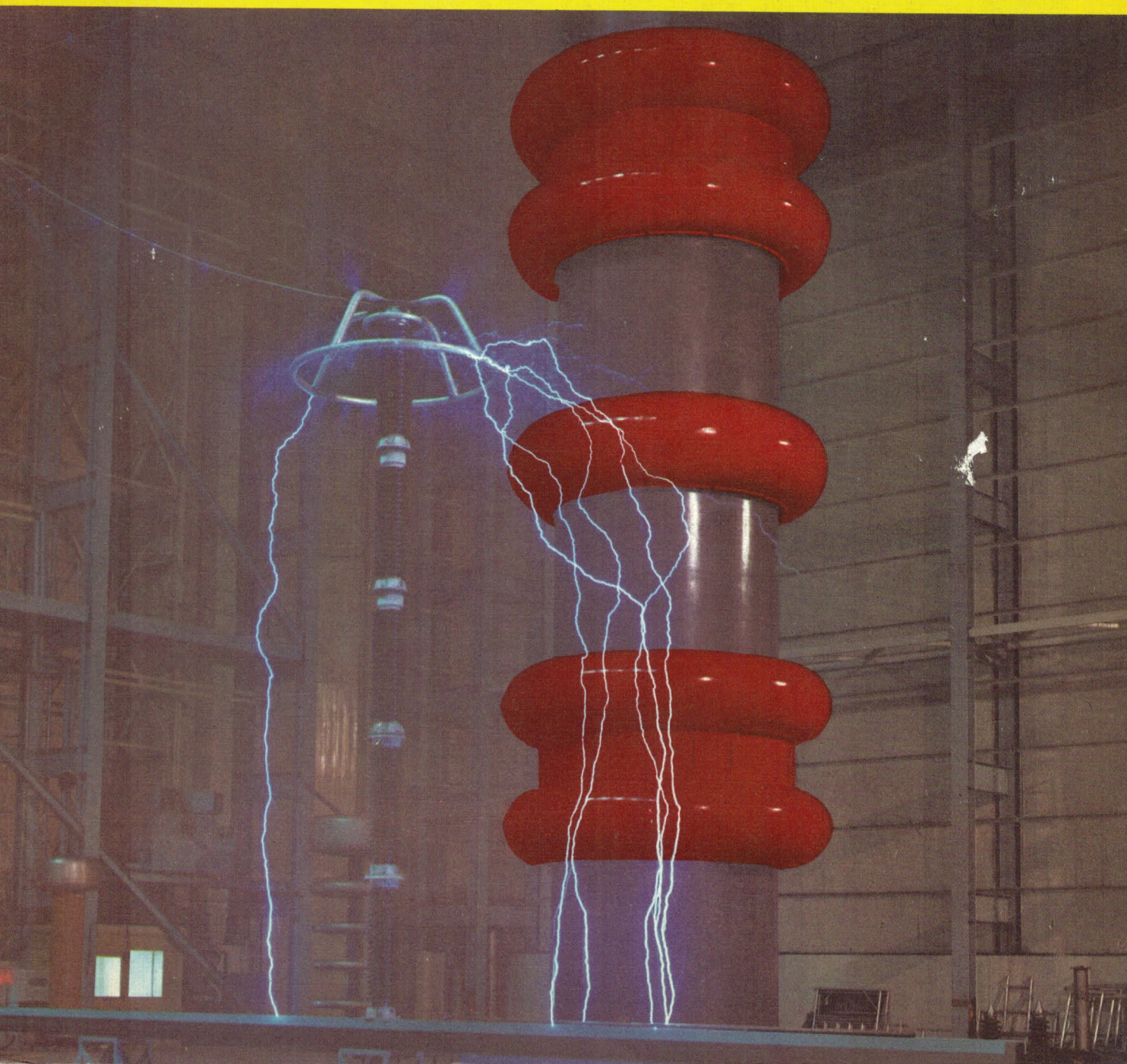
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Different instruments in an orchestra present special problems in Hi Fi reproduction.

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No problem.

The A.W.A. volume control eliminates distortion and gives you what you really want —60 "No Noise" watts of beautiful music.

Ask your Hi Fi specialist to show you the A.W.A. amplifiers with the "No Noise Knob."

You will like what you hear.



AWA

The "no noise knob"

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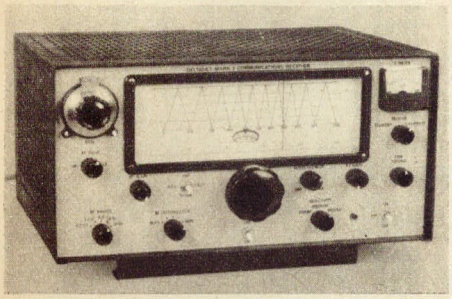
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ABC certified circulation in excess of 50,000 VOLUME 33 No. 1

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DELTAHET MARK 2: The description of the solid state Deltahet continues on page 52. This article discusses the front end and the main construction details.



RAAF RADIO: During the last 50 years, RAAF communications have developed from simple crystal sets to modern multi-channel systems. See page 12.

QUADRAPHONICS: Can an existing stereo system give the effect of four channels without the expense of four distinct channels? The article on page 89 describes ways to simulate the effect.

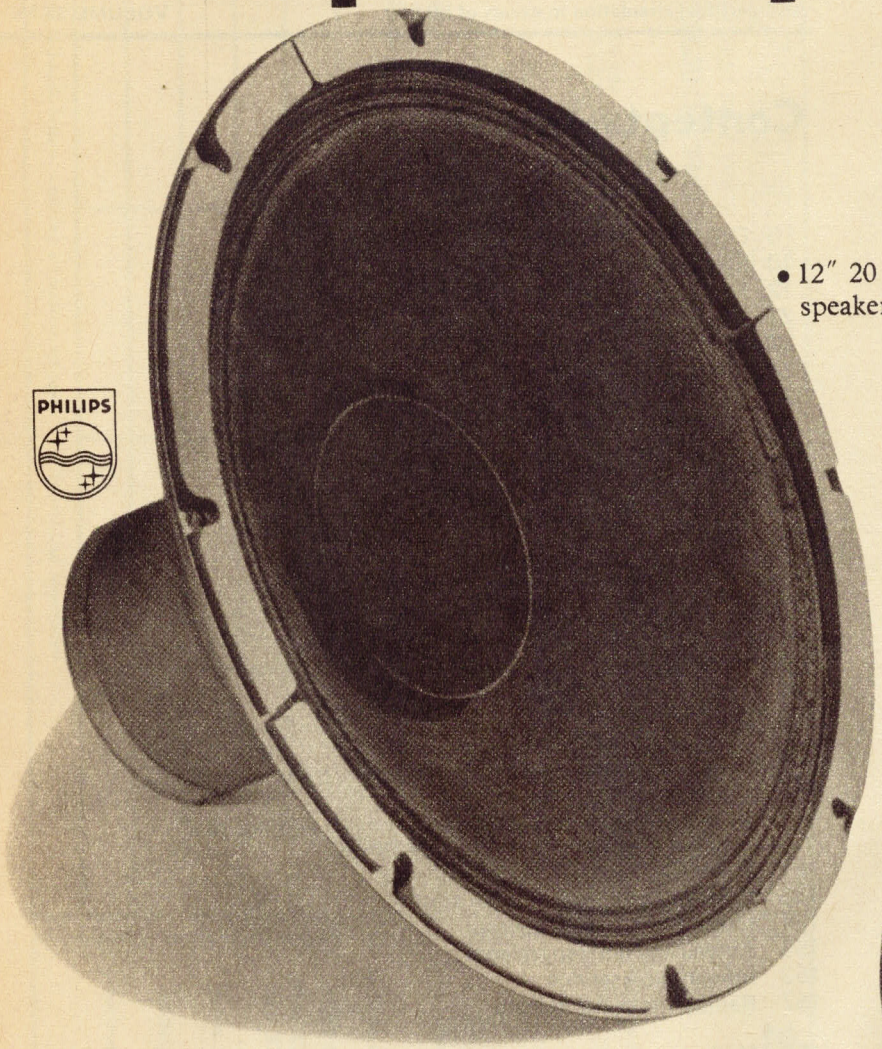
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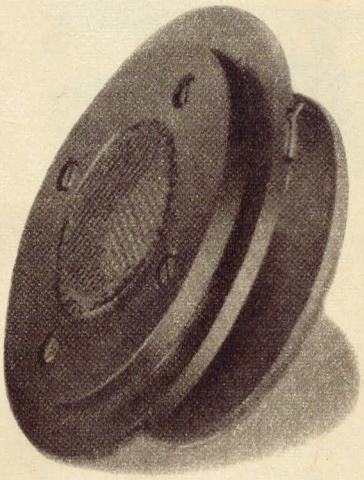
A 750KV insulator stack under test at the recently opened Clothier Laboratory of Reyrolle Parsons Ltd, in north-east England. To the right of the insulator stack is a 60ft high 3200KVA at 2000KV, test transformer built for the laboratory by Ferranti Ltd. Built at a cost of over $2-million, the laboratory is used to test electrical insulation up to 1500KV. It is named after the late Henry Clothier, a British pioneer in the field of electrical transmission.

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EDITORIAL VIEWPOINT

About servicing, and the future . . .

The servicing problem is still with us, and slowly but steadily becomes more serious. In almost every sphere of human activity more and more electronic equipment is being assimilated. Much of this equipment involves either new circuit techniques, new devices or new levels of functional complexity. Yet the number of suitably qualified and experienced servicing personnel is not keeping up with this growth. If anything it is slowly diminishing.

This really shouldn't be surprising, because very little real effort has ever been made to correct the situation. As in many other fields of technology, servicing is very much the neglected quarter of the electronics industry. That it is important – even essential – everyone will agree, but the majority turn blithely to loftier goals, and assume that servicing will somehow take care of itself.

As many have pointed out, there is an acute shortage of technical college courses and similar training schemes with a specific orientation towards servicing. One is tempted to deduce from this that the remedy for the continuing decline in the servicing field lies in the hands of those planning and administering the training courses, or perhaps in the hands of those above them holding the pursestrings. Yet surely the ultimate remedy cannot be simply a matter of spending more and more money on longer and more intensive training programs, in order to produce increasingly larger numbers of ever more highly skilled (and hence more highly paid!) service technicians. A carefully planned program of recruitment and training is certainly going to be necessary, and the sooner this is started the better. But if the servicing problem is ever going to be fully solved, we will need to attack it not only from the "people" end, but also from the "equipment" end.

The logical course seems clear: We should design all new equipment so that it presents fewer servicing problems than before.

Philips and other companies have already made a worthwhile move in this direction by adopting the "replaceable circuit module" system for their domestic television receivers. The module approach is a good one, and could make a very big contribution to the ultimate solution of the servicing problem. But I suggest that two important developments will need to take place if we are ever going to realise its full potential.

One is that modules will need to be fabricated automatically, and in such large quantities that the unit cost will fall to the level necessary to permit "throw-away" servicing. The other is that modules will need to be standardised in a coherent and planned way, to prevent unnecessary duplication and proliferation. It would be ironic in the extreme if modules were allowed to develop in a manner as chaotic as that of transistors and integrated microcircuits.

The first of these developments may not be very far away, judging by the rapid progress being made in refining production techniques. But the second is a rather different matter, and may never occur at all unless definite steps are taken.

It is to be hoped that those concerned will be able to co-operate sufficiently to ensure that modules do in fact become a partial solution to the servicing problem, and not just a further liability.

Jamieson Rowe

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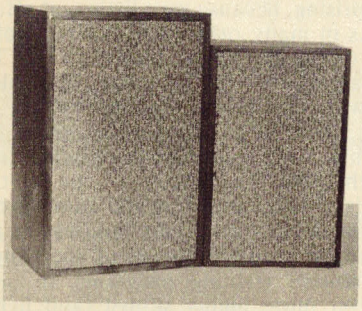
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SPEAKER SYSTEMS

NEW MAGNAVOX 8-30 SYSTEM



Featured in "E.A." Jan. 1971, it handles 30 watts RMS, features a new high performance 8" speaker, two 3" tweeters, and is available in cabinet 20⅞" x 12⅞" x 8⅞" (1 cu. ft.) or 23⅞" x 15½" x 10⅞" (1.6 cu. ft.). Available in teak or maple veneer.

COMPLETE SYSTEM

Kit of Parts . . . . . **$49.00** (1 cu ft), **$59.00** (1.6 cu ft)
Built and Tested . . . . **$61.00** (1 cu ft), **$74.00** (1.6 cu ft)

SEPARATE COMPONENTS

8-30 speaker only **$20.73**
3TC tweeter only **$3.72**
Enclosure kit (1 cu ft) . . . . **$16.50** (maple), **$19.00** (teak
Enclosure kit (1.6 cu ft) . . . **$28.50** (maple); **$31.50** (teak)
Built Enclosure (1 cu ft) . . **$28.00** (walnut), **$32.00** (teak)
Built Enclosure (1.6 cu ft) . . **$43.50** (walnut), **$48.50** (teak)

ECONOMY BASS REFLEX SYSTEM

"E.A." design, Nov. 1970, consists of a Rola C8MX speaker in cabinet 20" x 11" x 9". Ideal for low wattage.

COMPLETE SYSTEM

Kit of Parts (teak or maple) **$24.00**
Built and Tested (teak or walnut) **$36.00**

SEPARATE COMPONENTS

C8MX speaker only **$8.26**
Enclosure kit . . . . . **$15.00** (maple), **$16.50** (teak)
Built Enclosure . . . . . **$26.50 (maple), $29.00 (teak)**

WHARFEDALE SPEAKER SYSTEM KITS

The Wharfedale Super Linton, Melton and Dovedale III are now available as build-yourself kits, featuring INSTROL quality cabinet kits in choice of maple or teak veneer.
The Super Linton kit employs an 8" and 3" speaker, frequency response 40-17,000Hz, cabinet 21" x 11½" x 9½". 15 watts RMS
The Melton kit employs a 12" bass and a tweeter, cabinet 22¾" x 13" x 10". 25 watts RMS.
The Dovedale III kit employs a 12" bass, 5" mid-range and 1" tweeter. Cabinet 28" x 15½" x 10". 35 watts RMS.

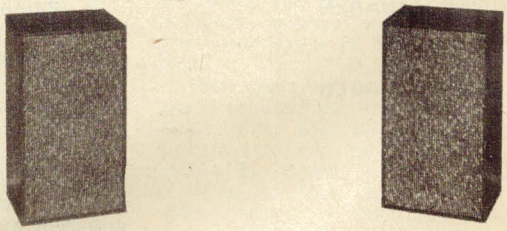
COMPLETE SYSTEM

Super Linton kit (Unit 3) **$49.50**
Melton kit (Unit 4) **$90.00**
Dovedale III kit (Unit 5) **$128.00**

SEPARATE COMPONENTS

Unit 3 encl kit. . . . . **$16.000** (maple), **$19.00** (teak)
Unit 4 encl. kit . . . . . **$23.00** (maple), **$26.00** (teak)
Unit 5 encl. kit . . . . . **$29.00** (maple), **$32.00** (teak)

NEW LEAK SPEAKERS



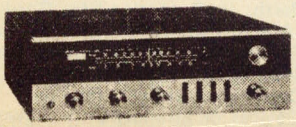
Leak have just released three new speaker systems.

The model 200 is 0.78 cu ft (18 watts RMS).
The model 300 is 1.3 cu ft (18 watts RMS).
The model 600 is 2.65 cu ft (40 watts RMS).

Model 200 . . . . . **$81.00**
Model 300 . . . . . **$106.00**
Model 600 . . . . . **$177.00**

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AMPLIFIER KITSETS

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A fully solid-state control unit incorporating a dual linear integrated circuit. (Refer E.A. Nov. 1969.)

Kit of Parts **$49.00** (Reg post $1.35)
Built and Tested **$69.00** (freight $2.00)
Aluminium knobs extra .. **$2.00**

SEPARATE COMPONENTS

Printed Board .. .. **$3.05** (Post 20c)
Etched Label .. .. **$2.12** (Post 25c)
Metalwork .. .. .. **$7.00** (Post 75c)

PLAYMASTER 128 AMP.

A high-powered transistorised stereo amplifier for use with the 127 control unit, providing a performance equal to most expensive imported amplifiers.

Refer "E.A." Jan., 1970.

Kit of Parts $105.00 (Reg Post $2.00)
Built and Tested $125.00 (Freight $2.00)

SEPARATE COMPONENTS

Printed Board .. .. $2.37 (Post 20c)
Metalwork .. .. .. $6.80 (Post $1.05)

P'master 129 Stereo Amp.



A high quality stereo amplifier built around just two IC's. 3 watts per channel. Refer Oct. 1970.

Kit of Parts **$54.00** (Reg Post $2.00)
Built and Tested **$68.50** (freight $2.00)

SEPARATE COMPONENTS

Printed Board .. **$3.23** (Post 20c)
Etched Label .. .. **$2.52** (Post 25c)
Metalwork .. .. **$5.67** (Post $1.05)

ELECTRONIC MUSICAL INSTRUMENTS

KEYLESS ORGAN

Played by touching a stylus on to a series of metal contacts, it has a 1½ octave range including sharps and flats. Refer "E.A." Jan. 1969.

Kit of Parts **$35.00** (Reg Post $1.35)

SEPARATE COMPONENTS

Printed Board (Gold plated) **$4.60** (Post 20c)
Printed Board (Nickel plated) **$3.68** (Post 20c)
Metalwork .. .. .. **$5.03** (Post 65c)

ELECTRONIC BONGOS

This unit, which can be fed into any amplifier, can simulate bongos. Refer "E.A." Apr. 1970.

Kit of Parts **$13.00** (Reg post $1.35)
Built and Tested **$19.00** (Freight $2.00)

SEPARATE COMPONENTS

Metalwork .. .. .. **$6.13** (Post 75c)

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Instrol specialises in Guitar amplifiers and Guitar Speakers, and the Instrol-Playmaster 116 and 117 guitar amplifiers are the finest available (precisely to "Electronics Australia" specifications).
They are available as kits of parts as well as built and tested, each kit being complete in every detail down to the last nut and bolt. Chassis is ready drilled, cadmium plated and finally passivated to avoid fingermarking. The front label is beautifully finished with black lettering on silver-white background. The amplifiers include such extras as 3 inputs, vibrato and extra treble pull switches and chrome housed foot switch.

	Price	Freight
40 watt (116) kit ..	**$78.00**	($2.00)
60 watt (117) kit ..	**$86.00**	($2.00)
40 watt (116) built ..	**$98.00**	($3.00)
60 watt (117) built ..	**$106.00**	($3.00)
Fuzz Box Kit	**$13.00**	(85c)
Cover with handles, extra $9.93		**(75c)**

SEPARATE COMPONENTS

Chassis .. .. **$4.72** (Post 65c)
Chrome foot switch housing **$2.15** (Post 25c)
Etched Label .. .. **$2.45** (Post 25c)

MUSICOLOUR



It will audio-modulate coloured 240V lamps to give vibrant, colourful displays, being fed from your amplifier. Refer "E.A." Oct. 1969.

Kit of Parts, **$47.50** (reg. post $2)
Built and tested, **$59.50** (freight $2)

SEPARATE COMPONENTS

Printed Board .. .. **$2.89** (Post 20c)
Etched Label .. .. **$2.12** (Post 25c)
Metalwork .. .. .. **$3.73** (Post 65c)

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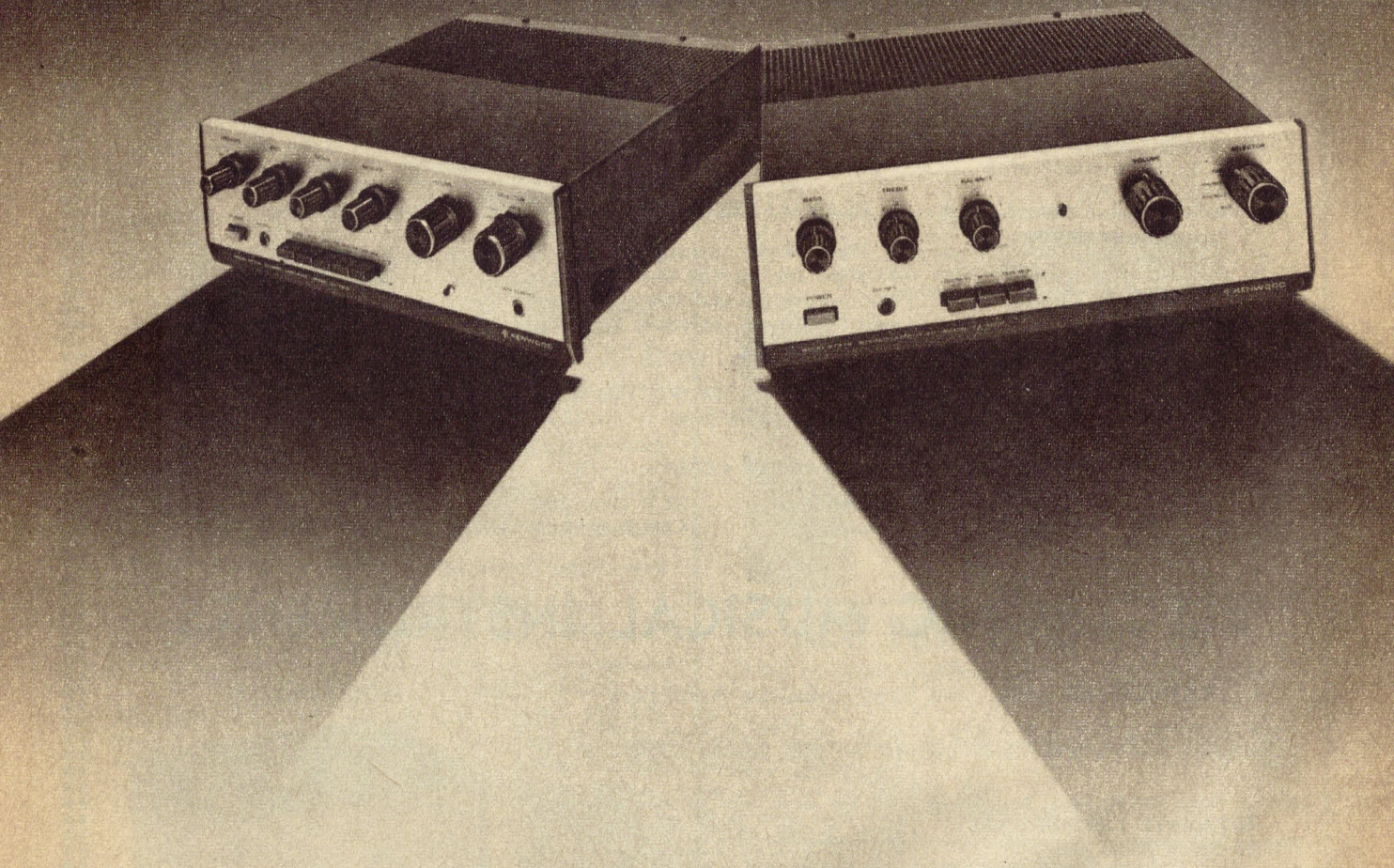
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STEREO AMPLIFIER **KA-4002**

46-WATT (IHF 4Ω) SOLID STATE
STEREO AMPLIFIER **KA-2002**



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Talk to an audiophile and he'll tell you KENWOOD's KA-4002 and KA-2002 are far and away the two most superior compact amplifiers. With that superb KENWOOD touch for combining all that's new and dynamic with the soundest, most reliable stereo advances, the KA-4002 delivers a robust 80 watts (IHF 4Ω) with hush-hush distortion in a streamlined, sophisticated-circuit package. No less dazzling a performer, the KA-2002 also symbolizes the highest in stereo amplifier standards. With a zesty 46 watts (IHF 4Ω) its graceful component harmony will be a day-by-day joy as you discover it is equal to your toughest demands.

SPECIFICATIONS OF KA-4002
- CONTINUOUS POWER OUTPUT: 33/33 watts (each ch. at 4 ohms)
- INTERMODULATION DISTORTION: 0.5% (at rated)
- FREQUENCY RESPONSE: 15-50,000 Hz +1.5 dB (main input)
- POWER BANDWIDTH (IHF): 18-30,000 Hz
- DIMENSIONS: 13"(W), 4-5/8"(H), 9-7/16"(D).

SPECIFICATIONS OF KA-2002
- CONTINUOUS POWER OUTPUT: 19/19 watts (each ch. at 4 ohms)
- INTERMODULATION DISTORTION: 0.8% (at rated output)
- FREQUENCY RESPONSE: 17-50,000 Hz + 2 dB (main input)
- POWER BANDWIDTH (IHF): 20-30,000 Hz
- DIMENSIONS: 13"(W), 4-5/8"(H), 9-7/16"(D).

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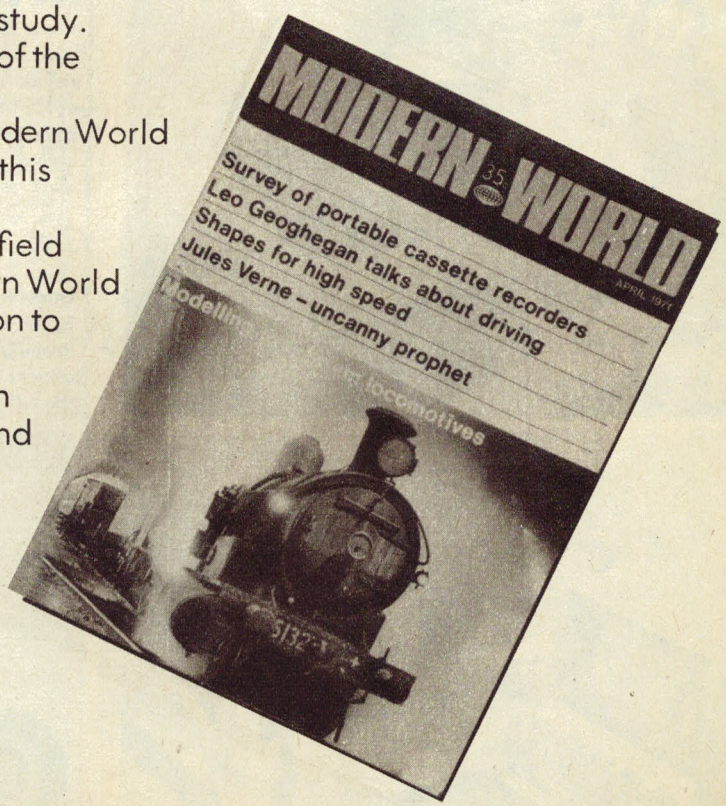
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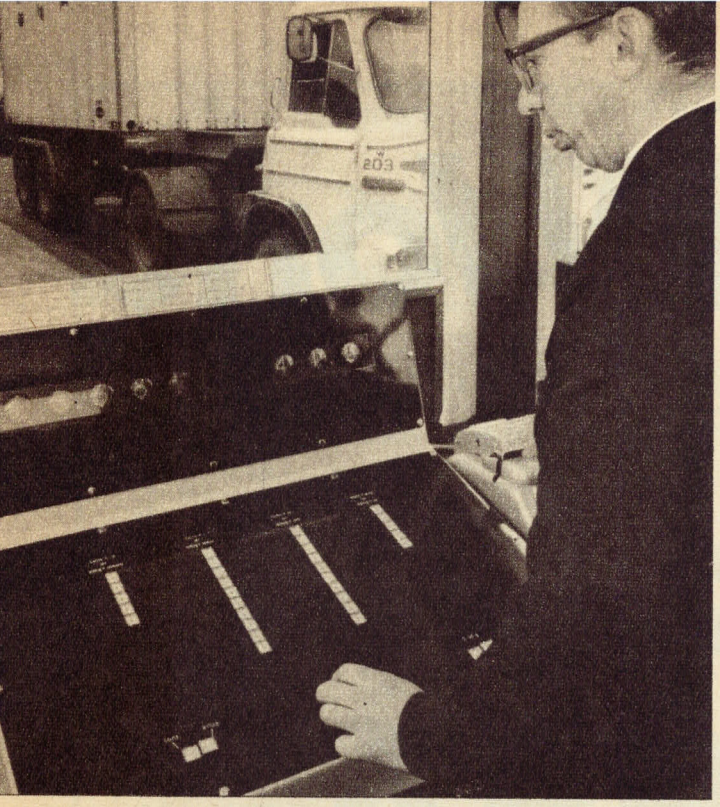
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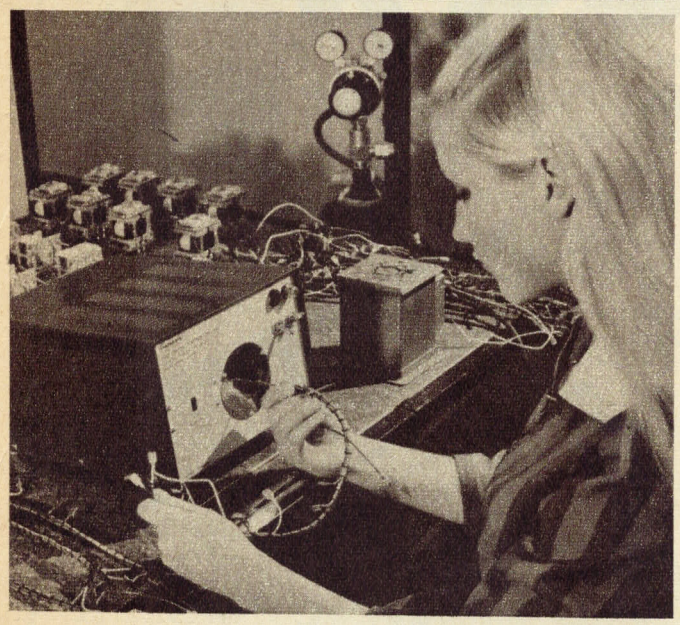
Check out Modern World.

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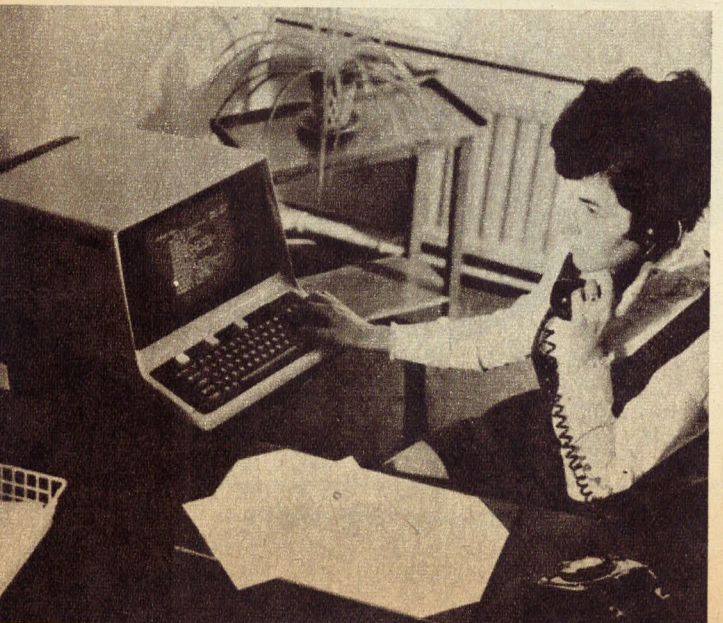


Electronic weighbridge. (Top left.) In the container terminal at the port of Liverpool, England, this new Avery electronic weighbridge calculates the lateral and longitudinal centres of gravity of loaded containers, thus detecting unevenly packed and potentially dangerous units before shipment. The machine can also be used as a normal weighbridge.

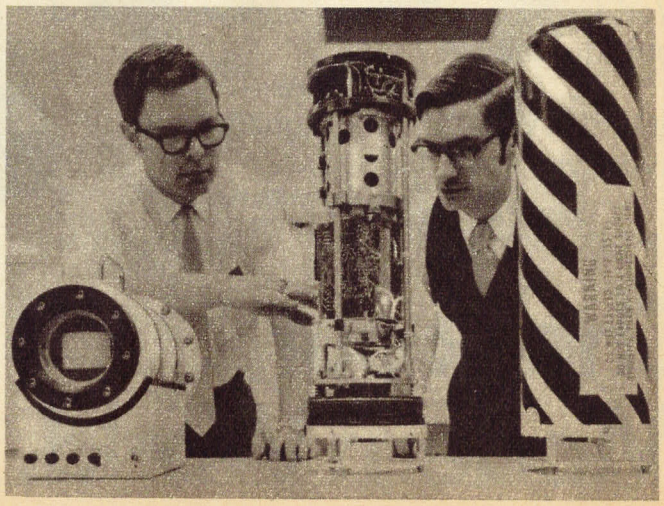


Wire stripper. (Centre.) This new production tool introduced in the UK by Gardeners Transformers Ltd rapidly heats enamel covered wire in an inert gas under controlled temperature conditions, to decompose the enamel without damaging the wire. As the wire is withdrawn, it is cooled rapidly in a draught of the inert gas to prevent oxidation. The stripper can handle very fine wires (down to 50 B&S) and twisted wires.

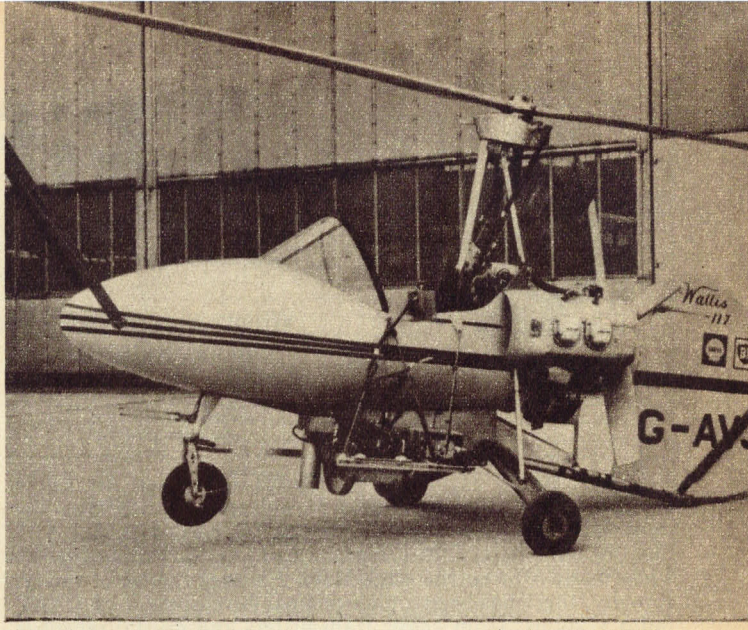
Bank data system. (Below left.) First of its kind in British banking, a new real-time data communications system has been ordered from Marconi-Elliott by Barclays Bank in London. The system will include no less than 100 video terminals of the type pictured, with an M2140 central processor. The system will be used principally on foreign exchange transactions.



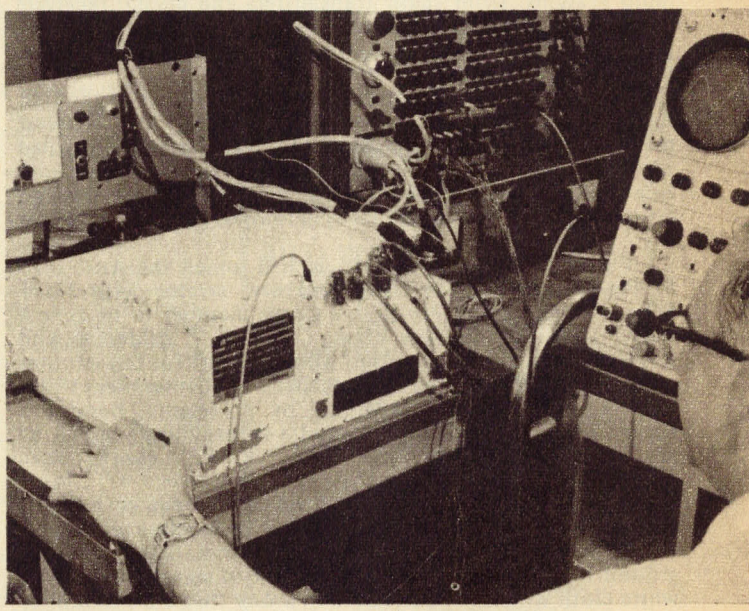
Underwater TV camera. (Below right.) Developed by Westinghouse in the USA, this black-and-white camera for underwater use has an imaging section identical to that of Apollo colour cameras. The camera operates within the very strong watertight shell at right. On the left is a miniature TV monitor, housed in a similar enclosure.



Detecting pollution. (Top right.) A Wallis WA-117 autogyro is being tested as a carrying vehicle for the Hawker Siddeley Dynamics Linescan 212 sensor, an infrared aerial survey system which can detect pollution in rivers and estuaries. Although it cannot take off and land vertically, the autogyro can operate out of small areas. It is highly manoeuvrable at low air speeds and is easily handled on the ground. The aircraft is powered by a Rolls-Royce Continental O-200-B aero engine which is said to give minimum noise and vibration.

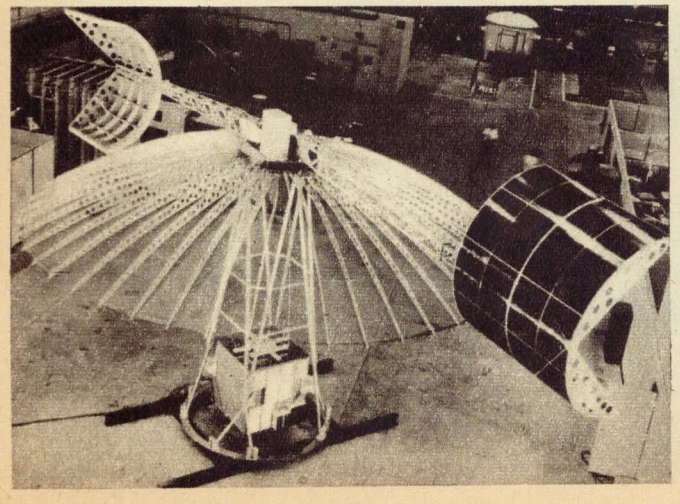


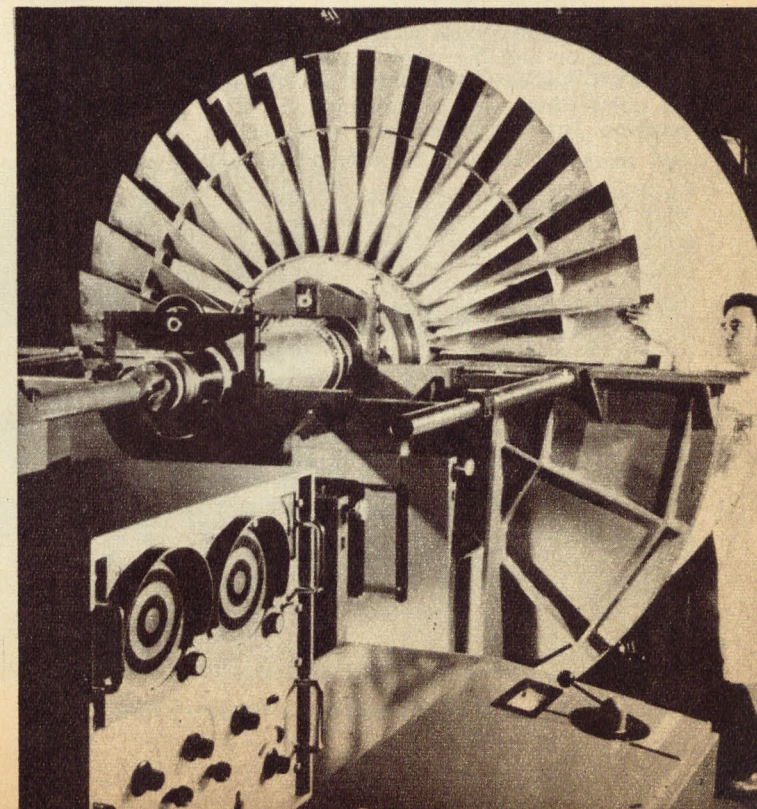
Apollo power. (Centre.) This electric power inverter was used on an Apollo flight in December, 1968. It has been tested and modified for use in future flights, at the Westinghouse aerospace electrical division in the USA where it was designed and built in December, 1966. Every Apollo command module has three of these inverters, to change a 28V DC supply from fuel cells or batteries to 115V and 200V 3-phase AC power at 400Hz.



Engine testing. (Below right.) A fan module for a Rolls-Royce RB 211 engine, developed for the Lockheed L-1011 TriStar aircraft, is balanced on one of two electronic balancing machines at the Rolls-Royce aero engine division in Derby, England.

Indian TV satelite. (Below left.) This umbrella-shaped communications satellite will beam educational television to remote villages in India, a country at present served by only one station in the New Delhi area. To be launched in 1973, the satellite has a 19ft reflector, 10ft wide solar panels for power, and a 4ft cube of instruments at the base of a 19ft tower. Honeywell is producing the controls for the satellite, while Lockheed is responsible for the reflector and solar panels.





Fifty years of

When the RAAF was formed in 1921, many senior officers regarded radio as unnecessary and virtually useless gadgetry. Today the force could not operate effectively without extensive radio systems.

by Group Captain E. R. Hall (ret.)

On March 31, 1971, the Royal Australian Air Force celebrated its 50th Anniversary. This period has seen the development of the Service's aircraft from the 138 mph SE5 biplane and similar flimsy constructions developed during the First World War to the sleek Mach 2 Mirage fighter of today. Equally, there has been a phenomenal development of RAAF radio systems, from spark transmitters and crystal receivers to the modern multichannel communications systems, precision electronic navigational equipment and high-powered radars.

When the RAAF formed in 1921, the duties of the first signals officer, Flying Officer H. Johnston, and wireless mechanic, Corporal H. W. Barfield, were mainly concerned with the unpacking of the gift stores received from England. In addition to the aircraft, the stores included spark sets and crystal receivers which had been developed during World War I.

Both Johnston and Barfield had joined the Australian Flying Corps early in 1916 and saw service with No 1 Squadron AFC. Another Flying Corps member to become a RAAF signals officer was Flying Officer L. J. Balderson who flew a 105 miles-an-hour Avro 504K aircraft for ten minutes on the day he joined the RAAF in September 1921. Balderson, an electrical engineer by profession, became a signals officer in 1923 and started a career during which he set the foundations for the RAAF short wave communications network.

Because of the high noise level in the open cockpits of aircraft, communications were limited to wireless telegraphy transmissions from the aircraft to the ground. Signalling from ground to air was carried out by the use of signalling strips of white cloth which were arranged in a way that a maximum of four strips were used to convey a message.

The primary role of early RAAF aircraft was artillery co-operation and the main transmitter, the Sterling Mark I spark set, was designed for this use. It had a range of about 15 miles when used in conjunction with a ground crystal receiver. The transmitter used an induction coil, condenser and spark-gap supplied by a 6-volt accumulator producing 35 watts of power. A coil in the form of a helix served as a transformer between the oscillatory circuit and the aerial. The wavelength of operation was about 120 to 300 metres and the aerial was usually trailed to a length of about 180 feet. The transmitter was operated by a key in the primary circuit in series with the accumulator.

For artillery co-operation, the aircraft observer interpreted targets and strikes and signalled the information to the ground. To receive the W/T spark transmissions, the ground operator used the Mark II crystal receiver.

The first continuous-wave (CW) transmitter used by the early RAAF was the type 57 transmitter, which was also the first RAAF transmitter in which valves were used. Two valves were used in parallel and the normal power input was 75 watts. It was designed to operate on 1,000 and 2,000 metres and, with an aerial of 250 to 300ft, ranges of up to 250 miles were achieved from aircraft to ground. The HT power supply was provided by a wind-driven generator mounted in the slipstream of the aircraft.

The first valve receiver used by the RAAF was the TF receiver, described as a combined tuner, detector and amplifier. It was designed for the reception of spark and CW signals on the ranges 500 to 700 metres and 1,000 and 2,500 metres, and spark signals only on 150 to 350 metres. Three valves were used in the receiver but one or three valves could be utilised by the selection of one of two telephone jacks on the front of the receiver. The filaments were supplied by a 6-volt accumulator and a battery was used for the HT supply of 100 volts. Initially this receiver was used in aircraft and on the ground. Later it was used only for training purposes, and continued in this role up to the start of World War II.

Pilots opposed the use of wireless in aircraft mainly on the grounds of its unreliability and many pilots considered it to be surplus and unnecessary weight in the aircraft. Some senior officers expressed the view that visual and written messages were the only reliable methods and must be considered as the primary means of communications. But the enthusiasm of the wireless members remained high and, with the direction and encouragement of Flying Officer



RAAF radio

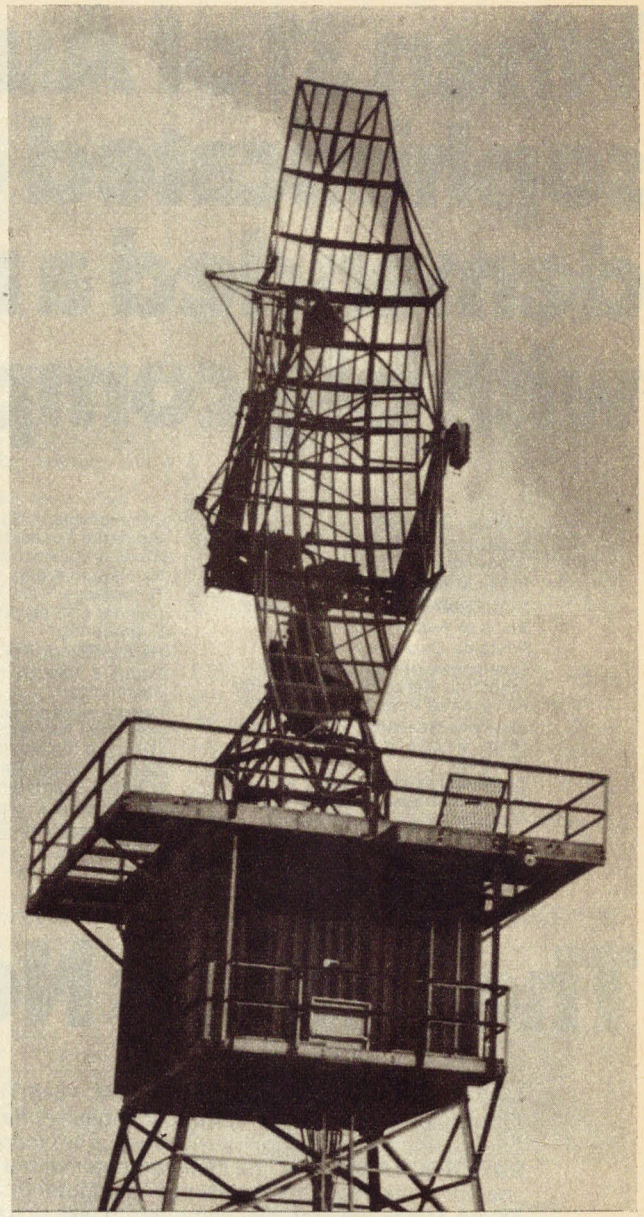
Balderson, they designed and built wireless equipment in the RAAF wireless sections.

The year 1924 was significant in the story of the RAAF wireless organisation. In that year there were achievements which gave notice of the vast potential of wireless as a means of communications. A CW transmitter T21A, similar to the type 57 transmitter and operating on 800 to 2,500 metres, was fitted to a Fairey 3D seaplane in which Wing Commander Goble and Flight Lieutenant McIntyre completed the first flight around the Australian Continent. The TF receiver was carried and Goble, with previous Morse experience, was the operator. This flight marked the first occasion on which RAAF wireless was carried during an outstanding accomplishment in the history of aviation.

The first inter-Service wireless link was set up in 1924 between the RAAF station, Point Cook (9DR), and the Navy Office (VHN) at Victoria Barracks, Melbourne. Initially using aircraft wireless equipment and later equipment made by the RAAF, the link was used to pass messages between Air Board and Point Cook. The messages were hand-carried between the Air Board and the Navy Office. This link operated for several years.

With the tight defence budgets and restrictions on spending which were a feature of the 1920s, the early aircraft sets remained until new equipment came with new aircraft in 1929. In the meantime, with the guidance of Flight Lieutenant Balderson, the wireless members had designed and built both ground and aircraft wireless equipment. No 3 Squadron's formation and move to Richmond, NSW, in July 1925, afforded an opportunity for Balderson and his staff to demonstrate the long distance communications capabilities of their wireless equipment.

In November 1925 a wireless point-to-point link was opened between Point Cook and Richmond. Using raw AC on the high tension of 250 watt transmitters built at Point Cook, and operating on 38 metres, satisfactory communications were established on 1st November. The unofficial callsigns were PADA for Point Cook and NOPA for Richmond. Flying Officer Balderson and Sergeant C. F. Gates controlled the Point Cook end; and Flying Officer C. S. Wiggins, who was the first direct entry RAAF signals officer in July 1925, and Sergeant O. Studley operated the Richmond terminal. On watch on the afternoon of 3rd November, Point Cook advised Richmond that Windbag had won the Melbourne Cup.



The "nodding" type antenna of one of the RAAF's modern radar height finders. This is used in conjunction with an azimuth type radar to form a complete air surveillance system.



Laverton Signals Office in 1931. The AT1 transmitter is on the wall at the left of the window. This photograph and others used with this article are reproduced by courtesy of the RAAF Central Photographic Establishment, Laverton.

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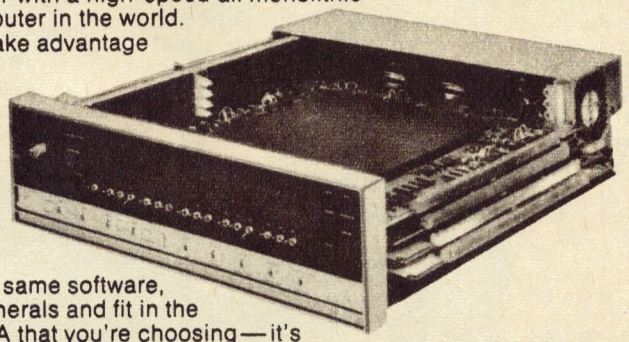
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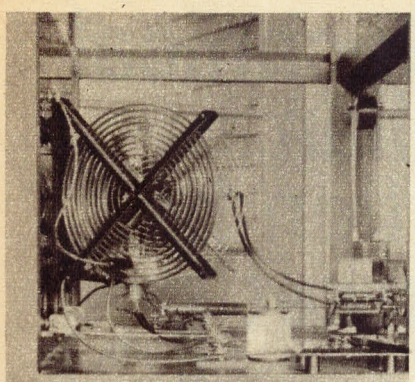
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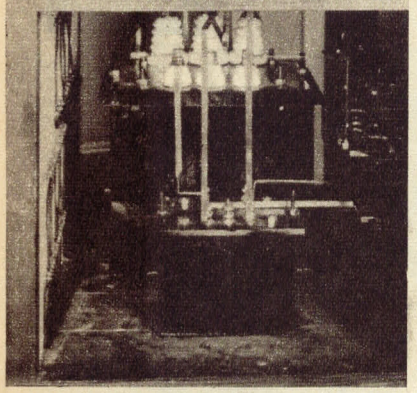
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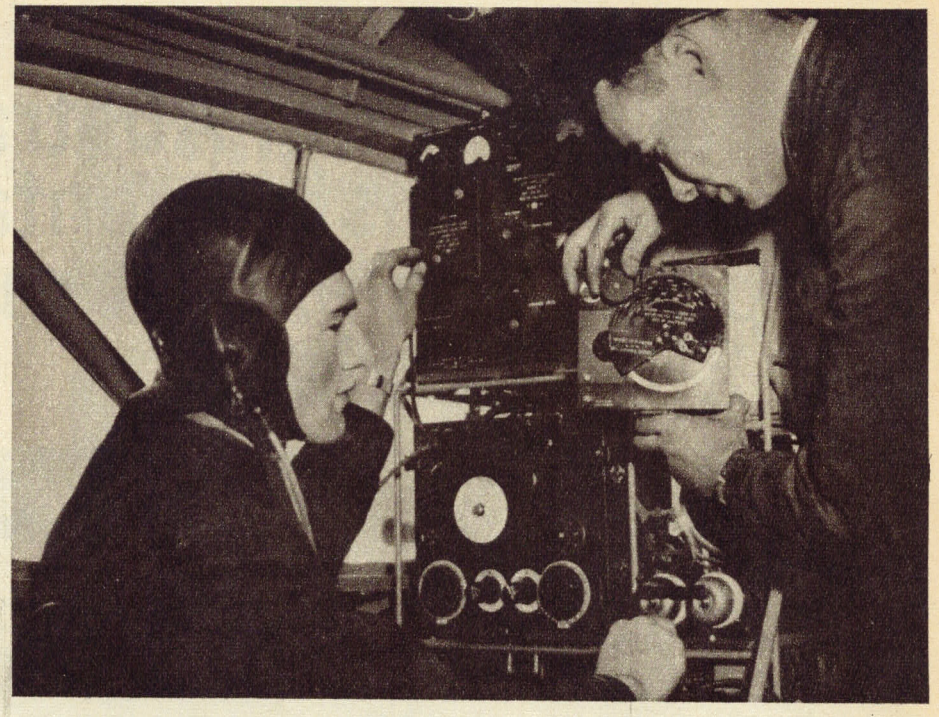
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LEFT: A 500W transmitter designed and constructed by RAAF personnel in 1926. ABOVE: A radio operator's position in RAAF aircraft, 1938, comprising an R1082/T1083 receiver and transmitter combination

The morale of the RAAF wireless members was very high. They were always very keen to learn and experiment. Using RAAF-built radio equipment they contacted amateur radio operators throughout the world. As a result of their successes, Balderson arranged a test with the Royal Air Force at Cranwell, England. On 1st June 1926, a link with the RAF was opened and became a permanent arrangement. This link was the first regular communications link by radio between Australia and the United Kingdom.

