Noel Walker, Herman Weiland (12), John Little (13), and Leonie Cairns (11).

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magazines or cipher groups and the speeds used would be most helpful to the operators.

STH. INDIA AMATEUR RADIO CLUB

A copy of "SIRAN" South India Radio Amateurs Newsreel just to hand contained some interesting articles on Single Side Band.

The editorial by G. V. Sulu, VU2GV, comments on the rapid change that has taken place in the use of SSB by amateurs throughout the world except in India and Ceylon, and urges amateurs in those countries to follow suit as quickly as possible.

Also in the magazine was mention of some difficulties that existed in the distribution of QSL cards to VU2 amateurs and suggested that QSL cards be sent to Post Office Box 53, Bangalore, India until the problem is resolved.

In a note from G. V. Sulu VU2GV, editor of the magazine news is given of the formation of an amateur TV group, and A. N. Venkatraman, VU6VU, is the first to receive an amateur TV licence in India. Normally the VU6 prefix is allocated for non-radiating experimental stations but since there is no provision in the Indian licensing regulations to provide for amateur TV special permission has been granted under existing regulations.

However it is anticipated that the Government will amend the Indian Wireless Telegraph Act to cover amateur television.

The chairman of the TV group is A. V. R. Rao, VU2BB, and several others including G. V. Sulu, VU2GV, are awaiting their TV licences. Plans are also in hand to produce a special issue of "SIRAN," in February, devoted to amateur TV which it is hoped will contain an article on the subject from Australia.

VU2GV also mentions their interest in the efforts of the W.I.A. toward the formation of a Region III Conference, and the fact that there are only 470 amateurs in the whole of India. Of this number 10 per cent reside in Bangalore City proper, where the Bangalore Amateur Radio Club is located.

CLASSIFIED ADVERTISING

Advertisements in these columns cost \$0.60 per line. Each line contains the equivalent of five words each of nine letters. Minimum size of advertisements is two lines. Please note **PAYMENT MUST ACCOMPANY ALL ADVERTISEMENTS EXCEPT THOSE PLACED BY ACCREDITED AGENCIES.** Your advertisement for the February issue must reach our office before January 6th. Address your advertisement to the Advertising Manager, **ELECTRONICS Australia**, Box 2728, G.P.O., Sydney.

FOR SALE

TV PICTURE TUBES:

1-year warranty \$10; 2-year warranty \$12. Plus old tube. These are trade prices. All types except bonded and 27in. All duds must be under vacuum and scratch free. When ordering by mail, add freight. Sure Brite Picture Tubes, 22a Victoria Street, Lewisham, Sydney, N.S.W. Phone 56-6363.

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For those who want the ultimate in perfection. Sound operated relays, built-in 2-channel mixer, auto slide projection, 4 heads, 4 tracks, 4-speed A and B monitors, reverb., echo, stereo, mono, free range to 20KC, plus or minus 3dB; dynamic range is 60dB. Wow and flutter less than 15 per cent, channel sep. 50dB. V.U. meters, auto. rewind, clutches for tape protection, sound on sound, gold relay contacts, auto. torque controls, remote control, rewind, play, back recording stop and start, disconnectable auto. recording level control battery and AC operation, etc., etc. German made, light and compact. You will never see more features or quality for your money. Push-button control. A dream to operate and own. Prices from \$145 to \$250/10/1. N.S.W. Distributors: Tomlin's Radio, 528 Liverpool Road, South Strathfield, 642-4215. Country and trade inquiries welcome.

SELL all back issues "ELECTRONICS AUSTRALIA" in stock all times. 1939-56 copies 30c. 57-63, 40c. 1960 to date, 50c. Post incl. T. WEIR, 56 O'Connor Street, Haberfield, Sydney. 71-2539. Wanted to buy copies.

SSB transmitter with HT pwr. supply. 813. VFO, VOX, 80m, 20m, phasing rig and works well. Pwr. supply delivers 2KV at 750ma. Sell \$200. A. Athans, 1381 Malvern Rd. S.C.C., Vic.

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CHEAP radio components and equipment for sale. For instance, 50 modern resistors 9/1 plus 1/1 postage. Write for free price-list to T.S.F. Electronics, 338 Shannon Avenue, Geelong, Vic.

CUSTOM BUILT TRANSFORMERS: Power, Audio, etc. Single or quantity production. Amplifiers, P.A. Systems, battery chargers, rectifiers, electric motors, transistor radios. General engineering, fitting and turning, sheet metal work, etc. Parkinson Transformer P.O. Box 523, South Brisbane. Phone Beenleigh 33, Qld.

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FOR SALE

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For the benefit of experienced we list sets of data sheets available for several different designs of organ. Alan Douglas transistorised design and the Clyde organ construction kitset. "Harmonics" pre-assembled units and complete organs. Please send S/J cheque or postal note to cover part cost and printing and posting. Peska Pty. Ltd., P.O. Box 306, Frankston, Vic.

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We do not sell spare parts

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Tel. 27-5831 (3 lines)

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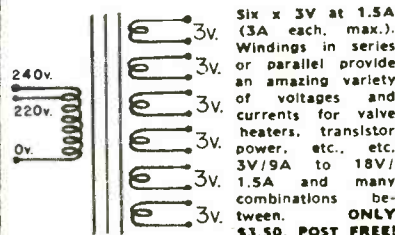
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Send for detailed Specs. Sheet.