To provide new transmitters for the local and overseas circuits, Balderson in 1926 designed and directed the construction of transmitters with outputs of 500 watts and one kilowatt. Both transmitters were designed as single valve oscillators and operated on 25 to 45 metres. The 500 watt transmitter was housed in a wooden framed cabinet about 5ft in height by 3ft by 2ft 6in with a bakelite panel front. On the front panel were mounted the tuning controls and four meters in the radio frequency section, and three voltage controls in the power supply section.

With these transmitters and the results achieved on the Richmond and Cranwell circuits, wireless was accepted in the RAAF as a means of ground-based communications. But the purblind views of pilots and senior officers would not let wireless be accepted as a means of aircraft communications.

Formal RAAF wireless training started at Point Cook in 1928. Prior to this date wireless operators and mechanics were enlisted as qualified members. Aircraftmen H. W. Berry and A. T. Carson joined the RAAF in 1926 as the first two holders of the PMG commercial first class operator's certificate to enlist. From the first RAAF course in 1928, 17 members graduated, and of these five later became wing commanders and two others became squadron leaders. The first RAAF radio school opened in 1935 at Laverton with Flight Lieutenant Berry as commanding officer.

Between 1928 and 1932 Squadron Leader Balderson made a major contribution to the development of RAAF high frequency wireless equipment. As officer in charge of the wireless development at No 1 Aircraft Depot, Laverton, Balderson designed and directed the construction of four transmitters and four receivers. These transmitters included the very successful wall-mounted one kilowatt push-pull AT1. This transmitter gave exceptional performance for many years when used for communicating with aircraft and between ground based stations. The other transmitters were the AT2, an aircraft version of the AT1; the AT3 with 6KV on the final stage; and the AT4 high powered transmitters.

In the receiver range there were the AR1 MF and HF ground general purpose receiver; the AR2 MF and HF general purpose aircraft receiver; and the AR3 and AR4 receivers, using the then recently released screen grid valves, to replace the AR1 receiver. By building these transmitters and receivers, Balderson was able to keep the RAAF supplied with new wireless equipment when no suitable commercially-made equipment was available.

The introduction in 1937 of the RAF transmitter and receiver type R1082/T1083 gave the RAAF its first operationally reliable and high performance aircraft radio equipment. The transmitter was for general purpose aircraft use and operated on the bands 136 to 500KHz and 3 to 15MHz with four plug-in coils. It was capable of CW, ICW (interrupted continuous wave) and RT (radio telephony) transmissions, with a CW output of about 60 watts. The 5-valve R1082 TRF receiver covered about the same bands with a number of plug-in coils. The receiver would go smoothly into oscillation and an oscillation tester in the form of a touch point was provided on the front of the receiver.

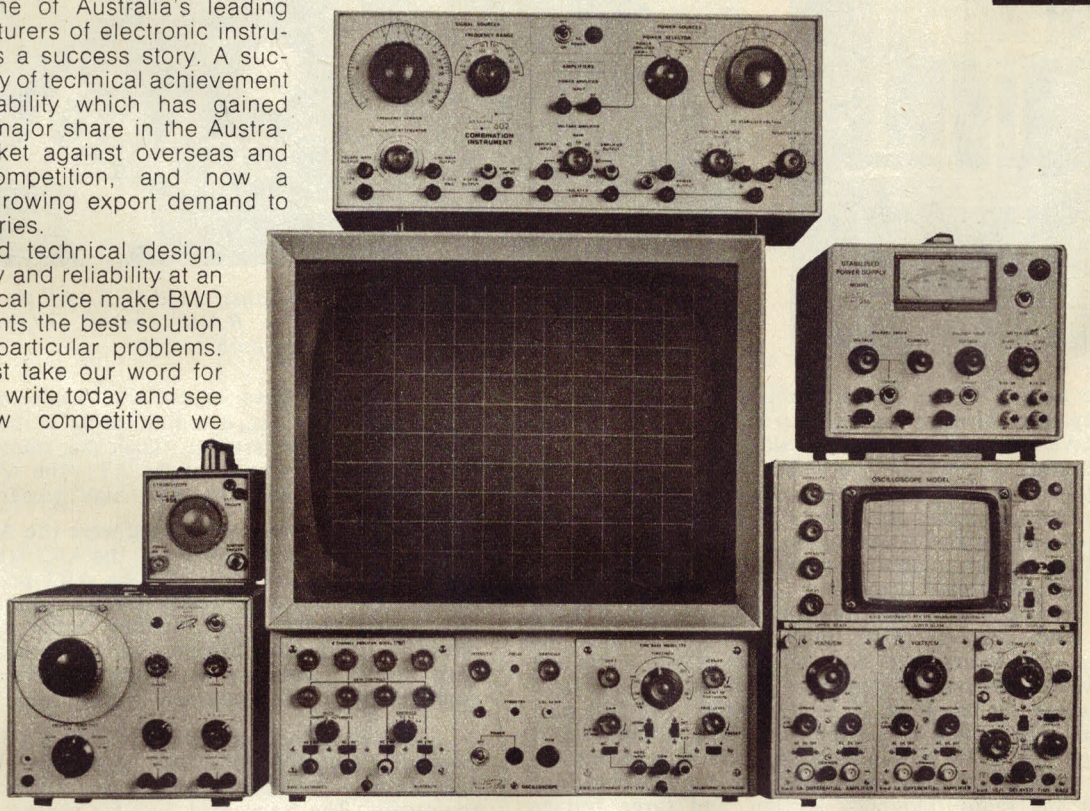
The first R1082/T1083 equipment in the RAAF was installed in a Dragon Rapide aircraft which, with Flight Lieutenant A. G. Carr as pilot and Sir Herbert Gepp as passenger, carried out a geological survey in the Northern Territory. During this survey, the aircraft was lost on the shores of Lake Mackay in Central Australia for ten days. The Rapide's wireless operator, Sergeant W. C. Blakeley, using the normal battery supply, gave an exceptionally outstanding display of operating and technical ability by being able to maintain communications with Laverton for the full period. This remarkable demonstration did much to assure senior officers of the capabilities of radio as a means of communications. Corporal W. T. Taylor operated the R1082/T1083 radio equipment in the Gannet aircraft which

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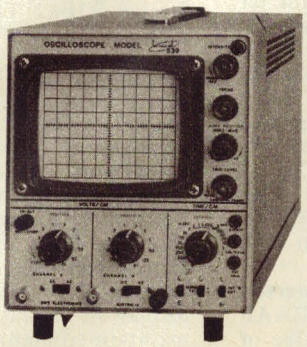
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found the Rapide. In February 1938, Gannet A14-3 became the first radio-equipped RAAF aircraft to undertake a flight from Australia. The purpose of the flight was to take Air Vice Marshall R. Williams to Singapore to represent the Australian government at the opening of the floating dock. Throughout the flight further proof of the efficiency of the R1082/T1083 radio installation was given by Sergeant W. T. Taylor.

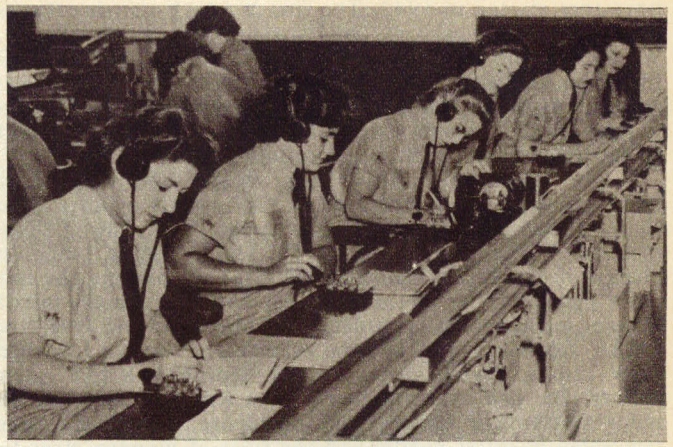
The R1082/T1083 equipment was installed in Anson aircraft when these twin-engined reconnaissance aircraft were introduced in the late 1930s. The importance of radio for aircraft communications was recognised when it was realised that it was a very efficient method of reporting shipping information during seaward sweeps. So vital was radio for this work that, if the radio equipment was not working correctly, the flight was aborted. This recognition had at least established radio as a means of aircraft communications.

Prior to the outbreak of World War II the RAAF wireless operators and mechanics had responsibilities in all phases of radio work. An operator working signals office watches with aircraft or on the ground point-to-point links could be transferred to undertake the tuning and maintenance of ground transmitters, or the operation and maintenance of MF direction finding stations, or the operation and maintenance of equipment in aircraft.

In addition to the radio work in aircraft, the wireless operator or mechanic had to look after the electrical system, the engine-driven generators and the electrical wiring to bomb racks. From this wide experience there emerged personnel able to meet demanding obligations as officers when they were commissioned in World War II.

A specification was written in 1938 by Warrant Officer C. F. Gates and Flight Sergeant J. W. Reddrop for a general purpose radio transmitter and receiver for aircraft use. Because it was becoming increasingly more difficult to obtain radio equipment from overseas, the specification was passed to the Australian radio industry. As a result, Amalgamated Wireless (A/sia) Ltd developed and produced the AT5/AR8 radio installation. This equipment, in aircraft, ground and portable configurations gave valuable service throughout World War II when it was used by Australian and US Forces. It is the only Australian-designed military radio equipment for aircraft use ever to go into quantity production.

The AT5 transmitter was rated at 50 watts and operated on the frequency ranges 140 to 500KHz and 2 to 20MHz. Facilities included transmission on CW, MCW, RT and Pulse. The AR8 receiver covered the bands 140 to 740KHz and 765KHz to 1MHz. Direction finding facilities were incorporated. An aerial coupling unit, power supply and pulse unit completed the AT5/AR8 installation. The equipment was installed in at least 12 different types of



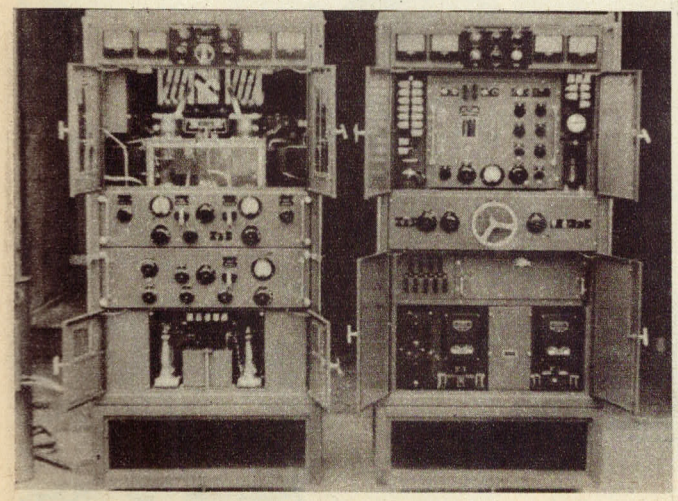
WAAAF telegraphists at Frognall, 1943.

RAAF aircraft. It was also used in marine craft and in numerous ground applications.

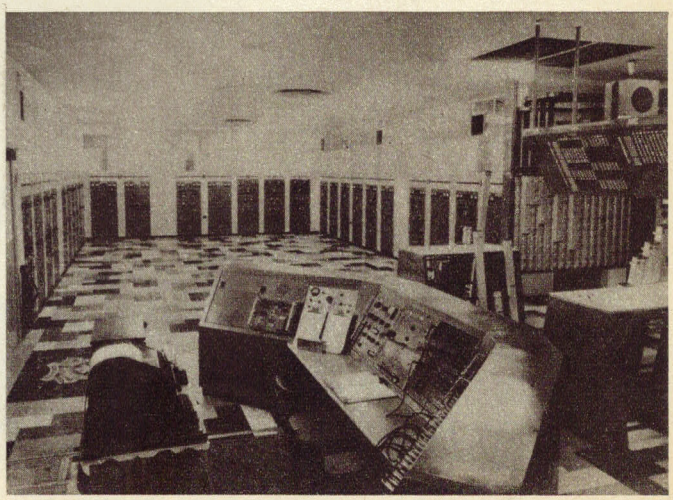
With the outbreak of war in September 1939 there was frantic activity to expand the communications network by opening new bases, installing new equipment and training more operators and mechanics. A ready reserve of WT (wireless telegraphy) operators was provided by the RAAF Wireless Reserve and about 200 of its members were called up at the start of the war. The Wireless Reserve, which had been run in conjunction with the Wireless Institute of Australia since 1929, conducted regular sessions in training its amateur radio operator members in RAAF procedures. When the members of the Reserve reported for duty most of them were given a short course before they took their places as operators on the many radio watches. In this way the Wireless Reserve allowed the RAAF signals organisation to meet its heavy commitments in the change to wartime conditions.

When RAAF squadrons went on overseas service, radio operators and mechanics went with them. Warrant Officer C. V. Smith was the radio operator mechanic on a No. 10 Squadron Sunderland when it made the first RAAF operational flight in World War II. The flying boat was fitted with the R1082/T1083 radio installation. Three squadrons went to Malaya, where their radio operators and mechanics gave valuable service both on the ground and in the air.

To overcome shortages in signals musterings, the Womens Auxiliary Australian Air Force was formed in March 1941. The initial intake included telegraphists, and the training of more telegraphists, teleprinter operators and signals office clerks followed. The training of WAAAF radar



The RF unit and power supply of an AT26 transmitter, in use 1952.



General view of RAAF Radio Transmitting Station, 1963.

operators started in 1942. The first WAAAF signals officers were Flight Officers O. A. Wooster and L. M. Bailey. WAAAF radio personnel served in signals offices, DF (direction finding) stations and radar stations in the southern areas of Australia and as far north as Townsville. They made a major and valuable contribution to the efficiency and effectiveness of the radio organisation.

To assist the Royal Air Force with Far East communications networks, six RAAF signals officers were sent on loan to Singapore in November 1941. One of these officers, Flight Lieutenant A. E. Tinkler, after being in charge of the Inter-Command WT Station, became the last chief signals officer of the RAF Far East prior to the fall of Singapore. After the capitulation of Singapore and Java, five RAAF signals officers became prisoners-of-war. In Japanese POW camps, Flying Officer W. M. Moore, a RAAF radar officer who had been attached to the RAF and had erected radar stations in Malaya and Singapore, built radio sets concealed in water bottles and the soles of wooden clogs to bring news to the prisoners-of-war.

After joining the RAAF in 1925, Flying Officer C. S Wiggins specialised in radio. He was seconded to the Department of Civil Aviation for special duty in 1937 but he was recalled to the RAAF for wartime service. He became Director of Signals in July 1940 and as a Group Captain he was responsible for the RAAF signals officer Headquarters Allied Air Forces and RAAF Command. For this outstanding service and the generation of the high standard of the RAAF signals organisation in World War II, Group Captain Wiggins was awarded the CBE.

Radar brought new and pressing demands to the RAAF. After studying the new technique in the United Kingdom, Wing Commander Pither directed the RAAF radar organisation in the formation of 146 radar stations and the installation of several hundred aircraft radar sets.

The LW/AW Mark 1 radar set was the outstanding air warning ground radar and its use was a major factor in the successful conclusion of the war. This transportable set operated on a frequency of 200MHz with a peak power of 10 to 15 kilowatts, a PRF of 50Hz and a pulse width of 20 microseconds. The 32-element array, when crated ready for transport, weighed 2½ tons. The transmitter and receiver were developed by Radiophysics Laboratory and manufactured by the Gramophone Company Ltd, and the aerial array was designed and built by the NSW Department of Railways.

The ground radar stations were often located in remote and isolated places and the operation of these stations was carried out under the most arduous conditions. Despite the poor conditions, irregular food supplies and the extreme tedium of the work, the staff of the radar stations maintained an ever vigilant watch. Their work was not glamorous and, because of the secret nature of their task, few outsiders knew of the excellence of the work they carried out; their reward was the pride of accomplishment.

When Darwin was bombed on 19th February, 1942, Pilot Officers H. W. Hannam and B. L. Glassop were installing the first Australian radar station. To make best use of the radar warnings and to control fighter squadron operations, a fighter control sector was developed. The requirement was vague. As radio officer of the sector, Flying Officer A. L. Northey was responsible for providing a communications network. The links with the radar stations, radio direction finding stations and aircraft were developed by trial and error, but the sector control system was built up to become a model for the mobile fighter control units formed later for the island campaigns.

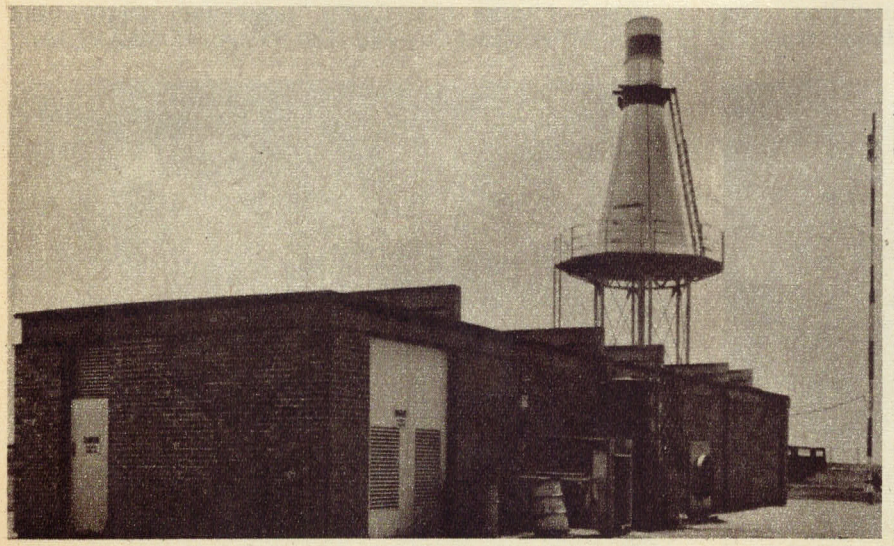
In June 1943 the RAAF Headquarters WT station moved from Victoria Barracks to a gracious old two-storey mansion in Canterbury, Victoria, and became known as Frognall. Squadron Leader A. C. A. McBride was the commanding officer of the unit during the peak period of operation when it handled over 8 million groups of traffic a month. With an average of over 10,000 messages per day, Frognall was the largest station of its kind in the British Commonwealth.

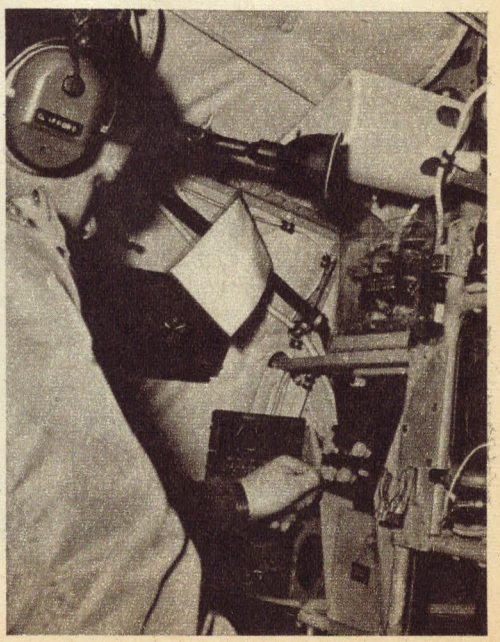
High frequency transmitters in stations at Point Cook, Laverton and Ballarat were operated from Frognall. Mainly Australian-made transmitters were used at these stations and included the AT16, AT18 and the AT20 transmitters. The 500-watt AT20 transmitter was designed as a ground station unit for fixed and mobile applications. It became the most successful transmitter of its type during World War II and was produced by both Standard Telephones and Cables Pty Ltd, Sydney, and Eclipse Radio Pty Ltd. Both the AT16, 15 kilowatts, and the AT18, 20 kilowatts, were built by Standard Telephones and Cables Pty Ltd, Sydney.

A remote receiving station at Werribee was used by Frognall. Most of the receivers for the HF circuits were the very successful AR7s which had been made by Kingsley Radio Pty Ltd.

Throughout World War II members of the RAAF radio organisation served in all theatres of war. In Timor in 1942 they operated behind enemy lines. They operated in Sunderland flying boats and other reconnaissance aircraft seeking out enemy submarines and protecting Allied shipping.

In addition to signals office, transmitting station and

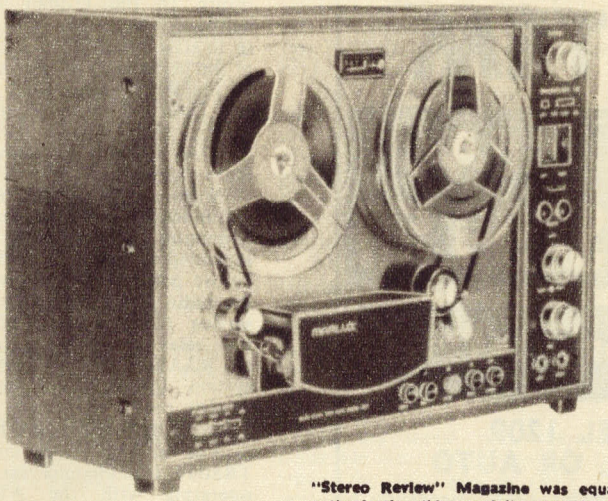




ABOVE: An RAAF Tacan station in 1967. RIGHT: The radio operator's position in a modern aircraft. Despite the complex systems now carried, miniaturisation has made possible the compact installation shown.

ENCEL BRINGS YOU GREAT VALUE AND QUALITY IN 4-TRACK TAPEDECKS

AUTO/REVERSE MARLUX 407—ONLY $425.00!



The Marlux 407 has all the features that make a great recorder—push-button solenoid control of tape motion, hysteresis synchronous capstan motor, supply and take-up reel motors for smooth tape spooling, electrical speed change, tape tension control for standard and thin base tape etc.

American High Fidelity Magazine reviewing Marlux 407 enthusiastically says—"the unit offers high performance and versatility in a well-engineered and handsomely-styled open reel format aimed at the serious home tape enthusiast. Especially notable are its low wow and flutter, low distortion, excellent signal to noise ratio, absolute meter accuracy and smooth extended response. Thanks to its careful engineering and construction it is a pleasure to use and to listen to.

"Stereo Review" Magazine was equally enthusiastic. "A carefully thought out and well-made machine. In an A-B comparison of input and output signals, virtually no difference could be heard between them at 7½ ips." Marlux 407 offers 4 heads which allow reverse play plus off-tape monitoring. Frequency response — 30-20,000 Hz at 7½ ips, 40-16,000 Hz at 3¾ ips. Two speeds — 7½ and 3¾ ips, rewind or fast forward time — less than 60 seconds for 1,200 feet.

As the magazine "Audio" says in its review—"Marlux 407 is certainly a lot of tape machine for the money. It would make a fine addition to any good quality stereo system, bar none!"

At the Encel price of only $425 it is outstanding value! *

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3100/e — Encel price $26.50

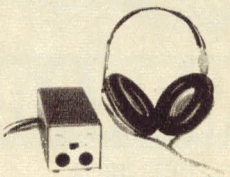
A top-quality magnetic unit approved for use in broadcasting stations throughout Australia in systems that meet the Australian Broadcasting Control Board standards.
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Cleans recordings automatically ahead of the stylus. Weighted base requires no fixing.
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RENOWNED STAX SR-3 STEREO HEADPHONES

(with SRD-5 adaptor)
World's finest electrostatic headset.
Hi-Fi News Review states, "response is very smooth with no obtrusive peaks or colouration . . . a sense of realness about the sound . . . comfortable to wear for extended periods.
They are by no means expensive and are probably better than any other headphones at present available, certainly better than any we have tried."
Australian Hi-Fi in a recent review says: "We performed comparison tests between Stax headphone and our monitor speakers and decided that our monitor speakers will have to go! These headphones offer a performance, which, while not perfection, is the nearest thing to it which we have yet experienced in either speakers or headphones."
Encel price $76.50. *
NOTE: Ask for copies of reviews from authoritative technical journals on all items marked.*
All prices quoted include Sales Tax.

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MICRO MR-211 TURNTABLE

A 4-pole hysteresis, synchronous, outer-rotor motor and feather-touch selector gives positive 33 1/3 and 45 R.P.M. Static balance S-shaped tone arm, fully compensated, accepts standard ½in mounting cartridges. Oil-damped lift. Baseplate silver finished, mounted in wooden base with plastic cover.
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MICRO MR-111 TURNTABLE

Engineered for high-quality reproduction. Vibration-free belt drive: 33 1/3 or 45 R.P.M. Baseplate matt black. High-precision tone arm and hydraulic lift.
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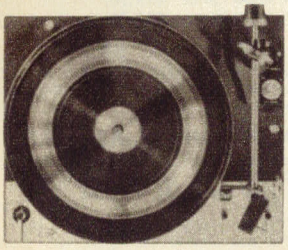
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Absolutely complete—ready to plug in—no extras to buy. Here's a wonderful opportunity to obtain a splendidly matched Hi-Fi System, with superb sound, at far, far below usual price. Normal price for this system is $644, but we have cut the price to $499.50.
What a buy!

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NEW Dual RECORD PLAYER



MODEL 1209
MANUAL OR AUTO

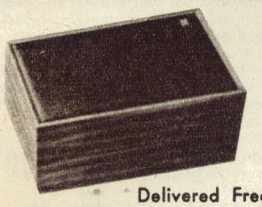
4 pole shielded motor, non magnetic T/T4.2lb weight, Quality Tone Arm, Anti-Skate Adjustment, Pitch Control, Cue Control, 3 speeds — wow and flutter less or equal to 0.09%. Fitted with Shure M55E Magnetic Cartridge (Elliptical Stylus) and complete with player base and perspex cover. Changer facilities if required.

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Monarch A5000 Specifications. 30 watts RMS per channel at 8 ohms. Harmonic Distortion 0.2% at 25 watts. Frequency response 20-40 KHZ. Hum and Noise—60dB. Controls—input selector, mode switch, tape monitor, volume, balance, treble, bass controls, speaker switch A. B or A plus B, loudness, HI filter, Low filter and phone jack. Walnut housing.



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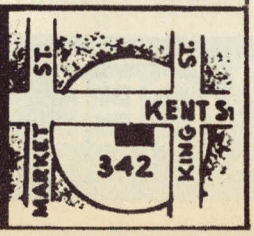
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receiving station work they operated switchboards, manned radar stations and maintained radio equipment in squadrons wherever the RAAF served. In Australia, they trained men and women for radio service and serviced and repaired radio equipment in depots. RAAF officers filled radio staff appointments in Australia and with the RAF and US Forces.

Peace came in 1945 and, for many thousands of radio members, with it came a return to the civilian way of life – to continue where they left off six years before or to start a new life. For those who remained in the permanent Air Force there was the task of building a peace-time radio organisation. As Director of Telecommunications and Radar, Wing Commander J. W. Reddrop directed the re-establishment of the RAAF radio organisation for nine years.

Working on a 24-hour basis, Frognall continued as the centre of the RAAF communications network. But post-war plans remained undefined and several years elapsed before peace-time plans were formulated for the radio organisation. In becoming the first service to introduce automatic telegraphy tape relay operation to its network in 1949, the RAAF brought a faster and more accurate system to its communications. The new system produced a very efficient network, operated by RAAF and WRAAF operators.

For aircraft VHF communications the TR5043 four-channel set remained in use, operating with the AT17 VHF ground transmitter. From plans written in 1949, a new air-ground-air HF system was established to control reconnaissance, bomber and transport aircraft. But the equipment used included the same sets produced for World War II.

In 1952 the RAAF received its first new post-war ground radio equipment in response to RAAF specifications. The 5 kilowatt HF AT26, designed for fixed and mobile use, was installed for CW, SSB and FSK (frequency shift keying) circuits. The AT25 was introduced for MF beacons. The AT24 20KW transmitter was introduced specifically for meteorological broadcasts, which had been a RAAF responsibility since 1930. All three transmitters were made by Standard Telephones and Cables, Sydney.

After the war, No 1 Air and Ground Radio School at Ballarat became the only RAAF radio training centre. Ballarat had been the site for No 1 Wireless Air Gunners School which started in 1940 and the new school took over the buildings which had been used for WAG (Wireless Air Gunner) training during the war. The signaller, replacing the WAG, was trained at Ballarat. The post-war school also trained radio mechanics, telegraphists and WRAAF teleprinter operators. The school was transferred to Laverton in 1961. From 1940, in the 21 years of residence in Ballarat the two schools had trained 20,000 members for the radio organisation.

This training had been supplemented by radio apprentices since 1948. This scheme has represented a good source of radio officers. At least 26 per cent of radio apprentices have been commissioned. D. R. Johnson and R. J. Clark, two of the first apprentices to be commissioned, are now serving as wing commanders.

A. G. Pither became the first RAAF cadet to enter the Duntroon Military College when he joined in 1927. He completed his flying course in 1931 and, after a signals officers course in 1932, he specialised in radio. He was appointed to introduce radar into the RAAF. As Group Captain Pither, he became Superintendent of the Woomera Rocket Range in 1951. After several years as Director

of Telecommunications and Radar at RAAF Headquarters, he became commanding officer of No 1 Aircraft Depot and, later, officer commanding RAAF Laverton. For his loyal and outstanding service he was awarded the CBE.

Of the 305 radar officers who were serving in the RAAF in 1945 only four continued to serve in the post-war Air Force. It was not until 1955 that the RAAF received its first new post-war ground radar equipment. This formed the heart of a control and reporting unit at Brookvale, near Sydney. The radar and communications systems provided early warning and fighter intercept facilities. Similar, but improved, equipment was provided at Darwin about seven years later.

A mobile control and reporting unit, with radio technicians maintaining its radar and communications equipment, had also been in operation at Butterworth in Malaya. In the meantime, all signals officers had received extensive radar training and became known as radio officers.

Recently two modern mobile control and reporting units, with radar, electronic computer and communications equipment, have been added to the Air Force inventory at a cost of more than seven million dollars for each unit.

This modernisation of radio elements supporting RAAF air operations is part of a continual up-dating of the radio services of the Air Force. From its inception, the RAAF radio organisation has been among the leaders in the use of new techniques. As a part of its ground communications network, the RAAF led the way in Australia with the recent introduction of a computerised automatic message switching system. This network also uses multi-channel SSB and FSK radio circuits to feed into its communications centres.

UHF systems, including direction finding stations, have been introduced for local aircraft control. Ground Controlled Approach (GCA) equipment is used for the guidance of aircraft on final approach during adverse weather conditions. TACAN (Tactical Air Navigation) stations throughout the country provide precision distance and bearing information for TACAN-equipped aircraft.

Each of the RAAF Neptune and Orion reconnaissance aircraft now carries over a ton of radio and electronic installations. As crew members, air electronics officers operate these advanced systems. All RAAF aircraft are fitted with radio navigational aids and communications equipment for safety and control purposes. The air-ground-air communications network modernisation program is costing more than five million dollars.

Since World War II, RAAF radio members have served overseas to operate and maintain ground and aircraft radio installations in Japan, Korea, Malta, Malaya and Vietnam. Many of its members have studied new techniques and electronic systems in the United Kingdom, France and USA.

In the 50 years since the spark sets and crystal receivers were unpacked at Point Cook the RAAF radio members have kept abreast of technological developments. From the days when radio was opposed as an aircraft communications system, radio has become vital to the RAAF.

The establishment and maintenance of the efficient and most effective RAAF radio organisation of today has been an achievement in which all its members, both past and present, may enjoy the pride of accomplishment. In the future, there will be the challenge of new and exciting technological advances and their application to Air Force communications. The rapid adoption of these techniques will keep the Royal Australian Air Force in the forefront as a modern fighting service.

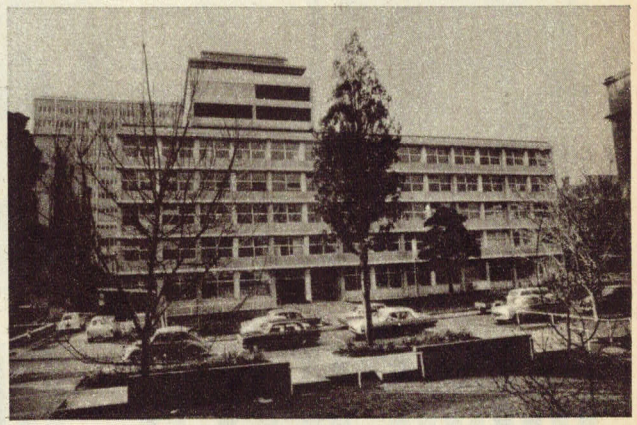
NOTES ON THE AUTHOR

Group Captain E. R. Hall joined the RAAF in May, 1937, and passed No 6 Wireless Course with distinction. After service with No 2 Squadron and Station Headquarters, Laverton, he was commissioned in 1940. As a staff officer at RAAF Headquarters in 1941, he was responsible for radio installations for Empire Air Training Schools. In October, 1941, he was posted on loan to the RAF in the Far East where he became the first RAAF officer to serve at Butterworth. He designed and directed the construction of the mobile signals unit which sent the last message from Singapore before its fall. He was a POW from 1942 to 1945.

After World War II, he filled many staff appointments, including a tour with the Air Attache, Washington, USA. For the last four years before he retired in 1968 he was Commanding Officer of the RAAF School of Radio. Group Captain Hall is a Fellow of the Institution of Radio and Electronic Engineers Australia. ■

IREE CONVENTION IN MELBOURNE

The School of Architecture, University of Melbourne, will be the venue for the Thirteenth National Radio and Electronics Engineering Convention.



The Institution of Radio and Electronics Engineers Australia has staged the convention at two yearly intervals since 1945. The first convention was held in 1938, in conjunction with Australia's sesqui-centenary celebrations, but the second was delayed because of the war. It is Australia's premier electronics exhibition, and has continued to grow in size and in stature.

This Thirteenth Convention, to be held from May 24 to 28, is expected to attract 1500 delegates, many of them from overseas, as well as from all Australian states. Apart from these delegates, who will participate in 40 three-hour technical sessions, the displays of equipment associated with the convention are expected to attract between 12,000 to 15,000 visitors during the five days of the proceedings.

The space given over to industrial exhibits in 1971, at 14,000 square feet, is nearly four times the size of the exhibits area of conventions held in the early 1960s. At the Thirteenth Convention more than 60 companies, including all the major names in the Australian electronics and communications industries, will be exhibiting.

The technical lecture program will reflect the current state of research and development in electronics science and engineering being undertaken in Australian industrial and Government research establishments. The program, restricted by available time to about 100 papers, has been carefully chosen from more than 140 papers offered.

The convention keynote lecture will be delivered by Dr B. N. Oliver, vice-president, research and development, Hewlett-Packard Company, Palo Alto, California, USA.

Other overseas speakers will include:–

Mr J. R. Pollard, special projects executive with the Plessey Telecommunications Group in the UK.

Dr W. F. Poschenrieder, Siemens AG, Munich, West Germany.

Mr W. L. Germany, director and chief engineer, Pye TVT Limited, Cambridge, UK. Mr Germany will be accompanied by two other senior engineers from Pye TVT, who will present papers on television topics.

Mr H. L. Zahn, an executive engineer with the West German Fernseh organisation who, with three of his colleagues, will present papers on colour television.

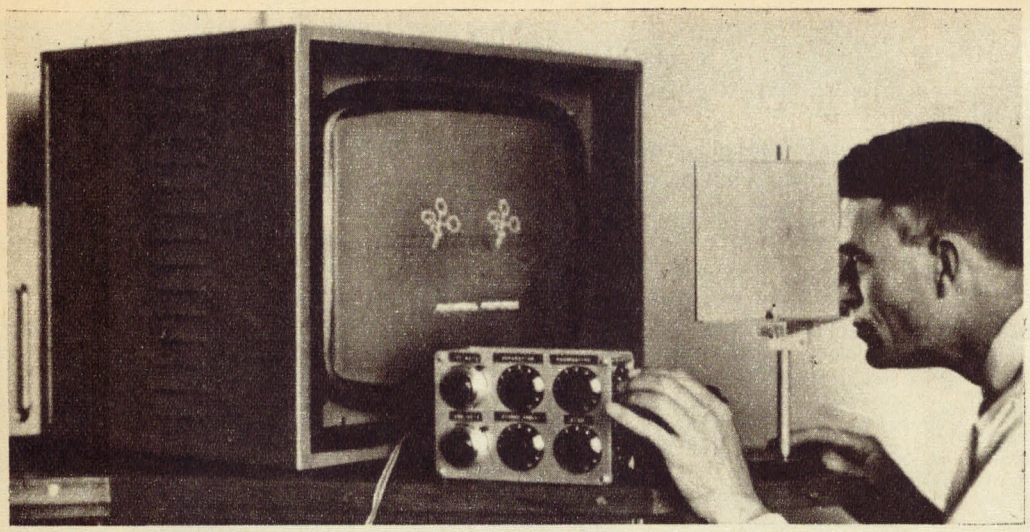
Mr D. Boswell, manager of a Hybrid Microelectronic facility operated by Standard Telephones and Cables Limited, at Paignton, United Kingdom.

Many of Australia's most notable electronics engineers will contribute to the program. Their papers will range over such widely divergent subjects as integrated circuits, videophones, computer control, computer aided design, acoustics and audio, colour television, physics and device theory, electronics hardware, equipment practice, communications systems, high-frequency measurements, radio navigation, communications theory and computer applications.

Each speaker will devote 25 minutes to the address and 25 minutes to discussion with the audience.

A new feature will be the presentation of a number of papers reporting up-to-the-minute research, details of which will be announced only shortly before the convention opening.

The social activities of the convention will include an opening day luncheon, a dinner on Wednesday, May 26 and a cocktail party on Friday, May 28. There will also be separate programs of visits to interesting technical establishments concurrently with the lecture sessions and visits and excursions for the ladies.



by W. J. Perkins
National Institute
for Medical Research,
Mill Hill, London

COMPUTER DISPLAYS IN 3-D

Complex chemical and biochemical molecule structures can be examined in three dimensions with a technique developed in the UK. The method involves the creation of stereo displays by a small computer, and the use of simple optical equipment to transform the pictures produced into representation of three dimensional structures.

Digital computers are widely used for complex or tedious calculations, while in research they find their main applications in the processing and analysis of experimental data. But if they can be employed for the preliminary assessment of ideas, they may also have an important role in helping man to think.

Analogue computers have been used in this way to simulate ideas that can be represented by mathematical models. Here the operator is provided with a visual display on a cathode-ray screen. This display may present the response of a model to changes for comparison with the system behaviour discovered by experimental data. The research worker may adjust manual controls, which represent significant parameters in the system and can thus interact directly with the computation and observe the effects of such changes on the screen. In this way, the analogue computer may be employed to test ideas and, possibly, to guide the next step in an investigation.

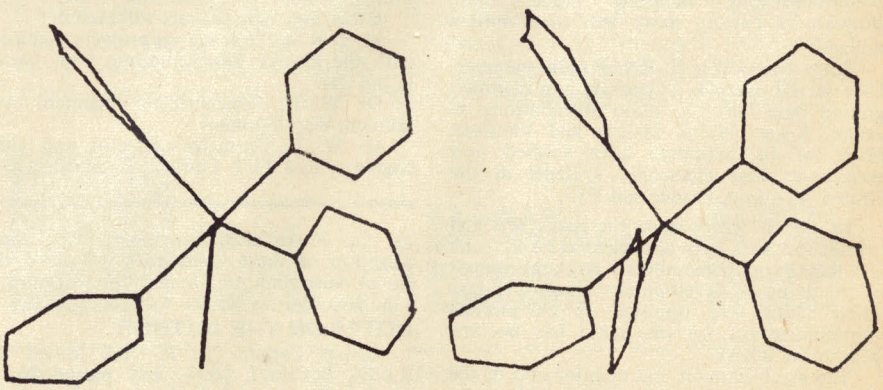
For digital computers to be used at this intuitive level, communication between man and machine must be improved in both directions. This requires visual displays and appropriate programs to allow the operator to interact with the computation by adjusting the equipment's manual controls. This method of working, however, necessitates the exclusive use of a computer system by the operator. Consequently, to be economically feasible, the cost and thus the overall size of such a system would have to be limited.

A system developed at the National Institute for Medical Research, London, is based upon a small computer, Model DDP 516, with a store of 8192 words of 16-bit length supplied by Honeywell Computers, Newhouse, Lemarkshire, Scotland. An interface unit, comprising an analogue/digital converter for eight channels and digital/analogue conversion for four channels, permits data input and output to be transferred in analogue form. The visual display unit consists of a conventional cathode-ray screen with a pen recorder to provide a permanent record of graphic output, together with a teletypewriter for printing some input instructions and output of certain information.

Programs are written to locate any two sets of co-ordinates on the display screen and to draw straight lines between them. Data presented in this form can thus be displayed as a series of vectors. Curves are represented as a sequence of small vectors, giving adequate resolution for most purposes. Interaction with the computation can be achieved by programs which allow for pre-arranged modification by means of teletypewriter instructions and analogue control devices.

A three-dimensional structure may be represented on a cathode-ray screen as a two-dimensional line image with depth indicated either by perspective or by suitable brightness variation. An appreciation of the third dimension can also be obtained by smoothly rotating the image about an axis to allow continuous observation of the changing projections as they appear on the cathode-ray display screen.

The structure may be rotated about each orthogonal axis with the necessary transformations for each projection calculated by the computer and the new position displayed. The angle of rotation about each axis is represented by voltages obtained from three potentiometers which can be controlled



Pen recordings of phosphorous pentaphenyle obtained with the equipment described in this article. Note the different angles of presentation of the two recordings, which allow them to be viewed as a stereo pair.

manually, allowing the operator to manipulate a three-dimensional structure to any desired orientation.

Consequently any structure, for which co-ordinates in three dimensions and their connectivities are known, can be displayed and manipulated. A limit to the ultimate size of any structure is set by the capacity of computer store but the small computer used at the National Institute for Medical Research was able to display structures as sophisticated as the operator could reasonably handle.

In photography, stereoscopic effects can be obtained by taking two views of an object, with the camera displaced laterally between pictures by an average interocular distance of about 2½in. When these pictures are placed side and side and observed through a system that permits each eye to see only one picture, a stereoscopic view is obtained. The ability to translate and to rotate the cathode-ray display provides similar basic facilities for obtaining stereo pairs which can be orientated to any position while viewing takes place. The display of the structure is first duplicated and the two images separated; the right-hand image is then rotated independently around the Y axis by applying a further transformation. Suitable arrangements for presenting the separate images of this stereo pair to the individual eyes is then necessary. Although the photograph opposite shows a scientist directly viewing the tube with the aid of a dividing screen, it is fairly easy to arrange a print-out of two separate line drawings, for normal stereoscopic viewing.

Initial applications for this technique have been in the study of molecular structures where the positions of the atoms in three dimensions and the bond lengths have been previously calculated from x-ray diffraction data. From this information physical models may be produced, but they are tedious to construct and somewhat inflexible.

The same data, fed into the computer together with the interactive display program, can be used to produce a computer model on the display screen that can easily be manoeuvred into position. Complete structures can thus be observed from all viewpoints, and particular orientations selected to demonstrate specific features. A permanent record of the display can then be taken on a pen recorder suitable for reproduction as a stereo pair. This saves considerable time, both in the selection and the drawing of such complex structures.

Selected parts of macromolecules may be displayed and the conformation studied for comparison with other experimental information. A title is provided for each molecular display and individual atoms are labelled. These labels are used to locate any particular atoms and they may be included in the display. The display can also be changed by the alteration, addition or subtraction of data, allowing the operator to insert and test new ideas and theories.

As an alternative display form for a permanent record an anaglyph may be produced in which the two images are drawn in different colours with sufficient separation to avoid overlapping. Fusion of the images is obtained by viewing through spectacles with appropriate colour filters for each eye.

In biomedical research for which displays were originally developed, the addition of the third dimension to the displays has been of immediate value in the study of molecular structures. Consideration has been given to other applications, including vectorcardiography, electron microscopy, x-ray image analysis, electro-encephalography and stereotaxic measurements. Many more potential applications will, no doubt, be found, apart from biomedical research. ■

The International Telecommunication Union (ITU) in 1971

The year 1971 will be marked by extensive activity in the field of space telecommunications and by continued planning, standardisation, and co-ordination work in all sectors of telecommunications.

Two events of paramount importance in the field of telecommunications in 1971 will be the world administrative radio conference for space telecommunications, and Telecom 71, the first world telecommunications exhibition. Both are being organised by the International Telecommunication Union (ITU) and will be held in the Palais des Expositions, Geneva, Switzerland.

World Administrative Radio Conference for Space Telecommunications (WARC-ST), generally known as the Space Conference, will be held from June 7 to July 17. It is considered to be one of the most important conferences which the ITU has held for the past 25 years, and will bring together delegates from more than 100 countries.

The object of the space conference will be to consider, revise and supplement the administrative and technical provisions of the Radio Regulations which affect space communication. A special joint meeting of CCIR study groups to prepare the technical bases for this conference was held in Geneva from February 3 to March 3.

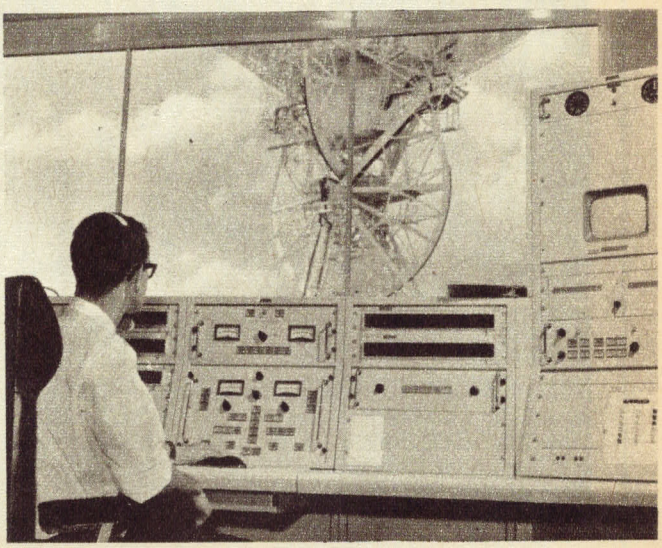
Seminars, symposia and an international festival of films on telecommunications and the use of electronics in modern life will also be held in connection with Telecom 71.

World-wide TV special. A one-hour television special, called "Mondovision", will be broadcast from Geneva to more than 800 million viewers throughout the world on June 17 to mark the opening of Telecom 71. Intelsat has offered the ITU free use of its satellites for the program. The practical details of the broadcast will be organised by the European Broadcasting Union.

Other activities held or planned for the first half of this year are as follows:

Plan committee for Africa. The regional plan committee for the development of the telecommunication network in Africa was held in Lagos, Nigeria, from January 18 to 27 to establish a general plan for the international telecommunication network based on short-term estimates until 1974 and long-term estimates until 1978.

Administrative council meeting. The 26th session of the ITU administrative council, composed of the representatives of 29 countries, will meet from May 1 to 21. In addition to consideration of ITU activities and administrative and budgetary questions, the council will discuss the different questions posed by the convening in 1973 of the Plenipotentiary Conference which is the supreme organ responsible for revising the International Telecommunication Convention, the treaty binding the member countries to the ITU.



Australia, with its six space tracking and communication stations, has a vital interest in this year's space conference. The control console of the Honeysuckle Creek station is shown (right).

Telecom 71 will take place from June 17 to 27 during the space conference and will have the theme "Message for the 21st Century". The first world telecommunications exhibition, it will cover all fields of telecommunications, including broadcasting, television, electronics, data transmission, audio-visual media, and related fields.

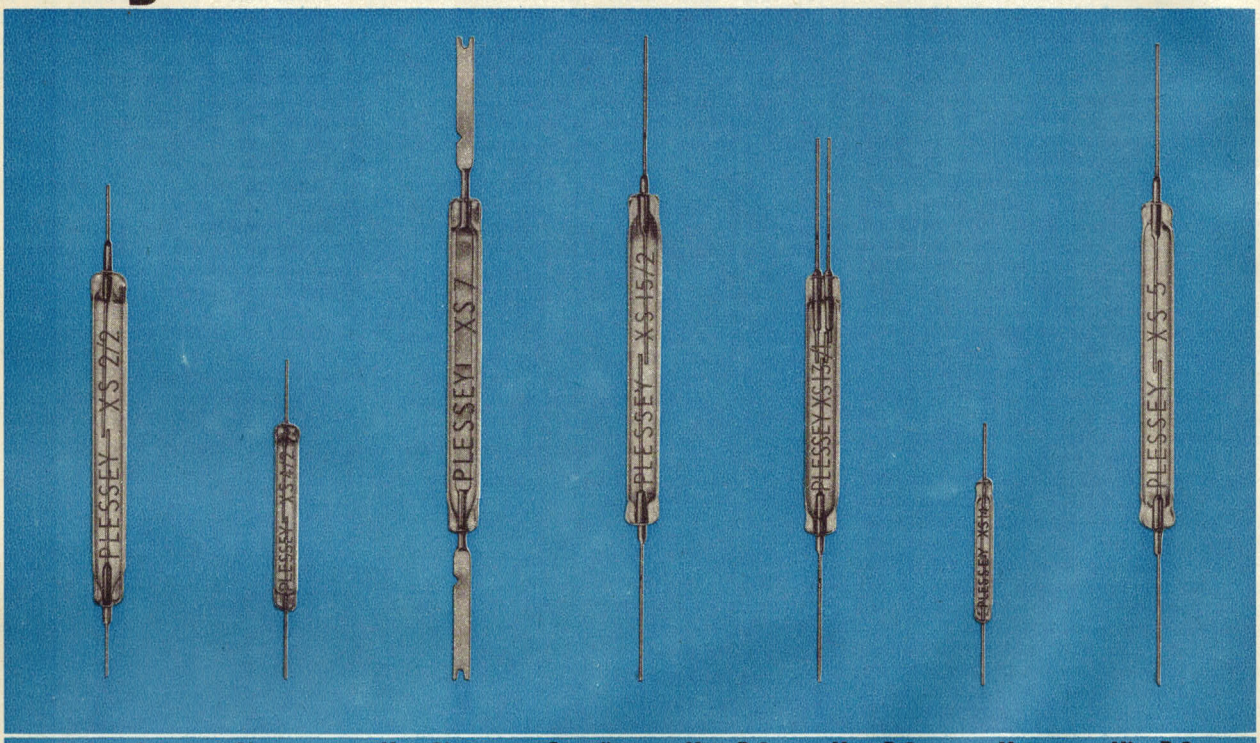
Telecom 71 will provide an opportunity for the public and experts from throughout the world to assess the important part played by telecommunications and electronics in the modern world. It will also allow the representatives of the world telecommunications industry to assess their ability to meet the ever-increasing demands in telecommunications, information processing, and mass communication.

From the vast panorama of all the telecommunications equipment and systems, it should also be possible to discern the broad outlines of the development of modern media which will have a considerable impact on the world of tomorrow.

Third World Telecommunication Day, on the theme "Space and Telecommunications", will be celebrated by ITU member countries all over the world on May 17. It provides an opportunity to tell the public about the various aspects of telecommunication techniques, and for bringing home the importance of these techniques in the modern world.

Further details of these and other ITU activities may be obtained from the International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland. ■

PLESSEY
Dry Reed Inserts



Preferred Types	Glass Length (inches)	Max. Glass Diameter (inches)	Overall Length (inches)	Max. D.C. Switched Current	Max. D.C. Switched Voltage	Max. Switched Load Watts	Min. D.C. Breakdown Voltage
XS2	2.0	0.217	2.75	0.5	250	15	750
XS4	1.1	0.156	1.815	0.15	250	5	500
XS5	2.0	0.217	3.6	0.5	250	15	750
XS7	2.0	0.217	3.6	0.5	250	15	750
XS13	1.375	0.25	3.1	0.25	250	10	300
XS14	0.83	0.125	1.5	0.1	250	3	400

Plessey Dry Reed Inserts offer extreme life and reliability since their contacts are totally sealed within an inert gas-filled glass envelope. A range of standard, miniature and subminiature types is available which includes both single pole "normally open" and single pole changeover configurations. Associated bobbins, coils and suitable biasing magnets are also available.

The bobbins employ a unique patented method for retaining the insert in position, providing secure anchorage and facilitating replacement when necessary.

Operation

Operation of dry reed inserts is by a magnetic field which can be generated by a coil or permanent magnet. The combination of a coil and reed insert offers a relay of the highest professional standard. In this form dry reed inserts are used by the million in telephone systems and similar applications.

Application

Plessey Dry Reed Inserts are used with alarms, control systems and fail-safe devices of every kind. The high speed of operation permits their use in monitoring movement of fast reciprocating and rotating parts. Furthermore their low contact resistance enables them to handle signal level currents, while types are available handling several amps. This versatility is far greater than that provided by any other single type of switch or relay.

Full technical information and application data available on request from Professional Components Department, Villawood, N.S.W. or Plessey Ducon Interstate Offices.

PLESSEY
Ducon

Plessey Ducon Pty Limited
Box 2 PO Villawood NSW 2163
Telephone 72 0133

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Adelaide	76 3434
Perth	21 4821
Auckland (N.Z.)	78 509

AD6

FLUXMETER CHECKS SATELLITE POWER

In-orbit testing of satellites in Britain's "Skynet" defence communications system has proved a difficult task, and has necessitated the development of specialised testing equipment. One such instrument is discussed in this article.

The master plan for the in-orbit testing of Skynet communications satellites called for accurate measurement of the microwave power/unit area – "flux" – received from the spacecraft at the surface of Earth. These measurements were required for contract purposes, for diagnostic purposes and to enable calculations to be made of the spacecraft effective radiated power (ERP).

It was therefore decided to construct a special equipment which would primarily be for the measurement of 7.3GHz flux, but which would also include a facility for polarisation determination. This equipment, the Fluxmeter, was to be as small and as simple as possible in order to facilitate accurate calibration, to give high reliability and to allow of easy transportation.

Prior to the development of the Fluxmeter, most flux measurements had been made with large terminals. However with such terminals there are considerable difficulties in arriving at the accurate calibration of aerial gain. Errors also arise because of variations in aerial gain and in tracking performance, and because of gain variations and non-linearities in the complex terminal equipment. As a result, it is difficult to achieve repeatable results and, in practice, measurement error may well be as large as 1dB RMS. By using a small aerial, most of the above errors are greatly reduced.

Essential design considerations for a Fluxmeter must include:

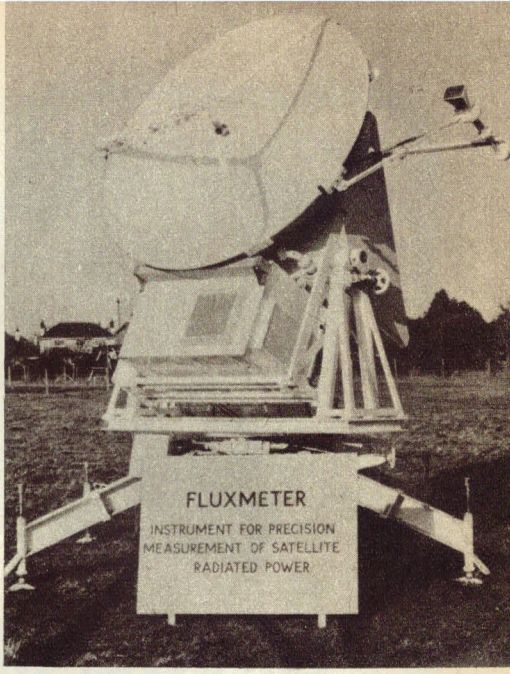
(i) an aerial of known gain;
(ii) an accurate standard of microwave power (four are available);
(iii) a stable and linear receiver, which incorporates a true square-law detector, to compare the flux received by way of (i) with that generated by (ii).

In the SRDE Fluxmeter, item (i) is a 1.8-m diameter parabolic aerial with circularly polarised feed; but also included is a plane-polarised standard gain horn for measurement of the polarisation of the spacecraft radiation. Item (ii) can be any one of four sources incorporated in the instrument, and item (iii) is a receiver where power comparison is performed by adjustment of IF (70MHz) precision attenuators so as always to keep the detected output power constant.

The manually steered parabolic aerial has a focal length/diameter ratio of 0.25, gain 38.38dB and axial ratio 1.1dB; and the horn has gain 21dB and an axial ratio in excess of 40dB. The aerial, horn, power standards and microwave receiver are all mounted on a two-wheel trailer. Three waveguide switches allow the receiver to be connected either to the dish, the horn or the power standards

The horn is mounted on an in-line rotating joint so that the variation in flux with polarisation angle can be explored, variation in joint loss with rotation angle being very small (0.02dB). The receiver incorporates a tunnel-diode amplifier (noise figure 5.5dB). Signals are mixed down to a first IF of 70MHz and then to 10.7MHz.

Receiver bandwidths are defined by the use of temperature-stabilised crystal filters at the latter frequency. Signal level is detected by a true RMS metering circuit and displayed on a 10-inch chart recorder and a digital voltmeter. The IF receiving equipment is mounted in two racks. If necessary, for example in the event of electrical mains failure, the equipment can be run from a small petrol-engine driven generator.



The SRDE Fluxmeter for precision measurement of satellite radiated power.

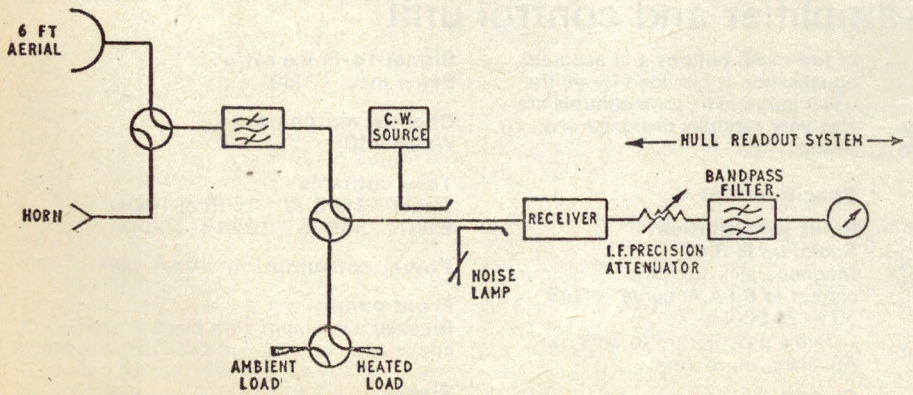
The four standards of microwave power built into the Fluxmeter are:

(i) a noise lamp and directional coupler assembly having an effective noise temperature of 930 degrees K (error 8°K);
(ii) an ambient temperature matched load;
(iii) a heated matched load (600°K), which is still under development;
(iv) a continuous wave (CW) source providing calibrated signals between -100dBM and -140dBM. By combining the calibration of these four standards a composite calibration can be derived for the most convenient standard, that is the noise lamp. Receiver noise bandwidths of 8.66KHz, 607Hz and 44Hz are provided to achieve signal-to-noise ratios of at least 10dB with the weak spacecraft signals (between -120 and -140dBM). Because of the narrow bandwidths in use, the local oscillators must have high frequency stability (four parts in 10^9hour). The 44Hz bandwidth is achieved using a special frequency-locked receiver and is only required when the horn is in use.

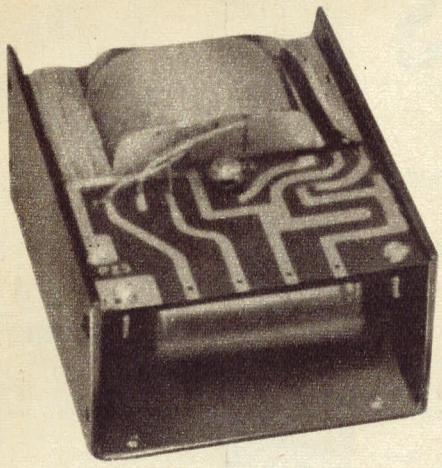
Up to the time of writing, the Fluxmeter had been involved in four official Skynet tests: three ERP tests and one axial ratio test. In all cases, repeatability and agreement with the best available pre-launch figures has been remarkably good. In fact, for the communication channels, mean in-orbit data and pre-launch data for peak ERP has not differed by more than 0.2dB.

The Fluxmeter could be used as a test instrument for satellite communications systems other than Skynet and NATO types, but the down frequencies would have to be around 7.3GHz. All calibrations of the microwave components have been performed at that frequency and use at any frequency far removed from 7.3GHz would entail a comprehensive re-calibration program.

(Condensed from an article by A. C. Hay and A. McCulloch, Signals Research and Development Establishment (SRDE), Ministry of Technology, Christchurch, Hampshire, England.) ■



Block schematic diagram of the Fluxmeter.



PZ.5 and PZ.6 Power Supply Units

Two types of mains-power supply units are available for use with Sinclair high fidelity equipment. For the majority of domestic applications the PZ.5 will be found completely adequate. Where very low-efficiency loudspeakers are used, however, it will be necessary to use a PZ.6 Stabilised Power Unit. Use of the latter is also indicated where maximum outputs are required from the amplifier system under extreme operating conditions.

PZ.5
Unstabilised power supply unit recommended for two Z.30 amplifiers and Stereo 60 for all average requirements.

Specifications

Output:
30 volts/1·5 amps maximum.

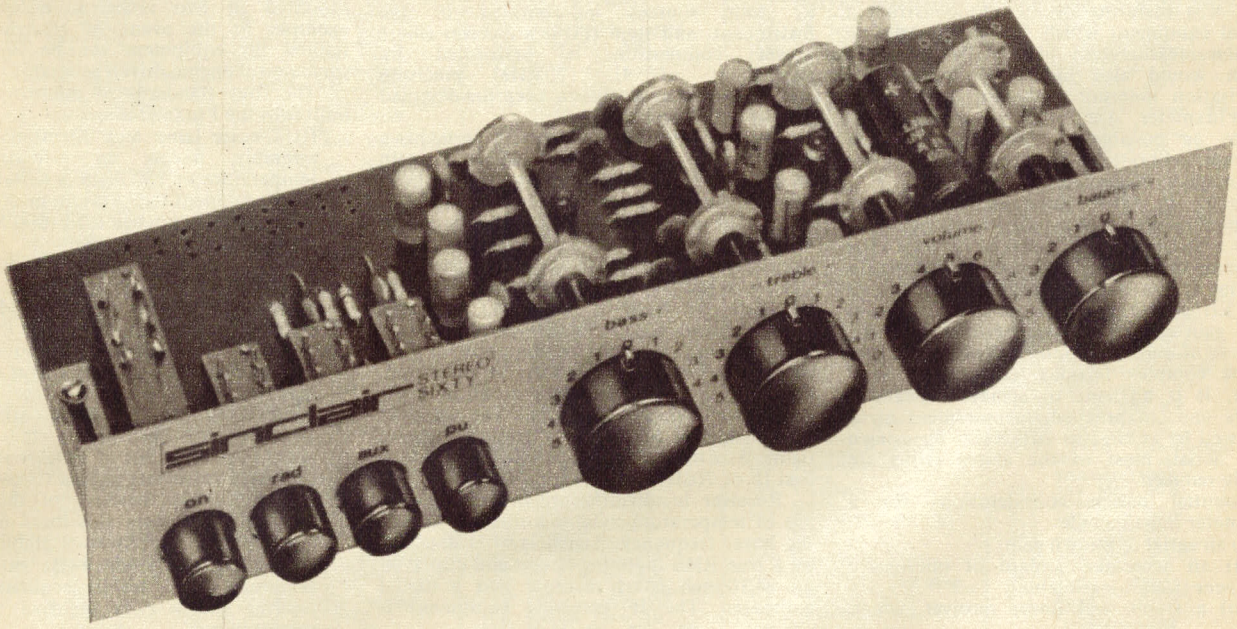
Mains input:
110-240 volts ± 20% 50/60Hz.

Size:
3·9″ × 2·8″ × 1·6″

PZ.6
Stabilised mains supply unit delivers 35 volts at 1·5 amps with ripple less than 20mV at any output up to maximum current.

Size:
3·9″ × 2·8″ × 1·6″.

SINCLAIR PRODUCTS for the ELECTRONIC CONSTRUCTOR



Stereo Sixty Pre-amplifier and control unit

Elegantly modern design with original concepts in circuitry make this pre-amp and tone control unit meet the most stringent high fidelity standards. Basically it is for use with two Z.30 amplifiers powered by a PZ.5 (or PZ.6), but it is equally satisfactory used with other good power amplifiers. Silicon epitaxial planar transistors are used throughout and a very high signal-to-noise ratio has been achieved together with excellent channel separation. The unit is very easy to mount in cabinet or modern plinth with motor and pick-up assembly.
Input selection is by means of four push buttons and accurate equalisation is provided for all the usual inputs. The tone controls are also very carefully designed and tested.

Specifications

Input sensitivities:
Radio: up to 3mV
Magnetic pick-up: 3mV
correct to R.I.A.A. curve ± 1dB
20 to 25,000Hz
Ceramic pick-up: up to 3mV
Auxiliary: up to 3mV.

Output:
250mV.

Signal-to-noise ratio:
Better than −70dB

Channel matching:
Within 1dB.

Tone controls:
Treble +15dB to −15dB at 10kHz
Bass +15dB to −15dB at 100Hz.

Power consumption: 10mA. max.

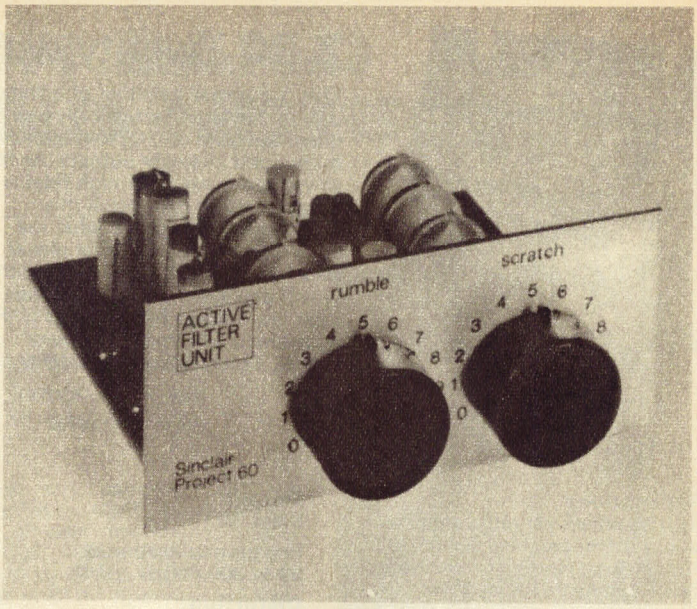
Front panel:
Brushed aluminium with black knobs and controls.

Size:
8¼″ × 1⅝″ × 3½″.

GE:P560A

Active Filter Unit

The Sinclair Active Filter Unit is a new addition to our Project 60 range of high fidelity modules and is designed to complement the other modules in the range. Its performance is such, however, that users of other amplifier systems might well consider adding it to their assemblies.
The purpose of a filter unit is to reject frequencies above (scratch) or below (rumble) a specific cut off frequency when these frequencies contain unwanted interference. The Sinclair A.F.U. is unique in that the cut off frequency is continuously variable for both the scratch and rumble units and, as the attenuation in the rejection band is rapid (12dB per octave), the removal of interference can be achieved with less loss of the wanted signal than has previously been possible.
Each channel of the A.F.U. has an overall gain of unity and, as the imput impedance is high and the output impedance is low, it may be connected between the pre-amplifier and power amplifier sections of any amplifier. Both amplitude and phase distortion have been made quite negligible by the careful design and the large amount of negative feedback employed.



Specifications
Designed for connection between the Stereo 60 pre-amplifier and two Z-30 or Z-50 power amplifiers.
Employs two Sallen & Key type active filter stages, the first being a rumble (high pass) filter and the second a scratch (low pass) filter. The two stages use complementary transistors to minimise distortion.
Supply voltage 15 to 35V
Current 3mA max. Gain at 1kHz, filters flat 0.98 (—0.2dB)
H.F. cut off (—3dB) variable from 28 kHz to 5kHz
H.F. filter slope 12dB/octave
L.F. cut off (—3dB) variable from 25 Hz to 100 Hz
L.F. filter slope 12dB/octave
Distortion at 1kHz (35v supply) 0.02% at rated output (250m V R.M.S.)
Frequency response, flat position, 35 Hz to 20kHz—1dB
25 Hz to 28 kHz—3dB
Built, tested and guaranteed



IC.10 Integrated Circuit 10 watt amplifier

The Sinclair IC.10 is the world's first monolithic integrated circuit high-fidelity amplifier and pre-amp. It has 5 watts R.M.S. output (10w. peak). The circuit is a specially processed silicon chip, one-twentieth of an inch square by 0·01 inch thick, containing 13 transistors, 3 diodes and 18 resistors. This, together with its connecting pins, is bonded to the supporting heat sink which runs through the solid plastic package in which the circuit is encapsulated. The resultant product is infinitely more rugged than any amplifier ever made available before to the public. The IC.10 is a true high-fidelity amplifier possessing distinct advantages over conventional types. The most important are complete freedom from thermal runaway and very low distortion level. Thus battery operation is perfectly satisfactory. As an audio amplifier, the IC.10 requires only the addition of components such as tone and volume controls. However, it can also be used in many other applications including servo amplifiers, etc, since the circuit is d.c. coupled in both its sections. The manual provides details of an extraordinarily wide range of applications together with all necessary instructions.

Specifications

Output:
Class AB. 10 watts peak, 5 watts R.M.S. into 3 Ω with 18v. supply.

Frequency response:
5Hz to 100kHz ± 1dB.
Total harmonic distortion less than 1% at full output.

Power gain:
110dB (100,000,000,000 times) total.

Supply voltage:
8-18 volts.

Sensitivity:
5mV.
Input impedance adjustable externally up to 2·5 MΩ for above sensitivity.

Size:
1" × 0·4" × 0·2".

Circuitry:
3 transistors in pre-amp; 10 (including two power types) in power amplifier. Both sections are d.c. coupled, and a high level of negative feedback is applied over all. With a transistor cut-off greater than 500MHz, the pre-amp can be used as an RF or IF stage and the whole IC.10 used as a radio receiver without the need to add further transistors.

Full range of Sinclair Products obtainable from Goldring Engineering (A'asia) Pty. Ltd.
See over for address details.

GE:P560B



Z.30 Twenty watt high fidelity amplifier

This is a power amplifier of advanced design, having a fantastically low distortion level of 0·02% at maximum output and all lower outputs. As far as we know, no other high fidelity amplifier made can match this specification, no matter what the price. Nine silicon epitaxial planar transistors are employed in circuitry which enables the Z.30 to operate from any voltage from 8 to 35 without adjustment and from any power supply. Essentially a high fidelity power amplifier of the very highest standards, the gain of the Z.30 is such that it can be fed directly from a crystal pick-up enabling it to be used in an economy battery operated record player for example. The versatile Z.30 has very many applications, however, ranging from high fidelity to P.A. and laboratory work and these are fully detailed in the comprehensive manual included with the unit, which is supplied built, tested and guaranteed.

Applications
Hi-fi amplifier: car radio amplifier: record player amplifier fed directly from pick-up: intercom: electronic music and instruments: P.A.: laboratory work, etc. Full details for these and many other applications are given in the manual supplied with the Z.30.

Specifications

Power output:
15 watts R.M.S. (30 watts peak) into 8 ohms using a 35 volt supply: 20 watts R.M.S. (40 watts peak) into 3 ohms using a 30 volt supply.

Output:
Class AB.

Frequency response:
30 to 300,000Hz ± 1dB.

Distortion:
0·02% total harmonic distortion at full output into 8 ohms and at all lower output levels.

Signal-to-noise ratio:
Better than −70dB unweighted.

Input sensitivity:
250mV into 100K ohms.

Damping factor:
> 500.

Loudspeaker impedances:
3 to 15 ohms.

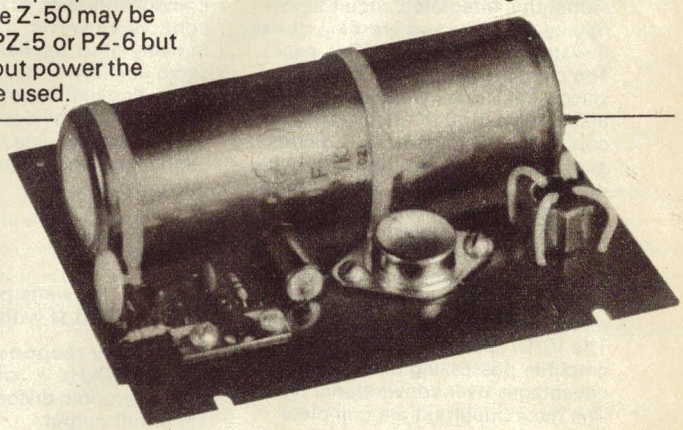
Power requirements:
From 8 to 35 volts d.c. (the Z.30 will operate ideally from batteries if required).

Size:
3½" × 2¼" × ½".

Z-50 Forty Watt RMS (80 watt peak) High Fidelity Power Amplifier

The Z-50 has been designed for applications requiring higher output power than the Z-30. The maximum supply voltage is raised to 50 Volts and the output power is 40 watts continuous R.M.S. in to 3 or 4 ohms and 30 watts continuous into 8 ohms. The Z-50 is otherwise identical to the Z-30 in design and specification, the increased power being obtained by using much higher current power transistors used well within their rated limits. The Z-50 is, of course, compatible with the other Project 60 modules, such as the Stereo 60. Where the full output power is not required the Z-50 may be used with the PZ-5 or PZ-6 but for the full output power the PZ-8 should be used.

This unit is a stabilised power supply providing 45 volts at up to 3 amps. It is supplied without mains transformer as it is designed for use with a readily available "Radiospares" unit. Z-50 built, tested and guaranteed



PZ·8 Power Supply Unit

PZ-8 45 volts power supply unit for use with **Z-50** amplifiers Available with or without mains transformer.

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GE:P560C

TECHNICAL DIGEST

Ceramic filters suitable for television IF strips

Ceramic filters capable of operating effectively at VHF seem likely to displace conventional tuning coils in the IF strips of television receivers, and in channel filters for community antenna TV systems.

A ceramic filter element with a strong physical resemblance to the germanium point-contact diodes that started the solid state revolution for aperiodic circuits may do the same for periodic circuits. The resemblance is especially close toward the end of the production process, where the elements are batch processed in a wafer of about the same thickness as those used in semiconductor diodes. Scribing separates the elements, which are mounted in the same all-glass, hermetically sealed package used for diodes.

The ceramic elements – called Piezonators – were developed at the Wireless Research Laboratory of the Matsushita Electric Industrial Co. They operate in the 30 to 200MHz range of the VHF band, which makes them ideal for use in the video IF amplifiers of TV receivers and also as CATV (community antenna TV) channel filters. Matsushita expects to tool up for filter production, design a colour TV set using them, and put the set on the market within a year.

The new material is a lead titanate with a small amount of dopants. With a dielectric constant of about 200, an order of magnitude lower than that of previous materials, the material operates at higher frequencies by reducing stray capacitance and maintaining a sufficiently high impedance for matching to the circuit. The material has a very high electromechanical coupling coefficient, and it is this which gives the broadband response, because of directional characteristics that can be controlled to give a high coefficient for desired modes and a low one for undesired modes. Its physical structure minimises spurious response due to mechanical coupling.

Piezonator material starts with a thickness of 500 microns to counteract warping during firing. After firing, wafers are ground and lapped to about 120 microns for use in the 50MHz region. A final reduction in thickness to within 0.5 micron of the target puts filters within 100KHz of design value. Final frequency is adjusted by controlling the thickness of electrode material evaporated on the wafer's faces.

Polarised wafers are scribed and diced to produce filter element chips. Because of the resulting rough edges the chips are symmetrical on a microscopic scale, which further reduces spurious response by scattering and dissipating unwanted modes. Chips are mounted in glass packages between a nailhead and a pointed spring contact that applies a predetermined pressure on the middle of the chip. This point-contact mounting contributes to low vibration loss. Insertion loss is only about 5 or 6 decibels.

The new filter elements have arrived on the scene at the right time, because it is just becoming possible to build monolithic ICs with the required gain at video IF amplifier frequencies. But the value of an IC amplifier disappears if the TV set still uses conventional filter circuits.

For example, current Matsushita colour sets require a total of seven interstage transformers and wave-traps, a trimmer capacitor, three fixed capacitors, and two trimmer resistors in the frequency selective circuits of the video IF amplifier. Two large shielded enclosures must be used to prevent inductive component coupling from degrading circuit performance. What's more, the components need 10 adjustments after assembly to assure desired frequency characteristics.

All these components can be replaced by two Jaumann-type ceramic filters, one at the input to the IF amplifier and the other between the IF amplifier and video detector. The input filter – the more complex of the two – contains a ferrite-core transformer, a fixed capacitor for tuning, two ceramic filter elements, and a fixed capacitor for balance. The design uses the antiresonant frequency of one ceramic filter element to give about 26dB attenuation of the sound IF frequency of the channel being received. The antiresonant frequency of the other ceramic element is used to reject the adjacent channel. This filter replaces both the traps and bandpass filter used in a conventional colour TV. Initial versions of the filter require one tuning adjustment, but company engineers say coils requiring no adjustment can be produced.

The output filter – which needs reject only what remains of the received channels' sound IF frequency – can be simplified and has only one ceramic filter element and a balancing capacitor.

The company's 110MHz CATV channel filter is similar to the TV input filter but uses a trimmer capacitor rather than a fixed capacitor for balance. The trimmer is needed to obtain balance at the higher frequency, but is may be possible to use a fixed capacitor in the future. And for CATV two Jaumann filters in cascade can provide a channel filter with a wide bandpass and good selectivity.

A ceramic filter has also been developed at Matsushita for automatic fine-tuning circuits. Two transformers and three capacitors, which require two adjustments, can be replaced by one ceramic filter that requires no adjustments. ("Electronics", 28/9/70.) ■

Unique "battery" is really a capacitor

An energy-storage device not strictly a battery but which still exhibits extremely good charge retention and recharge capability has recently been marketed in the USA by Gould Ionics Inc. The device is an electrolyte capacitor-type device which will hold its charge at more than the 97% level for well over 16 months. As well as packing an extremely high capacitance into a small area, thus providing very compact capacitors for long term counting and timing applications, the device is being tested for supplying volatile avionic memories with standby power.

The device is called an energy-storage device, or ESD, and contains a solid electrolyte of extremely low conductivity (less than 10^{-1} mho/cm). Two electrode wafers separated by an electrolyte wafer apparently give capacitance values up to 300F/in . The discharge characteristics resemble those of electrolytic capacitors in that current flows during charge and discharge, unlike dielectic capacitors where current does not flow in the device itself.

The company also hold a patent on another solid electrolyte battery for non-reserve applications which can be stored for over 10 years and will operate from -65°to 160°F. A special high-temperature version has recently been introduced for operation at 350°F for over 26 days. This type has been used for deep-well drilling where high temperatures are normally encountered. ("Design Electronics", January, 1971.) ■

HI-FI is more harmonious with SONY AMPLIFIER/TAPE DECK combinations



TA-1144 Amplifier

This integrated Stereo Amplifier assures superior sound even at low frequencies. Output of 30 watts RMS per channel for wide dynamic range with very low distortion. Can be used separately as a pre-amplifier or power amplifier for use with other external stereo equipment or in a multichannel system. Very advanced controls, too.

SPECIFICATIONS: POWER AMPLIFIER SECTION—Power output: max. power, 150w both channels. Rated 30w per channel RMS. **Harmonic distortion:** less than 0.2% at rated output (20 Hz-20kHz). **Intermodulation distortion:** (60 Hz:7 kHz = 4:1): less than 0.2% at rated output. **Power band width:** 10 Hz-50 kHz (1HF). 20 Hz-20 kHz at rated output. **Freq. response:** 15 Hz-300 kHz ±2 dB. **Signal-to-noise ratio:** better than 90 dB. **Damping factor:** better than 70 (8 ohms). **PRE-AMPLIFIER SECTION—Inputs:** PHONO-1, PHONO-2. TUNER, REC/PB, TAPE, AUX-1, AUX-2, AUX-3. REC OUT, PRE-OUT, REC/PB. **Harmonic distortion:** (at 1 kHz) TUNER, AUX-1, AUX-2, TAPE—less than 0.05% at rated output. **Freq. response:** TUNER, TAPE, REC/PB, AUX-1, AUX-2, AUX-3—10 Hz-100 kHz ±2 dB. PHONO-1, PHONO-2, R1AA equalization curve ±0.5 dB. **Signal-to-noise ratio:** PHONO-1, PHONO-2 better than 70 dB (1.2 mV). TUNER, TAPE, REC/PB, AUX-1, AUX-2, AUX-3 −90 dB (150 mV). **Dimensions:** 16⅝ (W) x 5 13/16 (H) x 12⅝ (D). **Weight:** 17 lb. 1 oz.



Lowest priced quality Tape Deck TC-352D

Three separate heads for erase, record and play back—ideally isolated from one another. You can monitor tape while you record so you make sure you are recording exactly what you want. Frequency responses on standard tape are 30-20,000 Hz at 7½ ips, 30-13,000 Hz at 3¾ ips, 30-7,000 Hz at 1⅞ ips. Special tape selector for optimum performance whether you use standard or SLH tape. Retractable pinch roller for quick and easy tape threading and automatic shut-off for really fool-proof operation. World-renowned tape recorder technology at a popular price . . . with smart appearance to enhance your decor.

To: **Jacoby Mitchell & Co. Pty. Ltd.,** 469-475 Kent Street, Sydney, N.S.W. 2000.

Please send me information on the Sony TA-1144 Amplifier and the TC-352D Tape Deck.

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DIGEST

REMOTE CONTROL PARACHUTE FOR EMERGENCY DROPS

A remotely controlled parachute that "homes in" on a selected landing site after deployment at transonic speeds has been developed in the Sandia Laboratories of the USA's Atomic Energy Commission, at Albuquerque, New Mexico.

The parachute is guided by an operator who uses a small radio control console similar in some respects to those used by model aeroplane enthusiasts. By manipulating the control device lever, the operator opens and closes specially designed flaps on the parachute canopy. This turns the parachute to left or right and controls the angle at which it glides downward.

The operator, located either on the ground or in an aircraft, guides the parachute with the aid of television. The screen gives him a bird's eye view of the landing area as recorded by a small gyro-stabilised television camera located in the payload, suspended by the parachute shrouds.

Without radio control, such parachutes miss their target centres by an average of about 150 feet for every 1,000 feet of descent. With radio control, the error has been reduced to about seven feet per 1,000 feet of descent.

Still greater accuracy may be achieved with automated guidance, through which the system would "lock in" to a radio signal, and guide the parachute to the target area without need for manual control.

"An obvious future application is the delivery of supplies either to marooned people or to devastated areas," says Alan Y. Pope, Sandia's director of aerothermodynamics. "It also could be used to direct mail or high priority goods."

Pope sees these parachutes being used to drop lifeboats to survivors of capsized ships, or to deliver emergency supplies to remote areas stricken by natural catastrophies such as the recent Pakistani cyclone disaster.

"If this system had been on hand and ready for development at the time," said Pope, "a single C-5A could have solved all the medical supply problems faced by the victims in one day."

In such situations, guided parachutes carrying supplies could be landed where needed – outside a hospital area, for instance, or in a village square. Pope said supply loads of up to five tons "should be no problem" for the new system.

Considerable remote guidance work has been done at Sandia with Para-foils and other parachute types. However, these were suitable only for low speed deployment. The system now being tested can be deployed at velocities both below and above the speed of sound.

The parachute – designed by W. B. Pepper of Sandia's Rocket and Recovery Systems Division – is a modified version of a standard heavy-duty 32 panel ribbon design, measuring 24 feet in diameter.

The lower five feet of the canopy is lined with nylon cloth and fitted with four flaps – one opposing pair for glide control and a second opposing pair for roll (turn) control.

Two glide flaps, each two panels wide and five feet high, are interconnected by cable so that as one opens the other closes. Either forward or backward glide, at an angle 20 degrees from the vertical, can be achieved by this method.

Two "butterfly" roll flaps, located 90 degrees from the glide flaps, are interconnected so that as the clockwise portion of both flaps close, the counterwise portions open. When the portions located on the clockwise sides are open, the system will roll counterclockwise.

The flaps are opened and closed by means of cables attached to small windlasses driven by reversible electric motors. In turn, the motors are controlled by radio signals transmitted from the control console.

Flight test models of the new system were produced by Sandia's Rocket and Recovery Systems Division, with assistance from personnel in the Labs' Upper Atmosphere Project organisation. Sandia is a research and development laboratory of the Atomic Energy Commission. ("Electronics Weekly", 2/12/70.) ■

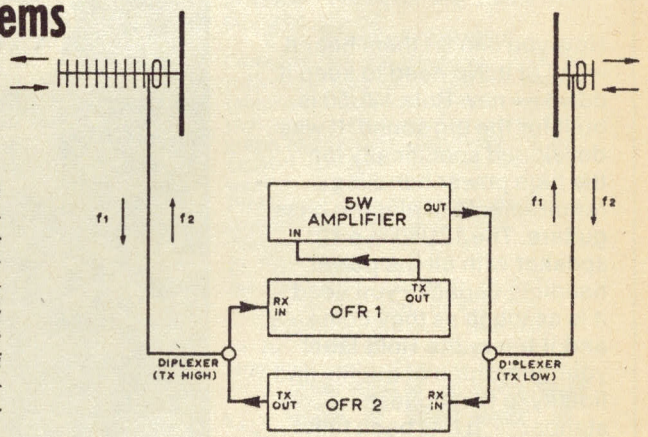
On-frequency repeaters for mobile systems

Pye Telecommunications Ltd, in the UK, has developed an On-Frequency UHF Repeater (OFR) which, the company claims, not only makes the greatest possible use of frequencies, but also simplifies operation and gives the user economic advantages.

The Pye OFR provides a simple and effective method of extending the range of UHF mobile radiotelephones without additional radio frequencies. It operates in the frequency band 450-470MHz.

The OFR overcomes a number of difficulties associated with area coverage beyond that obtainable with a single base station. These difficulties are usually resolved by additional base stations which operate on separate frequencies, involving further frequency allocation and introducing linking and control problems. The OFR is especially valuable in schemes involving personal radiotelephones, where equipment size limits power and operating range. One or more repeater stations can be used to improve communications in selected areas. The equipment is compatible with existing schemes and can be added without adverse effects. The economy in frequency allocation which the OFR provides is an advantage in the planning of schemes.

An OFR station (see diagram) for two-way operation comprises an outward path repeater (OFR 1), a return path repeater (OFR 2), two diplexers and two special antennas for linking the base station and the additional area to be covered.



Schematic diagram of a typical 5W On-Frequency Repeater station. The 12-element Yagi antenna on the left side is beamed towards the base station while the three element Yagi at right is directed towards the additional service area.

Each path repeater consists of a high gain UHF amplifier which is built on a single panel. The input and output frequencies are identical and the gain of the amplifier is adjustable up to 100dB maximum. The outward path repeater provides an RF output of 0.5W but a power amplifier can be included to increase the output in this direction to 5W. The return path repeater operates at lower orders of signal strength, with inputs down to 0.5uV (p.d.) from mobiles in the additional area. The repeater station site must be carefully chosen to obtain the necessary input levels.

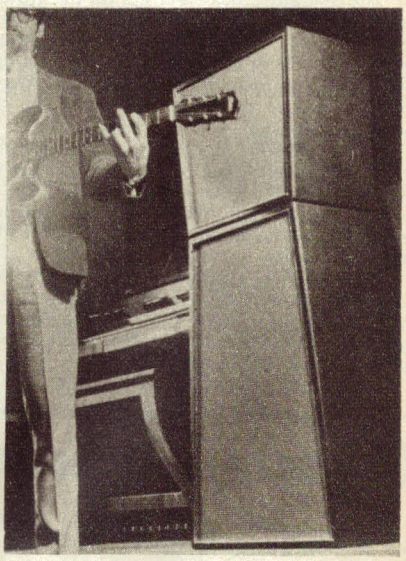
The antenna installation can be varied to meet scheme requirements; a typical installation has a 12-element Yagi antenna, beamed towards the base station, diplexed to the input of the outward path repeater and the output of the return path repeater. A 3-element Yagi, having a 60° beamwidth to provide coverage of the additional area, is similarly diplexed to the outward path repeater output and the return path repeater input. A screen is fitted behind each antenna to reduce mutual coupling to a minimum. The antennas are carefully sited to obtain isolation in excess of the required amplifier gain. ■

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DIGEST

AUTOMATIC SLOT LOADING CASSETTE DECK

A slot loading transport mechanism for Philips-type tape cassettes, developed in Belgium by Staar SA, permits cassettes to be simply pushed into a slot in the transport to be engaged and played. The system lends itself to an automatic changer arrangement.

The basic Philips compact cassette system requires insertion of the cassette along the axes of the reel hubs and capstan. This is accomplished by broadside-loading, which is acceptable for home and portable use but unsuited for auto use where the space requirements and distraction were considered excessive.

Theo Staar, President of Staar SA, recognised this problem initially and in 1965 he filed a patent application which covered a mechanism that permitted slot-loading. As the cassette is pushed into the slot, it bears against pins attached to a plate on which is mounted the motor-flywheel-capstan system and the two hubs (figure 1). The plate is hinged at four points by parallel-action linkages attached to the main chassis. As the cassette is inserted the hubs and the capstan swing up into the appropriate openings, engaging the reels fully and pinching the tape between the capstan and pinch roller in the final position when contact is made between the tape and the head.

When the hinged plate is fully engaged, it is latched into position. Release of the plate and ejection of the cassette can be effected by several means:

1. A simple eject button which mechanically unlatches the plate.
2. A solenoid which duplicates the action of the eject button. This solenoid is connected to a sensing circuit which automatically ejects the cassette at the end of the tape.
3. This solenoid and sensing circuit provide a means of automatically ejecting the cartridge should the power be turned off while the cassette is engaged. This protects the capstan follower and tape.

Many systems have been devised to sense the end-of-tape condition. Those which sense program material are subject to unwanted false triggering by a long silence on the tape. Those which sense a conductive tab on the face of the tape are limited only to those cassettes that are so equipped. Space limitations preclude the insertion of tension-sensing switches in the cassette.

Staar devised an ingenious system based on the motion of the supply reel which avoided all of the limitations just outlined. By coupling a SPDT switch (S1) to a cam on the supply hub, shaft information is fed into the eject-solenoid circuit (figure 2).

The circuit consists of two direct-coupled transistors driving a solenoid. Ordinarily R1 and R2 bias Q1 to a cut-off condition which results in Q2 operating in saturation and activating the solenoid. When power is applied, however, the charging current of C1 drives Q1 to saturation for the brief period before the motor comes up to speed and the tape starts moving. When this occurs, the contacts of S1 alternately short C2 (through low-value resistor R5) and connect it across C1. The average recharging current of C2 is sufficient to bias Q1 to saturation, cutting off Q2 and keeping the solenoid unactivated. When the tape motion stops, C2 is either shorted out of the circuit or charged up fully. Soon Q1 is no longer forward-biased; it stops conducting and Q2 is driven to saturation, energising the solenoid. Time constants are such that after 1.5 seconds the solenoid is activated, the cassette is ejected, and the system is turned off.

Another interesting feature covered by Staar patents is the "Sensitune" device. In the basic unit, Fast-Forward and Rewind functions are initiated by the lateral motion of the Eject lever, which is spring-loaded and returns to the normal play mode when released. In the Sensitune model, this lever locks into either fast mode. An auxiliary tape head senses the program material on the tape and, in conjunction with associated circuitry, automatically senses the (minimum) four seconds of silence between selections. The circuit then automatically actuates a solenoid which unlocks the fast-mode lever, returning to the playback mode. This permits the user to skip a tune or replay a tune by simply activating the fast-mode lever in the desired direction.

A more recent development is a transport mechanism which automatically senses the end of the tape on the cassette and reverses tape direction to play the other tracks. The Fast-Forward and Rewind push-buttons automatically reverse function when the tape reverses so that the Fast-Forward button functions as Fast-Forward irrespective of the direction of tape motion.

A further development for home entertainment use is a cassette changer which incorporates the control features of the bi-directional unit just described. In this unit, a small tray which accepts up to eight cassettes is loaded on to the top of the machine. The first cassette drops into a slot, plays, reverses, plays the return tracks, and then rises to the tray. The tray advances to permit the next cassette to play. This process continues until the last cassette is played at which time the cassette returns to the tray and the mechanism shuts itself off. There is also a 24-cassette version of the changer which uses a rotating tray. ("Electronics World", December 1970.) ■

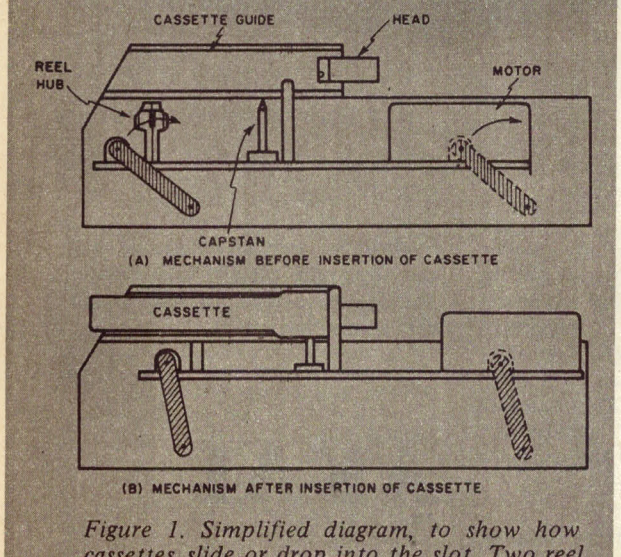


Figure 1. Simplified diagram, to show how cassettes slide or drop into the slot. Two reel hubs and capstan, mounted on a plate, move up into the cassette to drive the tape.

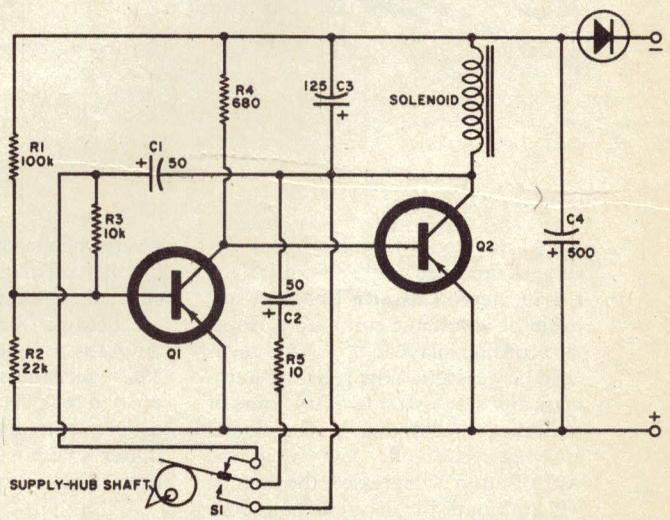
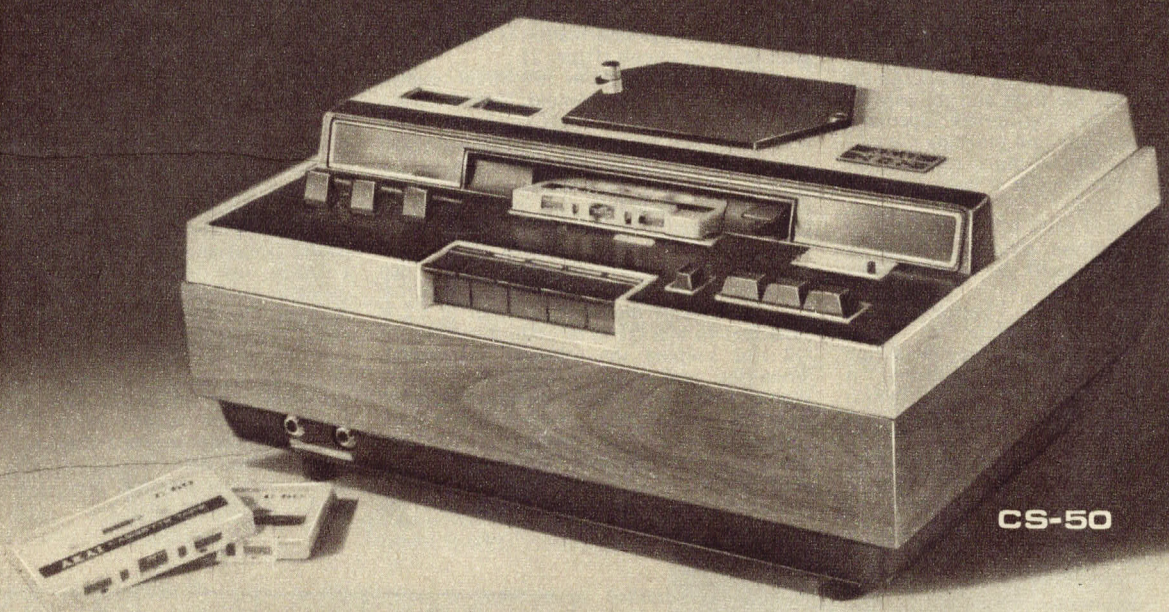


Figure 2. The cassette-eject circuit. When the supply reel stops turning at the end of the tape, the solenoid is energised. This unlatches the plate on which the hubs and capstan are mounted, and pushes the cassette out of the slot.

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SCIENTIFIC AND INDUSTRIAL NEWS

British joint conference

A conference on "Electronic Control of Mechanical Handling" will be held at the University of Nottingham, England, from July 6 to 8, 1971. It is being organised by the UK's Institution of Electronic and Radio Engineers in association with the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Institution of Production Engineers, the Institute of Materials Handling, and the National Materials Handling Centre, Cranfield. By definition, the common denoninator of all papers presented will be electronic control; it is not, however, intended that they should deal with detailed electronic circuitry.

Papers will be presented under the following broad headings: Overall management of mechanical systems; routing systems; cranes, stackers, palletisers, and robots; components and sub-systems. Further information may be obtained from the Conference Department, The Institution of Electronic and Radio Engineers, 8-9 Bedford Square, London WC1B 3RG, England.

International trade fair

An International Trade Fair, to be staged at the Sydney Showground from August 12 to 21, 1971, is attracting more exhibitors and a wider range of products than the last International Trade Fair in 1969, says a statement released by the organisers. The event this year has received the official recognition and support of the Mr Askin, the Premier of NSW, said: "My government is very pleased to be able to support the International Trade Fair in 1971. The 1969 Fair impressed me by the wide range of exhibits from so many parts of the world, including products from Eastern Europe, and I have no doubt at all that the Fair made a most significant contribution to trade and understanding between Australia and many other countries."

The exhibition is being sponsored by the Sydney Chamber of Commerce Inc, the Chamber of Manufacturers of NSW, and the Retail Traders' Association of NSW. It is the only Australian exhibition officially recognised by the Union des Foires Internationales, the official world fair organisation. It is being organised by Industrial and Trade Fairs Pty Ltd, 77 Pacific Highway, North Sydney, NSW 2060, from whom further information may be obtained.

Management seminars

Five seminars on advanced technology topics will be held between April and October by the Institute Division of Control Data Australia Pty Ltd in conjunction with Control Data Corporation's Institute for Advanced Technology in Washington, USA. Seminar leaders will be either full-time members of the Institute of Advanced Technology or US consultants under contract. The first seminar, on management information systems, will be held in Sydney on April 19-21 and in Melbourne on April 26-28. Other topics are data base and file organisation, documentation and debugging, advanced management systems analysis, and management of data processing budgets. The number of participants for each seminar is limited to 20. Inquiries to the Institute Division, Control Data Australia Pty Ltd, 283 Alfred Street North, North Sydney, NSW 2060.

Hospital maintenance

Beaumont Hospital, Royal Oak, Michigan, USA, is using a Burroughs B 2500 computer system to keep track of maintenance schedules for all equipment. The hospital's Preventive Maintenance Inspection (PMI) program was introduced by Joseph Morgan, an assistant director of the 711-bed hospital. About 3,000 items, including operating room equipment, medical testing devices, laboratory equipment, mechanical systems, and other types of machines, are filed in the computer's memory. When a piece of equipment is due to be inspected, a maintenance ticket is printed out automatically by the computer, describing the work to be done and what type of person should do the job.

Morgan notes that, "Before PMI, equipment would unexpectedly break down, wear out or give us unforeseen problems, because it was nearly impossible to manually maintain files on service schedules for the thousands of things that need periodic fixing in the hospital. Now, the computer handles the information beautifully, specifying where to get spare parts, if necessary; identifying equipment by description, location, model, and in the near future, by past service history." In addition to PMI, the computer also processes regular hospital accounting and administrative work, including a patient accounting system for in-patient and billing procedures.

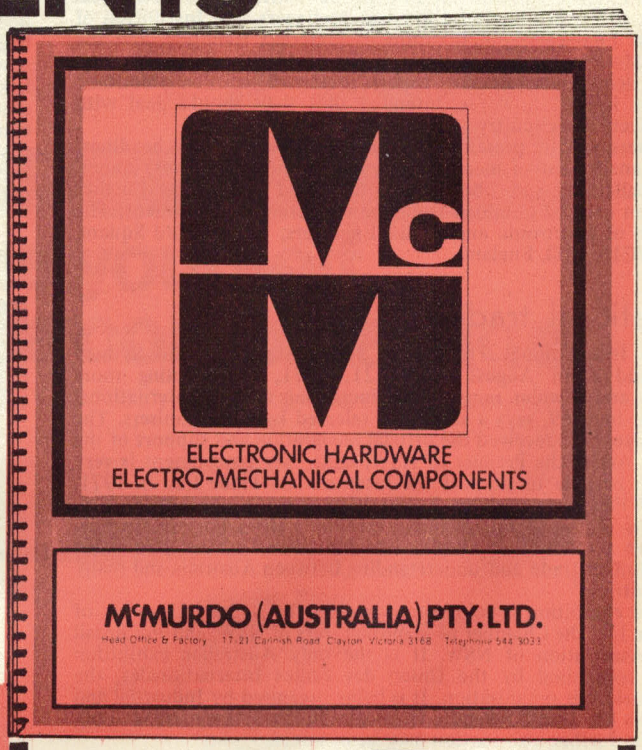
New BSR record player



The final test on a McDonald MP 60 single play unit being made by a supervisor at BSR Ltd in the English Midlands. The McDonald range, launched recently in the UK, is for the hi-fi enthusiast who prefers to make up his own installation. As well as the single play unit, there are three autochange/single play units. (BSR Ltd, Powke Dane, Cradley Heath, Warley, Worcs, England.)

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Computerised exchange

The Overseas Telecommunications Commission (Australia) has placed in order for a $1.9-million computer controlled international telephone exchange. The new exchange will be installed in the commission's second international telecommunications terminal at Broadway, Sydney, plans for which were announced recently. The contract for the supply of the exchange was awarded to L. M. Ericsson Pty Ltd, of Melbourne. Total cost, including installation and ancillary equipment is expected to be about $2.5 million.

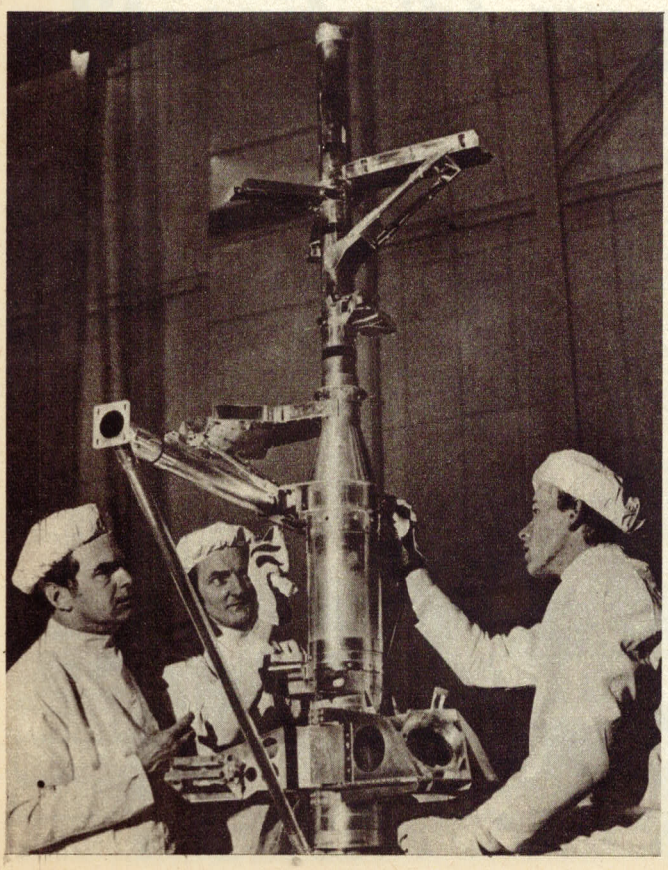
The exchange, designated as a "stored program computer controlled switching system", will be capable of handling 1,340 overseas telephone circuits. This will be in addition to the 630 circuit capacity of the commission's present conventional crossbar type automatic telephone exchange at Paddington. Although at different locations, the exchanges will work in parallel. The new exchange is scheduled to go into service in 1973. Its capacity should be sufficient to cope with demand until at least 1975. However, the exchange is capable of expansion and can form the basis of Australia's international telephone switching system until about 1985.