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MODEL 643 STEREO RECORD PLAYER



FEATURES

Functions perfectly - "rumble", "wow" and "flutter" completely eliminated.

Special flexible rim - belt drive from truly vibration-free patented motor suspension which isolates all vibration from base plate.

Drive spindle ground and polished to extremely fine tolerances. (0.000,04").

The turntable is provided with nylon and bronze bearings. These are self-lubricating and no lubrication should ever be necessary.

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Interchangeable pickup heads enable use of monaural and stereo, ceramic or magnetic cartridges.

The pickup arm is provided with adjustment for both stylus pressure and height.

Asynchronous motor (not tied to mains frequency) with special governor making motor independent of mains voltage and frequency.

Outstanding Danish design produced under strict quality control: every turntable individually test run and carefully checked before leaving factory.

TECHNICAL DATA.

Two models are available 643 & 643F. The 643F has a special mounting bracket to hold an SRT pre amplifier and also has windings on its motor to provide power for the pre amplifier.

Supply Voltage: 240 volts, 50 c/s

Pickup: Merula ceramic or B & O SPI in plug in heads with standard mounting holes.

Motor: 2 pole asynchronous motor and centrifugal governor, speed regulation $\pm 15\%$. The complete motor and speed change assembly is suspended from the main chassis by 3 horizontal spiral springs, excessive vertical movement being prevented during transport by 3 plastic "buffer bobbins".

Power consumption: 11 watts.

Wow & Flutter: Less than $\pm 0.2\%$ peak.

Belt drive: Ensuring extremely low rumble

Pickup: Lift/replace device.

Mat: Moulded rubber 9 inches dia. stroboscopic markings.

Length: 13.2 in. (335 mm)

Width: 10.1 in. (255 mm)

Height above mounting board: 2 in. (50 mm)

Depth below mounting board: 3.3 in. (85 mm)

Weight: 11 lbs (5.0 kg)

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An exceptionally pleasant sounding ceramic on account of its low distortion. Its high compliance minimizes record wear.

Frequency Response: 20 cps - 14,000 cps
+2dB 40 cps - 12 cps
Output: 65 mV/cm/sec.
Intermodulation: less than 2% by 8 mv.
Tracking weight: 3 gm
Loading: 2 Megohm

B & O-SPI MAGNETIC CARTRIDGE

Frequency Response: + 2.5 dB from 30 c/s
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Output Voltage: 7mV per channel at 5 cm sec. at 1000 c/s.
Channel separation: 20 dB minimum.
DC Resistance: 1250 Ohms
Inductance: 200 mH
Recommended Tracking Force: 3 grams
Compliance: 5×10^{-6} cm/dyne in all directions.
Moving mass: Less than 3 mg.
Recommended Load: 47,000 ohms or higher.
Weight: 10 grams
Stylus Standard: Diamond, radius of curvature: 17 μ (7 mil).
Stylus replacement: See special literature.

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G.R.D.

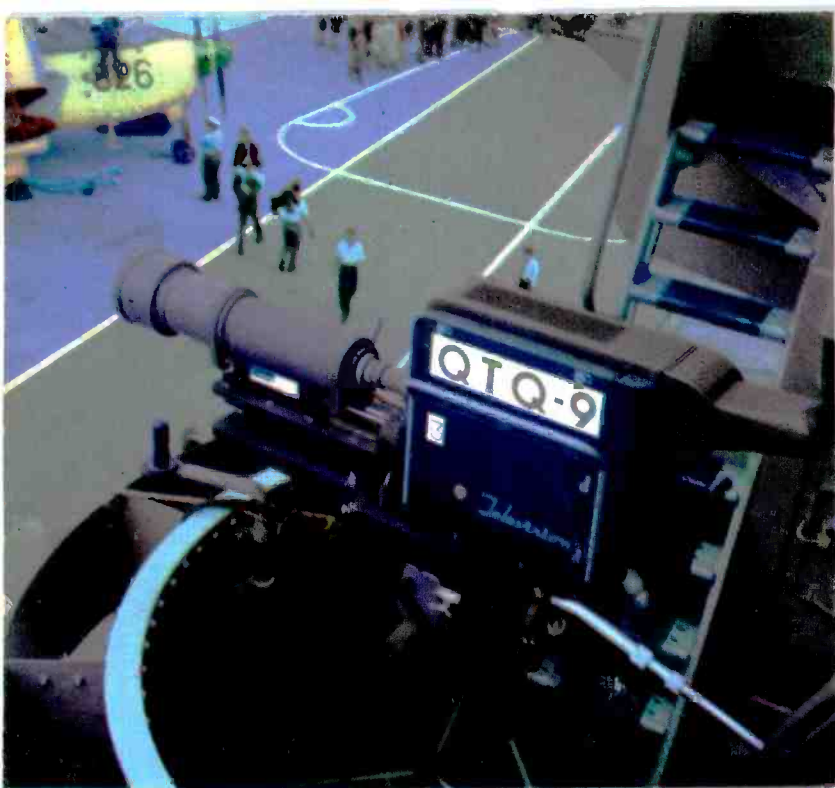
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Made in Denmark

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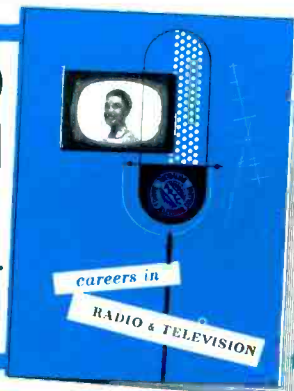
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