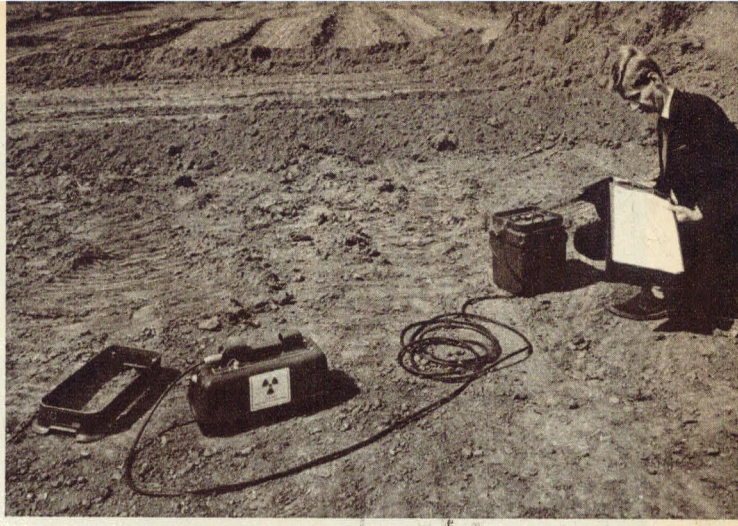
Ship-shore telephone

The Australian Post Office and the Overseas Telecommunications Commission introduced a ship/shore radiotelephone service at Brisbane on December 30, 1970. The new services permits people on suitably equipped ships, pleasure craft, or other vessels within range of the Brisbane station to have direct telephone interconnection into the Australian national telephone network. The service is continuous and standard commercial rates apply to the calls.

Lead conference

The 4th International Lead Conference will be held in Hamburg, West Germany, from September 21 to 24, 1971, under the aegis of the European Lead Development Committee. The Lead Development Association, London, is organising the technical program, and a committee representing German lead producers is making local arrangements. The program will include technical sessions (with full simultaneous translation in English, French, German and Spanish) on: Lead batteries; lead cable sheaths; new developments in lead metallurgy and technology. Further details may be obtained from the Australian Lead Development Association, 95 Collins Street, Melbourne, 3000.





A high-precision, multi-purpose system to measure quickly and non-destructively the in-place density and moisture of soils and other road building materials was featured at a recent exhibition in London. Known as the Hydrodensimeter HDM4, it will also measure the asphalt content and density of asphalt bases and surfacings. It is transistorised and incorporates a rugged scaler and surface gauge, with accessories for air-gap count ratio measurements, standardisation, and direct-transmission density determination. A sealed nickel-cadmium battery magazine provides the low power consumption required. The design provides complete safety for the operator; all high voltages are confined within the surface gauge and embedded in capsules for extra protection. Separate radioactive sources provided are small and efficiently screened. (Tellurometer [UK] Ltd, Oakcroft Road, Chessington, Surrey, England.)

Camera for Skylab

A television camera fitted with a Westinghouse secondary electron conduction tube similar to those used by Apollo astronauts is being used in an x-ray solar telescope to go on the Skylab orbiting satellite to be launched in 1972. The solar telescope has been sent aloft five times on rockets and returned with x-ray photographs. The telescope obtains high resolution x-ray photographs of the sun which are portrayed on a TV monitor and then photographed with Polaroid film. The telescope was designed, built and tested by the American Science and Engineering Corporation, Massacusetts, USA.

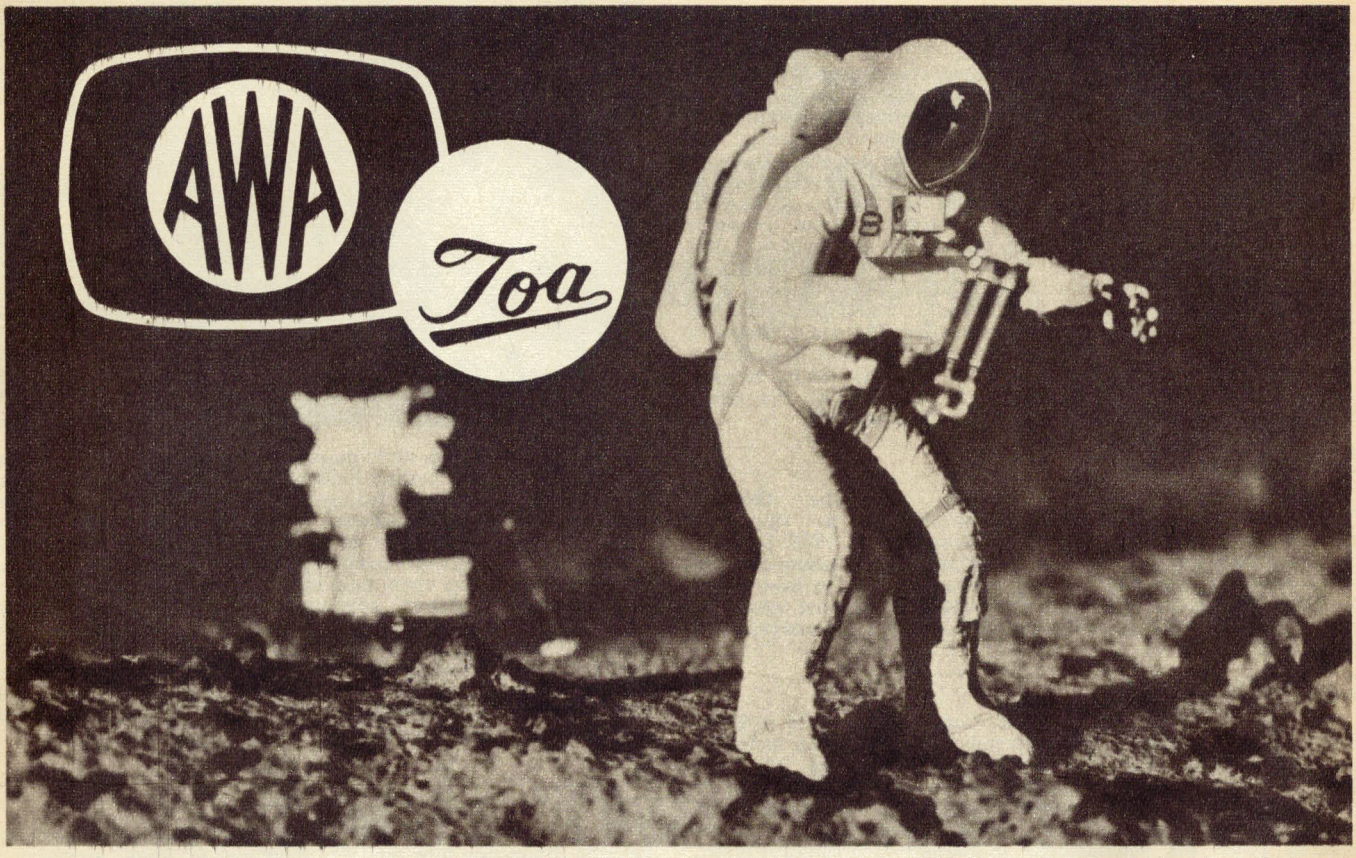
Present planning is that three teams of astronauts will go up at different intervals on the first orbiting space laboratory. The first will fly 28 days and then bring down a load of film with images obtained by the solar telescope. After a two-month interval, the second team will go up for 56 days and return with two loads of film. A month later, the third team will go up for another 56 days to complete the mission.

Laser communications

Standard Telecommunications Laboratories Ltd in co-operation with the British Post Office Research Station has developed a tiny laser, about 0.5mm long, that gives an adequate continuous output of light at room temperatures. Called a double heterostructure gallium arsenide laser, the device is a step towards the realisation of fibre optic transmission lines capable of carrying hundreds of times more information than present coaxial systems. The company states that fibre systems to be developed soon will carry as many as 100 television channels, and that such systems, using a bunch of fibres, are likely to be essential to realisation of video telephones on the scale of present audio telephone networks.

British satellite

In addition to present work on Intelsat IV satellites (which includes the construction of this lightweight mast to carry communications antennas), the space systems group of British Aircraft Corporation has received a contract valued at $1-million for the manufacture of sub-systems for Intelsat IV satellites. The group will produce further solar arrays, battery packs, wiring harnesses, spun and de-spun satellite structures, and the satellite's rocket adaptors. See also "Electronics Australia", March 1971, page 37. (British Aircraft Corporation, 100 Pall Mall, London SW1, England.)



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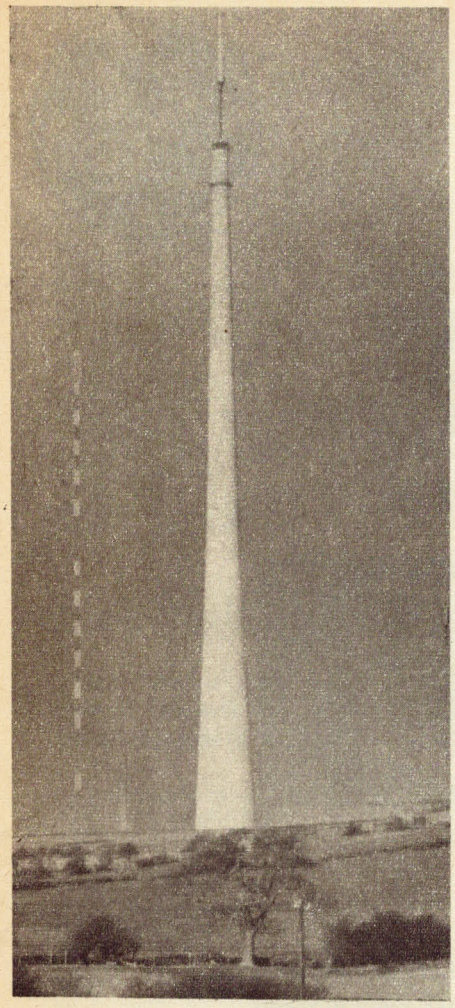
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This slender, graceful tower is Yorkshire Television's new 1080ft transmitting mast on Emley Moor, built to replace the 1265ft tubular steel structure which collapsed in March, 1969. Some 20,000 tons of concrete went into its construction. From a diameter of 80ft at the base it tapers to 20ft at a height of 900ft. On top is a 180ft steel lattice carrying the antennas.

University radio

The University of Adelaide has been granted a licence to operate its own radio station. It will operate on 1630KHz, outside the normal broadcast band, with a radiated power of 300W. It is expected to be on the air later this year. Under the terms of its licence, the station must play no music and the programs must relate only to courses provided by the university for its students. Plans for the station were announced after an anonymous donor gave the university $100,000 to establish an educational broadcast system.

Resources analyser

A system of earth resources analysis by computer controlled interpretation of aerial photographs has been introduced by Honeywell's systems and research centre in the USA. An automatic tree species classifier forms part of the system. A series of aerial photographs is studied by a skilled interpreter who assigns symbols to identify typical features such as texture, density and shape. The computer is then programmed to extract automatically those features of interest, ignoring other material. A series of photographs of the area being studied is then fed into the classifier which evaluates them in minutes. The selective analysis facility could be applied to studies of pollution, water resources, population trends, or geological problems.

Canadian conference

Scientists, engineers and other authorities in the electrical and electronic fields are invited to participate in the biennial International Electrical, Electronics Conference and Exposition to be held at Toronto, Canada on October 4, 5 and 6. More than 100 papers will be presented on electrical and electronics subjects. Further information may be obtained from Dr William V. Tilston, Chairman of the Technical Program Committee, International Electrical, Electronics Conference, 1819 Yonge Street, Toronto 295, Ontario, Canada.

News flash system

Fujitsu Ltd has manufactured two electric news flash boards to be used at the 11th Winter Olympic Games to be held at Sapporo in northern Japan in 1972. Using integrated circuits and a minicomputer, FACOM-R, the on-line electronic news flash system is the first to be used for any Olympic Games. One board will be installed at the outdoor speed skating stadium at Makomanai, where the opening ceremony will be held, and the other board at the indoor skating rink, also at Makomanai, where the closing ceremony is to be held.

The information processing of the records of events at the games will use a data communication system utilising mainly two large electronic computers, FACOM 230-60s. The news flash system will be directly connected to this data communication system. It will be controlled by the minicomputer and, at the same time, a lamp control system will be used for quick and accurate reporting of the results of events.

Teaching microscope

This Vickers 10A teaching microscope, exhibited in London recently, provides excellent optical performance and is sturdily constructed from rigid aluminium with chemical and knock resistant plastic coating on the foot and limb. Protection against damage to the coarse and fine focus adjustments is provided, and the mechanism is contained in the base of the instrument so that mechanical components cannot be interfered with.

A neat compact instrument, it is claimed to be the only low-cost teaching microscope incorporating illuminators with two built-in low voltage lamps, one for transmitted light and the other for oblique incident lighting. This allows the study of larger specimens as well as standard mounted slides.

Interchangeable inclined monocular and binocular viewing heads easily rotate on a smooth nylon fitting to any desired position with the image always remaining central during rotation. Further features are a phase contrast unit, polarising accessories, an integral condenser with aperture diaphragm, and a daylight blue filter. (Vickers Instruments Ltd, Haxby Road, York YO3 7SD, England.)

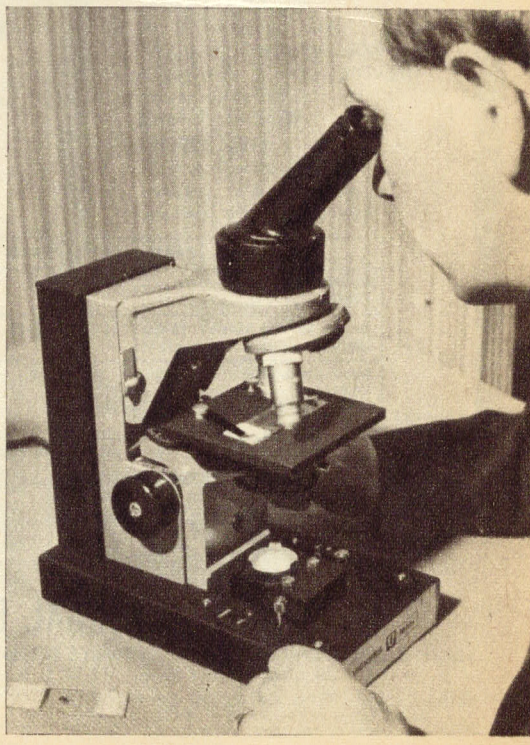
Space tracking contract

The Australian Department of Supply and the National Aeronautics and Space Administration (NASA) have completed negotiations of a new contract under which NASA will reimburse the department for the cost of maintenance and operation of its tracking stations in Australia. The new contract replaces a number of separate contracts previously covering the various stations. The stations are: Deep Space Station, Island Lagoon, SA; Deep Space Communications Complex, Tidbinbilla, ACT; Carnarvon Tracking Station, WA; Honeysuckle Creek Tracking Station, ACT; Space Tracking and Data Acquisition Network (STADAN) Station, Orroral Valley, ACT.

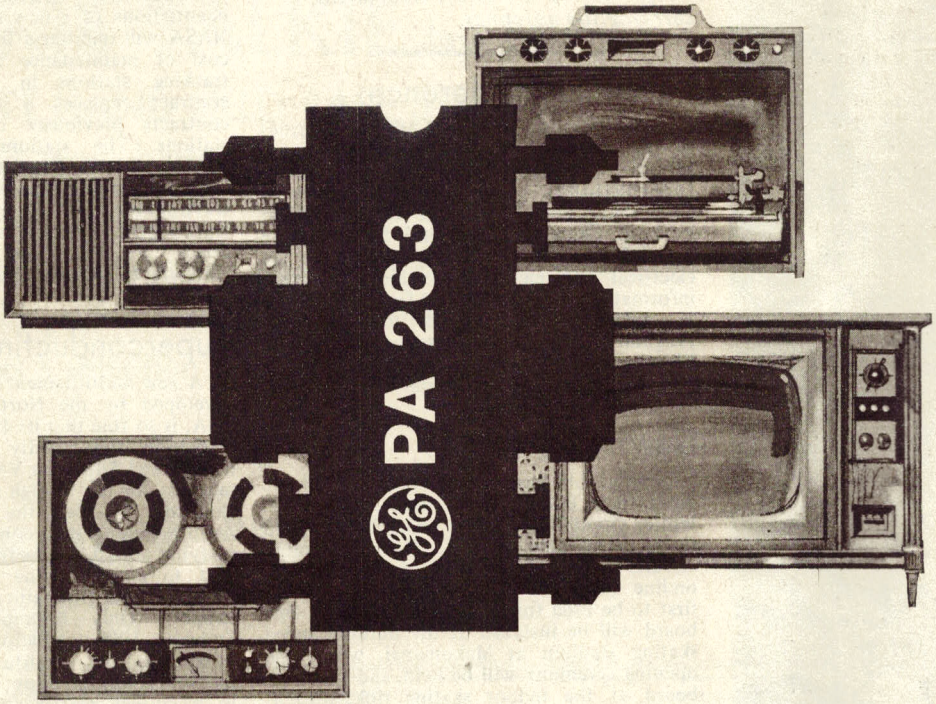
Superconducting wire

A new multifilament superconductor wire, developed by the Norton Company in the USA, is so fine that its 400 strands make up a thickeness only slightly larger than a human hair. Called Supercon VSF, it is wound round magnets for use in high energy research. It is claimed to be the first commercial multifilament superconductor capable of carrying pulsed or low-frequency AC and the first to combine fine filaments with high packing factor (the ratio of superconductor to copper). Only 0.2mm in diameter, the Supercon VSF conductor contains more than 400 highly stable superconducting niobium-titanium alloy filaments embedded in a copper matrix for high thermal and electrical stability.

By making possible varying magnetic fields of up to 100Kg with negligible losses, the new conductor extends the advantage of superconductors in nuclear research. Using the new product instead of conventional copper windings to provide the pulsed



New 3.5 watt power amp joins General Electric's IC family



Supply voltage range from 12 to 30 volts assures design flexibility for consumer audio products

GE's new PA263 integrated circuit power amplifier delivers up to 3.5 watts continuous audio power into a 16 ohm load. The device features high sensitivity—full output with as little as 9mV input open loop. Designer latitude is provided by operation over a wide range of supply voltages (12–30V) and load impedances. The PA263 is the latest in GE's family of power amplifiers for consumer audio applications (see table).

	PA234	PA266	PA237	PA263	PA246
Rated Power (Watts)	1	1.5	2	3.5	5
Supply Voltage Range (Volts)	18–25	11–25	12–27	12–30	12–37
Minimum Input Voltage (mV at full output open loop)	100	8	8	9	12
Frequency Response (± 3dB)		30 to 100KHz			

New dual-channel preamp IC teams up with five power amp IC's

General Electric's new PA239 dual-channel stereo preamp contains two identical 68 dB gain amplifiers designed to feed any of the five power amp IC's. Featuring a high impedance input (typ. 250K ohms) and very low distortion (typ. 0.5%), the device contains its own power supply filter to help back up its low noise characteristics.

The PA239 preamp requires only a few external frequency-shaping components, and is ideal for many types of consumer stereo equipment for auto, home or portable use.

For prices of General Electric's IC's in the quantities you need, write to: *Australian General Electric Ltd.*, Dept. 40-33, 103 York St., Sydney N.S.W. 2000

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magnetic fields for controlling nuclear particle motions in accelerators makes possible very substantial power savings. (Special Products Division, Norton Australia Pty Ltd, Nyrang Street, Lidcombe, NSW 2141.)

Faster Datel service

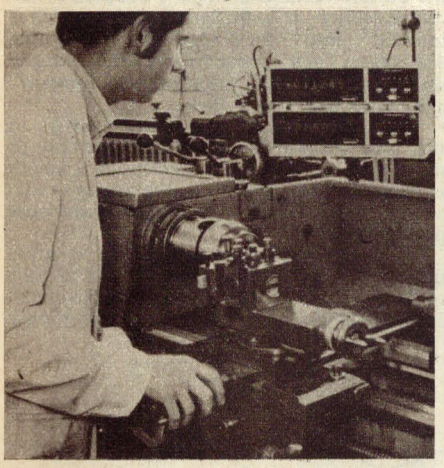
A higher speed of data transmission became available on the public Datel service on January 1. Datel provides the necessary connections through the telephone network to enable digital data to be transmitted between business premises and computers, or between computers. Modem (modulator/demodulator) equipment hitherto has operated at 200 bits per second or at 600/1200 bits. Now, however, modem units operating at 2400 bits per second have been introduced. The modem units are leased to subscribers by the Post Office. The original equipment is made and supplied by two local companies, members of the ATDA, but the 2400-bits modems are imported.

New York symposium

"Computers and Automata" is the topic of the 21st in a series of annual international symposia organised by the Microwave Research Institute of the Polytechnic Institute of Brooklyn. It will be held from April 13 to 15 in New York City, USA. Most of the papers will deal with important current problems in the design and use of computers, but the methods used and their solutions have been largely developed in connection with automata and other mathematical abstractions. Two divergent trends are represented: the very large multi-user computer systems, and the smaller special purpose computers.

The symposium will open with an introductory session of invited papers followed by a series of consecutive sessions on: programming languages; operating systems; computation complexity; logical design; and computer models. The 22nd in this series of symposia, with the topic "Computer-Communications Networks and Teletraffic", is scheduled for April 4 to 6, 1972. Further information on either symposium may be obtained from the MRI Symposium Committee, Polytechnic Institute of Brooklyn, 333 Jay Street, Brooklyn, NY 11201, USA.

Machine-to-size indicator



A Venture machine-to-size indicator in use. It gives a direct digital readout of either the amount of metal still to be removed or the amount actually removed. The compact size and economic price have been achieved by the use of a custom-designed IC. The unit is part of a range of equipment which Smiths Industries exhibited at the recent CETIA Exhibition in Sydney. (Smiths Industries Ltd, Wembley, Middlesex, England.)

New ISO president

On January 1, 1971, Francis L. LaQue, Canadian-born president of the American National Standards Institute, began a three-year term of office as president of the International Standards Organisation (ISO). He succeeds Faruk A. Sunter, president of the Turkish Standards Institution. Mr LaQue is consultant to the International Nickel Co, with which he has been associated since 1927, and is also chairman of the US Department of Commerce panel on engineering and commodity standards. He has been a forceful advocate in expanding and strengthening the participation of the USA in the work of ISO and its affiliated organisation, the International Electrotechnical Commission.

Computer aids education

An educational service, called the Total Information for Education System (TIES), uses a data processing system for 29 school districts in the Minneapolis-St Paul region of Minnesota, USA. Together they have an enrolment of some 245,000 students in 200 primary and 80 secondary schools in a seven-county area. All the district terminals, with CRT input and display units, are linked over telephone lines to a Burroughs B3500 computer at the TIES headquarters in Roseville.

Using a comprehensive and integrated data base developed for TIES, the computer processes census information, student histories and reports, activity and facility data, computer assisted instruction programs, personnel files, payroll and finance, and administrative records. The system analyses census figures to ensure that there are adequate teaching facilities for students reaching school age. When a student arrives at a school, the computer enrols him, schedules his classes, and establishes his educational record. While in school, the computer checks attendance, gives assistance in instruction, and records marks and grades. After graduation, the system monitors a student's subsequent progress by questionnaires to evaluate the the effectiveness of the education received. The system also provides a basis for prescribing individual learning experiences best suited to a student's aptitudes.

Japanese LSI council

Eleven major Japanese manufacturers have formed a technological co-ordinating body for the standardisation of their large scale integrated circuit (LSI) products. The main aims of the council are to standardise the number of pins and other basic structures of LSIs, to streamline the different manufacturing processes and shapes of LSI packages, and to standardise the levels of efficiency of LSI units by purchasing testing units. Differences in circuit arrangements and non-basic aspects will continue. It was also agreed that if any one of the 11 companies has difficulties meeting a customer's specifications, other council members will help by supplying semi-finished products. ■

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SWR Reflectometer, Slotted Line for the VHF Powermatch System

Here are two further accessories for the VHF Powermatch measuring system presented in February. One is an SWR reflectometer, the other a slotted line. Both are easy to build, and each can be of great value in checking and optimising aerial-feedline matching.

When a transmission line is used to connect a radio transmitter to an aerial, the largest proportion of RF power from the transmitter is fed to the aerial when the effective loading resistance of the aerial is arranged to match the so-called "characteristic impedance" of the line. Similarly, when a transmission line is used to connect an aerial to a receiver or receiving converter, the received signals will be fed most efficiently between aerial and receiver when both the aerial and the receiver input circuitry are matched to the line impedance.

Accurate impedance matching of transmitting aerials, receiving aerials and receiver input circuits to the transmission line is therefore quite important. This is no less true for the radio amateur than for the professional broadcaster operating at high power levels with sophisticated equipment. Faced with the limitations of a relatively modest aerial system and a relatively low level of transmitter power, the amateur must generally ensure that he is making the best possible use of his facilities.

Generally speaking, there are two practical approaches which may be followed in checking impedance matching. One approach is to connect the device to be checked to the feedline, and feed RF power along the line to it from a low power transmitter or similar source. The degree of matching can then be gauged by measuring the extent to which power is reflected back down the line. The less power reflected, the more accurate is the impedance match.

This method is quite direct, although it is usually only suitable for checking aerial matching. At the power levels involved most receiver input circuits suffer severe overload, and even if damage does not occur the input resistance may differ quite markedly from the normal value. The results may therefore be quite misleading.

The alternative approach is to actually measure the loading impedance of the device concerned, and compare it with the nominal characteristic impedance of the feedline cable. While perhaps less direct than the first approach, this method has the advantage that in the event of a mismatch, it indicates the direction in which the device impedance must be changed to improve the situation.

Neither approach offers inherently greater accuracy, nor does either offer clear advantages in terms of convenience. In fact there are times when each is preferable, either because it allows a deeper analysis of the situation, or because it allows a more rapid check on the value of modifications.

For this reason, the Powermatch system has been designed to include accessory units for both types of measurement. Two different accessories have in fact been designed to make measurements using the "reflected power" approach, and these will be described in the present article. A following article will describe a further accessory designed to make measurements using the "impedance" approach.

Why two different accessories designed for the "reflected power" approach? Again, the reason is that two different measurement methods are available, and each has advantages.

One accessory is an **SWR reflectometer** or dual directional coupler, also known as a "monimatch" or "SWR bridge". This type of device functions by directly sensing the relative proportions of RF power flowing in each direction along the feedline. The basic theory of operation was described by the author in the article "A Fresh Look at the SWR Reflectometer", in last month's issue.

The other accessory is a **slotted line**, which allows monitoring of the variations in electric field intensity associated with the "standing wave" pattern which is set up along the feedline as the result of interference between the forward and reflected power components.

Of the two types of device, the reflectometer is the more practical at lower frequencies. The slotted line must be at least a half-wavelength long, and preferably one wavelength, in order to be able to properly sample the standing wave pattern. This makes it rather unwieldy at 144MHz and lower frequencies. On the other hand it is difficult to construct a reflectometer to perform reliably at 1296MHz and higher, yet at these frequencies the slotted line becomes compact, convenient and reliable.

Each type of instrument therefore has its own sphere of usefulness, and if the amateur operates on bands covering a wide range of frequencies, the construction of both can be easily justified. This also has the advantage that the two may be used to cross-check results at those frequencies in the middle of the VHF-UHF spectrum where both are capable of reliable operation.

Like most SWR reflectometers which have been described, the unit presented here is based on the configuration shown in figure 1. It consists of three short sections of transmission line, arranged in such a way that the outside sections are lightly coupled to the centre section. It is the latter section which is inserted into the feedline connecting transmitter and aerial, while the outside sections are used to monitor the "forward" and "reflected" power flow.

As normally described, reflectometers of this type generally consist of an assembly of metal rods or wires, mounted inside a length of large-diameter tube. For the average radio amateur, this type of construction can pose problems.

For example he may well find it quite difficult to obtain short lengths of rod or tube of the required diameters, in a suitable metal. Metal suppliers are generally loath to supply

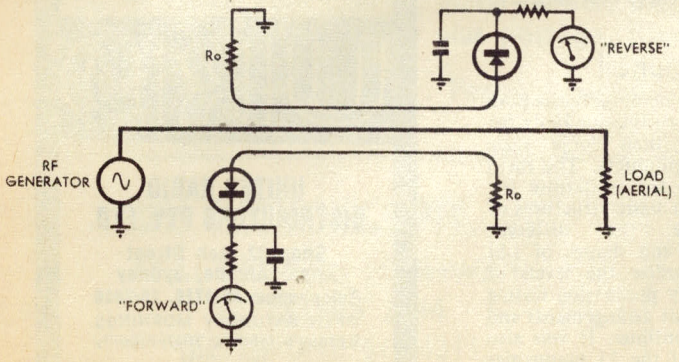


Figure 1: The basic configuration used for the SWR reflectometer accessory.

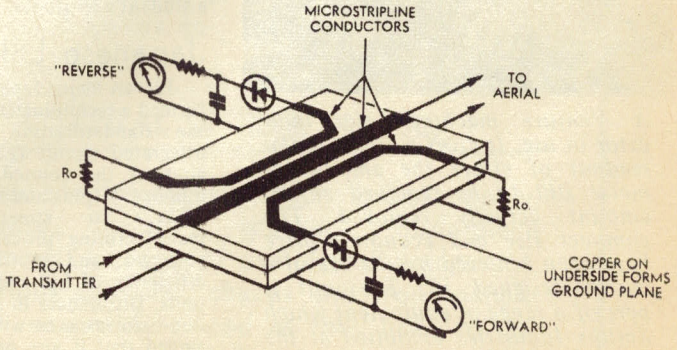
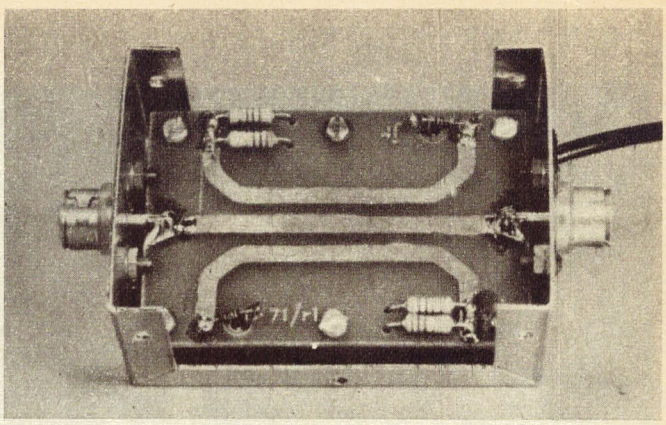


Figure 2: The device uses microstriplines, formed using two printed wiring boards.

by JAMIESON ROWE



The inside of the reflectometer, showing the microstripline conductors, terminating resistors and diodes. The unit shown is the 75 ohm version.

short lengths, because of the trouble involved. This means that the required materials must be either salvaged from the proverbial "junk-box", or obtained from a scrap metal dealer. In either case it may be necessary to adapt or modify the design to suit the material available.

During assembly, there is the further problem of ensuring that the various lines are spaced evenly and accurately both between each other and with respect to the outer shield tube. Even when great care has been taken, the characteristic impedance of the coupled side lines may still differ significantly from the design figure, and the two may not have sufficiently equal coupling to the centre line. This generally makes it at least desirable for the amateur to test both the terminations and the coupling factors of both lines, before the unit can be put into use.

In an effort to solve these problems, the author has based the present design not on a critical assembly of rods, wires and tubes, but rather on a small printed wiring board. Or to be more accurate, it consists of two small wiring boards which are bolted together.

The three sections of transmission line are not in the form of conventional co-axial lines, but instead are in the form of sections of **microstripline.** For those who have not met it before, microstripline is a type of transmission line consisting of a single conductor strip spaced evenly from a conducting sheet or "ground plane".

As with other types of transmission line, RF energy travels or "propagates" along a microstripline in the form of electromagnetic waves. The bulk of the energy in the waves is concentrated in the space between the strip conductor and the ground plane. The speed of propagation along the line depends upon the dielectric material separating the strip and the ground plane, while the characteristic impedance of the line is a function of the strip width, the separation between the strip and the ground plane, and the dielectric.

Figure 2 shows the basic arrangement of the new printed board SWR reflectometer which has been designed using the microstripline approach. It may be seen that all three sections of line forming the directional couplers of the device are in the form of microstriplines. The strip conductors of the lines are etched on one side of the board assembly, with dimensions and spacing to provide the appropriate characteristic impedances and coupling coefficients, while the largely unetched copper laminate on the other side of the board assembly forms a common ground plane.

By adopting the microstripline approach for the new reflectometer, two important advantages have been gained over more conventional designs. The first is that construction of the unit has been very much simplified. There are no rods, wires of tubes of critical dimensions to be obtained or fabricated, and no tricky assembly jobs involving accurate spacing of parts. Only a straightforward printed wiring board assembly, on which a handful of minor components are mounted before housing in a standard small aluminium utility box.

The second advantage is no less important. Because of the stable and predictable conductor dimensions and spacing provided by the wiring board pattern, the characteristic impedances of the main and coupled lines are accurately maintained at the design values. The coupling coefficients for the two coupled lines are also maintained quite accurately in balance.

As a result, when the unit is completed there is no need to check either the matching of the coupled line terminations, or the balance. It is ready for use immediately following assembly. Any residual errors due to within-tolerance component variations should be negligibly small for most practical purposes.

The wiring boards used in the device should be made from epoxy fibreglass laminate rather than from the less costly bakelised paper laminate. The reason for this is that epoxy fibreglass has lower losses and is more stable and predictable as a dielectric material. The material used for the prototype unit was "Epocor" laminate, marketed by Standard Telephone and Cables Pty Ltd. It is single-sided board, 1/16in thick with a "1 oz" copper laminate, coded type EPO/1/16/S/1.

As the microstriplines of the reflectometer have been designed using the parameters of this material specified by the manufacturer, it is strongly suggested that readers use the same material. The use of material having characteristics different from EPOCOR might well degrade the performance of the reflectometer to a significant degree.

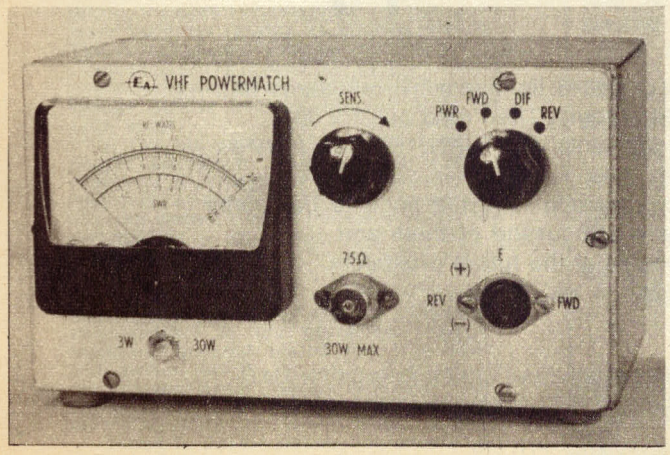
Two single-sided boards are used, each measuring 3in x 2in. One board provides the microstrip conductors, and the other the ground plane. The two are clamped together with both laminate surfaces facing outwards, using six small 1/8in Whitworth screws and matching nuts.

The reason for using two single-sided boards screwed together, rather than one double-sided board, is that this enables standard 1/16in board to be used to obtain a microstripline dielectric of 1/8in. The double thickness is required in order to obtain the correct microstripline characteristic impedances, while using copper conductor strips of practical width.

Two alternative patterns have been produced for the upper or "conductor" board, the two differing in terms of the width of the conductor strip for the centre or "primary" line. The width of this conductor on one pattern corresponds to a nominal characteristic impedance of 75 ohms, and on the other pattern to an impedance of 50 ohms. It is thus possible to build the reflectometer to suit either a 75 ohm or a 50 ohm co-axial system as desired, simply by using the appropriate top board.

The coupled secondary lines on both board patterns have a width corresponding to a characteristic impedance of 75 ohms. Thus the terminating resistors are the same on both the 75 ohm and 50 ohm versions of the device, consisting of two 150 ohm ½watt composition resistors in parallel for each line load.

The board patterns for the unit are being supplied to those manufacturers who make a practice of supplying boards for "E-A" projects. Thus readers should be able to obtain ready-made boards for the project in the near future.



The basic Powermatch unit, which was described in the February issue. Together with its accessories, it forms a versatile VHF measuring system.



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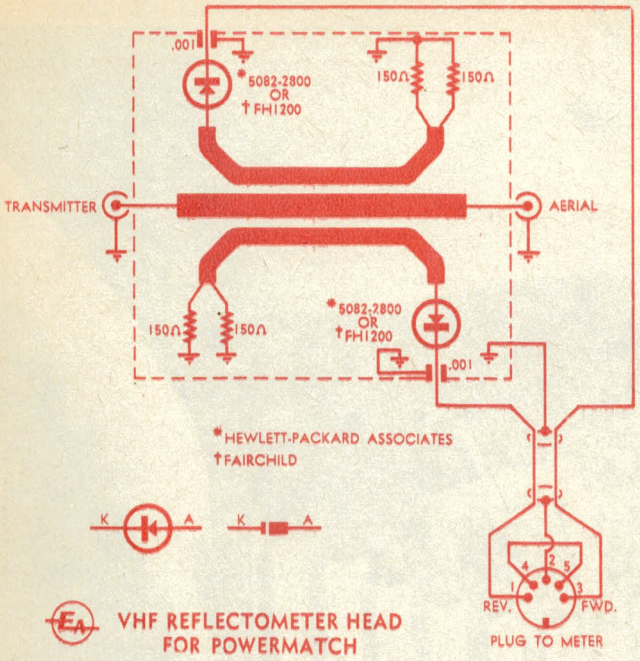
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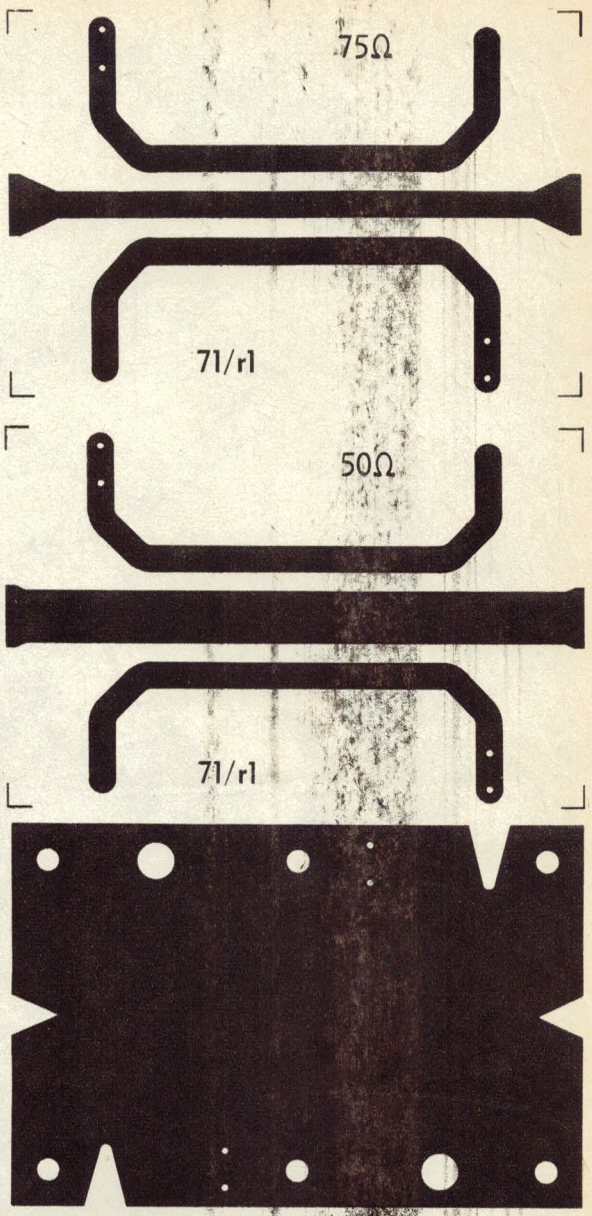
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EA VHF REFLECTOMETER HEAD FOR POWERMATCH

The circuit for the SWR reflectometer, which is the same for both the 75 ohm and 50 ohm versions.



The printed board patterns for the reflectometer, shown here actual size to permit tracing if desired. At right is the lower board, while above it are the alternative upper boards.

The nominal dielectric constant for the EPOCOR material used for the boards is 4.4, which gives the microstriplines a velocity factor of 0.47. The coupled line lengths on both the 75 ohm and 50 ohm top boards is 4.5cm, which when the velocity factor is taken into account corresponds to a free space length of 9.45cm. This amounts to only 0.138 of a wavelength at 435MHz, becoming a quarter wavelength only when the frequency is raised to 770MHz.

Theory thus suggests that the performance of the new reflectometer should be maintained to well beyond the 420-450MHz amateur band. The author is happy to report that practical tests have supported this prediction quite well. Without adjusting the prototype device after assembly, it produced SWR readings of less than 1.05:1 at frequencies in all VHF amateur bands up to 435MHz, when monitoring power flow to the dummy load of the VHF Powermatch. Such low readings tend to vindicate the designs of both the reflectometer itself and the dummy load.

The detector diodes used in the device should be of the hot-carrier or Schottky-barrier type if the performance is to be maintained to beyond 450MHz. The diodes used in the prototype were Hewlett-Packard devices, type 5082-2800, which although quite low in cost are capable of excellent performance well into the GHz region. These are the same as used in the power rectifier of the VHF Powermatch, and in the RF voltmeter probe.

As noted in the earlier article, the 5082-2800 may be purchased in small quantities by mail from Hewlett-Packard Australia Pty Ltd. In NSW the address is 61 Alexander Street, Crows Next, 2065, while in Victoria the address is 22-26 Weir Street, Glen Iris 3147.

Alternative hot carrier diodes may be used, such as the Fairchild type FH1200. This has a lower breakdown voltage than the 5082-2800, only 25V compared with 70V. However this should present no problems because the power levels present in the secondary lines of the reflectometer will normally be quite low.

But note that the lower breakdown voltage of the FH1200 makes it quite unsuitable for use in the power rectifier of the basic VHF Powermatch, or in the RF voltmeter probe.

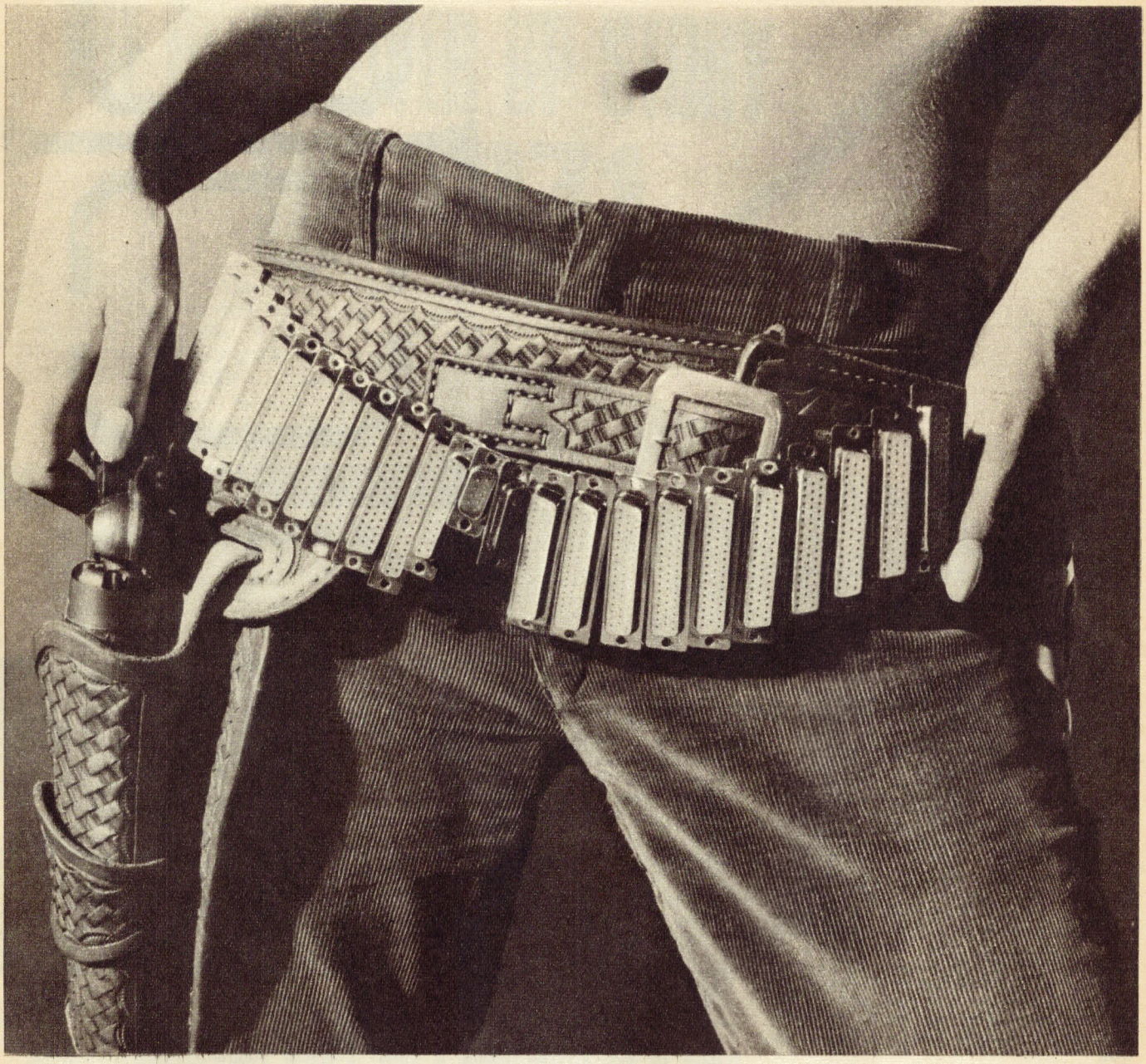
The detector diodes and the terminating resistors are mounted directly on the printed board assembly. The "live" ends of the terminating resistors are soldered directly to the ends of the secondary lines, while the "earthy" ends pass through holes in both boards and solder to the ground plane. The anodes of the diodes are soldered directly to the appropriate ends of the secondary lines, while their cathode leads are soldered to the lugs of .001uF feedthrough capacitors used to provide low-inductance detector reservoirs. The "earth" rings of the feedthroughs are soldered to the ground plane copper of the lower board, and the lower lugs are used for the output lead connections.

When the resistors and diodes are soldered into position on the board assembly, their pigtails should be kept as short as possible in order to minimise lead inductance and stray capacitance. As the short leads will tend to increase the risk of component damage by over-heating during the soldering, it would also be wise to use a pair of long-nose pliers or a surgical "mosquito" clamp as a heatsink.

The completed board assembly of the reflectometer is mounted inside a small aluminium utility case measuring 3¼in x 2¼in x 1½in. RF input and output co-axial connectors are mounted centrally on the ends of the case, as may be seen from the photograph. The twin shielded output cable carrying the DC detector signals to the main Powermatch unit leaves one end of the case via a small grommetted hole, being terminated at the far end with a 5-pin DIN plug.

The co-axial connectors used on the prototype unit are the well-known Beeling-Lee type, which offer quite good performance at relatively low cost. They have a nominal impedance of 72 ohms, but for amateur purposes may be used quite satisfactorily with both 75 ohm and 50 ohm systems.

Inside the case the board assembly is supported by four solder lugs which are clamped under the co-axial connector mounting nuts. The narrow ends of the lugs are first soldered to the ground plane copper



Switch on

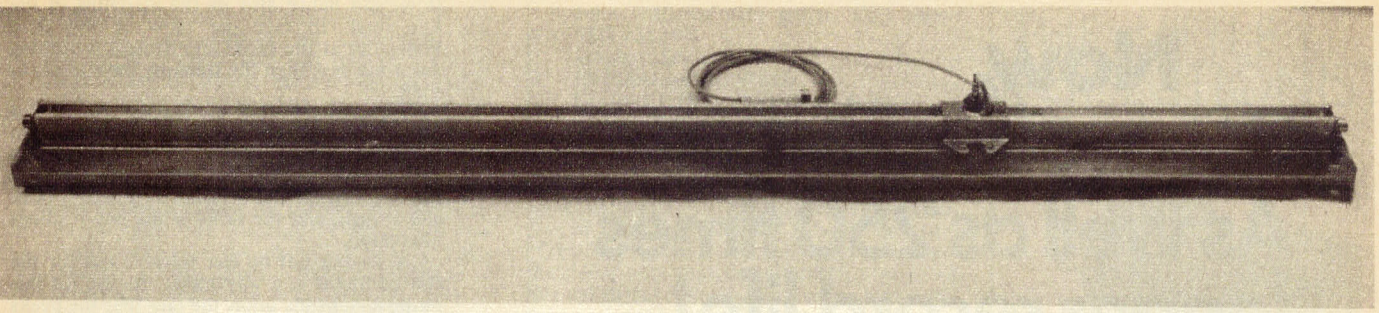
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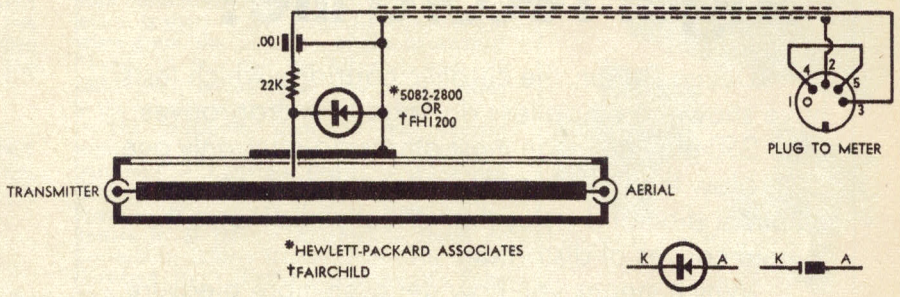
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Above is the completed slotted line, which is 42 inches long. At right is the schematic diagram. Note the use of a hot-carrier diode.



VHF SLOTTED LINE (ACCESSORY FOR POWERMATCH)

of the lower board, and then bent at right angles in such a way that when the board assembly is lowered into the case, the holes in the lugs align with the connector mounting screws when the top surface of the board assembly is just touching the underside of the centre spigots of the connectors. Screws are then passed through the connectors, case ends and lugs, and nuts dropped down in the 1/8in spaces between the board assembly and the case ends to complete assembly. Finally the connector centre spigots are soldered to the ends of the centre microstripline conductor.

Just before the board assembly is mounted in the case in this manner, the shielded detector output cable should be fed through the grommet in the case end and the leads soldered to the feed-through lugs on the lower side of the board assembly. The cable braid is also soldered to the ground plane copper, to complete the meter return circuit.

When the unit is completed, it may be used immediately. As noted earlier, the printed board microstripline construction obviates the need for the line matching adjustments and balance checks required with more conventional designs. It is simply a matter of connecting the unit between the main transmission feeder and the aerial, using a short jumper cable, and plugging the detector output cable into the VHF Powermatch unit.

Readings of "forward" and "reflected" power flow in the line may be read simply by turning the Powermatch function switch to the appropriate positions. The usual procedure is to turn the sensitivity pot of the Powermatch to the minimum (fully anti-clockwise) position, and switch to the "forward" position. The RF power is then fed into the line, and the sensitivity pot advanced until the meter gives a full-scale reading. Switching to the "reverse" position then allows the reflected power flow to be read off directly in terms of SWR.

The coupling coefficients of the reflectometer have been designed so that full-scale readings should be obtainable in the "forward" position even with very modest power levels. On the 52-54MHz band, where sensitivity is lowest, no difficulty should be experienced in obtaining full-scale deflection unless the power level available is below 3 or 4 watts. On the higher bands the coupling coefficients are greater, so that even less power is required.

In addition to the switch positions allowing forward and reflected power measurement, the Powermatch also provides a position for indication of the difference between the two components. This position is useful when making adjustments to an aerial or matching system, because it allows changes to be observed without the need for repeated switching back and forth between the forward and reverse positions. Any improvement in matching is immediately indicated by an increase in the difference meter reading.

This completes the description of the new SWR reflectometer. The slotted line accessory will now be described.

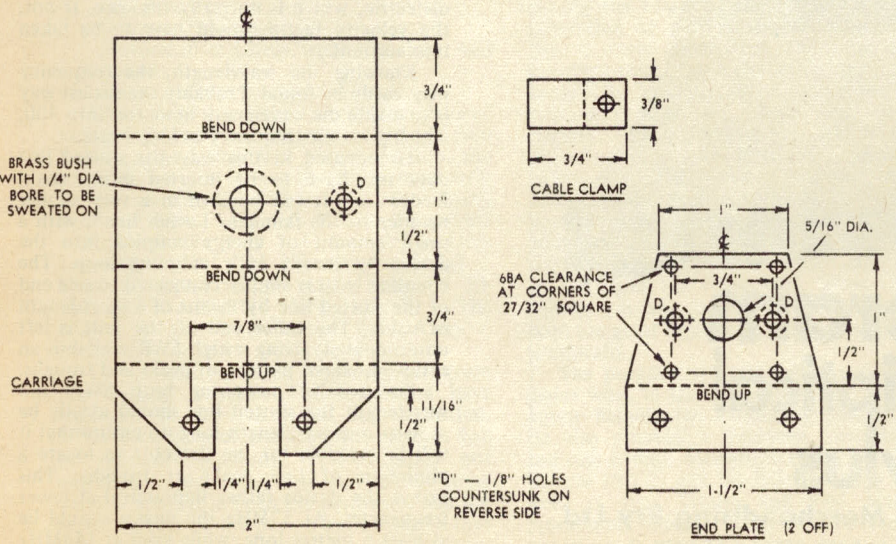
Although probably less familiar to the average radio amateur than the SWR reflectometer, the slotted line is basically a very simply and straightforward device. It consists essentially of nothing more than a section of co-axial transmission line provided with a longitudinal (lengthwise) slot in the outer conductor. The purpose of the slot is to allow a small detector probe to be inserted for sampling the internal electromagnetic field at any position in the line section.

The probe may be arranged to sample either the magnetic component of the electromagnetic field, or the electric component.

If there is a mismatched load connected to the feeder line into which the slotted line section is inserted, both "forward" and "reflected" power components will be flowing in the line. Interference between the two power components will cause a standing wave pattern to be set up along the line. The standing wave pattern will consist of regular variations in field strength along the line, the pattern of variation being quite steady and fixed in position.

The difference in field intensity between the maxima or "peaks" and the minima or "troughs" of the standing wave pattern depends, as one might expect, on the relative magnitude of the reflected power component compared with the forward component. The smaller the reflected component as a proportion of the forward component, the less pronounced the standing wave pattern and the difference between peaks and troughs. Conversely the larger the reflected component as a proportion of the forward component, the more pronounced the standing wave pattern and the difference between the peaks and troughs.

The difference between the peaks and troughs is thus a good indicator of the ratio between the forward and reflected power



Patterns for the probe carriage, cable clamp and end plates for the slotted line accessory. All are made from 18G sheet brass.

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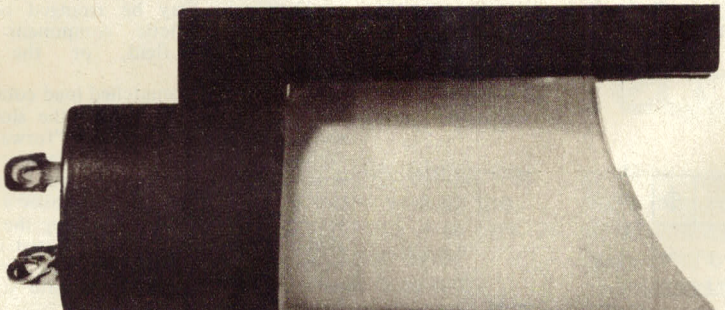
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flow, and hence also of the matching of the line load. In fact the ratio of the field intensities at the peaks and troughs is nothing more nor less than the **standing wave ratio,** or SWR.

The slotted line is ideally suited for measuring SWR, as it allows direct location and measurement of the standing wave peaks and troughs. The probe is simply moved along the line to find and measure an adjacent peak and trough, and the ratio of the two readings calculated.

A second but no less valuable use for the slotted line is as a wavemeter. Its use for this purpose depends upon the fact that the peaks (and the troughs) of the standing wave pattern are always spaced by an exact half-wavelength. The wavelength of the RF energy flowing through the slotted line may thus be found quite simply by measuring the distance between two successive peaks (or troughs), and multiplying by two. (This assumes that the slotted line uses an air

PARTS LIST

SWR REFLECTOMETER

- *1 Utility case, 3¼in x 2¼in x 1½in.*
- *2 Epoxy fibreglass printed boards, 71/rl (50 or 75 ohms as desired) together with ground plane board.*
- *2 Hot carrier diodes, Hewlett-Packard type 5082-2800 or Fairchild type FH1200.*
- *4 150 ohm ½ watt composition resistors.*
- *2 .001uF feedthrough capacitors.*
- *2 Co-axial sockets.*
- *Length of 2-core shielded cable, 5-pin DIN plug, nuts and bolts, screws, ¼in grommet, solder, etc.*

SLOTTED LINE

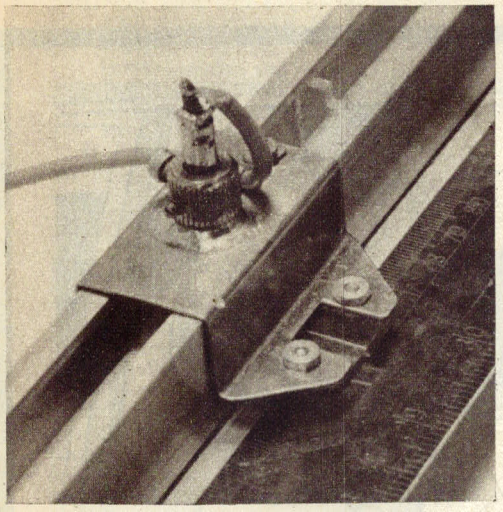
- *1 40in length of aluminium extrusion, Comalco type E-865.*
- *1 39¼in length of ¼in diameter rod, aluminium or brass.*
- *1 Hot carrier diode, Hewlett-Packard type 5082-2800 or Fairchild FH1200.*
- *1 22K ½ watt composition resistor.*
- *1 .001uF feedthrough capacitor.*
- *2 Co-axial sockets.*
- *Length of shielded cable, 5-pin DIN plug, scrap brass for end plates and probe carriage, wood for base, metre rule, screws, etc.*

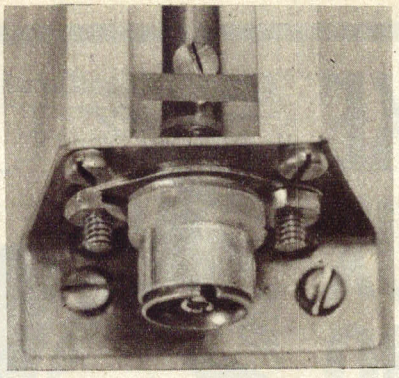
dielectric, which is normally the case. If not, the velocity factor would have to be taken into account.)

Knowing the wavelength, the frequency may easily be found. Probably the easiest way is to divide the wavelength in metres into 300, which gives the frequency in Megahertz.

To be used in this way the slotted line does not have to be inserted into a main feeder line. It can be used in a very similar manner to the familiar "Lecher line", with a small amount of energy coupled into the device by means of a coupling loop. The coupling loop is simply connected to one end of the slotted line by means of a short length of cable. The other end of the unit is left unterminated, giving a high SWR and thus an easily measured pattern of peaks and troughs.

For use in measuring both SWR and wavelength the slotted line should ideally be at least one wavelength long, to ensure that it will be possible for the detector to locate a minimum of two peaks or troughs. This makes the device rather impractical at lower frequencies. At 52MHz the device should be at least 6 metres long, while even at 144MHz it should ideally be 2 metres long — approximately 6 feet 7 inches!





At left is a close-up of the slotted line carriage, while above is a view of one end.

As even a 2 metre long line would probably present problems of storage and use for most radio amateurs, the unit shown in the photographs has been kept to a length of 40 inches. This limits its primary use to frequencies above 300MHz. However it can be used to measure both SWR and wavelength on the 144MHz band, providing short spacing cables are inserted into the main feedline to "shift" the standing wave pattern along until a peak and a trough are available in the slotted section. The SWR may then be measured as before, although the distance between the peak and the trough will have to be multiplied by four in order to obtain the wavelength.

In view of this ability to use the shorter line to make useful measurements even on the 144MHz band, it would seem unnecessary to consider a longer unit. However if the reader to desires, there is no reason why he should not build a longer unit based on the same design.

The construction of the slotted line shown is based on a length of aluminium extrusion. The extrusion has a square cross-section, and is rather like a square tube except that one side is not completed. On the fourth side are two stub walls, separated by a gap of ½in. Although this gap is rather wider than one would ideally like for the slot of a slotted line, tests have shown that very little energy is radiated. The extrusion thus provides a convenient and labour-saving way of providing the outer conductor of the unit.

The extrusion measures one inch square (outside), with walls approximately 1/8in thick. It is a stock extrusion from the range manufactured by Comalco Industries Pty Ltd, being coded type E-865. The 40-inch length used may be obtained readily from Comalco distributors in the various states, whose addresses may be obtained from Comalco sales offices.

The centre conductor of the line is formed from a 39¾in length of ¼in diameter round rod. This may be brass or copper, although in the prototype unit aluminium was again used. This is again a standard aluminium extrusion, and would be available from the same suppliers.

With an outer conductor having four complete sides and internal dimensions of ¾in x ¾in, the ¼in diameter inner conductor would give the slotted line section a characteristic impedance of approximately 69 ohms. The reduction in capacitance produced by the fairly wide slot increases this figure to about 72 ohms, so that the unit should be ideally suited for 72-75 ohm co-ax systems.

Actually, because of the relatively short length involved, the unit should also be satisfactory in 50 ohm systems. However if a lot of work in 50 ohm systems is anticipated at UHF and microwaves, where the small impedance discontinuity might become significant, it would be wise to use a centre conductor with a suitably larger diameter. For a nominal characteristic impedance of 50 ohms the centre rod should ideally have a diameter of 11/32in, but the more readily available 3/8in size rod should be quite satisfactory.

Screwed to the ends of the main extrusion are small L-shaped brackets which mount the input and output co-ax connectors and also serve as mounting feet for the line. In the prototype the brackets are made from 18 gauge sheet brass, but aluminium would also be suitable.

The ends of the centre conductor rod are drilled axially so that they slip over the centre spigots of the co-ax connectors. Holes are then drilled and tapped for 6BA setscrews to ensure a good contact to each connector spigot.

The co-ax connectors are screwed to the end plates via countersunk head 1/8in screws, which are arranged so that the heads are flush with the inside surface of the brackets. Each bracket is in turn screwed firmly to the ends of the extrusion by means of four 6BA screws which mate with holes tapped in the extrusion ends.

Additional support for the centre conductor rod inside the line is provided by four spacers fashioned from 1/8in acrylic sheet ("Perspex" or similar). These are simply squares of acrytic approximately ¾in by ¾in, with a ¼in hole drilled centrally to clear the conductor rod. Two of the spacers are positioned near the ends of the unit, to relieve strain on the co-ax connectors, while the other two are spaced at approximately 13 inches from the ends. The latter spacers have small slots filed centrally in their upper side, to clear the sliding test probe.

The test probe itself is quite simple, consisting basically of a standard shunt diode detector. The only difference from a conventional circuit is that here the input coupling "capacitor" is formed by the stray capacitance between the probe and the centre conductor of the slotted line.

The diode used in the probe should ideally be a hot-carrier type, particularly if the unit is

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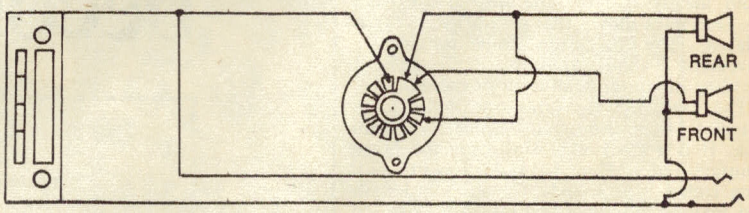
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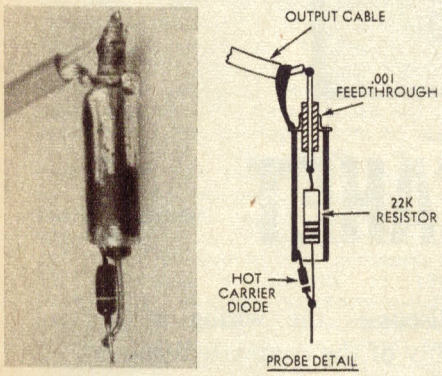
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AD15

to be used at high UHF and microwave frequencies. Either the Hewlett-Packard 5082-2800 or the Fairchild FH1200 would be suitable, as the peak inverse voltage will be quite low. However if the unit is only likely to be used on the lower VHF bands, a germanium device such as the OA90 could be used.

The probe is mounted on a simple sliding carriage bent up from a scrap of sheet brass. The carriage slips neatly over the line extrusion, and allows the probe to be moved smoothly up and down the line. The front of the carriage has a bent up lip which is provided with a small acrylic cursor to allow distance measurements using a metre rule or yardstick.

To allow convenient adjustment of the penetration of the probe into the line, the



A photograph and diagram showing the construction of the slotted line probe assembly.

active probe components are mounted on a short length of ¼in diameter brass tubing. This is clamped by setscrews in a small bushing which is soldered to the top of the carriage. In the prototype unit the tubing for the probe was salvaged from the sleeve of an old telephone jack plug, while the carriage bush was from an old-style instrument knob.

The construction of the basic probe unit may be seen from the photographs. It is assembled as follows. First one pigtail of the 22K series resistor is cut to about 3/8in long, and soldered to one centre lug of the .001uF feedthrough. The outer flange of the feedthrough is then soldered to one end of the ¼in support tube, with the resistor inside the tube. A small slot is then cut or filed in the opposite end of the tube, and after cutting the anode lead of the diode to about ¼in long, this lead is soldered into the slot in such a way that the excess solder may be filed away to restore the tube to its former diameter. A pair of pliers or a "mosquito" clamp should be used to prevent overheating of the diode during the soldering operation.

The free pigtail of the 22K resistor is bent over to contact the cathode lead of the diode at a point some 3/16in from the diode body. The two are then soldered together, again using a heatsink to prevent damage to the diode. Finally the surplus resistor pigtail is removed, and the diode pigtail cut short at about 5/16in from the diode body.

The shielded cable which connects the output of the detector probe to the Powermatch metering circuit is attached to the probe after assembly. The inner conductor is soldered to the feedthrough capacitor lug, while the braid is soldered to the top of the brass tube. When the probe is mounted on the sliding carriage the cable is anchored to the carriage by a small C-clamp fashioned from a scrap of brass sheet.

The position of the probe in the carriage bushing is used to adjust the coupling. The idea is to use the minimum coupling which will give satisfactory readings on the Powermatch meter, as a large amount of coupling will cause the probe to disturb the line conditions.

The wiring of the 5-DIN plug used to connect the slotted line to the Powermatch has been arranged so that the output of the probe detector is read with the switch in the "forward" position. The sensitivity control is connected in circuit, to allow the meter to be set to full-scale on a "peak". The magnitude of a trough may then be read directly from the linear 0-10 meter scale as a fraction of the peak amplitude.

Note that in construction and assembly of the slotted line, care should be taken to ensure that the centre conductor of the line is straight and supported centrally in the main extrusion. If there are bumps or bends in the rod, these will result in changes to the probe coupling along the line, and thus mask the variations associated with the standing wave pattern.

Both the SWR reflectometer and slotted line accessories just described enable the forward and reflected power flow components in an RF feeder line to be resolved. Because of this they are both very useful for rapid evaluation of the matching of aerials and other loads. However in the event of a mismatch they do not provide sufficient information regarding the exact nature of the load impedance to enable the amateur to decide easily the most effective way in which he can remedy matters.

To obtain sufficient information for this to be done it is necessary to use an instrument such as an RF impedance bridge, and the next Powermatch accessory to be described is an instrument of this type. Although simply constructed, it is capable of accurate measurements from HF right through to the 432MHz band.

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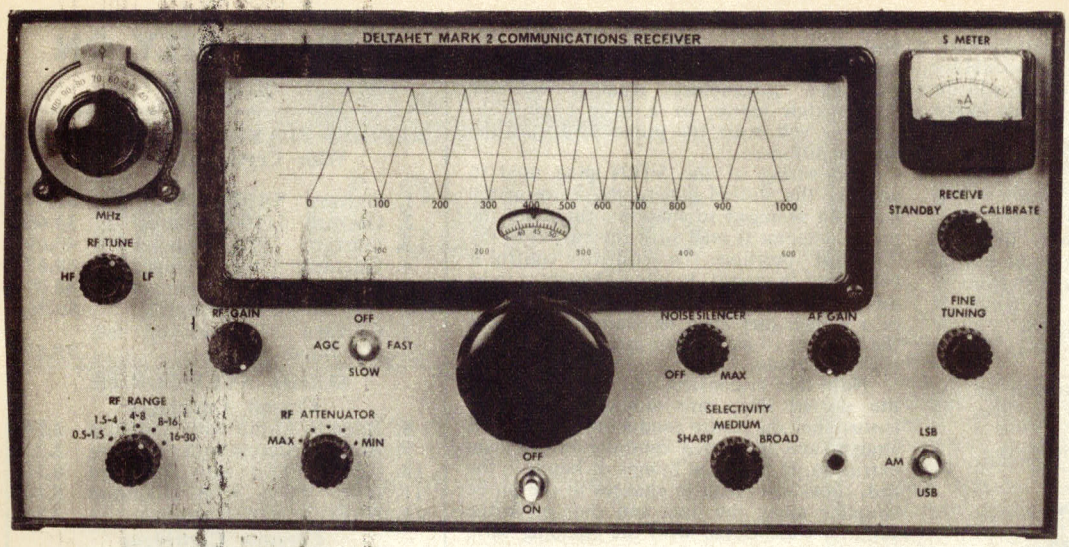
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This is a front panel view of the completed receiver. While there are many controls, there is no sense of crowding. The main dial can normally be read off to the nearest KHz, with logging facilities available.

The SOLID STATE DELTAHET —3

Continuing the description of the Mark 2 Deltahet, this article discusses the wiring of the sub-assemblies for the "front end", and progresses to deal with the assembly of the complete receiver.

Due to a natural limit on the amount of space available for any one article, we were obliged to stop our discussion of the construction of sub-assemblies at the tunable IF section. This leaves the front end to be dealt with, along with one or two other small items. And so we carry on from this point, leading to the assembly details of the complete receiver.

The second mixer assembly is on a small board with 5 pairs of tags, the wiring for which is shown in the diagram. The only points of note are that the end holes on the board are used for final mounting purposes and the 470 ohm resistor should be set to one side so that it does not obstruct the hole.

The first and third mixers are identical, except for the slight difference between the two input transformers. Each mixer is assembled on a board with six pairs of tags. The transformers are mounted and fixed in the same way as those on earlier assemblies. However, the terminations are somewhat different as the coils are bifilar wound and it is only a matter of identifying the primary and secondary windings. The 2-20pF solid dielectric trimmers are soldered across adjacent lugs as shown in the diagram. The balancing potentiometers can be mounted easier if the outer lugs are shortened and the centre lug is made to protrude through the appropriate hole on the board.

The 1MHz crystal oscillator and harmonic generator are accommodated on a board with 7 pairs of tags. All components except the trimmer for the crystal are mounted on the board, including the crystal socket. The board is held in place with a screw at each end of the board and one of these screws performs the dual function of holding the crystal socket as well. Before soldering the crystal socket lugs to the corresponding lugs on the board a countersunk head screw is used together with a spacer to screw the socket firmly in its final position. With the lugs in the right position, they may be soldered.

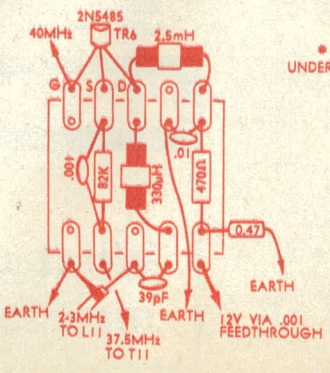
The first VFO and the two isolating amplifiers are all mounted on one board with 9 pairs of tags. All items are contained on the board as shown in the diagram, except the tuning capacitor C54 and its series capacitor C53. The air wound coil L7 and the trimmer C52 are wired directly to the board and together with all the other components, there is little room to spare. This calls for due care in wiring this unit, but no trouble should be experienced in placing all the components as shown.

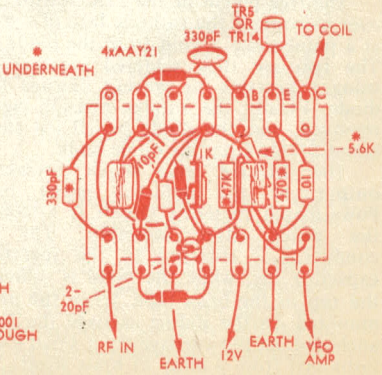
The last sub-assembly is the RF amplifier. In addition to the switch, the rest of the components are accommodated on two boards, each with 11 pairs of tags. One board is used to mount the five toroidal coils, L1-L5. These are mounted in the positions shown in the diagram. The ends of the windings are terminated at convenient adjacent tags on the board. In the case of the lower frequency coils, which are wound with relatively fine wire, this is not in itself sufficient to fix the coils securely to the board. These coils are best secured by simply tying the toroid to the board with a piece of nylon cord. While not so necessary with the coils wound with heavy wire, this procedure is still a good idea, ensuring that they do not move about.

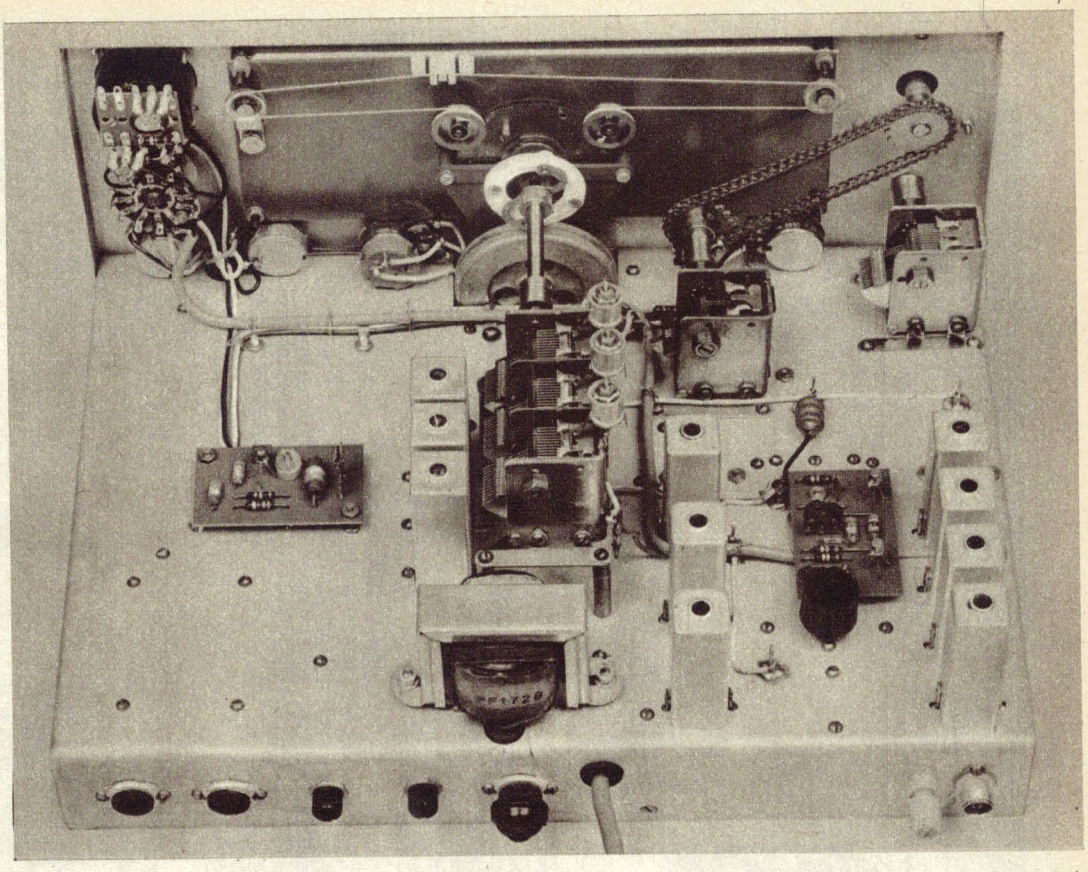
The second board accommodates the major part of the components and is wired according to the diagram. Make sure that all the interconnecting wires are complete before any attempt is made to take the assembly of this board any further. But note that the three capacitors in series with the tuning capacitor are not wired at this stage.

The two above sub-assemblies are mounted on the rear end of the range selector switch, being separated from each other and the switch with ½in long spacers. The first step in the assembly involves fitting the first pair of spacers to the rear ends of the two switch retaining screws. Generally, there is about 1/16in of thread protruding beyond the nuts. The screws used in MSP switches are 5BA and the threaded spacers which are readily available are 1/8in Whitworth. These dissimilar threads do not mate very well but due to the short length of the thread, it is possible to screw the spacers on, provided due care is taken. If you can substitute Whitworth

The second mixer, immediate right, is very simple and easy to build. The first and third mixers are identical, except for the input transformer windings, details of which were given in the table earlier.







The rear view of the chassis shows clearly all the major components. Note particularly the chain drive to the MHz tuning capacitor. Most of the above chassis wiring may also be seen, including some of the .001uF feed through capacitors.

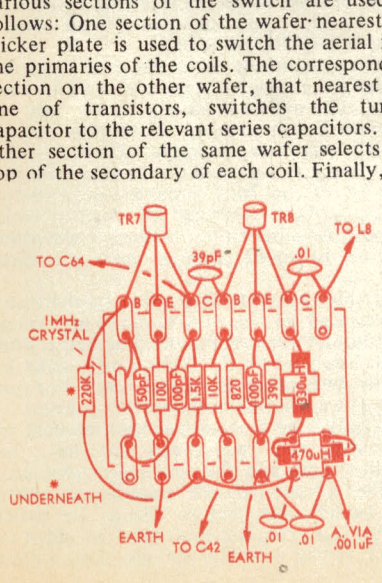
by IAN POGSON

screws, so much the better.

Having mounted the spacers, check the centre-to-centre dimension between the spacers with that of the third hole from each end of the two boards. More than likely you will find that the two holes are too close together. A little filing with a small round file will put this right.

The board with the coils is mounted against the spacers at the end of the switch, with the coils away from the switch. The second board is spaced away from the coil board with the second pair of ½in spacers. Two round head screws, 1/8in x ¾in are used to secure the two boards to the spacers on the switch.

The assembly is now ready for the outstanding wiring and components. The various sections of the switch are used as follows: One section of the wafer nearest the clicker plate is used to switch the aerial into the primaries of the coils. The corresponding section on the other wafer, that nearest the line of transistors, switches the tuning capacitor to the relevant series capacitors. The other section of the same wafer selects the top of the secondary of each coil. Finally, the otherwise spare section of the wafer nearest the clicker plate is used to shortcircuit certain coils as required. Care should be taken here, as it is easy to make a mistake.



When wiring and fitting the crystal oscillator, reference should be made to details given in the text.

The wiring involves the interconnections between the various contacts on the switch and coils, together with the series tuning and aerial capacitors. The latter capacitors are wired with very short leads, to anchor them closely to the lugs on the switch. The other leads up to the coil board will need to be fairly long and these should be run directly, with the use of some nylex tubing for insulation where necessary.

This completes the sub-assemblies but before we fit them into the metalwork of the complete receiver, now would be the opportune time to deal with a couple of other items.

If you have not purchased a front panel, complete with control designations, then you will presumably be interested in doing them yourself. On the prototype, we used "Tekni-Cal" transfers, which result in quite a professional looking job. However, this line is no longer available and unless some readers may be fortunate enough to still have supplies, then it will be necessary to resort to some other brand or type of lettering. Two other products which come to mind are "Instantype" and "Letraset". Lettering is effected with these two products by "rubbing" the letters from the base paper on to the panel to be lettered. Regardless of the method used, it is a good idea to give the panel a coat of clear lacquer, which gives a worthwhile protection.

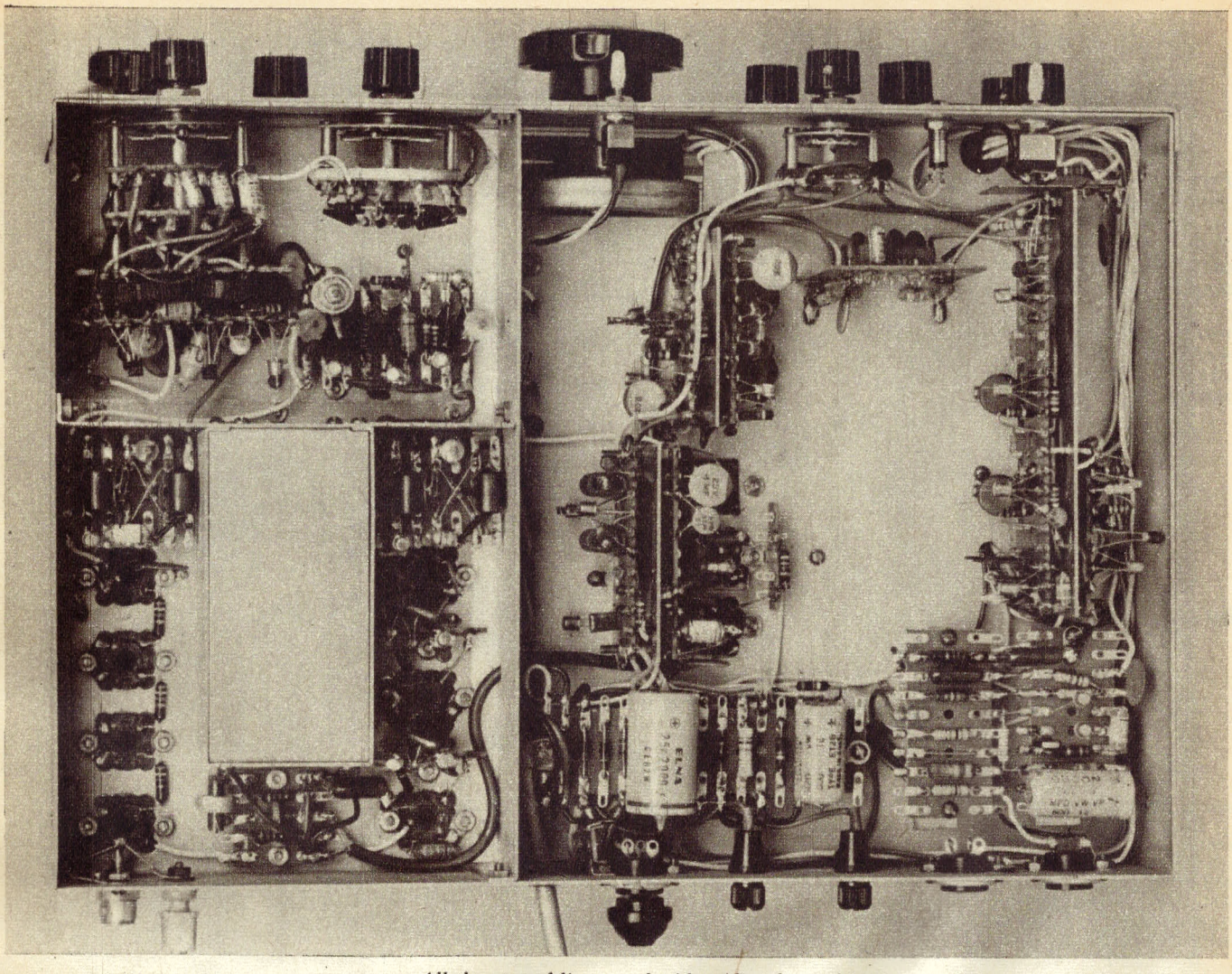
While we are on the subject of lettering, it will ultimately be necessary to mark in the calibrations on the dial scale, after the calibration process has been completed. Any of the above systems may be used. Meanwhile, readers may wish to replace the original pointer on the Eddystone dial movement with a thinner one, to permit best use to be made of the scale calibrations. We made up a replacement pointer in the following way.

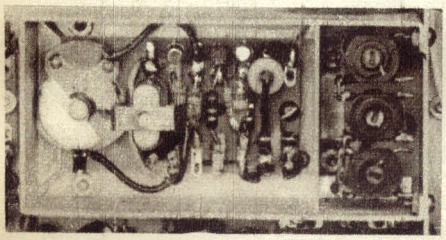
Start with a piece of 16 gauge tinned copper wire, and hammer it flat, leaving about ¼in round at one end. Use a hammer with a good smooth face and hammer on a hard, flat surface, such as part of a vyce. Use care and patience and keep hammering, not too hard, until a reasonably flat surface is obtained on one side. Then turn the wire over and treat it in the same way. When the wire bends, it should be straightened, to allow the job to proceed properly.

Having done a reasonably good job up to this point, there will be undulations, due to uneven hammering. These are removed by carefully filing both flat surfaces. The edges may also be straightened up by a little filing. When satisfied with the result, the original pointer is removed from the carriage. This is done with a soldering iron, after the paint has been removed from the original soldered joint. The new pointer is substituted, soldering it into position at the round end. Make sure that the edge is at right angles to the direction of travel of the pointer. Other adjustments will also suggest themselves. Cut the pointer to length, with a 45 degree end bevel, and then give it a coat of black paint.

With all the sub-assemblies and preliminaries completed, we are now in a position to start on the final assembly and wiring of the complete receiver. Having just made up the new pointer, its carriage may now be re-fitted to the runner and the drive cord may be set approximately to its correct position.

The front panel may now be assembled with its components, except the RF tuning control and those on the bottom line. These





All the assemblies may be identified from this picture of the under chassis, and each section may be compared with its appropriate wiring diagram. The crystal oscillator section is obscured by the cover plate; details of this section may be seen in the small picture at the left.

will be put in place when the front panel is fitted to the chassis later on. It could also be convenient at this time, to add the S meter board to the back of the meter. Also, the flexible coupling may be added to the Eddystone dial shaft. A short length of ¼in diameter rod will be needed for the MHz dial shaft but this can be added later on.

Final assembly is largely a matter of commonsense. However with a project of this size it is very easy to fall into traps, such that an item already fixed must be removed so that another item may be assembled. To avoid this, it is proposed to mention these points as we go along.

Starting off with a blank chassis, the first items to be fitted could be the main partition between the front end and tunable IF. Then comes the partition behind the RF amplifier and first VFO, followed by the "U" shaped partition. There are nine feed through capacitors which may be soldered or screwed in, according to the type used. The sockets, fuses, etc, may be fixed to the back skirt, not forgetting the rubber grommets here and there.

If you are using a ready-made chassis, with all the major holes punched, then all is well. However, for those builders who are making up their own metalwork, there may be a problem in not having a square punch for the 10 coil holes. If you have a ¾in round punch, then it is possible to cut out suitable holes with it and some supplementary drilling, as shown in the detailed drawing. This operation should preferably be carried out before the foregoing items are fitted.

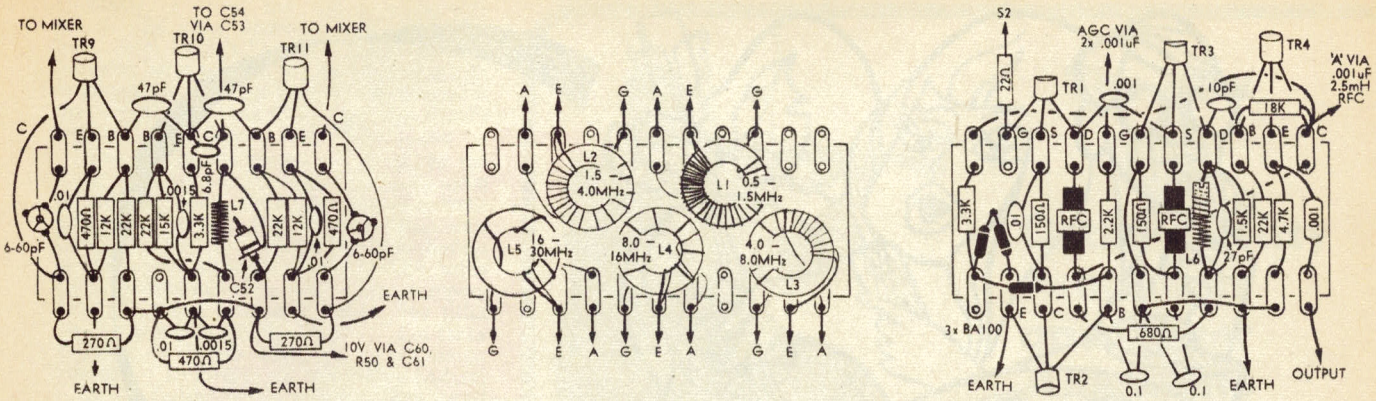
When screwing the power transformer in place, we suggest that you use 5/32in Whitworth or similar screws. We also stood the transformer feet off the chassis by placing an extra nut between the foot and the chassis. This reduces the transfer of heat from the transformer to the chassis. By doing this, we avoid undue temperature rise in the chassis, with less heat conduction to the oscillator coil and other components which may be sensitive to temperature changes.

The coils for the tunable IF, 37.5MHz and 40MHz filters may be fitted next. Make very sure that each coil is the right one for the particular position and that the terminations are suitably orientated for the external wiring. The three coils for the 32MHz low pass filter may also be fitted at this stage. Care should be taken to add to these input and output leads of sufficient length, but connections should not be made between the respective coils at this juncture. The small shield partition may also be added.

Before mounting the single gang capacitor for the RF tuning, a length of hookup wire should be soldered to the rotor lug, of sufficient length to reach its termination on the RF amplifier assembly. Similarly, the 150pF capacitor should be soldered to the rotor lug of the 70pF variable capacitor for the first VFO. Care should be taken to avoid any possible short circuit to chassis, when the capacitor is passed through the appropriate hole.

At this stage, we may either fit the front panel and go on from there, or we may carry on without the panel for the time being. This is a decision which the builder may make to suit his own convenience and ideas. For our purpose, we will follow the former course.

Initially, the front panel may be held in place with the two rotary switches, the indicator lamp and the two toggle switches. For the present, the RF amplifier assembly may be left out. Before fitting the panel however, an extension shaft must be added to the RF tuning capacitor spindle. Also a bush



The wiring details for the first VFO board are shown at the left. Care should be taken here, as a lot of components have to be fitted into a limited space. The centre diagram shows the disposition and terminations for the toroidal coils, while the diagram at the right shows the wiring details for the RF amplifier circuit.

may be added to the panel for this spindle, but if any difficulty is experienced due to binding the bush may be omitted.

A short extension spindle is also added to the first VFO tuning capacitor spindle, together with another spindle for the MHz tuning dial. These spindles must be of the correct length such that when the sprocket wheels are added, these may be lined up to take the sprocket chain. It may be necessary to move the variable capacitor slightly to take up any undue slack in the sprocket chain, and thus avoid any backlash. The sprockets are screwed to the spindles such that the dial is at the end of the scale, with the capacitor fully meshed.

The three gang tunable IF capacitor calls for special care in mounting. Before doing so however, a lead must be soldered to each of the three lower stator lugs. These leads must be of light good quality coaxial cable, it being essential to shield the leads on their way to the coils. As a preliminary, the leads should be cut so that they will be long enough to reach the coil terminations. The ends soldered to the capacitor lugs should be bared a good ¼in or so. As it is not necessary to make an earth connection at this end, the braid should be cut back clear of the centre conductor.

Later on, when the chassis has to be turned over for wiring and assembly operations, it will be necessary to pack up the power transformer so that all other above chassis components clear the work bench. This applies particularly if the trimmers are fitted to the gang at this stage. If they are left until later., then it would be quite practical to let the receiver rest on the front edge of the panel and the back edge of the gang. Anyway, this point can be left for the builder to decide for himself.

The gang is stood off the chassis by 1¼in or so, on pillars. We made the pillars from ¼in outside diameter brass rod, tapped 1/8in Whitworth at each end. Perhaps the best way of going about mounting the gang is to fix the spacers to the chassis first. Then the gang can be screwed tentatively to the pillars, having run the coaxial leads through the appropriate holes in the chassis. An extension spindle is fitted to the existing gang spindle, the length being such that it mates with the boss of the flexible coupling on the dial assembly.

Having made the setup thus, a check should be made to see if all is well between the dial and the gang. The gang may be a little off square and this should be corrected. Perhaps more important, the gang spindle may not be at the same height above chassis as the dial drive spindle, and this should be corrected. We found it necessary to add two flat washers atop each stand off pillar.

A further check should be made to ensure that when using the knob on the dial, the gang can be run from one extreme to the other smoothly and without any rough spots or tendency to bind. Finally, the grub screws in the drive arrangement should be tightened up so that the gang is fully closed when the dial movement is at the end of its travel in the appropriate direction.

The next logical step would be to fit the power supply board, followed by all the terminations, wiring, etc, associated with the power supply as a whole. The board is stood off the chassis with two ¾in long x ¼in diameter brass spacers, one at each end of the board. The flag heat sink for the shunt regulator transistor is fixed against the chassis under the spacer nearest the audio amplifier position. Under the screw next to the board at the other end we have fitted a clamp for the incoming power flex.

As we used a transformer with two 6.3 volt windings, we connected them in series and in the correct phase relationship. The join or "centre tap" is anchored on the lug of a 2-tag strip fixed by one screw of the socket nearest the power flex. This socket by the way, may be used to terminate various voltages from the power supply so that they may be used to supply ancillary equipment such as a converter. Just what is done here is best left to the builder.

Having completed the power supply, should the builder so desire, it may be tested. When satisfied that all is well, we may use the supply to feed each item as it is added to the main assembly.

The audio amplifier is also mounted with four ¾in brass spacers, one at each end of the two boards. The flag heat sinks for the two output transistors are held against the chassis, under the two spacers nearest the back of the chassis. Interconnecting wiring includes that to the speaker socket, nearest the corner of the chassis, with an earth lug fixed under one of the mounting screws. The leads to the volume control are run simply in a twisted trio of hookup wire, no shielding being required. The earth lead is soldered to a solder lug under the screw nearest the amplifier input.

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1800′	10D7M	1.0 MYLAR	9.15	4.25
2400′	5D7MT	.5 TENSIL MYLAR	11.90	5.25
3600′	3D7MT	.33 MYLAR	13.20	7.50
		5" REELS		
600′	15D5	1.5 ACETATE	3.40	1.80
900′	10D5M	1.0 MYLAR	5 32	2.50
1200′	5D5MT	.5 TENSIL MYLAR	8.70	2.75
1800′	3D5MT	.33 MYLAR	9.60	3.95

LENGTH	TYPE No.	DESCRIPTION & MIL. THICKNESS	NORMAL PRICE	OUR PRICE
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		3½" REELS		
900′	3D32MS	.33 MYLAR	3.90	2.25
		3" REELS		
150′	15D3	1.5 ACETATE	.95	.60
300′	5D3M	.5 MYLAR	1.95	.95
600′	3D3MS	.33 MYLAR	3.30	1.60
		CASSETTES C60	3.50	.99
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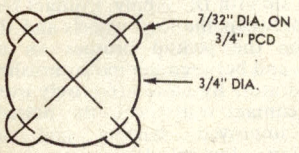
ADDRESS.....

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chassis. It is held with two screws, each ½in long, with the heads underneath the chassis. The three-nut-per-screw technique is used to stand the board off the chassis by about 5/16in. A large hole in the chassis near one corner of the board is for wiring purposes, both for the BFO and other items. Leads between the mode switch and the BFO should be run above the chassis and not underneath, where they would be adjacent to the IF strip assembly.

The IF strip and AGC assembly may now be fitted but before doing so, it would be a good idea to fix the two nuts to the mounting foot of the panel. This makes the task of screwing the panel in place much easier. If the panel is of solderable material, then the nuts may be soldered in place, held with a screw during the process. If however, the panel is of aluminium, then they may be fixed with an epoxy resin adhesive, such as Araldite.

We also found it necessary to provide a small shield plate at the end of the IF panel, to shield it from the mode switch. This shield was made from a piece of tin plate, 1in x 1in, with a 3/8in foot. The foot has a hole in its centre and this is used to fix it under the same



This is how we cut the holes for the coils in square cans, using a round punch.

screw which holds that end of the board to the metal panel. In addition, under the same screw and facing towards the end of the chassis, we fixed a 3-tag strip. This is used as a termination for C156, R152 and R154.

The filter block printed board is next in sequence. This is mounted with the copper side facing away from the front panel. A solder lug is also provided under each screw, facing towards the copper side.

The noise silencer assembly is mounted in a similar manner to the IF strip assembly and the same comments apply to the nuts on the foot of the panel. At this point all the external wiring for the IF strip, AGC generator, filter board and noise silencer may be completed. This includes the selectivity switch.

The tunable IF section is best done in two stages. The first stage includes the wiring around the three coils. The coaxial leads from the gang should be cut to length, with the centre conductor terminated on the appropriate coil lug. Under each coil can fixing screw, nearest the gang, is a solder lug, with two for the input coil L11. The braids of the coaxial cables are earthed at these points. The extra lug is used to earth the braid of a similar piece of coaxial cable which runs between L11 and the second mixer, via the main dividing panel.

Under the other fixing nut of L11 is another solder lug, with a further two on the corresponding point of L12. A small "L" shaped shield of tin plate, measuring ½in x ¾in with a ¼in foot, is used for shielding between L11 and L12. It is placed midway between these two coils, with the foot soldered to one of the lugs at L12. Also fixed under the nut in this position of L12, is a 5-tag strip. This makes a convenient terminating point and mounting for R70 and R71. Other items such as the capacitors associated with each coil are mounted with short leads, directly to the lugs of the coil former base.

The second stage involves mounting the tunable IF assembly, with its panel, in a similar fashion to that for the noise silencer. The interconnecting wiring virtually completes the receiver up to the tunable IF, leaving only the front end to be done.

The first VFO assembly is fixed with a ½in long screw at each end of the board, with the screw heads on the component side of the board. Again, the three nut technique is used to stand the board off the chassis by about 3/8in, with the final nuts above the chassis, one each side of the variable capacitor. Between this variable capacitor and the flywheel of the dial we have fixed a 5-tag strip. This is used for terminations of R141, some leads for the RF gain control, R50, etc.

The RF amplifier and switch assembly may now be fitted. We ran an earth lead from the nearest earth tag on the coil board, to a lug fixed under the nearest fixing screw for the variable capacitor, C54. A coaxial cable is run from the aerial terminal and coaxial socket, along the corner of the chassis, through the partition and up to the RF attenuator switch. The interconnecting wiring virtually completes this compartment.

The first and third mixers are fixed with two screws each. The screws are ¾in long, with the heads on the component side of the board. One screw is at the end hole of the board and the other is at the third hole in from the other end. Once again, the three nut technique is used, to space the boards about 5/8in from the chassis. Each board should have the external leads fitted beforehand, which would be otherwise difficult to do after it has been fixed. Make sure that the correct mixer is used for each position. Leads from the RF amplifier and first VFO compartment are brought through holes in the partition, adjacent to the respective lugs on the mixer boards.

Perhaps the next most convenient unit to install would be the second mixer. This is a very simple item and it is held with two ½in long screws, with heads above the chassis. Three nuts are again used to space the board from the chassis. The coaxial cable from the tunable IF may be terminated, the braid being earthed to the lug nearest the rear of the chassis. From this same point two earth links of hookup wire are taken, one each to lugs under the top screws which hold the crystal oscillator cover plate. These are necessary to reduce crystal oscillator harmonic breakthrough.

The 40MHz band pass filter is very simple to wire. We used two solder lugs under the can fixing screw nearest the two coil lugs to be earthed in each case. This allows a direct soldered earth connection. A 2-tag strip is fixed under a nut of the first transformer can, adjacent to the .001uF feed through capacitor.

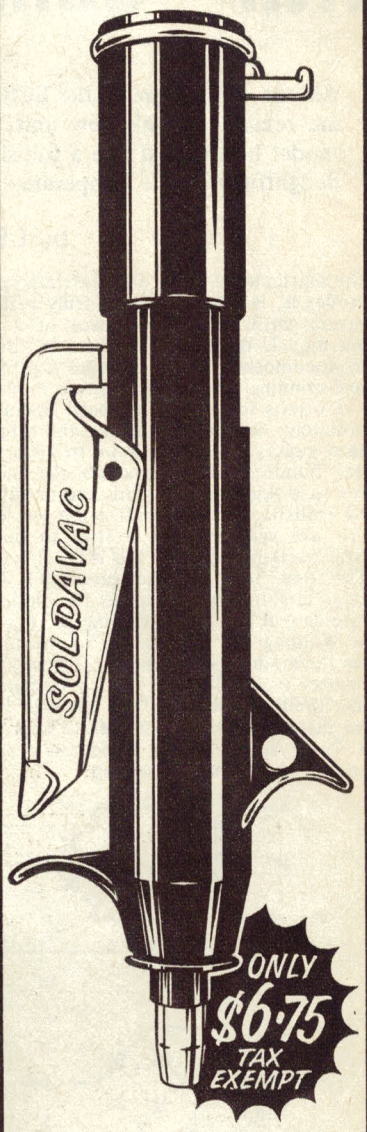
There is more to the 37.5MHz band pass filter and amplifier wiring, because of the amplifiers between T9-T10 and T10-T11. Between each of the three transformers just mentioned are 5-tag strips, to take the major components of the two amplifiers. The strips are mounted midway between the transformers as may be seen in the photograph. The tag on each nearest the crystal oscillator box is used for the supply voltage, and the other four are used to mount the transistor and other components. It should also be noted that we earthed the shield of the transistor to the earth lug on the strip.

It may be better to wire up most of each tag strip assembly before it is fitted into place. A further point of interest is that

(continued on page 158)

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SCR-PUT Model Train Control with "Simulated Inertia"

All the advantages of the SCR-PUT train controller described last month are retained in this new unit, which also includes circuitry to make the model behave just like a full-sized train. It is still very easy to build, and delightfully simple to operate.

by LEO SIMPSON

No matter how good a basic train speed controller is, it cannot achieve truly realistic operation with "direct" control of a low inertia model. Whereas "full throttle" on an actual locomotive simply provides maximum "wheel-spinning" acceleration, on a model loco it results in virtual full-speed operation immediately. Similarly, reducing the throttle to zero causes an actual train to coast for several hundred yards, whereas the model brakes to a skidding halt. This can hardly be called realistic, and in practice the modeller has to use very delicate control to obtain realistic starts and stops, if this is his aim.

The new unit we are presenting here contains circuitry which causes the model to operate as if it had the sizable inertia of a real train. Winding the throttle up to maximum causes the model train to move off slowly and accelerate smoothly up to its designated speed. Similarly, winding the throttle back causes the model train to decelerate smoothly to a lower speed, or to a complete stop, depending on the throttle setting.

As with the design presented last month, the train controller presented here has evolved functionally from its predecessors published in March 1967 and February 1968, but the circuit is markedly different. Our own experience with the earlier controllers and feedback from readers suggested that they were often difficult to drive, especially in low speed shunting manoeuvres. In addition, there were, perhaps, too many setting-up adjustments.

With these thoughts in mind, we have kept the number of adjustments on the new design to a minimum. The unit has but a single control knob, which functions both as throttle and brake. In addition, the unit has a switch which enables the inertia facility to be disabled to give "direct" control for low speed shunting operations.

For the benefit of readers who may not have seen last month's article on the subject, let us briefly describe the principles of operation of three types of model train control: the simple resistor control, the conventional transistor control and the SCR-PUT control which forms the basis of the unit presented here.

Figure 1 shows the basic circuits of all three; each may be seen to include a transformer/rectifier section which converts the AC mains to a pulsed DC output of about 12 to 15 volts. The circuits differ only in the control section used to vary the proportion of this pulsed DC output fed to the model train loco.

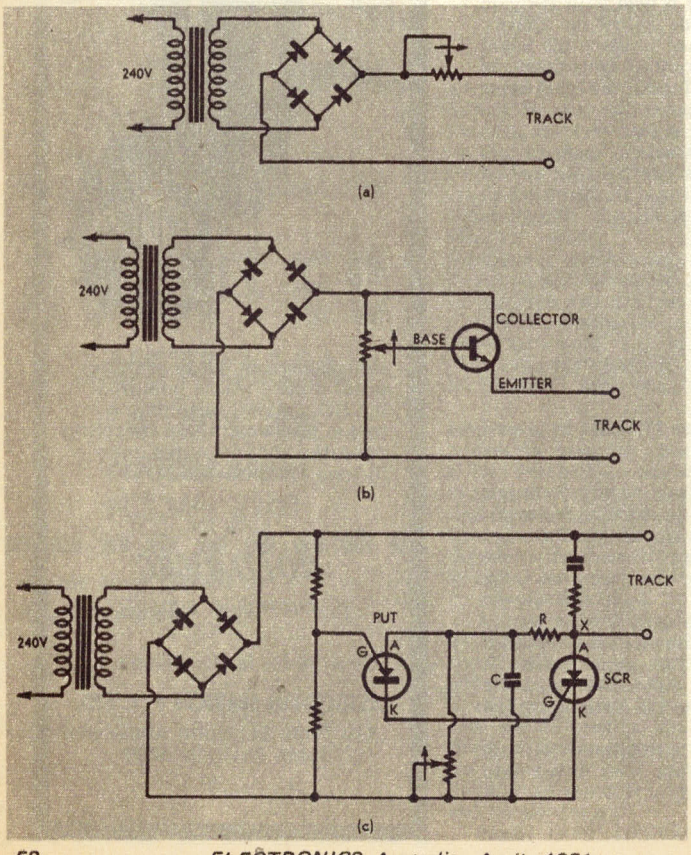
The reason why the output from the rectifier is generally not filtered to give smooth DC is that the "pulsed" DC is more capable of breaking down contact resistances than a smooth DC supply. Contact resistances exist between the loco wheels and the track, between the pickup brushes on the loco wheels and between the motor brushes and its commutator. By more effectively overcoming these contact resistances, the pulsed supply gives improved starting and smoother operation at low speeds.

In the resistor controller of figure 1(a) control is provided by a variable resistor in series with the supply to the track. This controls the current taken by the train directly. As the resistance is decreased, the current increases to make the train run faster. The resistor must be able to pass appreciable currents while dropping a large proportion of the supply voltage. It must therefore be a large and relatively expensive component.

While it has the advantage of simplicity, the resistor has the effect of making the supply voltage to the loco poorly regulated. Whenever additional current is drawn to cope with an increased load, the voltage drop across the resistor increases and the track voltage falls. The load/speed regulation is thus quite poor, particularly at low speeds.

Furthermore, the low speed operation and starting is especially poor because at low throttle settings the voltage applied to the loco is insufficient to reliably overcome the contact resistances.

In the simple transistor controller of figure



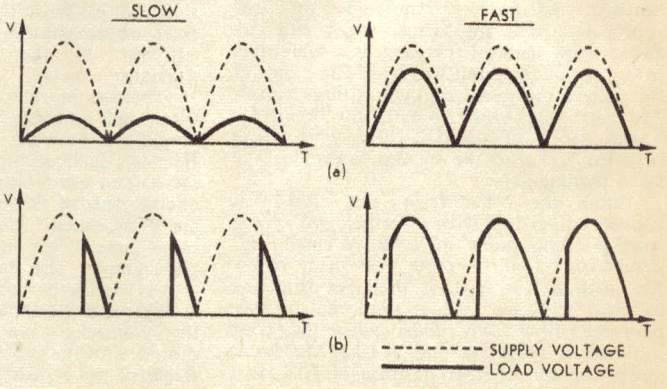


Figure 1, at left, shows the three basic train controller circuits discussed in the text. Figure 2, above, shows the output voltage waveforms for (a) transistor controller and (b) SCR controller.

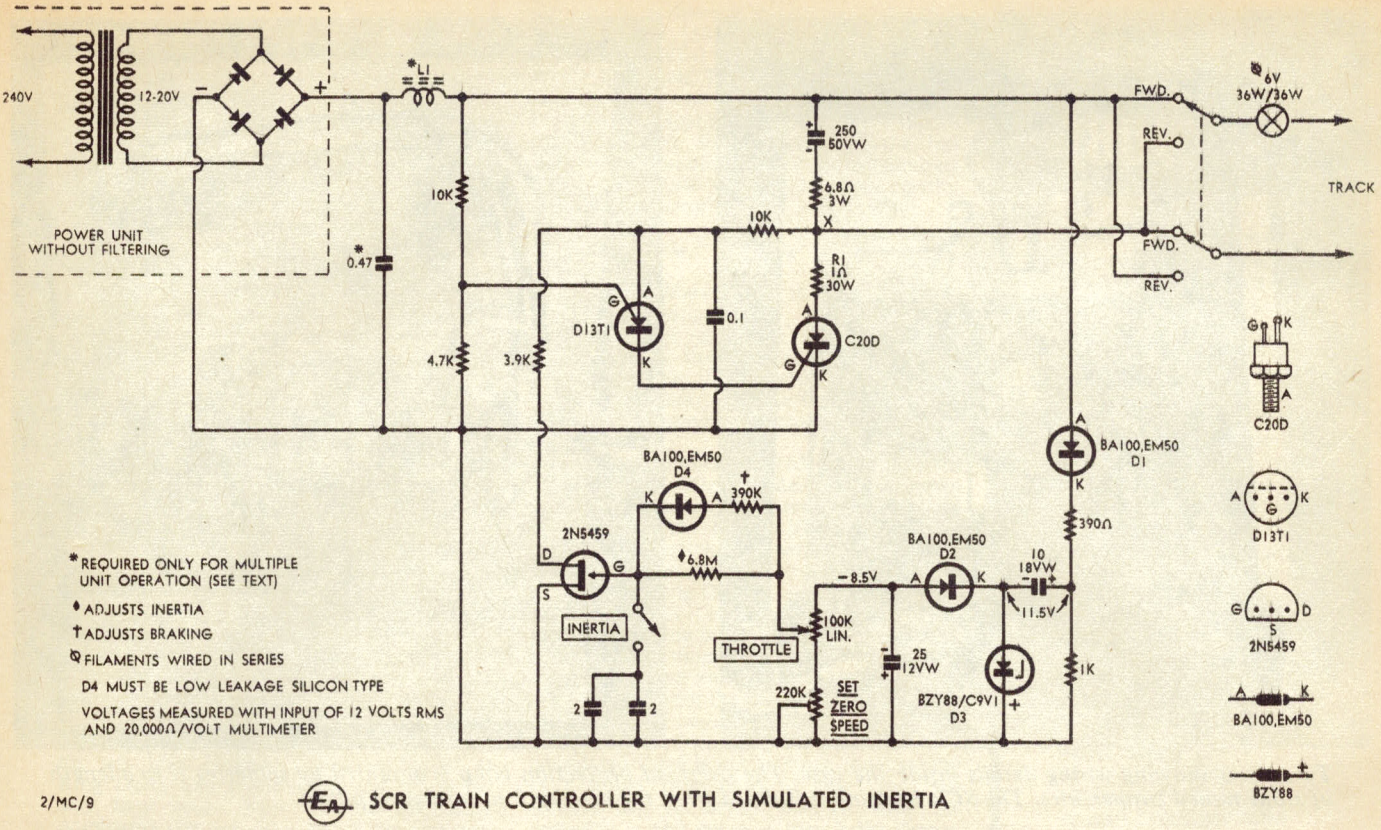


Figure 3. Complete circuit diagram of the new train controller. The lower half of the diagram is the section for simulated inertia. At right is an exterior view of the prototype.



1(b), control is performed by a power transistor in series with the supply to the track. The current through the transistor and the loco is determined by the transistor base voltage, which is varied by a potentiometer.

Like the simple resistive controller, the transistor must be capable of dissipating a considerable amount of power because it drops a substantial proportion of the supply voltage while passing the full load current. The power dissipated in the potentiometer is quite small because the transistor has a considerable current amplification factor.

The current through the transistor and hence through the loco, is dependent on the base current which, in turn, is dependent on the bias voltage applied between base and emitter. Now as the speed of the loco varies, the back EMF (electromotive force, or more simply, voltage) generated by the motor also varies. Because of the circuit configuration, this changes the voltage at the emitter of the transistor, and hence the emitter-base voltage. The result is a negative feedback action: when the loco is moving rapidly and generating a relatively high value of back EMF, less base-emitter voltage is applied to the transistor and accordingly, the latter delivers less current to the track.

Conversely, if the loco slows down, due to increased loading or an upward grade, the back EMF will tend to reduce. This will effectively increase the base-emitter voltage of the transistor and so more current will be delivered. Thus, there is a tendency to maintain the loco speed regardless of changes in loading and gradient; in other words, the circuit gives improved speed regulation compared with the simple resistor controller.

Yet to achieve a really worthwhile improvement in speed regulation over the resistive controller, the transistorised unit needs to be quite complex, as protection circuitry must usually be incorporated. And even with a complex transistor controller the performance is still not as good as with the SCR controller to be described.

Perhaps the main reason why the performance is not up to the standard of our SCR controller is that, like the simple resistive controller, it simply varies the amplitude of the pulsed DC fed to the loco. Thus, at low throttle settings the peak amplitude of the voltage fed to the track is very small and may be inadequate to overcome contact resistances.

Unlike the resistive and transistor controllers, the SCR circuit shown in figure 1(c) does not function by merely varying the amplitude of the pulsed DC. Rather it behaves as a switch, which is rapidly opened and closed to let through varying amounts of power.

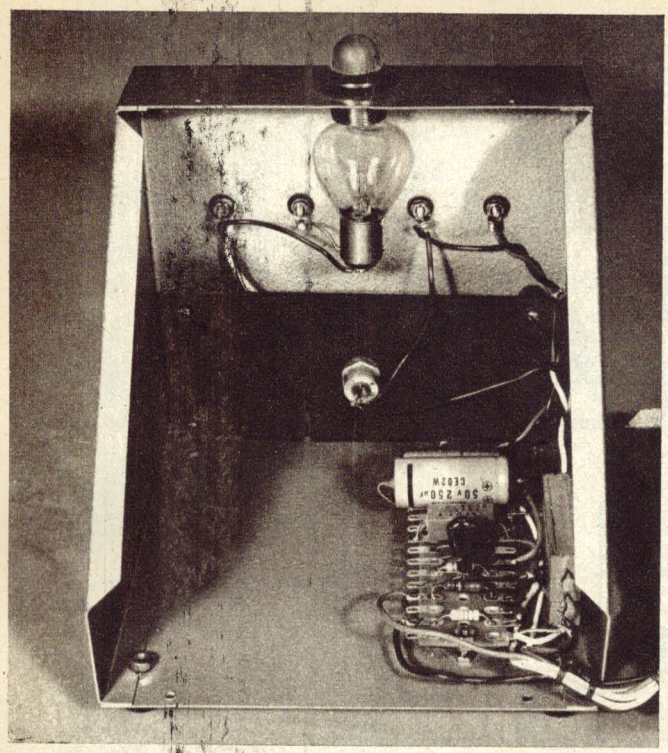
The SCR is a complex thyristor device whose construction and detailed behaviour need not concern us here. Basically, it can be considered to be a special type of rectifier diode which only conducts in the "forward" direction when it is "triggered" into doing so by a small voltage applied between its cathode and a third electrode known as the "gate". Whenever the anode-to-cathode current drops to zero or the anode-cathode voltage is reversed, the device stops conducting, whereupon it must be triggered on again when required.

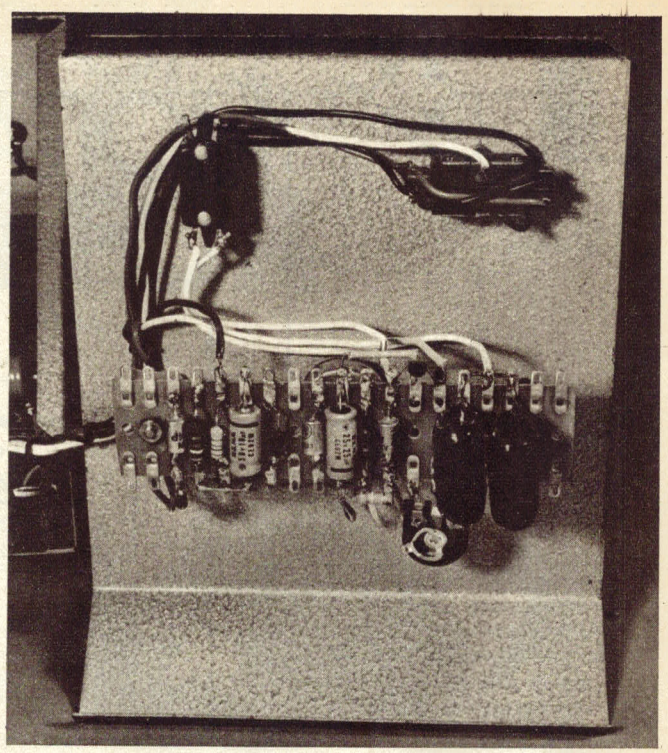
In the circuit of figure 1(c) the SCR is fed with pulsed DC whose amplitude drops to zero at the end of every half-cycle pulse. The SCR is triggered into conduction during each half-cycle and automatically turns off at the end of each pulse. It is the proportion of each half-cycle pulse during which the SCR conducts, determined by the time at which is is triggered into conduction, which controls the amount of power fed to the loco.

Thus, if the SCR is triggered early in each half-cycle pulse, more power is fed to the loco than if it is triggered late in each half-cycle. This type of control is known as "phase-control" or "pulse-width" control.

Because it is effectively a rapid, low-resistance switch, very little power is dissipated in the SCR. Bulky heatsinks are not required, even for quite high power operation.

The SCR controller has negative feedback from the armature of the train's motor so that, like the transistor controller, its load-speed regulation is good. The main advantage of the SCR controller over the transistor circuit is at slow speeds. Because the output waveform remains relatively high





Two views showing wiring details inside the case. The overload protection lamp is mounted by soldering it to a length of stout tinned copper wire. The SCR heatsink is isolated from the case by four insulating pillars.

in amplitude for all throttle settings, the SCR controller is able to break down contact resistances and give reliable running at much lower speeds than with the transistor controller.

The output voltage waveforms for both the transistor and the SCR controllers are shown in figure 2 for both high and low speeds. The supply voltage from the power unit is shown as a dotted line in each of the diagrams. The output voltage delivered to the track is shown as a solid line. The voltage drop across the transistor or SCR is the difference between the input and output voltage curves.

The difference in the operation of the two controllers can be clearly seen from these diagrams. The transistor controls the amplitude of the output pulses, while the SCR controls the proportion of the input pulses fed to the track.

The transistor controller gives a low amplitude pulse output at low throttle settings which may not always be able to overcome the various contact resistances. The higher amplitude output of the SCR controller, while still having the same "average" value effectively overcomes contact resistances and allows the train to run smoothly at lower speeds. It also helps the train to start more reliably.

The method of negative feedback application in the new SCR controller is unusual and represents a departure in design from that of our previous SCR controllers. These had the drawback that the negative feedback system used effectively applies to the SCR, at the instant of triggering, an instantaneous sample of the motor back EMF. This back EMF will contain a variety of spurious noise signals due to motor commutator hash, wheel sparking, block control switching and so on, which tends to cause erratic and jerky operation, especially at low speeds. The effect is particularly noticeable with the simpler types of loco having motors with a small number of poles and commutator segments; it also tends to be a problem when two locomotives are used in tandem.

To overcome this problem, it is necessary to arrange for the negative feedback mechanism to sample the average value of the motor back EMF rather than the instantaneous value. By averaging the motor back EMF over a short period, we still have the advantage of using negative feedback to improve speed regulation but erratic operation due to spurious noise signals is eliminated.

Referring now to the circuit in figure 1(c), the back EMF from the motor is actually averaged by the same RC circuit which is used to determine the SCR triggering point. In effect, the circuit is arranged so that the motor back EMF is subtracted from the supply voltage fed to the RC network, giving the required negative feedback action.

Actually, the SCR is not triggered directly as in our previous circuits, but is triggered by sharp pulses fed to its gate by a second thyristor device known as a "programmable unijunction transistor", or PUT. The PUT is very similar to a low power SCR but is triggered by a small voltage applied between gate and anode instead of between gate and cathode in the case of an SCR.

The PUT used here is the General Electric D13T1, a low cost type. In the circuit shown, the gate electrode is connected to a reference voltage which is derived from the pulsed DC supply via a voltage divider. When capacitor C charges up via resistor R to raise the voltage at the PUT anode by about 0.6 volts above that of the gate, the PUT conducts and delivers a sharp pulse of current to the gate of the SCR.

LIST OF PARTS

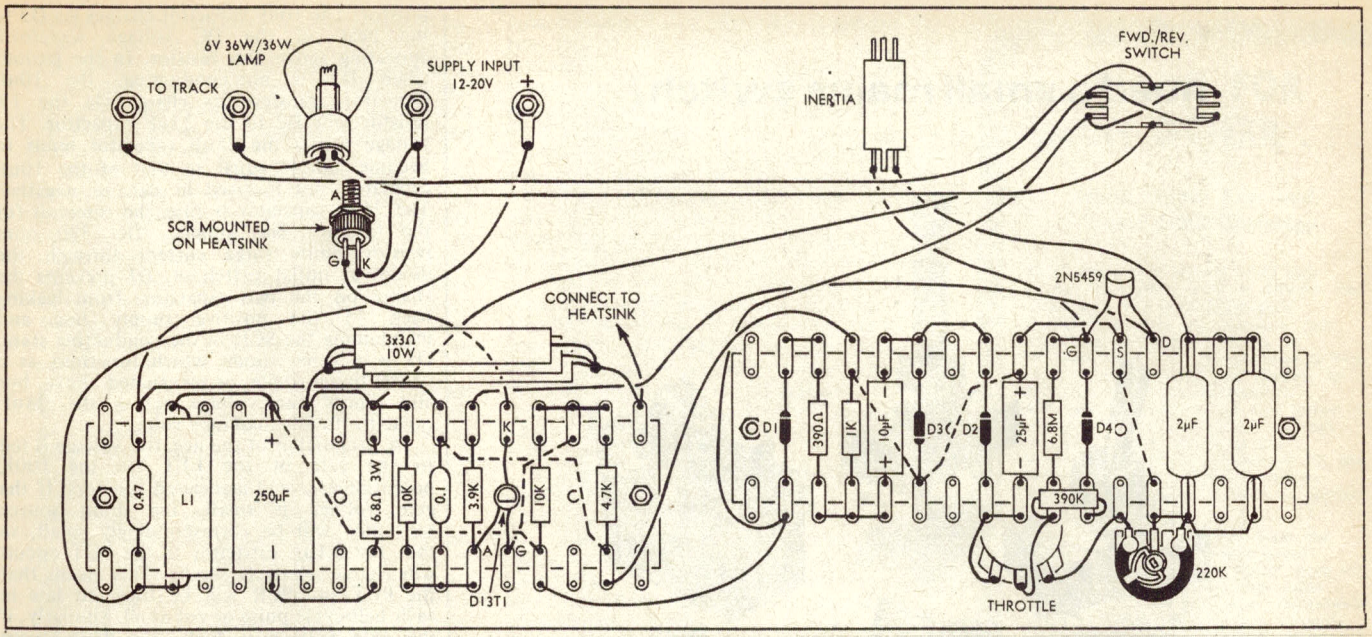
1 Sloping front case, 6 x 6 x 6in
1 Front panel, 6 x 6in
1 Heatsink, 5½ x 2½in x 16 SWG aluminium
1 Large Bezel assembly
1 6 volt 36-36watt twin filament lamp
1 DPDT toggle switch
1 SPST toggle switch
1 Control knob
1 RF choke (see text)
4 Spring-loaded terminals, assorted colours
4 ½in insulated standoff pillars (to mount heatsink)
2 17-lug miniature tagboards

SEMICONDUCTORS
1 C20D silicon controlled rectifier
1 D13T1 programmable unijunction transistor
1 2N5459 N-channel field-effect transistor
3 BA100 silicon diodes
1 BZY88/C9V1 zener diode

CAPACITORS
(higher voltage ratings may be used)
1 250uF/50VW electrolytic
1 25uF/12VW electrolytic
1 10uF/18VW electrolytic
2 2uF/50VW metallised polyester
1 0.47uF/50 polyester
1 0.1uF/50VW polyester

RESISTORS
(¼ or ½ watt unless specified)
1 x 6.8M. 1 x 390K, 2 x 10K, 1 x 4.7K, 1 x 3.9K,
1 x 1K, 1 x 390 ohm, 1 x 6.8 ohm/3 watt, 3 x 3 ohm/10 watt
1 x 100K (lin) potentiometer
1 x 220K preset potentiometer

MISCELLANEOUS
Nuts, screws, washers, solder lugs, rubber feet, hookup wire. cable lacing, solder.



The wiring diagram shows the interconnection of all circuit components and should be used in conjunction with the photographs. The tagboard on the left is the basic control circuit while that on the right is for simulated inertia.

This triggers the SCR which then conducts for the remainder of the half-cycle.

The negative feedback action is as follows. At the start of each half-cycle supply pulse, the SCR is non-conducting, having been turned off at the end of the previous half-cycle. Thus when the voltage at point "X" in the circuit begins to rise, its value will be equal to the rising supply voltage less the back EMF from the motor. If the loco is at speed, the back EMF will be high and the voltage at point "X" will be relatively low. Conversely if the loco is moving slowly, or stopped, the back EMF will be small or zero so that the voltage at point "X" will be almost equal to the incoming supply voltage.

The capacitor C will thus tend to charge slowly or rapidly, depending on the motor back EMF. This will cause the PUT and the SCR to trigger into conduction at a later or earlier instant in each half-cycle pulse, thus varying the power fed to the loco. Hence the circuit tends to exhibit good load-speed regulation. The speed of the loco is varied by the potentiometer connected in parallel across capacitor C so that it varies the proportion of the charging voltage at point "X" fed to the capacitor.

A resistor/capacitor network connected across the track form a hash filter. The resistor value is something of a compromise, as too small a value gives unreliable starting due to excess smoothing of the output waveform, while too large a value tends to give jerky operation at low speeds. The ripple current rating of the capacitor and the peak current rating of the SCR must also be taken into account. We have used a 250uF/50VW electrolytic capacitor and a 6.8 ohm resistor in the final circuit and these appear to be close to optimum.

As described, the circuit in figure 1(c) forms the nucleus of both the Basic Train Controller published last month and the modified version presented here. The only major additions are components to protect the SCR from overload, in both circuits, and in the new design additional circuitry to give simulated inertia.

With a conventional train controller, as noted earlier, the only way the operator can simulate the inertia of a full size locomotive is to very gradually wind up the throttle so that the model accelerates smoothly to the desired speed. Similarly, when slowing the loco, he has to gradually wind down the throttle so that the voltage supplied to the loco is very slowly decreased. In most cases, it is just not possible to "finger" the throttle control delicately enough to obtain the desired effect of a real train.

Referring again to figure 1(c), what is required to solve this problem is some sort of electrically controlled resistance element to replace the throttle potentiometer. We could then use slowly varying voltages to control the throttle and so simulate the effect of inertia with models. In fact, this is what we have done. The electrically controlled resistance element we have used is the drain-source resistance of an N-channel field-effect transistor (FET). The FET is controlled by a negative DC voltage applied between gate and source electrodes.

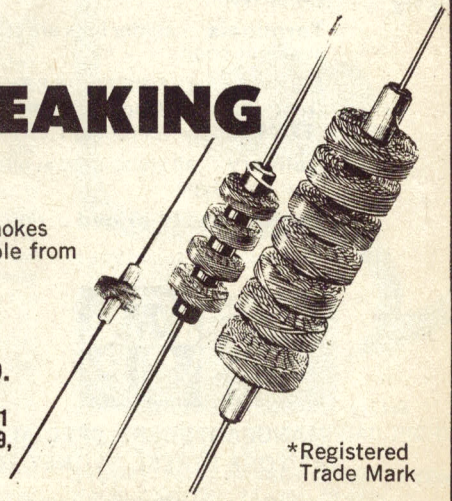
The FET used is a Motorola device, type 2N5459. As with other FETs, it is possible to vary the DC resistance from several hundred ohms to tens of megohms by varying the negative gate-source voltage between limits of, typically, -2 to -8 volts. This means that all that is required to use the FET in our circuit is some means of developing a negative bias voltage, together with suitable RC networks which will allow the gate-source voltage of the FET to be smoothly controlled.

Looking now at the main circuit diagram, readers will notice that it is split into two sections. The upper section is essentially the same as the basic circuit shown in figure 1(c). The lower section is the inertia circuitry.

In the inertia section, diodes D1, D2 and D3 are used to develop a negative DC voltage from the fluctuating positive supply line, as follows. Initially, all capacitors in the inertia circuit are discharged. As the voltage on the positive supply rail begins to rise, D1 conducts and a replica of the pulsed DC voltage waveform appears across the 1K

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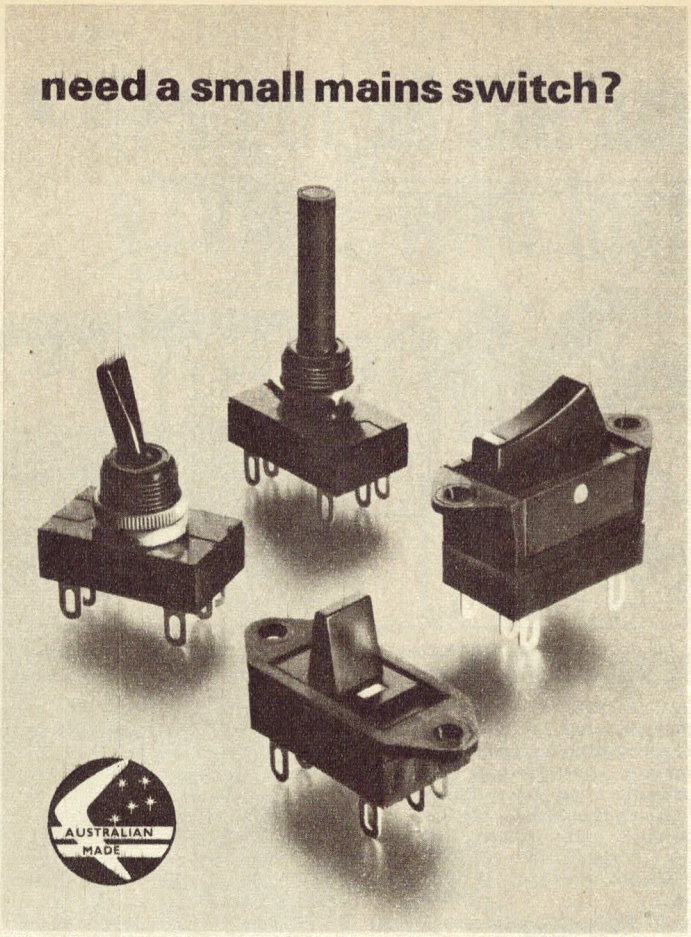


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resistor. The 10uF capacitor charges via D3 to the peak of the DC voltage waveform appearing across this resistor. In the periods when D1 is non-conducting, the 10uF capacitor transfers its charge via the 1K resistor and D2 to the 25uF capacitor. The voltage across the 25uF capacitor tends to become almost equal to that of the 10uF capacitor, but reversed in sign, ie, negative. The 25uF capacitor is thus the reservoir for the negative bias supply. The 390 ohm resistor limits surge current through the diodes at initial switch-on. D1 prevents the charge on the two capacitors from leaking back to the positive supply line and maintaining the SCR in the conducting state. D3 is a zener diode which functions as a conventional diode, as mentioned above, but also limits the voltage across the 25uF capacitor to less than nine volts.

A proportion of the negative voltage is fed to the gate of the FET via the 100K potentiometer and associated resistors. If the gate voltage is small, the drain source resistance will be correspondingly small, so that the 0.1uF capacitor in the PUT circuit will charge relatively slowly. This means that the PUT and SCR will be triggered late in each half-cycle pulse or not at all. Similarly, if the gate voltage is high, the drain-source resistance will be correspondingly high and the 0.1uF capacitor is allowed to charge rapidly so that the PUT and SCR are triggered earlier in each half-cycle.

Thus, it can be seen that the FET is an electrical equivalent to the throttle potentiometer in the basic circuit in figure 1(c). The 3.9K resistor in series with the drain of the FET offers a degree of protection to the FET and also determines the minimum resistance in the circuit.

The 100K potentiometer controlling the FET bias becomes the throttle. The 220K preset resistor connected in series with the potentiometer is arranged to set the zero speed of the loco when the throttle is in its minimum setting. It prevents the gate-source voltage from being reduced below a certain value.

The zener diode D3 limits the maximum negative voltage to less than nine volts, as mentioned above. This is just slightly more than the maximum "pinch-off" voltage of the 2N5459, and so ensures a progressive action in the throttle. The use of the zener also reduces the need to adjust the zero speed setting when the supply voltage is changed.

The voltage readings on the circuit diagram were taken with a rectified AC input of 12 volts RMS and a 20,000 ohms/volt meter. If the AC input is increased, the voltage across the 10uF capacitor will increase accordingly, but that across the 25uF capacitor is held constant by the zener diode. The voltage readings are unaffected by the throttle settings.

Inertia is arranged by switching 4uF of capacitance between gate and source of the FET. When the throttle potentiometer is advanced to a high setting, the capacitor must charge up via the 6.8M resistor and thus the FET bias rises very gradually. The train accelerates accordingly. The amount of inertia on acceleration is most easily controlled by the size of the 6.8M resistor. If a higher degree of inertia is desired then this resistor should be increased and vice versa.

If the throttle was reduced to zero after the loco had reached its full speed, the loco would take a very long time to decelerate to a full stop. Thus, we need extra components to increase the degree of braking when the throttle setting is reduced. This is accomplished by the diode D4 and its series resistor of 380K, which provide a shorter time-constant discharge path. The braking can

be increased by decreasing the series resistor and vice versa.

The ability to switch the inertia capacitor in and out of circuit adds to the flexibility of the unit. When the capacitors are switched out of circuit, the unit can be used as a "direct" controller without inertia, in much the same way as the basic train controller published last month. This makes low speed shunting manoeuvres much easier than if the inertia facility was in circuit permanently.

The only features of the circuit diagram remaining to be discussed are the inductor L1 and its associated capacitor, and the components for overload protection of the SCR.

If more than one of these controllers are to be connected to a common transformer/rectifier unit, the inductor L1 and the 0.47uF capacitor should be included. They form a filter which prevents mutual interaction between controllers due to false triggering from switching transients.

Protection against overload is provided by the resistor R1 and the lamp. If a short circuit is applied to the track, R1 limits the surge current to a value which is considerably less than the surge capacity of the SCR specified. The lamp then warms up and limits the steady state short-circuit current to less than five amps, which is again less than the continuous rating of the SCR.

For simplicity, no fuse has been fitted. As far as the SCR is concerned a fuse would offer no extra protection, since the steady current is limited to five amps. However, some constructors may wish to fit a fuse to the power supply circuit so that the transformer and rectifiers are protected against accidental short circuits when making connections to the controller.

The controller may be used with rectified AC inputs of up to 20 volts RMS, which maximum figure should be adequate for all likely situations. With most locos the input voltage should not be any more than 15 volts, otherwise the scale speed becomes excessive and completely unrealistic. As far as the circuit is concerned, the limit is mainly set by the voltage ratings of the PUT. Also, with high input voltages, the throttle tends to become very critical in operation – small movements of the control tending to produce large changes in speed.

A further and perhaps more important consideration is that the input voltage should be limited so that the form factor of the output current waveform does not become excessive at low throttle settings. If an excessive input voltage is used, the form factor (ie, the ratio of RMS value to average value) will be very high and the amount of heat dissipated in the loco motor will be high, at low throttle settings, for the amount of torque being produced. With the maximum of 20 volts we have specified, heat dissipation at low or high throttle settings has not been found to be a problem with the wide variety of locos we have tested with this controller. (See footnote at the end of this article.)

As with the basic controller published last month, one of the advantages of the design is that it may be constructed for high or low power operation with only minor circuit changes. The main circuit diagram shows the components for high power operation, ie, the unit may be used at output currents of up to five amps. By substitution of a lower power SCR, a different overload lamp and a higher value overload resistor R1, a lower power unit may be produced.

For a lower power unit an SCR such as the General Electric C106Y1 or Mullard BT100A could be used, giving a two amp capability. For these devices, the overload limiting resistor should be increased to 3 ohms at a

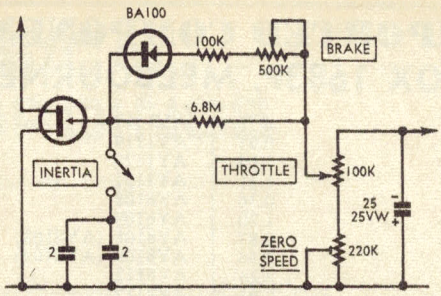


Figure 4: This modification to the FET circuit can be used to provide separate throttle and brake controls.

power rating of 10 watts. The overload lamp should be changed to a 12 volt/18 or 21 watt type. An automobile trafficator lamp would be very suitable.

It is worth noting that a Triac device may be substituted for the SCR if a suitable type is on hand. Economy Triacs such as the SC141D or AC06DR are suitable for direct substitution in the circuit as published. The overload components need not be altered since both Triacs have a current rating of 6 amps.

The main point to be considered when deciding if a particular SCR or Triac is suitable for the unit is that it should have blocking voltage ratings of 30 volts or more. When connecting a Triac to function as an SCR, T2 becomes the "anode" and T1 becomes the "cathode". Thus, if an AC06DR is used as an SCR, the case becomes the anode, the small terminal is the gate and the large terminal becomes the cathode.

Diodes D1 and D2 can be virtually any general purpose type, either germanium or silicon, provided they have a PIV rating of around 25 volts or more. However D4 must be a low leakage silicon type such as the BA100 specified.

The 4uF inertia capacitor in the prototype consisted of two 2uF/100VW metallised polyester capacitors in parallel. If size is not a problem, standard polyester or paper capacitors may be substituted. However if old paper capacitors are used, their insulation resistance should be checked – it should be of the order of 100 megohms or more, for satisfactory operation. Electrolytics, whether aluminium or tantalum types, are not suitable in this application.

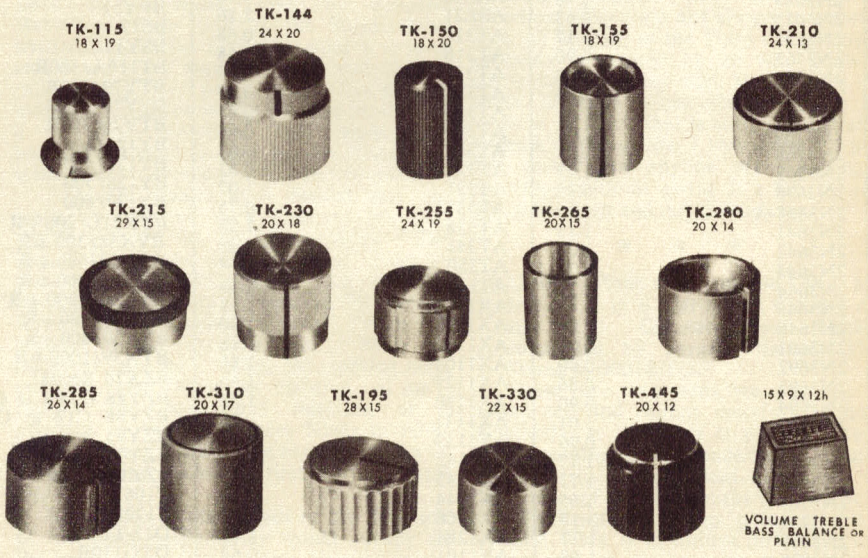
The prototype controller was housed in a 6 x 6 x 6in sloping front case. On the front panel are mounted the throttle control, the forward/reverse switch and the inertia disabling switch. At the top of the case is a large bezel which is used for the overload indicator lamp. At the rear of the case are two pairs of spring-loaded terminals, for supply input and track output repectively. All of the inertia circuitry is mounted on a tagboard on the front panel, while the major part of the remaining circuitry is mounted on a tagboard on the floor of the case.

Layout is not critical but good wiring practice should be followed. Most enthusiasts will have their own ideas about the final unit and may wish to house the power supply in the same case. Alternatively, several controllers could be housed in a large console for extensive layouts. Constructors who are

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2N443	3.51
2N456A	4.20
2N458A	6.12
2N489B	14.76
2N649	2.12
2N657	4.79
2N696	1.13
2N706A	1.08
2N930	1.80
2N1038	3.92
2N1046	17.94
2N1073B	11.60
2N1100	7.23
2N1302	1.01
2N1303	1.01
2N1304	1.13
2N1305	1.13
2N1306	1.32
2N1307	1.32
2N1308	1.64
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2N1563	5.45
2N1908	24.47
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2N2188	2.79
2N2189	3.57
2N2270	2.64
2N2646	2.19
2N2996	3.15
2N3005	5.32
2N3053	2.48
2N3055	2.63
2N3525	3.17
2N3563	0.90
2N3564	1.08
2N3565	0.86
2N3566	1.01
2N3567	1.08
2N3568	1.08
2N3569	1.23
2N3638	0.90
2N3638-A	1.13
2N3641	1.13
2N3642	1.26
2N3643	1.26
2N3644	1.13
2N3645	1.44
2N3646	0.90
2N3691	0.85
2N3692	0.90
2N3693	0.86
2N3694	0.90
2N3702	1.01
2N3703	0.96
2N3704	1.77
2N3705	1.73
2N3706	1.65
2N3731	3.17
2N3819	1.77
2N3826	1.68
2N4121	1.04
2N4250	1.17
2N4354	1.28
2N4355	1.65
2N4356	1.65
2N4360	1.58
2SB407	3.30
2SB474	3.30
3N140	2.55
3N141	2.34
20A2	0.78
20A4	0.91
20A6	1.04
20A8	1.21
AA119	0.36
AB1101	1.20
AB1102	0.87
AB1136	0.54
AC107	2.28
AC125	0.96
AC126	0.96
AC127/128	2.21
AC127/132	2.16
AC128	1.05
AC132	1.05
AC172	1.20
AD149	2.45
AF114N	1.08
AF115N	1.08
AF116N	0.93
AF117N	0.93
AF118	2.52
AN1101	0.60
AN1102	0.68
AN1103	0.60
AN1104	0.60
AN1105	0.60
AN2001	0.45
AN7102	0.90
AN7105	0.68
AS147	0.66
AS148	0.63
AS208	1.25
AS300	0.77
AS301	0.80
AS306	0.81
AS307	0.81
AS308	0.81
AS310	0.81
AS311	0.77
AS312	0.77
AS313	0.81
ASY73	2.12
ASY76	2.10
ASY77	1.83
ASY80	1.68
ASZ16	3.03
ASZ18	2.91
ASZ20	0.98
ASZ21	2.16
AT316	0.68
AT318	0.68
AT319	0.69
AT321	0.69
AT322	0.63
AT323	0.68
AT324	0.68
AT325	0.83
AT331	1.02
AT337	0.75
AT338	1.50
AT341	0.69
AT350	1.14
AT1138	2.66
AX1101	1.53
AX1103	1.70
AX1104	1.86
AX1108	1.86
AX1127	1.50
AX1130	1.50
AX1131	1.70
AX1132	1.50
AX1142	1.20
AX1143	1.58
AX1144	1.44
AX1166	1.37
AX1284	1.41
AY1101	0.68
AY1102	1.04
AY1103	1.35
AY1104	1.35
AY1108	1.65
AY1110	1.50
AY1112	0.69
AY1113	0.69
AY1114	0.60
AY1115	0.60
AY1116	0.68
AY1117	0.68
AY1119	0.60
AY1120	0.98
AY1121	0.98
AY6108	1.65
AY6109	1.65
AY8108 (AY8103)	3.75
AY8109 (AY8104)	3.00
AY8112	6.75
AY8113	6.08
AY8115	2.25
AY8116	1.80
AY8117	9.15
AY8135	5.40
BA100	0.44
BA114	0.39
BC107	0.83
BC108	0.76
BC109	0.91
BC147	0.76
BC148	0.68
BC149	0.79
BC157	0.89
BC158	0.76
BC159	0.89
BC177	0.91
BC178	0.84
BC179	0.92
BC186	0.79
BCY10	2.59
BCY11	3.24
BCY12	3.14
BCY39	5.19
BCY71	2.05
BCZ10	1.95
BCZ11	2.37
BCZ12	2.16
BDY20	3.51
BF115	0.87
BF145	0.64
BF167	1.08
BF173	1.15
BF177	1.63
BF178	1.80
BF179	2.04
BF184	0.72
BF185	0.72
BF194	0.67
BF200	1.32
BFY51	5.19
BS19	2.16
BSY11	8.43
BT110A/500R	3.00
BTY79/100R	2.70
BTY79/200R	3.03
BTY79/300R	3.45
BY126/200	0.48
BY126/400	0.56
BY126/500	0.63
BY127/800	0.78
BYX21L/200+R	1.35
BYX38/300+R	1.32
BYX38/600+R	1.62
BYX38/900+R	2.08
BYX38/1200+R	3.03
BYX39/600+R	3.14
BYX39/800+R	3.88
BYX39/1000+R	4.53
BZX70 Series	1.95
BZY88 C3V3 to C11	0.83
BZY88 C12 to C30	0.98
BZY95 Series	2.16
BZY96 Series	2.16
BZZ14 to 29	2.37
C106Y1	2.10
C122D1	3.78
D13-T1	1.95
DTG110B	6.96
DTG1010	15.16
EM402	0.45
EM404	0.63
EM406	0.78
EM410	1.39
FPT100	1.80
H35	8.07
MB05	1.88
MB1	2.03
MB3	2.65
MB6	3.39
MJE2955	4.55
MJE3055	3.06
OA5	0.65
OA10	0.87
OA47	0.65
OA90	0.32
OA91	0.33
OA95	0.39
OA202	0.75
OC20	6.38
OC22	3.03
OC23	3.80
OC24	3.45
OC44N	1.11
OC45N	1.11
OC74	0.96
2-OC74N	1.92
OC75N	1.49
OC140	1.95
OC141	2.60
OC201	3.78
OC202	3.68
OC915	2.21
OCP70	2.59
OCP71	4.32
ORP12	0.93
ORP60	1.77
PA40	4.83
PB40	7.28
SC40D	8.55
SC50D	13.05
SD55	0.63
SE1001	1.13
SE1002	1.20
SE1010	1.80
SE2001	0.98
SE2002	1.20
SE3030 (AY8112)	6.75
SE3031 (AY8112)	6.75
SE3032 (AY8113)	6.75
SE3033 (AY8114)	4.72
SE3035 (AY8114)	4.72
SE4001	1.05
SE4002	1.13
SE4040	1.20
SE5001	2.10
SE5002	2.10
SE5003	2.48
SE5020	4.05
SE5023	3.15
SE5025	1.35
SE60010.75SE6002	0.90
SE7001	4.05
SE7002	3.60
SE7070	4.05
SE7020	5.40
SE8001	4.05
SE8002	4.50
ST2	1.47
TIC44	1.68
TIC45	1.92
TIC46	2.03
TIC47	2.27
TIS37	2.36
TIS43	2.36
40360	2.48
40361	2.49
40406	1.80
40407	1.31
40410	1.65

F.E.T.'S

2n4889	2.70
2N5459 (MPF105	1.60
2N5485 (MPF106)	1.77
2N5245 (TIS88)	2.62
2N5458 (MPF104)	1.77
MPF102	1.77

INTEGRATED CIRCUITS

FUL900	1.20
FUL914	1.20
FUL923	2.25
FUL719	5.25
FUL723	7.27
FUL739	5.25
PA222	3.12
PA230	4.29
PA246	13.57

not used to assembling electronic equipment should follow the wiring diagram closely.

The SCR is mounted on a heatsink made of 16-gauge aluminium sheet measuring 5½ x 2½in. This is mounted on four insulating pillars on the rear of the case, so that it is electrically isolated. The heatsink is large enough to allow the controller to be operated at full power into a short circuit, if necessary, without damage to the SCR. It is shown blackened in the photograph but this is not necessary. For low power controllers using the BT100A or C106Y1 no heatsink is required and the SCR may be soldered directly into circuit.

Two 17-lug miniature tagboards are used to accomodate the minor components. The wiring diagram and photographs show the layout. The overload protection resistor R1 consists of three 3-ohm/10 watt resistors connected in parallel to give a 30 watt dissipation rating. The 250uF electrolytic capacitor should have a rating of 50 volts to ensure that it has sufficient ripple current rating. Do not mount the electrolytic capacitor close to the overload protection resistor otherwise it may be damaged due to the heat from the resistor.

The filter inductor L1 is not critical and is wound as follows: Start by winding a layer or two of thin insulation tape on a 1in length of ¼in diameter ferrite rod. If a full length ferrite rod has been purchased, it may be cut to length by filing a nick around the circumference and snapping it as if it was of glass. Close wind 50 or 60 turns of 24 or 26SWG enamelled wire of the insulation tape. Then wind insulation tape tightly around the rod in a couple of layers and the inductor is finished.

The supply input and track output leads are terminated to the spring loaded terminals at the rear of the case. These should be suitably colour-coded and labelled to avoid confusion and the possibility of incorrect connections. We suggest red and black for the positive and negative supply inputs and a different colour for the track terminals.

The overload protection lamp is wired directly into circuit using 16SWG tinned copper wire to support the lamp from one of the track output terminals. The lamp is a 6V car headlamp with the filaments wired in series. It is mounted directly underneath the oversize bezel at the top of the case.

The leads running to the front panel should be bound into a neat cable as shown in the photographs. This makes for neatness and helps prevent damage to the leads due to accidental clamping when the front panel is secured. Make sure that the leads have a free length of about 10 inches before lacing to ensure that the front panel may be swung away for servicing without straining any connections.

The only adjustment to be made when the unit is first connected to the power supply is the correct setting of the Zero Speed potentiometer. This is done by placing the loco on the track and switching the inertia facility out of circuit; then wind the throttle control fully anti-clockwise and adjust the 220K preset potentiometer until the loco neither moves not emits a buzzing noise. This is all there is to it.

Readers who have constructed last month's version and wish to incorporate the inertia circuitry may do so without alteration to the existing circuitry, in spite of the fact that the PUT circuitry in this month's version is slightly modified. The preset potentiometer in last month's version may be simply left in circuit, being adjusted so that the wiper is set to the negative end of the element.

Those readers who built the original SCR control units with simulated inertia as published in March 1967 and February 1968 may update their controllers using this month's circuit. This may be done while still retaining the separate throttle and brake controls. Figure 4 shows the necessary minor modifications to the main circuit diagram. The 100K resistor in series with the 500K potentiometer determines the minimum braking distance.

FOOTNOTE: Some model train enthusiasts decry the use of "pulse power" for model control, as they claim it causes undue heating of the loco motors. This is true only to the extent that for a given torque output, the heat dissipated in the motor will undoubtedly be higher for rectified AC input than for smooth DC. The reason for this is that the torque output is a function of the average value of the current, while the heat produced is a function of the RMS value. For a rectified sine wave, the ratio of the RMS current to the average current (ie, the form factor) is 1.11. With a phase-controlled SCR controller the form factor is higher, especially at low throttle settings.

This means that for a given throttle setting, the heat produced in the loco motor does tend to be higher for an SCR controller than for a resistor or transistor controller using unfiltered DC input. In practice, however, we have not found the heat produced to be any more noticeable than with transistor controllers, and certainly not excessive. Indeed, with the improved low speed running and starting provided by the SCR controller, the small extra heat produced is a small price to pay. ■

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FORUM

Conducted by Neville Williams

Some amateur gear can be duty-free!

In the December issue, we raised the question of import duty on equipment for amateur radio stations. There were some who suggested that we might as well have saved the ink. Fortunately, our editorial has discovered a department which is not as aloof from the amateurs' problems as has thus far been assumed.

As you might recall, we drew attention in the editorial to the fact that transmitters and transceivers peculiar to amateur radio stations were subject to import duty. Yet these items were not manufactured in Australia – and not likely to be, because of the limited size of the market. We pointed out that this was a very real deterrent to people taking up a hobby having worthwhile technological and sociological implications.

It was gratifying, therefore, to receive the following letter from the Department of Trade and Industry, Office of Secondary Industry, Canberra:

The Editor,
"Electronics Australia".
Dear Sir,

I have noted your comments concerning imported amateur radio equipment, which appeared in the Editorial Viewpoint of "Electronics Australia", December, 1970.

As you are probably aware, relief from the protective tariff system can be obtained through the by-law legislation, when such relief would not be detrimental to Australian industry.

In April 1970, the Customs Tariff was amended by omitting the requirement that concessional by-law entry may only be considered for goods for specified purposes or classes of users. The effect of the amendment was to delete the requirement that, unless goods were for an "essential" purpose, they were not eligible for by-law entry. Thus, purchasers of any imported goods of a "non-essential" nature do not have to pay a price inflated by a protective duty when there is no Australian production to protect.

It is the responsibility of importers to apply to the Department of Customs and Excise for concessional admission under by-law for goods which they wish to import. Consideration of such applications will be made on the criterion of whether suitably equivalent goods are reasonably available from Australian production.

We have been advised by the Department of Customs and Excise that, since April 1970, that Department has approved several applications for the import under by-law of certain types of amateur radio equipment.

Under these circumstances, it would be in the interests of importers of amateur radio equipment to consult with the Department of Customs and Excise re by-law at the time imports are being considered.

K. J. Nielson
(Director, Light Engineering and Electrical Section).

We would express appreciation to Mr Nielson for setting out the attitude of his Department to the needs of amateur radio operators.

What, precisely, does the letter mean? Does it change the position in relation to the individual amateur?

It may, or it may not.

It does say, quite positively, that the Department is prepared to give favourable consideration to certain types of equipment used by amateurs. That is an important starting point.

But don't lose sight of the phrase "certain types" of amateur radio equipment. Some items are peculiar to amateur stations, such as transmitters and transceivers whose coverage is limited substantially to the amateur bands. There may be other items which could qualify, such as linear amplifiers, designed only to cover the same frequencies.

There are many other items which, while used in amateur stations, are common to other technical areas. One would assume that these would retain their normal (and probably unfavourable) import duty status.

One would assume, however, that the way is clearly open for those who import items which do qualify, to seek a by-law giving them relief from import duties – and to pass on the saving to their local customers. It seems likely from the letter that something like this is already happening.

But let's not assume too smooth a passage.

An importer who wishes to bring in a line of equipment free of duty must apply for a by-law in very specific terms. Conventionally he will be asked to supply proof that the equipment is not manufactured – and cannot reasonably be manufactured – in Australia. This may involve writing letters to all potential manufacturers in the Commonwealth and obtaining from them an expression of their inability to supply.

Sometimes this process can go to absurd lengths and one instance was cited to me recently where an application for a by-law was refused because the letters tendered did not include various firms, apparently selected at randon from an industry directory – firms which allegedly had never shown the slightest interest in the particular class of product.

It may be that the official handling the application had no knowledge of the electronics industry; it may have been a show of officiousness; it may have been a put-off for some other reason.

But the result was the same: rather than spend more time (and therefore money) writing tedious and rather foolish letters, the applicant paid the duty – and passed it on!

We would hopefully assume that this is an exceptional case and that, in line with the sentiments expressed in Mr Nielson's letter, professional importers of certain amateur station equipment should be able henceforth to bring in amateur band transmitters, transceivers, linear amplifiers, etc, duty free, without an undue array of formalities.

In theory, exactly the same resource should be available to the individual amateur wishing to import an individual piece of equipment. Unfortunately, to a private individual, unaccustomed to the tedium and the formalities of buying overseas and importing goods, even an attenuated effort to obtain customs relief may be a serious deterrent. In short, a given amount of effort to bring in a half-dozen units, duty free may be worthwhile; the same effort to bring in a single unit duty free may be disproportionate.

A traveller, returning from overseas, would probably be better placed. He can purchase the item directly and either bring it back as excess or unaccompanied luggage, usually at a reduced rate. The item can be declared at the time of re-entry and become just a part of the usual customs and re-entry formalities.

But, even so, it would not be wise to arrive back in the country with an amateur band transceiver, simply assuming that "she'll be right mate!"

It would be much wiser to follow the advice of Mr Nielson and "consult with the Department of Customs and Excise re by-law at the time the imports are being considered."

One final point: the remarks about private individuals importing or bringing in transmitters and transceivers apply only to licensees of amateur radio stations. I

IN NEXT MONTH'S ISSUE

STARTING: A NEW BASIC ELECTRONICS COURSE. Have you a friend or acquaintance who would like to make electronics their hobby too? If so, they should be particularly interested in our May issue, which carries the first instalment of our revised and updated "Basic Electronics" course. It starts right at the beginning, and is therefore ideal for those with no prior background.

SURVEY OF PICKUP CARTRIDGES. An article which should be of great interest to all hi-fi enthusiasts. It discusses the points to consider in choosing a pickup cartridge, and lists the cartridges available on the Australian market together with their specifications.

ABOUT STAGE LIGHTING CONTROL

Dear Sir,

As the Australian representative on CIE (International Illumination Commission) Committee E.3.1.9.2 on Lighting for Stage and Studio, and one whose professional existence is concerned with equipment for that purpose, I would like to comment on the article in your February issue, describing the Q-file system of lighting control.

To begin with, the "nightly back-stage drama" of the opening paragraph has been gradually disappearing for many years, as remote control of dimmers from relatively small consoles is commonplace, starting with electromechanical systems developed shortly after World War II; a 120-channel system of this type is currently still in use at Her Majesty's Theatre, London.

Thyristor dimmers replaced mechanical ones in the late 1950s. Advances of recent times are more concerned with the adoption of data recording devices to memorise or record the various lighting cues, and several manufacturers have produced systems with full intensity memory.

The first public demonstration of this type of control was in March 1966 by Strand Electric in London, which led to the supply and installation of two IDM/R systems in the Canadian National Arts Centre in Ottawa. These were commissioned at the time of completion of the theatres, in 1969. They used Sperry magnetic drum data stores capable of memorising 250 cues for each system, one having 250 dimmer channels and the other 180.

Since then, a number of drum memory controls with variants of the associated electronics have been installed, and Strand is now producing versions with American electronics for a number of projects under construction, including a 240-channel one for the Adelaide Festival Theatre, due for commissioning late 1972.

The Thorn system was developed under a contract with the BBC, essentially with the colour TV operational requirements of that organisation well in mind. It differs from other TV controls and all theatre controls by not having a console fader per channel always to hand. There is considerable difference of opinion as to whether this technique will be acceptable in the theatre, where the ability to "play" several lighting circuits together is of great importance.

To quote an overseas associate "instinctively, one wants to use all one's fingers, not just do one-finger exercises".

The repetition of performances in the theatre, involving numerous lighting cues, is not always as simple as it may appear, as no two are exactly alike. Apart from natural time variations or hoped-for delays due to applause, accidents can happen to sets or equipment. These factors all require immediate corrective action on the part of the lighting operator. This action may involve several dimmers, and sequential call up to the single fader can be awkward.

Unless semiconductor technology can continue drastically to reduce component prices, and offer reductions in assembly times for one-off equipment of this nature, then multi-preset direct control of thyristor dimmers without any memory aids will, it seems, be all that the majority of Australian theatre and TV practioners will be able to afford for some considerable time.

Yours faithfully
D. C. Irving MIES (Aust)

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understand that there is a liaison between the Customs Department and the Postmaster General's Department about all transmitting equipment brought into the country and there could easily be a hang-up if a non-amateur attempted to bring in transmitting equipment in a private capacity.

Be that as it may, our publicity relative to the problems of amateurs has helped to clarify and ease the situation and for this we should be grateful. How it will work out in practical situations, only time will tell.

Amateur radio and allied subjects seem to have claimed a fair share of the space in these columns of late but that's the way it sometimes happens. Here's a letter from a reader in Mt Hagen, TP&NG.

Dear Sir,

From the day I set foot in Australia, 20 years ago, I have enjoyed reading your magazine and I have found it more nourishing than any other. I do not know of any other magazine with a similar ability to "get to know" people of common interests and to bring them closer together.

I would like to comment on the letter by J.G. (December 1970). I am inclined to agree with your comments and I would even go one step further. I would like to see a convenient frequency, be it 27MHz or higher, used exclusively for radio control and run on similar lines to amateur radio. It would promote a new interest among radio hobbyists. The combination of radio control methods and aeronautics would be of great tuitional value.

There is one point in which I am inclined to agree with J.G. It has to do with the problem of CB-ing on a grand scale.

The standard of competence required of amateurs permits the individual selection of equipment and there is little danger of amateur stations becoming either a nuisance or a hazard to civil defence.

By contrast, the present trend to CB-ing using an input to the final of up to 2KW amounts to a stampede on an international scale. Measures should be taken to protect the rights of qualified operators in the respective countries who are conscientiously obeying the law.

It would be very sad indeed to see the shores of Australia invaded by this kind of CB traffic, American or otherwise, emanating from 2000W B/C transmitters. Should this problem be simply left to the FCC and its equivalent in other countries?

R.C. (Mt Hagen)

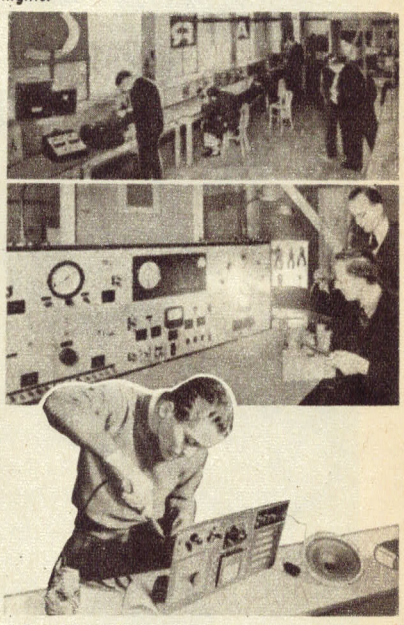
And that, I think is a very good question – and a very thorny one as well! Use of the Citizen Band, the Industrial Band (call it what you like) tends to be regarded as a matter for purely domestic determination. It is up to the authorities in each nation to say whether use of the particular part of the spectrum is to be encouraged or discouraged. The problem is, however, that transmissions around 27MHz are not limited to local areas. They can skip around the world as easily as transmissions on the 28MHz Amateur Band and clutter the spectrum space worldwide. Thus, decisions by the American FCC have a direct bearing on the use of the frequencies in Australia and NZ. ■

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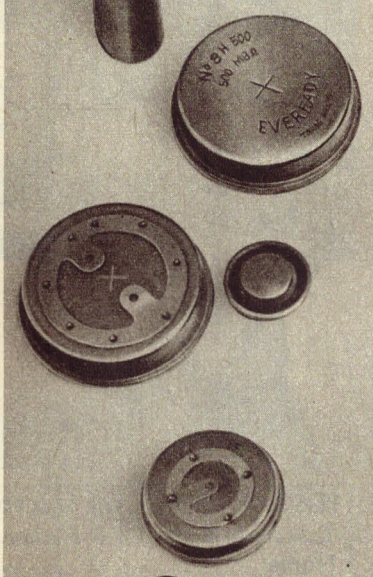
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085.P.133

Working With Meters

This is the first of a short series of articles discussing the practical application of meter movements. It covers the basic operation of the most common types of movements, and the methods which may be used to measure meter sensitivity and internal resistance. A following article will show how any particular movement may be arranged to perform a variety of measurement tasks.

by PHILIP PIK

Despite the dramatic growth of digital measuring techniques in recent years, there is still an important place in electronics for the familiar "analog" meter. In general this type of device is still to be preferred where a number of electrical quantities must be measured either simultaneously or at relatively low cost.

There is often a need, particularly in amateur and hobbyist situations, to arrange for a particular meter movement to measure a different quantity, or to display a different full-scale sensitivity, from that for which it was originally intended. For example it may be desired to use a basic micro- or milliammeter movement, obtained either new or from a disposals source, to measure the plate current of the PA or modulator valves in a high-power amateur transmitter, or perhaps to monitor the output voltage of a regulated power supply.

It is the aim of this article, and those which are planned to follow in later issues, to provide the basic information required for the practical application of meter movements. Described in this article will be the most common types of meter movement and their operation, and the methods which may be used to measure the basic sensitivity and internal resistance of a movement. Later articles will then describe the way in which this information is used to adapt a meter to perform a desired function, such as current, voltage or resistance measurement.

Meter movements are electromechanical devices which produce a mechanical change in position of an indicating pointer in response to an applied electrical signal. In general this change in position is produced as a result of the interaction of electric or magnetic fields, one of which is derived from the electrical energy supplied to the meter. The four most common types of meter movement are shown in figure 1.

Of the four, the electrostatic movement shown in (a) is the only type which employs interaction of electric ("electrostatic") fields. It is also the only type of movement which actually measures voltage, as opposed to current.

Basically, the electrostatic movement is a capacitor in which the electrostatic forces present between the plates are allowed to produce movement of one set of plates, this movement being opposed by a "restoring force" from spiral springs. The movement responds to AC as well as DC, the frequency response being limited only by the current carrying capacity of the meter and the capacitive loading effect on the circuit.

The response of an electrostatic movement is proportional to the square of the applied voltage, so that these meters give a true-RMS reading. However it is difficult to produce an electrostatic meter which is both sensitive and mechanically rugged, so that they are normally only used for measuring relatively high voltages.

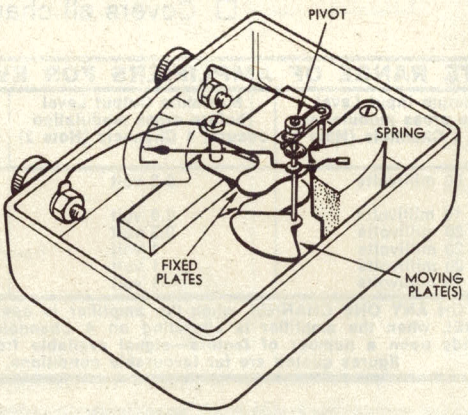
Another, perhaps not so well-known movement, is the dynamometer variety, shown in figure 1(b). It consists of two coils; one fixed, the other movable. The measured current flows in both coils, the interaction of the magnetic fields producing the torque. As the same current flows in both coils, the torque is proportional to the square of the current making the dynamometer also a true RMS movement.

The absence of any magnetic materials with their associated non-linearity makes the dynamometer inherently the most accurate movement. Accuracies of 0.1% are not uncommon. Because the coils possess significant inductance, the frequency response of this instrument is limited to about 200Hz for high accuracy. Another limitation is the high power requirement, 1 to 3 watts being typical. Dynamometers are available as ammeters with a range from 1 to 50 amps and as voltmeters from 1 to 300 volts.

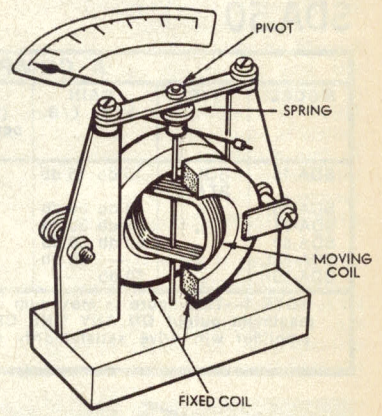
The moving iron movement, shown in figure 1(c), is closely related to the dynamometer type. Here the moving coil is replaced by a soft iron armature or vane, which is pivoted inside a fixed coil. A second soft iron vane is mounted inside the coil, but is fixed. When current flows through the coil, both the fixed and movable vanes become magnetised by induction, with the same polarity. The movable vane is thus repelled from the fixed vane, moving the pointer over the indicating scale.

The frequency response of these movements is limited to roughly 125Hz. The best obtainable accuracy is not as good as the dynamometer, being in the order of 0.5%. The general power requirement is somewhat lower at about 1 watt. Despite their greater inaccuracy the moving iron vane movements are more popular since they are less expensive. They are used mainly in automotive and other non-demanding applications.

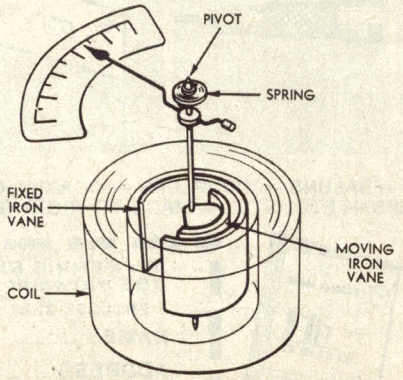
But probably the most common type of meter movement used in electronics is the moving coil or d'Arsonval variety, shown in



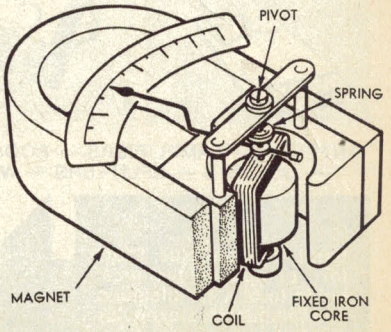
(a) ELECTROSTATIC



(b) DYNAMOMETER



(c) MOVING IRON VANE



(d) PERMANENT MAGNET MOVING COIL

Figure 1. The four basic movements. The text describes the operating principles of each.

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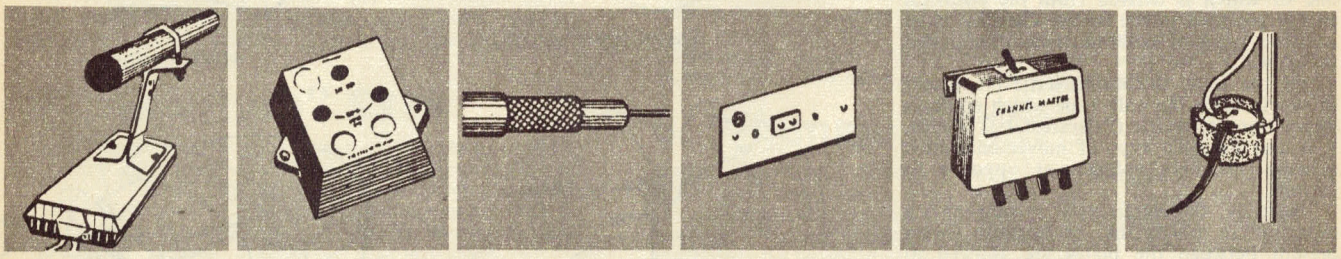
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SDA-31	,,	30 db 30 db	20 millivolts	0.3 volt	1.5 volts	100+	81.25
SDA-50	,,	50 db 50 db	20 millivolts	1 volt	4 volts	500	111.25
SDA-50L	,,	— 50 db	20 millivolts	1 volt	4 volts	500	95.00
SDA-50H	,,	50 db —	20 millivolts	1 volt	4 volts	500	95.00

NOTE 1—This figure is maximum input ON ANY ONE CHANNEL when the amplifier is operating on 4 Channels. NOTE 2—This figure is maximum output ON ANY ONE CHANNEL when the amplifier is operating on 4 Channels. NOTE 3—The number of outlets which an amplifier will drive satisfactorily depends upon a number of factors—signal available from the aerial, length of cable runs, etc. The figures quoted are for favourable conditions.



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figure 1(d). This type of movement relies upon the fact that a current-carrying coil of wire suspended in a magnetic field experiences a "torque", or turning force.

In its usual form, the moving coil meter consists of a multi-turn coil of very fine copper wire, suspended between the poles of a permanent magnet in such a way that it is free to rotate about its own axis. Attached to the coil is a light pointer which moves over a calibrated scale when the coil rotates. The magnet system is arranged so that the coil moves in a "radial" field, that is one whose intensity is effectively constant and at right angles to the plane of the coil.

When current is passed through the coil, a magnetic field is set up which reacts with the field due to the permanent magnet. The coil thus tends to rotate, rather like the armature of an electric motor. But opposing this rotation are two spiral springs, which tend to apply to the coil an opposing or "restoring" torque increasing in a manner directly proportional to the distance moved by the coil from its rest or "zero" position. The action of these springs is to bring the coil to

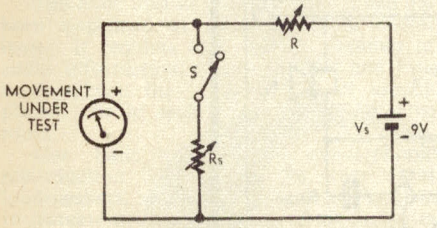


Figure 2. A simple circuit for measuring meter resistance.

rest in a new position whose difference from the zero position is directly proportional to the magnitude of the current flowing through the coil.

The movement is provided with damping to ensure that the coil and pointer come to rest quickly in the new position. The damping is provided by winding the coil on a copper or aluminium former, which acts as a "shorted turn" on the coil. When the coil and former move in the field, a current is induced in the former, and a reaction field set up in a direction which tends to oppose the motion.

It may be appreciated from the foregoing that the moving coil meter can only be used to measure direct currents which are either steady or changing only very slowly. It cannot in general be used to measure directly alternating currents, except perhaps those having an extremely low frequency. The inertia of the movement is such that the coil and pointer tend to remain stationary at the "zero" setting, being unable to follow the rapid reversals of torque.

In order to calculate the series and shunt resistances required to modify the range and function of a basic meter movement, we need to know two quantities: the internal resistance of the meter, and its sensitivity.

With a meter purchased new, it is likely that the internal resistance will be already known. However this is less likely with a disposals meter, and very unlikely with a meter salvaged from old equipment. In these cases the resistance will have to be measured.

Except for large low-sensitivity moving iron meters, it is generally not possible to measure the resistance of a meter movement using a standard ohmmeter or a resistance measuring bridge. The reason for this is that these instruments tend to drive excessive current through the movement, and may well cause permanent damage.

Luckily, the resistance of a meter may be measured quite easily using a simple circuit, consisting of nothing more than a battery and two variable resistors. No additional meter is required, because the meter being tested can itself be used to monitor the adjustments.

The idea is that the meter movement to be measured is connected to an effectively constant current source, which is adjusted for an indication at or near FSD of the meter. A resistance is then connected in parallel with the meter, and adjusted until the meter indication falls to half its initial value. The shunt resistance must then be equal in value to the internal meter resistance.

It should perhaps be noted that before attempting to measure either the internal resistance or the current sensitivity of a movement, a check should be made to ensure that the meter does not contain internal shunts, series multipliers, thermocouples, or other complicating devices. This involves opening the meter casing, an operation which calls for considerable care if damage is to be avoided.

Some movements may appear to contain either a low-value series resistor or a high-value shunt, which is usually in the form of a coil of wire rather than a moulded "resistor". This is not a shunt or multiplier in the normal sense of these terms, but a trimming resistor used to compensate for manufacturing tolerances and adjust the movement for the desired nominal sensitivity. As such, it should strictly be left connected to the meter.

However if the trimming resistor is inadvertently removed, no great harm is done. The only result will be that the shunts or multiplier resistors required for adapting the movement to the desired task may tend to have "awkward" values, corresponding to the untrimmed sensitivity of the actual movement.

Figure 2 shows the practical circuit used to measure meter resistance. The resistor R in series with the battery is arranged to have a sufficiently high value to ensure that the meter is fed from an effectively constant current source. This implies that the resistor should have a value higher than 100 times that of the highest resistance meter likely to be tested.

Most moving coil movements with current sensitivity figures below about 5mA FSD have a voltage sensitivity of approximately 100 millivolts. This is because the main factor controlling current sensitivity is the number of turns on the moving coil; sensitive movements thus tend to have a great many turns on the coil, while relatively insensitive movements have relatively few. The effect is to cause the voltage required for FSD to remain substantially constant.

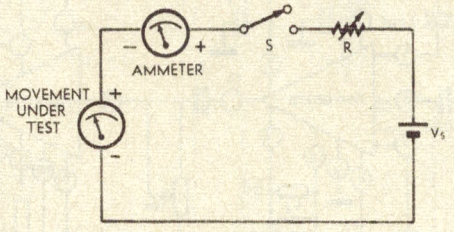
The highest resistance likely to be encountered in disposals moving coil meters will thus generally be 2,000 ohms, corresponding to a 50uA movement. This suggests that the resistor R in figure 2 should have a maximum value of at least 200K.

For testing the majority of moving coil meters, a 9V battery and a 250K variable resistor form an entirely adequate constant current source. These values have therefore been shown on the circuit; however they may not be adequate for moving iron instruments, as some of these have an internal resistance as high as 5K. To check such meters, a resistance of 500K or more will be required, together with a correspondingly larger supply voltage.

The operating procedure is as follows. With the switch S open, the series resistor R is adjusted until the meter reads a convenient value, preferably a value near FSD to ensure maximum reading accuracy. Next the switch S is closed, and the shunt resistor Rs adjusted until the meter reading is as close as possible to half its first value. The value of Rs is then equal to the resistance of the meter, and after opening S it may be measured using an ohmmeter or resistance bridge.

The current sensitivity of a meter movement is the second important quantity to be determined for the purpose of calculating shunts and series resistors.

The "sensitivity" of a meter movement is basically the measure of the power requried to produce full scale deflection (FSD). It is thus a function of the voltage and current



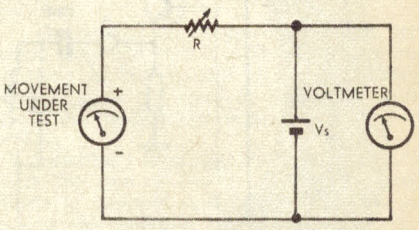


Figure 3, at left shows how an ammeter is used to measure current sensitivity, whilst figure 4. at right, shows the voltmeter method.

requirements of the movement, which will be related by the internal resistance.

Because of the way in which the voltage and current requirements of the meter movement are determined by the internal resistance, it is common to relate the sensitivity of a movement to the current required for FSD. Knowing this current sensitivity and the internal resistance, it is an easy matter to calculate the power or voltage sensitivity of the movement.

A term sometimes used to indicate the current sensitivity of a meter movement is its "ohms per volt" figure. This gives the total resistance of the meter and its appropriate series multiplier when arranged to measure voltage, and is expressed per unit volt. Thus a movement described as having a sensitivity of 20,000 ohms per volt will involve a total resistance of 20 Kilohms when used as a voltmeter reading 0-1V. By Ohm's law, the current sensitivity of such a meter is the inverse of the ohms per volt figure, or in this case 50 microamps FSD.

In the case of a meter movement purchased new, the current sensitivity will again normally be known. This may also be the case with a meter from a disposals source. However with a meter salvaged from a piece of equipment, it may be necessary either to measure the current sensitivity, with no idea of its approximate value, or to make a measurement in order to check one's suspicions.

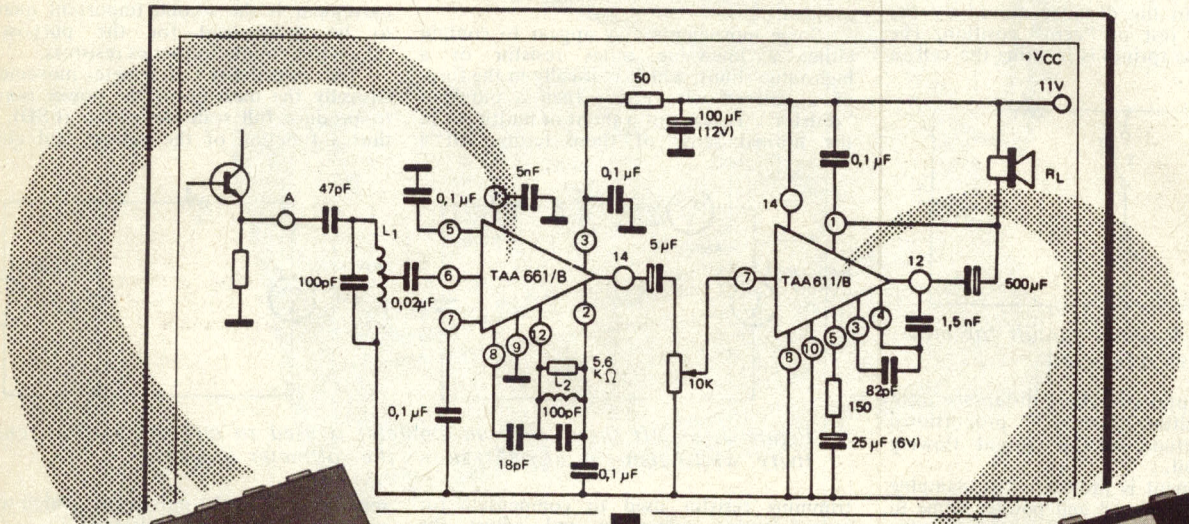
Figure 3 shows the basic circuit for measuring current sensitivity. The ammeter A may be nothing more than a standard multimeter with suitable direct current ranges. To make the measurement, the

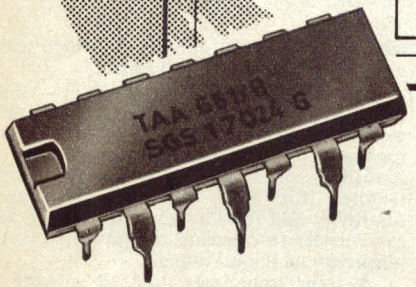
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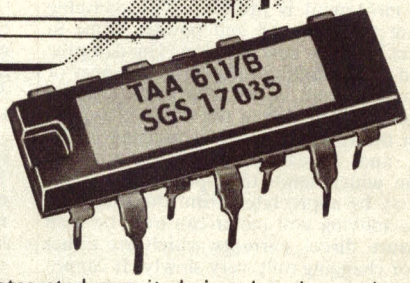
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multimeter range switch should first be set to the highest current range, and the variable resistor R adjusted to maximum resistance Switch S should then be closed, and R adjusted until the meter indicates FSD. The multimeter may than be switched to lower current ranges, to read the current flowing. It may be necessary to re-adjust R when this is done, to compensate for the changes in multimeter resistance. The final reading of the multimeter will correspond to the FSD current sensitivity of the meter movement being tested.

If neither an ammeter nor a multimeter with suitable current ranges is available, the alternative arrangement of figure 4 may be used. This uses a voltmeter, and relies upon being able to determine accurately the value of the adjustable resistor R. When R is adjusted for FSD on the meter movement, the current sensitivity is then found by dividing the supply voltage indicated on the voltmeter by the total circuit resistance.

If for the FSD situation the adjustable resistor R has a value which is more than 100 times the internal resistance of the meter movement, the current flowing will be for practical purposes equal to the supply voltage divided by R. In other words, the meter resistance becomes negligible and may be ignored. However if the available supply voltage is not great enough to allow R to be made more than 100 times the meter resistance, then the later will play a significant part in determining the circuit current, and should thus be taken into account.

Although the basic testing circuits of figures 2, 3 and 4 will generally be all that is required for checking individual surplus meters for internal resistance and current sensitivity there may be some readers who have a need to check many meters rapidly. Such readers may find figure 5 of interest, as it shows the circuit for a general-purpose meter checking unit.

The procedure for measuring internal resistance using the unit is as follows. Set switch S3 to position 2, and switch S1 to position 1. Then turn the potentiometer R1 fully anticlockwise, corresponding to maximum resistance in circuit. With S2 in position 1, the meter should now be showing some deflection, although it may only be very small.

The value of R1 should now be reduced, in an effort to produce an FSD reading on the meter. If this cannot be achieved, switch S1 should be turned to position 2, or if necessary position 3. Alternatively a decade box may be used for R1, with S1 turned to position 4. But for meter resistance measurement the decade box is not really necessary.

Once the movement is reading FSD, switch S2 may be moved to position 2. Potentiometer R2 is then adjusted until the pointer of the movement reads half of the FSD value of the scale indications. Note that this may not correspond to the physical midpoint of the meter scale, particularly in the case of a moving iron movement, due to non-linearity.

If it is found that the adjustment of R2 with the switch S2 in position 2 is difficult to carry out because the adjustment falls at the extreme end of the pot, position 3 should be selected. Position 4 allows a decade box or external resistor(s) to be connected into the circuit.

As the resistance of R2 at the half current deflection point is equal to that of the movement it is beneficial here to use a decade box, as then the meter resistance can be read straight from the box. Provision has also been made to switch an external resistance measuring instrument such as an ohmmeter across R2, by placing S3 in position 1. This

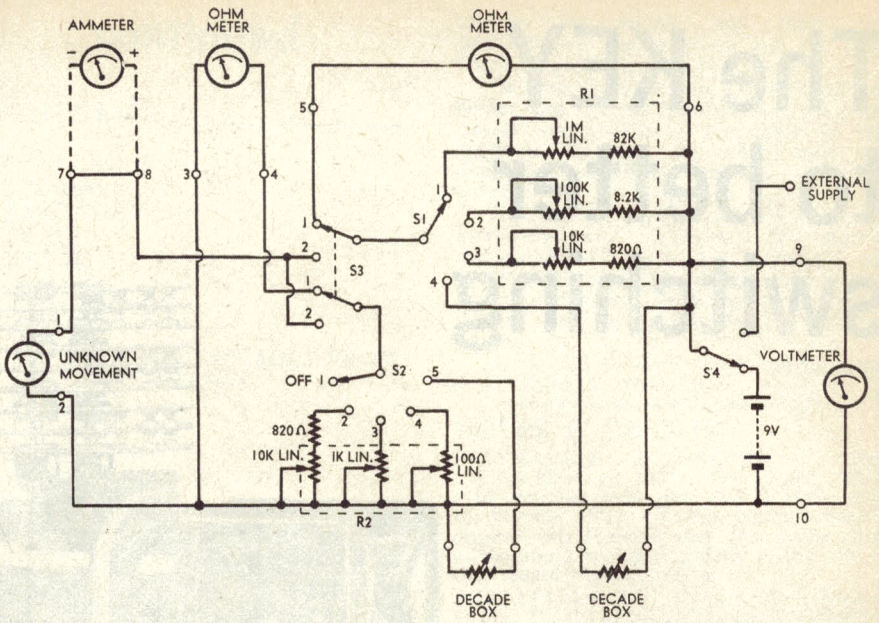


Figure 5. A flexible all-purpose circuit which measures the resistance and current sensitivity of almost any type of movement.

also automatically disconnects the movement from the circuit, preventing any possible damage.

Moving iron movements are measured using an identical procedure. However, it may be necessary in some cases to use a higher supply voltage. For this reason, a switch S4 has been included in the circuit. Normally DC can be used for both moving coil and moving iron movements. If, however, a moving iron instrument contains shunt or series resistances in the form of chokes and it is desired to keep these in circuit, it is preferable to use an AC supply of the frequency at which the movement is to be used.

The reason for this is that some of these chokes have magnetic cores and thus their impedance (reactance) is highly frequency dependant. Hence meters using this type of choke must be used at the designated frequency (usually marked on the scale), as inaccuracies otherwise result. Remember though that most basic moving iron movements can be operated over at least a limited range of frequencies from DC to about 200Hz or higher, depending on the type and make. Other than these precautions, the procedure for all the measurements is exactly as for a moving coil movement.

To use the unit of figure 5 to measure current sensitivity using the method of figure 3, an ammeter or multimeter with direct current ranges should be connected between terminals 7 and 8 in place of the link. Switch S2 should be placed in the "off" position, and S1 in one of the four positions depending upon the known or estimated resistance of the movement. R1 is then adjusted to give an FSD reading on the meter under test, as outlined in the procedure for figure 3.

The voltmeter method as described for figure 4 can also be used with the multi-purpose unit. In this case the link is used between terminals 7 and 8, and R1 used for FSD movement indication, after S1 has been positioned according to the meter resistance. To measure R1, S3 is then turned to position 1 and an ohmmeter or resistance bridge connected to terminals 5 and 6. The alternative is to use a decade box for R1, in which case the box itself will indicate the resistance value in circuit.

Once the two basic quantities of current sensitivity and internal resistance of a meter movement are determined, it is possible to calculate readily the shunts and series multipliers required to adapt it for use as a voltmeter, ammeter or ohmmeter. In the next article we hope to explain the procedure involved in this further step. ■

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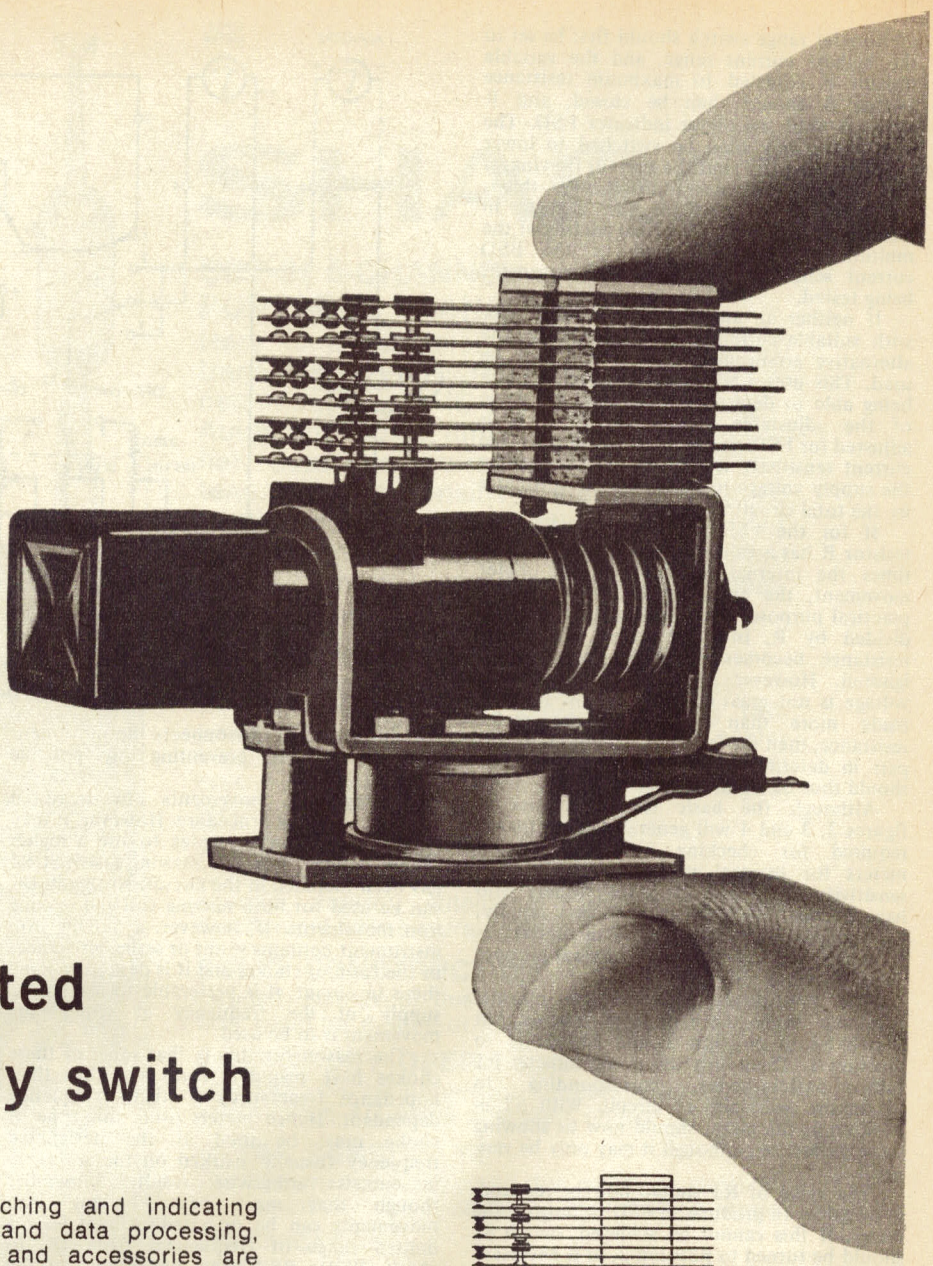
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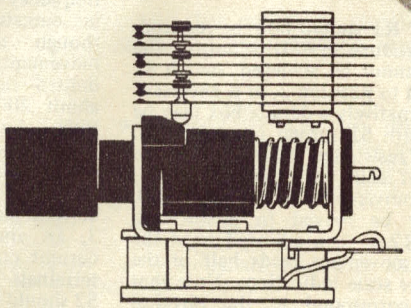


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TMC/15

Add a Bright/Dim Switch to Your Lights

Here is a useful idea for those people who wish to dim their room lights on occasion, but do not want to go to the trouble of installing a fully variable light dimmer. All that is required is a standard dual wall switch and a silicon power diode. Substitute them for the normal switch, and you can have the lights either bright or dimmed at will.

by LEO SIMPSON

There are many occasions in the home when the full brilliance of the room lamps is not required: when watching television, listening to music, dining in an intimate setting, or during parties. Perhaps the most versatile answer to this problem is a wall-mounted variable light dimmer such as the Varilight, which was published in the December 1969 issue of "Electronics Australia".

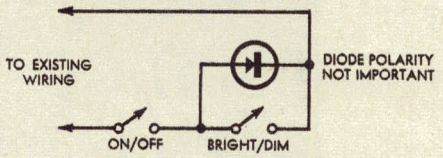
Fully variable dimming is not always needed, however. There may also be a problem of radio interference with such dimmers, due to the voltage pulses or "spikes" generated by the phase-controlled Triac circuitry. Operation is usually quite satisfactory in metropolitan areas where the signal from broadcast stations is strong, but real problems can arise in outlying country areas.

The idea presented here represents a different approach to light dimmers. In principle, a switch is used to connect a semiconductor diode in series with the mains input, so that in the "dim" position, the lamp is fed only with alternative AC half-cycles. This has the effect of considerably reducing the lamp brilliance.

Assuming an AC mains supply of 240 volts, the RMS value of a half-wave rectified sine wave is 170 volts. With typical incandescent lamps which have a very non-linear V-I characteristic, the power input under these conditions is reduced by 25 to 30%, and the brilliance reduced to less than half normal.

Besides simplicity, this arrangement has the advantage that it generates no radio interference. With a conventional dimmer, the Triac switches considerable amounts of power in very short time intervals and it is this which generates the interference spikes. Typically, the Triac switching time is of the order of one microsecond. By contrast, a silicon diode is virtually a "zero-voltage switch" because it begins to conduct heavily with a mere 0.6 volts forward bias. As a result, virtually no interference is generated by this simple dimmer circuit.

On the debit side, there is a tendency for the lamp to flicker. Under normal conditions with a sinusoidal mains input voltage, incandescent lamps are pulsed at 100Hz. The persistence of vision of the human eye and the thermal inertia of the lamp filament conspire to make any flicker unnoticeable. However, when half-wave rectified AC is applied to incandescent lamps, the flicker is at 50Hz and tends to become more noticeable. Just how noticeable the flicker becomes depends on a number of factors. If the lighting is indirect, generally no flicker is apparent. If the observer looks directly at the lamp, flicker may or may not be noticeable, depending on the filament temperature. However, some flicker is usually



apparent if the observer looks at the lamp "out of the corner of his eye".

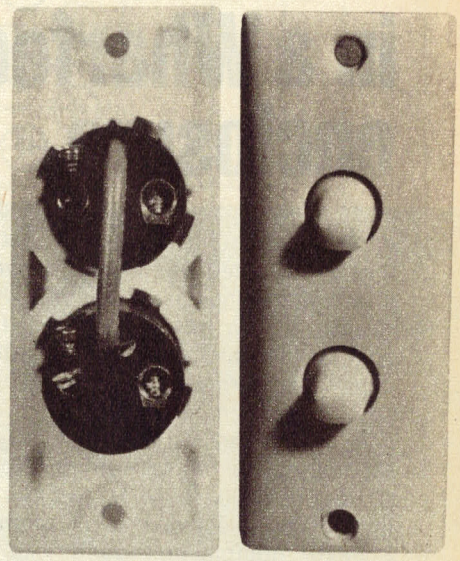
Having installed one of these dimmers in his home, the author has found that the flicker is not irritating and that he is generally quite unaware of it.

The diode used should have a peak inverse voltage (PIV) rating of at least 400 volts. It would be wise, however, to select a diode with a rating of 600 or 800 volts to ensure that it is not damaged by occasional "spikes" and surges which may be superimposed on the mains supply.

Listed below are the maximum wattage incandescent lamp loads which can be used with diodes having typical current ratings. We recommend that readers use silicon diodes of recent vintage, such as BY100, BY127 or EM406/408. These generally have more generous surge current ratings than earlier types.

500mA	140 watts
800mA	225 watts
1.0A	280 watts
3.0A	850 watts

Note that fluorescent lamps should not be used.



Front and rear views of the switch. The circuit is at left.

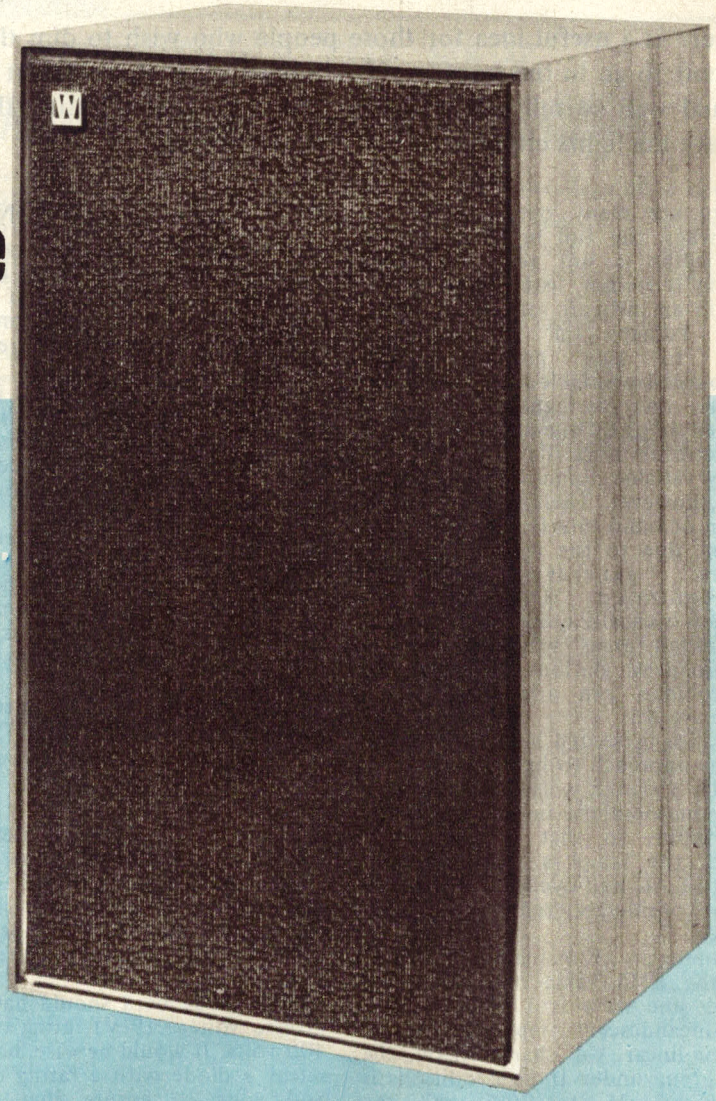
The most convenient way of installing the dimmer is to purchase a dual wall switch, as illustrated. The diode is shunted across the lower switch. A link of insulated wire is connected between the two switches, and the whole assembly is installed in place of the existing light switch. The upper switch is then the main ON/OFF control, and the lower switch BRIGHT/DIM. This arrangement is quite effective and one to which one can easily become accustomed. Our dual switch was an HPM type. ■

CORRECTION

A typographical error occurred in the Dynaco advertisement in August, 1970, January and February, 1971. The Dynaco Stereo 80 Kit price was incorrectly given as $558. The correct Kit price is $297.

GRD Instruments

The new Wharfedale "DOVEDALE III" provides the smoothest frequency response ever achieved in a Wharfedale enclosure.



Wharfedale sound has always been highly respected by the music lover and audio enthusiast alike; with the release of the new "Dovedale III" compact speaker system, Wharfedale have *surpassed even the obvious superiority of earlier Wharfedale enclosures.*

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THE SERVICEMAN

An early-to-bed television receiver!

Speak of a time bomb, these days, and one is likely to think of something other than luggage in an airliner's hold. But the other day I came across a time bomb of another kind – a TV set that used to fail after a fairly predictable period.

The complaint noted on my pad, alongside the call, simply said that the set "would only go for two or three hours, then stop dead". Would I come and look at it at the first opportunity?

When I called during the afternoon, the lady of the house said that the set had been behaving like that for some time but, as often happens, they'd simply put up with it until it happened once too often in the middle of an interesting show.

She explained that there was no fuss and no smoke. It simply stopped dead, with no picture and no sound. The screen went black, the speaker went dead!

That sounded rather like a high tension failure, though I couldn't imagine why it should be so long delayed each time or why the set would come on again, as if nothing had happened, next time they went to use it.

Anyhow, I turned the set on and checked sound and picture; I pulled the back off the cabinet and had a good poke around. There was not the slightest hint of trouble and, with the clock ticking the minutes away to no purpose, I simply gave up – for the time being at least.

I suggested to the good lady that she switch the set on next morning, around nine. I would call just before lunch and, if the set behaved as it was supposed to, it should have failed by about the time I got there. Provided there was no smell of burning, she was to leave it on until I arrived.

When I knocked on the door next morning, it was to be greeted with the news that the set had just stopped:

"Come in. You couldn't have timed it better".

Sure enough, the set was as dead as a dodo but, as I leant around the back, my nostrils picked up the unmistakable smell of ozone, accompanied by a faint frying noise.

Aha, an EHT fault!

With the back off the cabinet again, I was able to see into the EHT cage just enough to spot a bluish arc. Trying not to disturb anything, I slipped the cover of the EHT cage so that I could have a closer look.

And there was the 1S2 EHT rectifier, laying well over to one side, with an arc playing on to the bracket work of the line output transformer.

Switching the set receiver off, I set about to find why the 1S2 was in such an odd position. It didn't take long to work out what had happened.

In this set, the 1S2 socket sits on a pillar inside its shroud, the socket being held to the top of the pillar by a single screw. The trouble was simply that the screw was missing. Either it had been left out at the factory or during a previous service call. As a result, the 1S2 and its socket was merely sitting on top of the pillar, partially supported by the lead from the EHT winding.

During the course of time, it had gradually sagged over until the top cap came close enough to the metal frame to set up an arc.

As for the time delay, I could only think that the plastic around the EHT lead was changing its shape with temperature just enough to hold the valve clear when the set was cold and letting it sag, when things got warm. My guess was that the valve would not have been moving more than a quarter-inch, but it was enough to make the difference between arcing or not arcing.

And the sound?

As soon as I secured the rectifier socket into place and switched the set on again, everything returned to normal – and I gather that it has been normal ever since.

Most likely, the RF energy created by the arc was enough to block the AGC or quadrature detector. If I seem vague on this point, it is simply because, after a double-barrelled service call, I had no desire to pore over the chassis or the circuit trying to work out just what was why, or why was what.



"You can never tell with these intermittents. Don't call me – I'll call you!" ("Radio-Electronics")

I had found the fault that cured both complaints and I was happy enough to let it go at that!

So to my next story which also has to do with "the box"!

When a picture tube fails, there is little else that can be done other than replace it. There may be some argument about who meets the cost of the replacement and some apprehension lest it happen again. But, once the replacement has been effected and a few weeks slip by, the whole matter tends to be relegated to history.

And that's the way it was with a particular family in a suburb not far from my shop.

In fact, I didn't know the family existed until I answered the phone early one morning – the first call of a new business day. An agitated male voice simply asked: "Would you please call round as soon as you can to my house at ..... Our television set blew up last night and my wife is pretty upset!"

"Blew up? You mean stopped working?"

"No! Blew up bang, like a ---- bomb! "The tube's in little bits and the cabinet's busted!"

As curious as I was surprised, I went along to the address given and knocked on the door, to be admitted by a still obviously flabbergasted housewife.

There was no need to ask what had happened. I got it in summary form as I was led into the living room and a couple of times at full length as I examined the set.

The picture tube was in bits, all right – none of them larger than about two inches across and most of them about half that size. Behind the safety glass, I could see them lying in a heap in the bottom of the console cabinet.

The safety glass in its wooden frame was still in place, but only just! The force of the explosion had split the woodwork down both sides and across the bottom, so that the safety glass and its frame was hanging only by what was still intact at the top. Still, it had done its job and the only broken glass in the room was on the carpet immediately in front of the receiver.

Around the back of the set, the composition-board rear cover was also still in place but split vertically down the centre. Some of the screws didn't look too secure but, as I said, it was still in place – just!

Apparently the family had watched a movie during the previous evening, which kept the set running till about 11 o'clock. Then they'd simply switched it off and gone to bed in the usual way.

About 2 o'clock there had been this almighty bang which jolted everyone awake, fully convinced that a car had smashed into the house. Or maybe an aeroplane had crashed nearby. But there was no car, no aeroplane wreck, no flames, no confusion. Then somebody had spotted the television set – or what was left of it.

The lady duly volunteered the vital piece of information that the tube was a nearly new one, having been replaced only about six weeks previously by a serviceman attached to the company with which the set was insured.

Which brought me to the point: Why call me? What was I expected to do about it?

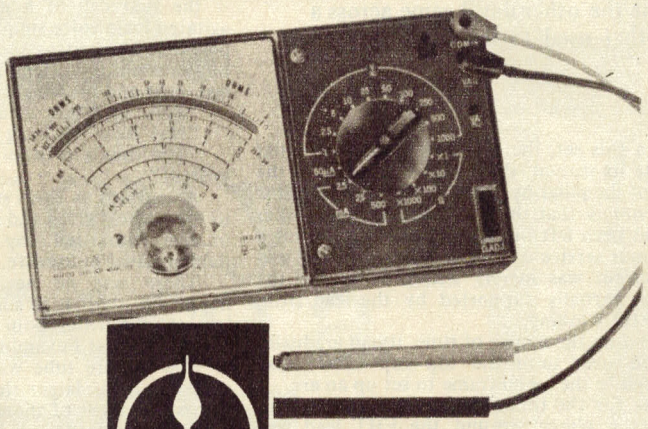
I gathered that the main reason was simply that they knew me as a local figure, who could probably be on the spot without delay. No less important, I could probably give them some guidance as to what to do in this rather shattering situation.

First off, I suggested that I should not

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AC Current:	0-10A
Resistance:	0-5K-50K-500K-5MΩ
Decibel:	—20 +22 dB (0 dB = 1mW, 600Ω)
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A TALL STORY . . .

BUT IT'S TRUE!

touch the receiver at all but that they should report it to the company which had installed the new tube. There may have been something amiss with the tube itself – a standard 23-inch type – or the metal clamp and gasket may have been wrongly installed. I pointed out that, quite apart from the tube and the rather mangled cabinet, there was a strong possibility that the wiring and small components had suffered damage. The dish-like chassis, mounted vertically behind the flare of the tube, must have copped the full force of the explosion.

Since I had to collect a fee to cover the call, I volunteered to ring the service manager of the company concerned – whom I happened to know personally – and acquaint him with what had happened. While it seemed the right thing to do on the occasion, I was also curious to know what the outcome would be!

So, some days later, I rang him again to find out what had happened.

But no one was any the wiser as to what had really caused the explosion, nor did there seem to be any sure way of finding out. It might have been the tube; it might have been the strap; it might have been a substantial drop in temperature when the family retired and switched off the room heating. It might have been a combination of all these things.

Whatever the cause, the tube manufacturer had replaced the tube free, under some sort of a policy they have to cover such eventualities – or perhaps worse.

The cabinet responded suitably to glue, re-touching, re-polishing and a new composition-board back.

And the chassis? Here was the real surprise. Though the wiring and the small components had taken the full force of the explosion, and though the pressures inside the IF transformers, etc, must have been considerable, the set operated normally when switched on, with the new tube in place.

A tall story? It sounds like it, but it's true.

So also is the following anecdote, which started with a TV set and finished in another realm altogether!

Why don't I learn to keep my big mouth shut? It's a phrase we use often enough; sometimes I wish that I could apply it rather more assiduously – as on a recent occasion, for example!

After finishing off a routine TV service call and, as much as anything by way of conversation, I remarked on an electronic organ standing in the same room. Something along the lines: "Which member of the family is the organist?"

As it transpired, I got much more than a simple reply to my simple question. In rapid order I learned that the wife was the organist; that the organ had been giving trouble, with a "funny sound" on some notes and that the official organ serviceman hadn't been much of a help. He'd simply maintained that there was nothing wrong with the instrument – and they thought otherwise!

Before I could get a word in, the good lady had switched the instrument on and was all poised to demonstrate the reason for her dissatisfaction.

"It can't be much", she said, "just two or three notes".

I protested that trouble with two or three notes could mean anything: faulty circuitry, faulty transistors, faulty key contacts – all things for a serviceman dealing with organs

generally or with that brand in particular. But I was to have no choice; I had to listen.

And listen I did! With the pedal well down, she dashed off several chords, ending with one note and an "I was right" expression on her face.

"Listen to that!"

I had to admit that it didn't sound too good, the note being accompanied by a prominent buzz.

My first impression was a fault in the loudspeaker or a vibration somewhere in the organ. But, no, it wasn't coming from the organ.

Crossing the room, I laid my hand flat on an expanded metal grille, which formed the front of an electric room heater. The buzz disappeared in a most convincing manner.

"Your room heater is vibrating", I explained. The wonder of it was that it didn't vibrate noticeably on a lot of other notes; it was such a flimsy, rattly device!

Unfortunately, I could see by the expressions on the faces of Mr and Mrs that they didn't quite believe me. So I suggested that I would play the note while they checked the heater themselves. At last the message seemed to get through – a room heater could make noises!

Then one of them seemed to remember: "Funny, you know. The organ serviceman said something about the heater, now I come to think of it!"

Having found myself on the organ stool, I ran over the other notes and bass pedals, finding another offender in the process: A china bird plaque on the wall above the organ was also adding a quota of rattle, while the metal fluorescent lamp fitting also seemed to be inclined to get into the act.

I suggested that the lamp fitting could be cured by simply tightening up a couple of screws, while a layer of felt glued to the back of the china bird would silence that. The heater was a more formidable problem and all I could suggest was that the metal grille could be wedged around the edge with some asbestos string.

As far as I could judge, the organ serviceman had been right in the first place. There was nothing wrong with the organ. The problem was all to do with gadgets in the room, which had never been designed "to keep their big mouths shut!"

The organ serviceman's only mistake was that he didn't go to quite enough trouble to get his message across.

And, finally, let's get right away from television sets and organs to flying saucers. Well not really . . .



The kind of accessability that servicemen could sometimes use! Shown is the Plessey DS4 data store, a relatively low-cost modular unit.

FLYING SAUCERS?

When something more bulky than normal caught my eye, I looked up to see a rather large holiday caravan pull up outside the door of the shop; leastwise, I should say: a car pulled up, drawing a rather large caravan!

A few moments later, a very suntanned gent walked into the shop carrying a cream, bakelite gadget that could have been a small flying saucer – except that flying saucers presumably would not be trailing two lengths of white flex. His question was simple and direct:

"Could you fix my power supply thing? It went bung last night!"

Without committing myself beyond a suitably contemplative "well . . . er . . . and . .h.hmmm . . ."I accepted the gadget and turned it over, to reveal some small figures moulded into the underside: "240V" and "9V".

"You use this with your er . . .

"Yeah. Use it with me transistor set. Saves the batteries!

"Reckon you can fix it while we do a bit o' shoppin'?"

I volunteered to try but hastened to explain that I couldn't guarantee to fix it all that easily. If the trouble was a faulty capacitor or rectifier, most likely I would be able to replace it. But if the power transformer had failed, it would be a question of finding one to fit and that could be a different story.

"Well, 'ave a go, mate. Be back in a few minutes!"

When the suntanned gent had gone on his way to do his "bit o' shoppin'", I undid the four self-tapping screws which held the gadget together. The moulding was about the size of a small soup plate and about two inches deep. While it could obviously stand on a shelf or table top, a slotted hole in the rear suggested that it was really intended to hang on a wall or inside a cupboard door, out of the way.

However, opening it up revealed a small step-down transformer, a single "top-hat" silicon rectifier, a couple of capacitors and a couple of resistors. Fairly obviously, a low voltage from the transformer was fed to a half-wave rectifier and then, as DC applied to filter electrolytic. This was followed by a couple of resistors, serving as filters, and a final output filter capacitor.

With the unit plugged into the power point, no voltage at all was evident across the miniature jack, which was obviously intended to plug straight into a transistor set. There was still no voltage at the tagstrip where the plug lead anchored inside the unit.

Further along the tagstrip I measured about 4 volts DC, which seemed to suggest that the rectifier was still functioning. The most obvious conclusion was that the output electro had failed, shorting the output and heavily loading the earlier circuitry.

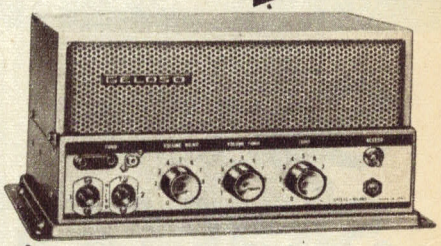
Unsweating the active end quickly proved the point when the capacitor measured a dead short on the multimeter. Fortunately, I had on hand a new 500V 15V electrolytic which was the same physical size as the 12V unit that had previously been fitted.

When the suntanned gent walked in a few minutes later, I was able to hand over the unit, collect my fee and assure him that "She'll be right, mate!" ■

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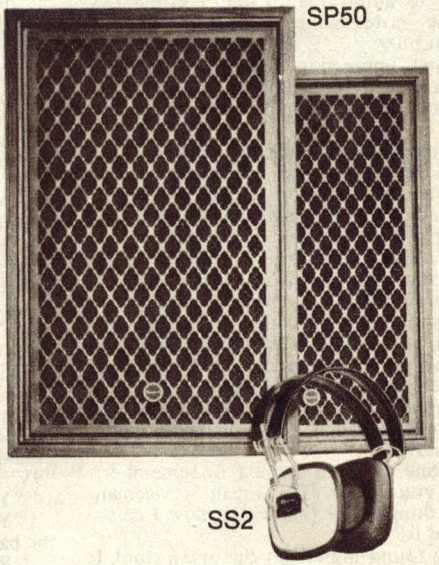
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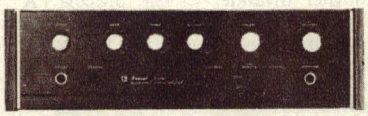
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We've illustrated two fully compatible Sansui stereo systems for you. Each one could be complete in itself; however, as illustrated, these fine solid state stereo systems share a turntable and tone arm (the record sound source) and they're linked by the remarkable new Sansui Model QS-1 Quadphonic Synthesizer. This unit simply converts 2 channel sources into dramatically effective four channel stereo.

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Sansui System "A" is illustrated on the right. This system would suit the dedicated stereo enthusiast. An AU-666 solid state stereo amplifier is linked to a matched pair of Sansui Model SP2000 4-way 6-speaker systems. Frequency response is 10-40,000 Hz. and power handling capacity 35 watts R.M.S. per channel into 8 ohm speakers. Wide range personal listening through the Model SS-20 stereo headset matches the audio quality of these beautifully finished speaker systems.

Sansui System "B" has been specifically designed for the budget conscious music lover, but becomes an excellent system for eventual quadphonic use. It combines the popular all-silicon transistor AU-101 stereo amplifier with hand crafted SP50 speaker systems. In the foreground you see the low priced Sansui Model SS-2 stereo headset.

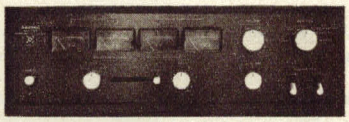
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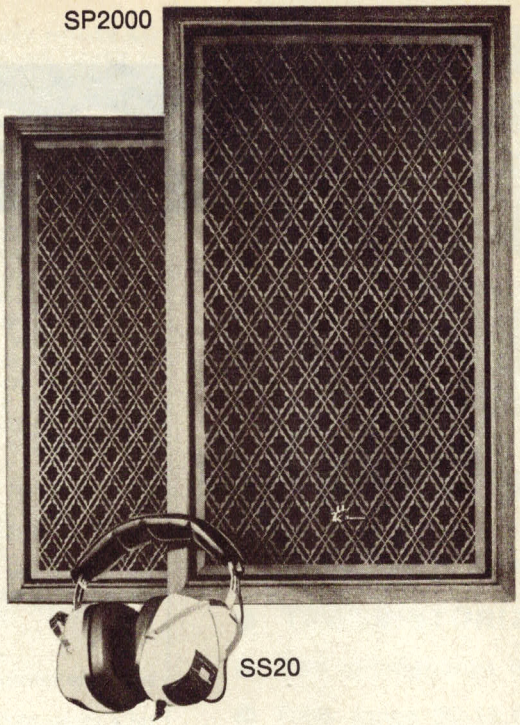
SR1050C



QS1

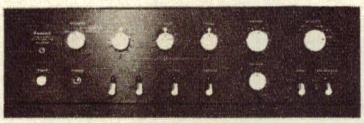


SP2000



SS20

AU666



The Sansui Model SR-1050C record sound source is common to both stereo systems.

You can start with either of these Sansui systems . . . and, if you wish, build them up to a quadphonic system by simply adding the Sansui QS-1 Quadphonic Synthesizer!

Here are brief specifications of the Sansui equipment illustrated for the technically minded.

You can see and hear Sansui stereophonic or quadphonic at your franchised Simon Gray dealer — he'll be glad to give you detailed information.

Call and see him soon. He'll help you make that important decision . . . Sansui **stereophonic** or **quadphonic!**

Sansui
Model QS-1
quadphonic synthesizer
Converts 2 channel stereo sources to four channel stereo.
Exclusive "phase modulation" electronic process, with space-age micro circuitry.
Frequency response:
Front channel — 20-20,000 Hz. ±1dB.
Rear channel: Concert Hall 1 — 20-20,000 Hz. + 1, — 2 dB.

Sansui
Model SR-1050C
stereo turntable
Two speeds. Four pole hysteresis synchronous motor.
Belt drive. Heavy alloy platter, micro-balanced.
Statically balanced tone arm, with lateral balancer and inside force cancellation device. Induced magnet cartridge with 0.5 mil. diamond stylus.
Frequency response — 20-20,000 Hz. Stylus pressure only 2½ grams.

Sansui
Model AU-666
stereo amplifier
Frequency response: 10-40,000 Hz.
Output: 35 watts R.M.S. per channel into 8 ohm speaker systems.
Sensitivity: 2-180 mV.
Sansui
Model SP2000
speaker systems
Frequency response: 30-20,000 Hz.
Power handling capacity: 35 watts.
Speaker complement: 12″ woofer, 6½″ and 5″ mid-range speakers; two 2″ horn tweeters, one 1⅜″ horn super tweeter.
Hand carved speaker grilles, selected walnut timber.

Sansui
Model AU-101
stereo amplifier
Frequency response: 25-40,000 Hz.
Output: 15 watts R.M.S. per channel into 8 ohm speaker systems.
Sensitivity: 3-200 mV.
Price: $139.
Sansui
Model SP50
speaker systems
Frequency response: 50-20,000 Hz.
Power handling capacity: 25 watts.
Speaker complement: 8″ mid-range woofer, new horn tweeter.
Hand finished cabinets of selected walnut, hand carved speaker grilles.

Sansui
Model SS-2
stereo headphones
Frequency response: 20-18,000 Hz.
Weight: 12 ozs.
Sansui
Model SS-20
stereo headphones
Frequency response: 20-20,000 Hz.
Weight: 26 ozs.

SGSQ-1471

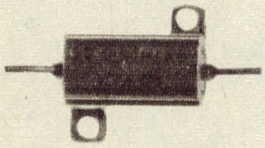
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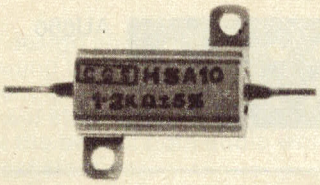
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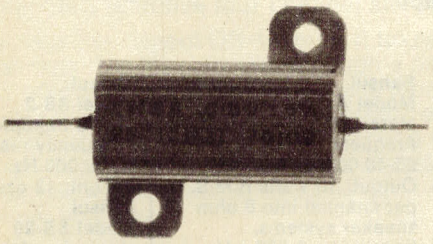
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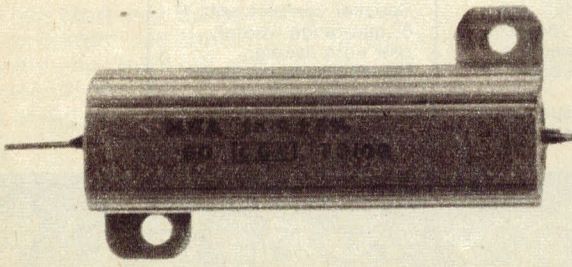


C.G.S TYPE HS POWER WIREWOUND RESISTORS









APPLICABLE SPECIFICATIONS

MIL-R-18546: This specification covers metal clad chassis mounted power wirewound resistors.

C.G.S. Type HS Resistors meet or exceed the electrical and mechanical requirements of this specification.

ELECTRICAL SPECIFICATIONS

Tolerance: HS Types are available in the following tolerances: ± 10%, ± 5%, ± 2%, ± 1%.

Temperature Coefficient:

HSA 5 to 50 HSV 10 & HSV 25	Above 50Ω,	25 ppm/°C is standard.
	1Ω to 50Ω,	50 ,, ,, ,,
	Below 1Ω,	90 ,, ,, ,,
HSC 100 & 200	Above 1KΩ,	30 ,, ,, ,,
	4·7Ω to 999Ω,	50 ,, ,, ,,
	Below 4·7Ω,	90 ,, ,, ,,

Insulation Resistance (dry): 10,000 MΩ Minimum.
1,000 MΩ min., after moisture test, at 100V dc.

Dielectric Strength: 1,000V a.c. peak HS 5 and HS 10 and HSV 10.
2,500V a.c. peak HSA 25, HSA 50, and HSV 25.
5,000V a.c. peak HSC 100 and HSC 200.

Style		Power Rating * (watts)		Resistance Range (ohms)	Max. Working Voltage	Max. Weight Grams
C.G.S.	MIL-R-18546	C.G.S.	MIL			
HSA 5	RE 60	10	5	0·05 to 8·2K	160	4
HSA 10	RE 65	15	10	0·05 to 15K	265	7
HSA 25	RE 70	25	20	0·05 to 36K	550	14
HSA 50	RE 75	50	30	0·05 to 86K	1250	32
HSC 100	RE 77	100	75	0·1 to 50K	1900	475
HSC 200	–	200	–	0·1 to 15K	1900	475

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An Electronic Game of Chance

If you have recently bought some surplus computer boards and are wondering what to do with all the transistors, diodes and resistors on them, then this project should provide the perfect answer. As well as being an intriguing device in its own right, understanding it will provide an interesting exercise in simple logic circuitry.

Over the years the "Reader Built It" pages have described a number of electronics games. Most of these had one common theme; the person actually plays the machine, possibly exercising a certain amount of skill, and wins or loses accordingly.

In this respect the following electronic game is different; it does not depend on the skill of the player. It is simply a game of chance which appears to be quite unpredictable. It is more like a conventional poker machine, with the important exception that the whole operation is completely electronic.

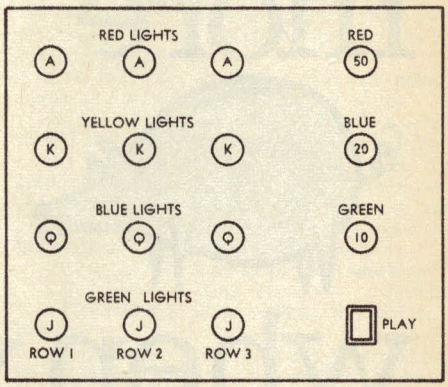
The layout of the console is shown in the drawing. On the left-hand side are 12 coloured lamps, arranged in three vertical rows of four lamps each. On the right-hand side are three lamps in a vertical row, with a "play" switch underneath them.

To operate the machine the player simply presses the "play" button. The lamps in each vertical row on the left-hand side will flicker sequentially for about five seconds, then one lamp in each row will light permanently, forming a lamp pattern, eg, yellow, yellow, and red.

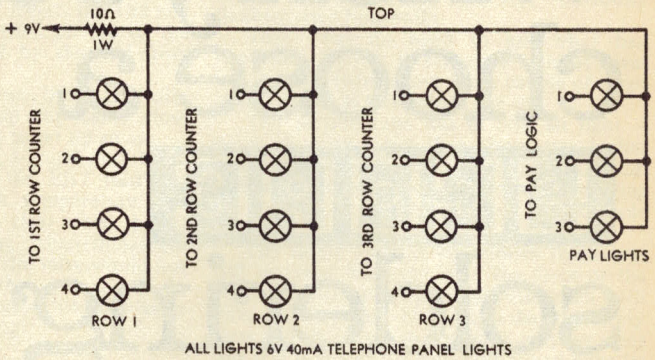
If the combination is a paying one (which this one is) one of the lamps in the right-hand row will light. (The blue lamp in this case.)

The circuit functions as follows: Transistors Tr1 and Tr2 form a monostable pair with, in their "at rest" condition, Tr2 conducting and Tr1 cut off. Associated with the two halves of the monostable are two driver transistors, Tr3 and Tr4. These control current from the nine volt rail to the remaining two major sections of the system: a pay logic circuit and three multivibrator/counter networks.

With Tr2 conducting, the base of Tr3 is pegged to the negative supply rail and Tr3 is cut off. Thus none of the multivibrator counter circuits can function.



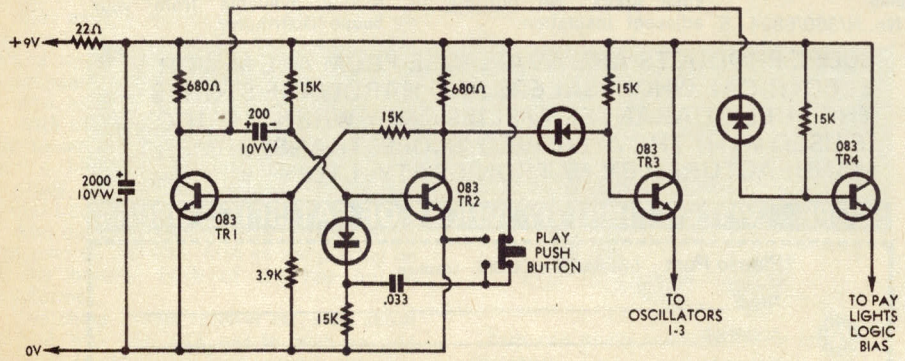
Layout of the display panel. The lamps on the left may be coloured and/or designated by playing card names, as indicated.



Wiring connections for the panel lamps. The numbers refer to the output connections on each of the three multivibrator/counter circuits.

LIGHT CONNECTIONS

The first part of the system comprises a monostable pair, Tr1 and Tr2, together with two switching transistors Tr3 and Tr4. These latter connect the 9V rail to one or other of the two major sections.



TRIGGER MONOSTABLE AND DRIVER OUTPUTS

When the play button is pressed, the .033uF capacitor, previously connected to the positive supply rail, is connected to the negative rail. By reason of the polarity to which it has been charged it will now apply a negative pulse to the base of Tr2, cutting it off and switching Tr1 into the conducting mode.

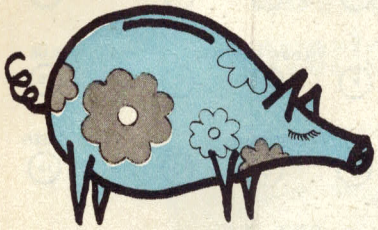
With Tr2 cut off, Tr3 conducts and effectively connects the nine volt supply rail to the three multivibrator/counter circuits. These are represented by a single circuit. Tr5 and Tr6 being the multivibrator circuit and Tr7-8-9-10 the counter circuits. As indicated on the circuit, each multivibrator operates at a different rate.

The four transistors 7, 8, 9, and 10 function as a two-stage ring counter and the operation of this is such that, at any one time, two of these will be conducting and two will be cut off. Transistors Tr11-12-13-14 and their associated diodes form a series of AND gates which conduct only when a particular

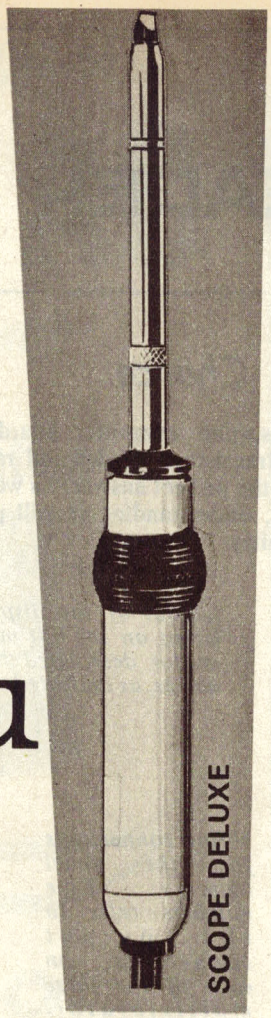
(Continued on page 87)

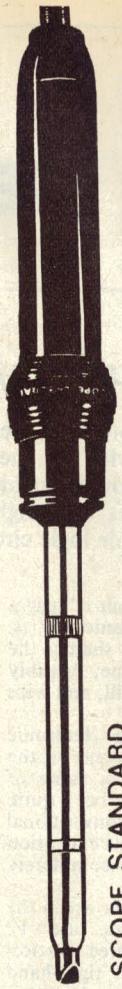
The main portion of the circuit is shown overleaf. The upper section shows the multivibrator/counter circuit (3 off) and the lower section the pay logic circuitry.

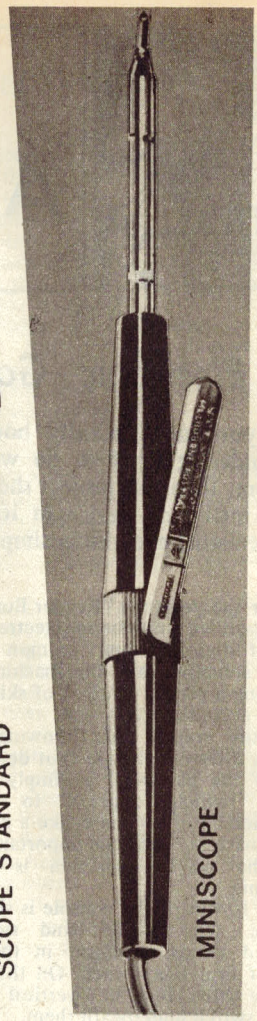
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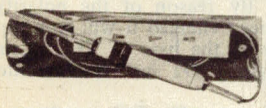


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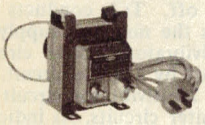








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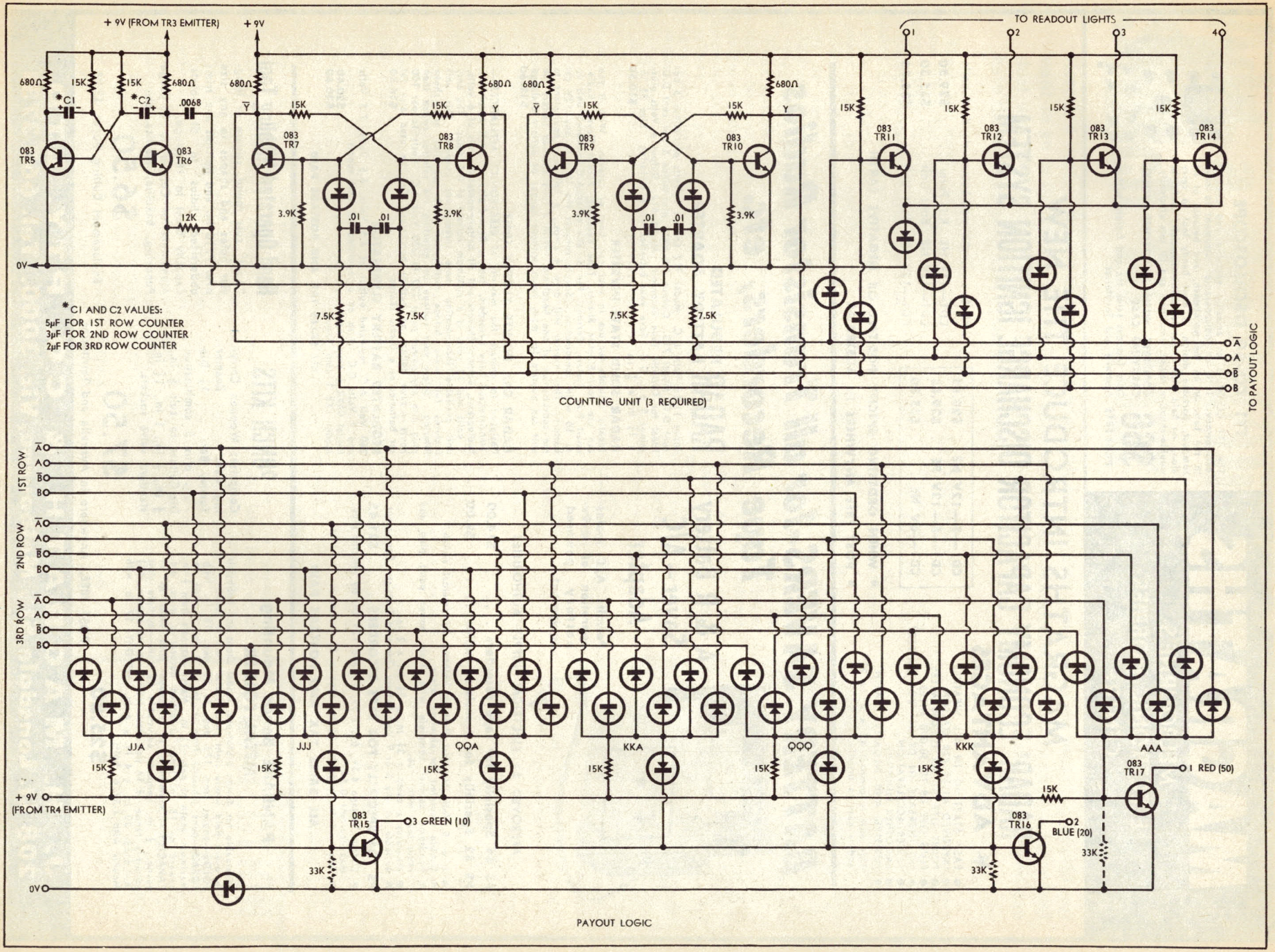
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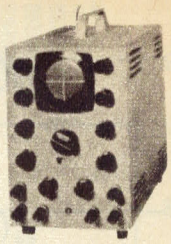
CITY _____ POSTCODE _____


+ 9V (FROM TR3 EMITTER)
+ 9V
TO READOUT LIGHTS
1
2
3
4
680Ω
15K
*C1
*C2
.0068
083 TR5
083 TR6
083 TR7
083 TR8
083 TR9
083 TR10
083 TR11
083 TR12
083 TR13
083 TR14
12K
3.9K
.01
7.5K
0V
*C1 AND C2 VALUES:
5μF FOR 1ST ROW COUNTER
3μF FOR 2ND ROW COUNTER
2μF FOR 3RD ROW COUNTER
COUNTING UNIT (3 REQUIRED)
TO PAYOUT LOGIC
1ST ROW
2ND ROW
3RD ROW
JJA
JJJ
QQA
KKA
QQQ
KKK
AAA
+ 9V (FROM TR4 EMITTER)
083 TR15
3 GREEN (10)
083 TR16
2 BLUE (20)
083 TR17
1 RED (50)
33K
PAYOUT LOGIC

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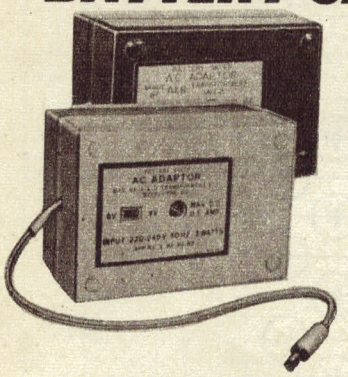
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PS 64 Specially for tape recorders $14.00

PS 82 Specially for transistor radios $9.00

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- Double insulated for absolute safety.
- Handsome cabinet complete with 3-pin power point plug and radio lead with plug.
- Measures a compact 3¼ in. x 2½ in. x 2 in.
- Suitable for any 6 or 9 Volt Battery Operated Transistor Equipment.

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- Output Voltage 4.5V, 6V, 7.5V, 9V and 12V DC by selector plug, max. current 0.5A.
- Size — 4 in. wide by 2¾ in. high x 5½ in. deep.

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A READER BUILT IT . . . continued

pair of counter transistors are cut off. Thus, when Tr7 and Tr9 are both cut off, the base of Tr11 will no longer be pegged down to the negative rail. Tr11 will thus be forward biased by the 15K resistor to the positive rail, will conduct, and the lamp in its collector circuit will light.

With each succeeding pulse from the multivibrator the combination will change and a different lamp will be lit. When the multivibrator stops, the last lamp alight will remain alight. Thus each of the three rows of lamps will have one lamp alight.

By nominating certain patterns as paying combinations the system could finish at this stage, provided the user was content to refer to a list of such combinations after each play. Since this can be something of a chore, the next stage was provided to sense any paying combination and indicate it by means of a single lamp. In fact three lamps are provided, each one indicating a different pay "value".

There are seven paying patterns in this machine, as follows:

LIGHTS	PAY LIGHTS
1. Red, Red, Red	Red – 50 points
2. Yellow, Yellow, Yellow	Blue – 20 points
3. Blue, Blue, Blue	Blue – 20 points
4. Yellow, Yellow, Red	Blue – 20 points
5. Blue, Blue, Red	Blue – 20 points
6. Green, Green, Green	Green – 10 points
7. Green, Green, Red	Green – 10 points

To do this I arranged a system of AND and OR gates fed by the output pulses from the three multivibrator/counter combinations. Transistors Tr15-16-17, with the associated diodes, perform this function. There are two OR functions associated with Tr15, four with Tr16, and none with Tr17.

(Editorial note: We have shown, dotted, a 33K resistor from base to emitter of Tr15-16-17. The presence of this resistor will ensure that the transistor remains properly cut off under all temperature conditions.)

PARTS LIST

37 083 transistors
91 diodes
RESISTORS
20 680
13 3.9K
12 7.5K
3 12K
42 15K
ALL ABOVE OBTAINABLE FROM COMPUTER BOARDS.
1 22ohm 1W
1 10ohm 1W
CAPACITORS
12 .01uF 100V capacitors
3 .0068uF 160V capacitors
1 .033uF 100V capacitors
1 5uF 12 VW
2 3uF 12 VW
2 2uF 12 VW
1 200uF 12 VW
1 2000uF 25VW
MISCELLANEOUS
15 grommets
9in case with sloping front panel
1 push button NO and NC contacts
1 240V 3A toggle switch
15 6V 40mA lamps

The unit was built in a 9in sloping panel box, the globes being held in with rubber grommets and coloured with felt tipped pens. All the circuitry was built on veroboard, three pieces each 7¾in long being cut from a 4in wide strip. The first board accommodates the monostable and drivers and the first row multivibrator and counter. The second board mounts the second and third row multivibrators and counters, and the third board the paying logic and counters.

To keep down the cost I used transistors, diodes, and resistors from obsolete computer boards available from advertisers in this magazine. In fact, the whole unit was designed around parts removed from these boards.

The whole unit runs off 9V and takes approximately 250mA of current continuously. I ran the prototype off batteries but a suitable power supply off the mains could be used with adequate filtering to prevent the monostable reacting to line transit.

(Submitted by Mr R. Scott, 46 Sandgate Road, Wallsend, NSW 2287.) ■

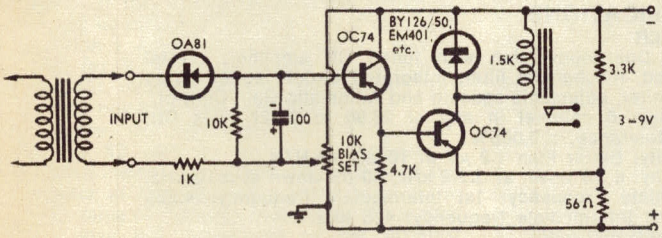
NOTES & ERRATA

PLAYMASTER 130 HEADPHONE AMPLIFIER (January 1971): The original mains cord earthing could allow the amplifier case to become "live" if the board becomes cracked. To forestall this, the mains cord earth should be taken directly to the case at the "record" output socket.

AUSTRALIAN TV STATIONS (January 1971): The list of NSW TV stations should be amended by the addition of: Richmond-Tweed ABRN 6-H, RTN 8-H.

Voice control for transmitter

Thinking of building a VOX system for that mobile transmitter? Here is a design which is so simple there is no excuse for not trying it.



As shown, the circuit is suitable for a positive chassis system. For a negative chassis system NPN transistors could be substituted.

The simple circuit shown here has proved to be very satisfactory. It uses only a few inexpensive components, is simple to make, and requires very little space.

It is a simple two stage direct coupled amplifier employing a couple of transistors which happened to be available. Other, similar types should be equally suitable. The diode in the input circuit rectifies the audio signal and charges the 100uF capacitor in the base circuit of the first transistor. Assuming a reasonably low impedance for the input circuit, this capacitor will charge quite rapidly.

The 10K pot in the first transistor base circuit provides variable forward bias and functions as a threshold control. It is set just below the point where the relay will pull in so that a small signal from the voice circuit will trigger the system. When the user stops speaking, the relay holds in until the charge on the 100uF capacitor leaks away through the parallel 10K resistor. It cannot discharge through the input circuit due to the diode.

The relay was a sensitive type with a coil resistance of 1500 ohms. The diode shown connected across it is to minimise inductive spikes which may damage the transistor.

(This article was originally submitted several years ago, by Mr C. S. of Bordertown, South Australia. We have no way of knowing whether Mr C. S. is still at the original address but, if he cares to contact us, we will be happy to pay him his contributor's fee.)

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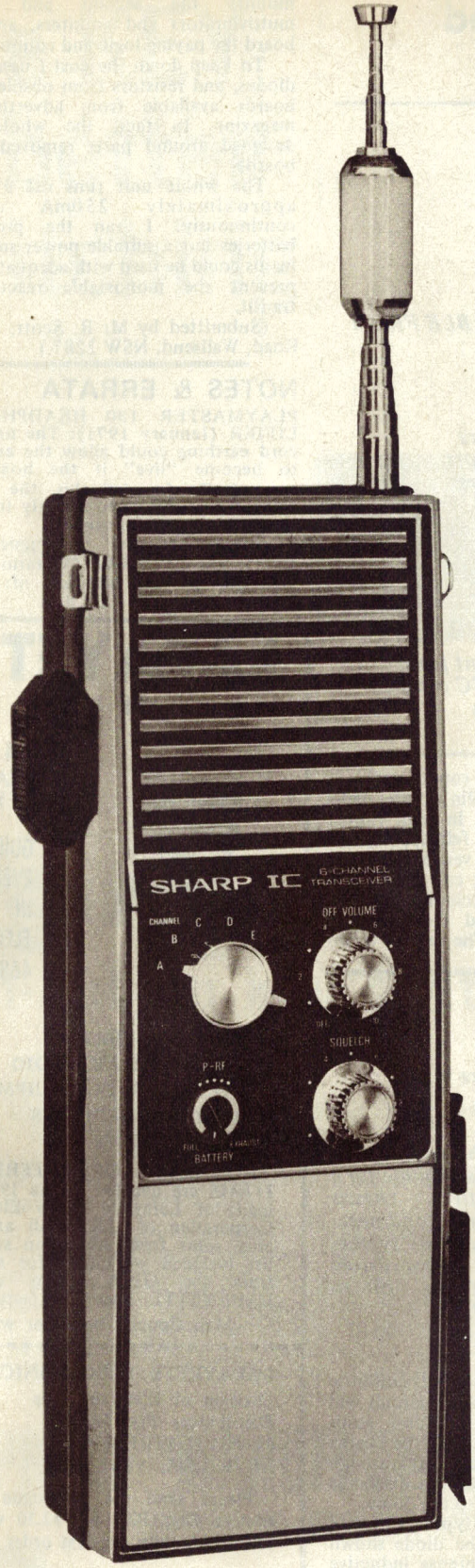
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Simulated Quadraphonic

As yet, very few audio enthusiasts have had the chance to listen at length, and in their own homes, to four-channel or "quadraphonic" sound. It is possible, however, to obtain a pseudo four-channel effect from ordinary stereo equipment. It's a fake but it's fun!

By NEVILLE WILLIAMS

But, first, why use the word "quadraphonic" when, to date, we seem to have preferred quadrasonic? Simply because quadraphonic appeals as the more logical choice, in view of the wide use of "monophonic" and "stereophonic".

The basic idea of quadraphonic sound has been explained at some length in earlier issues. It requires four distinct channels of audio information, four amplifiers and four loudspeakers; the loudspeakers are usually placed, one in each corner of the listening room.

One basic approach to quadraphonic reproduction is to use the two front loudspeakers, as in an ordinary stereo system, to recreate the sound pattern of the orchestra and artists on stage. The two loudspeakers behind the listening position recreate the sound "ambience" which the listener might be aware of in a typical auditorium. This would include reflections from the sides and rear of the auditorium and, perhaps, the sounds of a live audience. See figure 1.

The other main approach is to use the four channels and the four loudspeakers to project the sound of the performers towards the listener from any desired direction, at any instant, at the whim of the producer and/or recording engineer. This is commonly referred to as a "gimmick" application but it can be quite startling and very effective for some program material.

It remains to be seen whether quadraphonic reroduction will gain large-scale acceptance in the home situation and, if so, whether the ambience (or "purist") concept will be dominant or the gimmick application. If stereo provides any precedent, both will be exploited.

But these trends will only emerge – if at all – according to public reaction and the availability of genuine quadraphonic program material, whether in the form of four-track tape or specially encoded discs or radio transmissions. The public cannot react to genuine quadraphonic reproduction while the only commonly available program material is two-track stereo.

But "cannot" is a provocative word to an audio enthusiast, as evidenced by the fact that, during the past month, we discovered three members of our staff (including the author) all independently experimenting to see what kind of a pseudo four-channel effect could be obtained from their domestic stereo system. This article is largely the outcome of these experiments and observations.

It is appropriate to remark that none of those so involved was basically dissatisfied with their existing stereo equipment. In each case, the system was doing the job it was supposed to do – recreating a sound image spread across the loudspeaker end of the listening room, as in figure 2.

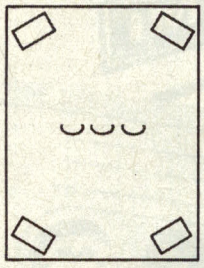


Figure 1

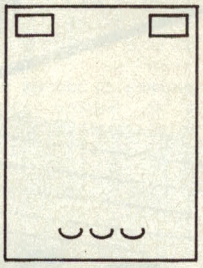


Figure 2

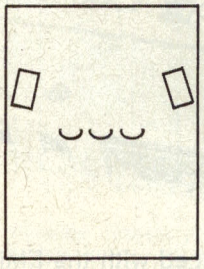


Figure 3

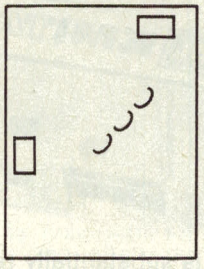


Figure 4

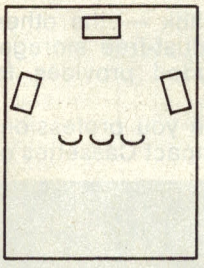


Figure 5

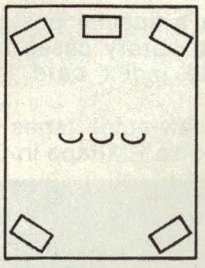


Figure 6

But, having achieved good frontal spread of the sound source, there remained the challenge awakened by all the talk about quadraphonic sound: Was some extension of the stereo system possible, such that an illusion of ambience, or even an illusion of four-channel gimmickry could be achieved? In other words, what about the rear of the listening room which contributed little more than an acoustically blank wall?

For almost as many years as there has been stereo in the home, it has been argued that, to surround himself with sound, the listener first has to get away from the traditional arrangement of having the loudspeakers at one end of the room and the listening position at the other. Arrangements which have been suggested are shown in figures 3 and 4.

Such arrangements will certainly tend to surround the listener with sound but they produce two fairly obvious problems. The first is that the listener is no longer seated effectively in the audience but on centre front-stage, with the instruments and/or performers seemingly arranged on either side of the listening position. This is certainly not acceptable to those who like to hear an orchestra as an entity in front of the listening position.

The second major problem is that, with more than one person in the listening group, relaxing in high-backed and padded chairs, each listener will tend to hear most sound from the loudspeaker on his own side of the room.

Installing a third (central) loudspeaker, fed with the sum of the left and right signals, tends to improve matters somewhat but still leaves the situation where the orchestra is spread unnaturally in respect to the listening position. This arrangement is illustrated in figure 5.

What of the arrangement in figure 6? Here the main stereo pair, possibly aided by a centre "sum" loudspeaker, are ranged along one wall of the listening room and recreate the main sound image. Another stereo pair, presumably operating at a lower level, are placed in the rear corners behind the listening position. They are simply fed with the same signals (though probably attenuated) as the main stereo pair.

This arrangement can offer very little, unless aided by some fortuitous accident of listening room acoustics. If the rear loudspeakers are kept at a low level, they are swamped by the front loudspeakers. If operated at a higher level, they may simply blur the stereo image or, at worst, dominate the distribution so that the sound seems to be coming from behind, rather than in front of the listening postion.

It emerges, as virtually a fundamental requirement, that the sound emanating from the rear loudspeakers be different from that heard from main system. The rear sound must have a characteristic of its own and, hopefully, should add to the total pleasure of listening.

In seeking a "different" sound, one possibility is to feed the rear loudspeakers with signals which have been passed through a reverberation unit and a separate power amplifier, as is common with electronic organs. In practice, however, this kind of reverberation has never found much acceptance in conjunction with high fidelity sound reproducing systems and it seems doubtful that it will do so now, as a means of simulating quadraphonic effects.

It so happens, however, that a signal can



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be derived from an ordinary stereo system which will at least fulfill the elementary requirement of being different from the signals utilised by the main loudspeaker system. It corresponds simply to the difference between the two stereo signals – a quantity which, to date, has been regarded as purely incidental to the operation of the system. Let's examine this idea more closely:

A normal stereo system provides and uses two distinct signals, one for the "L" or left-hand channel and one for the "R" or right-hand channel. When components of the two signals are in phase and are heard together in a symmetrical system (as in figure 2) they create the illusion that sound is coming from the space between the two loudspeakers. Thus a typical stereo system uses sound stimuli based primarily on "L" signals for the left-hand side, "R" signals for the right-hand side, and in-phase ("L+R") components to fill in the centre.

Some have questioned whether the subjective L+R effect is adequate with some program material or in some listening situations and have added a centre loudspeaker fed with an actual L+R signal. In some cases, they have picked up the signal by suitable connection to the outputs of the L and R power amplifiers. In other cases they have used a separate power amplifier fed with a mixture of the two signals, obtained through a resistive pad.

However, whether the centre stage area is filled in subjectively, or with the aid of an extra loudspeaker, the basic idea is unaffected: conventional "up-front" stereo depends on L, R and L+R information.

No use is normally made of the difference between the L and R signals and none was envisaged until recently. But the fact remains that there must be a difference between two dissimilar signals and, by suitable interconnection or sampling, a signal can be derived which is equal to the difference between L and R. This might be written down as L-R or R-L.

Mathematically, it might seem necessary to differentiate between these two quantities but, acoustically, the difference is largely one of phase; this, it may be argued, is unimportant in this context. Thus changing the phase of L-R turns it into -L+R, which is the same as R-L. We may care to argue about this but it does not affect the basic concept.

So the idea emerges: Having discovered a "different" and unused signal in a two-channel stereo recording, can it be used to good effect to drive one or more loudspeakers placed behind the listening position? Can it double for ambience? Can it provide a source for quadraphonic gimmickry?

First reaction may well be that the difference signal has no possible value or significance. It would appear to be a purely incidental – and accidental – component that would produce little more than a "noise".

In fact, it is possible to advance a case for regarding it more optimistically, at least where the recording has been made using a classic 45/45 stereo microphone.

The reasoning follows along this line:

Even though the stereo microphone is facing forward, directed obliquely towards the respective sections of the orchestra, the microphone is not completely deaf to sounds from other directions. It will respond to the general ambience and produce a resultant signal which is recorded along with the signal from the orchestra.

When the recording is ultimately reproduced, this ambience (echoes and audience noise) is actually heard along with the main signal. However, in a normal stereo system, it is largely swamped by the main signal and what of it is heard appears to be coming from the wrong direction; from in front of the listener rather than from around and behind.

The contention is that, if the L and R signals are mixed out of phase, there will be a substantial order of cancellation in the components which represent sound coming from the centre-stage area, as well as in the low frequency components originating over a still wider angle. There will, on the other hand, be very little cancellation in the ambience signals which energise the respective elements of the microphone from the entire side areas of the auditorium.

On this assumption, the ratio of ambience to original signal in the L-R (or R-L) component is much greater than that in the L+R component. What is more, the ambience component is not just random or accidental noise. Predominantly, it represents signal components created by reverberation and audience noise. In short, it is the very quantity we have been looking for and which has been assumed lost for all time!

The reasoning is that, if this can be presented behind the listening position in a suitable manner, it will simulate auditorium ambience to a useful degree.

Figure 7 represents a hook-up, which seeks to take advantage of this effect, and which has been publicised by David Hafler, president of Dynaco. Signals from the respective amplifiers are fed to the L and R stereo loudspeakers, as for a normal stereo system.

However, a third loudspeaker, wired between the two amplifier active terminals is energised only by the difference signal. This is placed behind the listening position, as shown. It must be assumed that it will be so placed in respect to the listening position and adjusted to such a level that it will produce the desired ambience effect. To permit such adjustment, a constant impedance pad is suggested between the amplifiers and the third loudspeaker.

If the layout of the room is such that there is a danger of a "hole-in-the-middle" effect, a fourth loudspeaker can be added, as shown in figure 8.

Reports from overseas would seem to indicate that a lot of hi-fi enthusiasts have credited one or other of these approaches with adding a new dimension to their sound reproduction.

However, there is little doubt that such a system would be heard to best advantage in large listening rooms, where the rear loudspeaker could be placed well back from the audience, or high above their heads. In such a room, further assistance would be forthcoming from natural reverberation.

Not all, however, are likely to be blessed with rooms of these dimensions and the placement of a rear loudspeaker relative to the audience could be a problem. It would too easily be heard as a point source of sound, reproducing a mixture of ambience and of non-cancelled signal, belonging predominantly to one channel or the other. This last remark will be explained at greater length a little later.

Figure 9 illustrates what is probably the most widely applicable arrangement.

The two existing stereo loudspeakers occupy their normal positions and are connected, again as normal, to the respective stereo amplifier channels. They reproduce the direct "on-stage" sound.

Two other loudspeakers occupy the "rear" corners of the listening room. They may typically be of similar impedance to the main loudspeakers, although higher impedance loudspeakers could be used. They are, however, connected in series and out of phase, being fed with the "difference" signal picked up from the two active amplifier outputs.

Being in series, and therefore presenting a higher total impedance than the main loudspeakers, those at the rear will absorb (and therefore deliver) less power than those at the front. This is in line with normal requirements and reduces dependence on attenuator pads. Further, by keeping the impedance of the extra loudspeakers as high as possible, loading problems on the power amplifiers will be minimised.

Being located in the corners, the rear loudspeakers can be kept a little more remote from the listening position and, being out of phase, they will tend to produce a more diffuse sound.

HAFLER/DYNACO SYSTEM

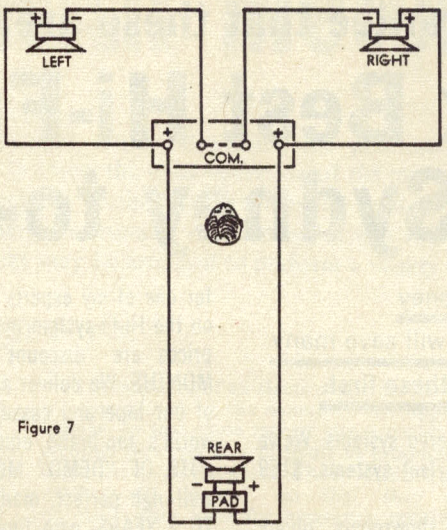


Figure 7

Simulated ambience provided by one loudspeaker behind the listener, with a constant-impedance pad to control output.

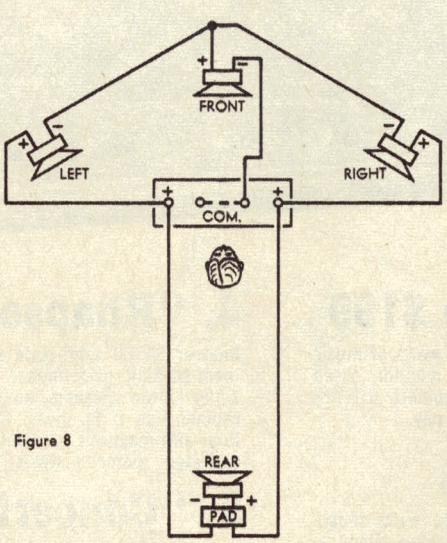


Figure 8

Similar in principle to the setup shown above, this uses a centre loudspeaker to reinforce the up-front image and widely splayed side loudspeakers to increase spread.



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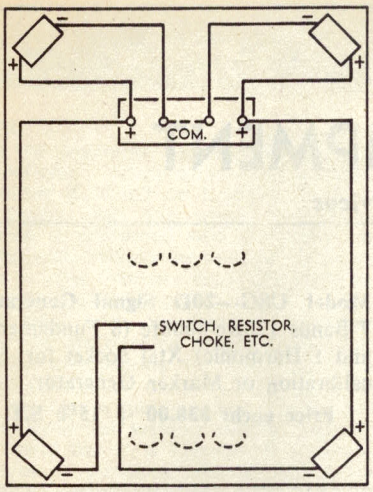


Figure 9

The system which formed the basis for our own experiments. As explained in the text, the position of the seating and the size and position of the rear loudspeakers would be governed by the size of the listening room.

To set up this kind of system, the loudspeakers should be arranged and connected as shown. Now play a mono record and have someone gently rotate the balance control while you listen to one of the rear loudspeakers. With the balance control somewhere near the centre position, it should be possible to observe an almost complete null, where very little signal is heard from the rear loudspeakers. This is the condition, in fact, where there is no difference signal.

Whether or not a complete null is achieved will depend on the frequency balance between the two halves of the stereo cartridge and the symmetry of the compensation and tone control circuitry in the two halves of the amplifier.

And whether such a null position corresponds to balance between the front loudspeakers will depend, in turn, on the symmetry of the main loudspeakers and their acoustic environment.

If one is going to be highly critical and demand a complete null in the rear loudspeakers, coincident with perfect balance from the front, a more elaborate system may have to be envisaged. This has led to suggestions overseas for a special unit which derives its signal from as early as possible in the stereo chain, reverses the phase of one channel, mixes the two channels and delivers a difference signal to an entirely separate power amplifier driving the ambience loudspeaker(s).

To date our zeal has not stretched this far and our reaction is that the simpler approach should give results to satisfy most listeners.

Unless there is a gross lack of symmetry somewhere in the system, it should be possible to set it up so that, with a mono record on the turntable, all the sound will appear to be coming from between the stereo pair in front, with vitually no sound from the rear. At least, this is the objective.

Before seeking to evaluate the behaviour of the system with a stereo record, extend the link between the two rear loudspeakers so that the circuit can be opened or closed from the listening position. Use a switch if you want to, but it will suffice simply to touch the leads together. This makes it easy, also, to close the circuit through a resistor, so that the level in the rear loudspeakers can be varied and observed.

For a first test on stereo, select a record of orchestral music which has even spread and which (hopefully) has been recorded with a central stereo microphone. A classical or semi-classical recording from the EMI stable would be a fair bet. Now settle down to listen.

The situation is reminiscent of a slogan once used by a popular sandwich spread: "Too much spoils the flavour".

Excessive output from the rear loudspeakers will have massed strings seemingly playing from the rear. Bringing the loudspeakers into operation will make the orchestra seem to jump towards you and stereo definition will largely be lost.

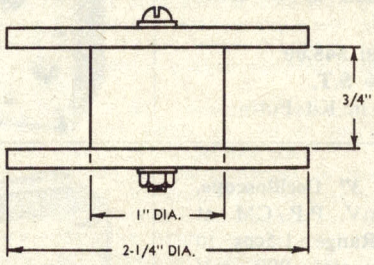


Figure 10

A typical bobbin for loudspeaker chokes, made from non-metallic oddments and held together (preferably) with a brass bolt. See text for suggestions in regard to the winding.

If this happens, move your chair forward. Or turn the rear loudspeakers around so that they are facing into the corners. Or use a series resistor in the connecting lead to reduce their output. What you should aim for, with this kind of record, is a gentle whisper of sound from the rear to enliven an otherwise dead area.

However, you will probably find that ANY sound from the rear will tend to cloud the stereo image from the front, and some enthusiasts have got "hung up" on this.

If clarity of the stereo image is the main criterion by which you judge a stereo system, then additional sound from the rear is possibly not for you. A favourable reaction to simulated quadrophonic will necessarily be based on an overall evaluation, where some element of "presence" in the otherwise dead corners of the room is judged to be a worthwhile gain, considered against some loss in frontal stereo definition.

Now try a record more in the "ping-pong" style, with sounds emanating from strongly defined zones from centre to the respective sides. You will find that gimmick stereo comes very close to gimmick quadraphonic. Centre front sounds stay where they are; sounds from either side may tend randomly to jump to the back of the room, depending on the relative levels and the exact listening position.

Sometimes the effect will be less than successful. A singer wandering from centre-stage to one wing may suddenly pop up behind you!

The best approach, really, is to listen to a selection of records, with the wiring to the rear loudspeakers still accessible in the listening position. Try to settle on a level which will give the best overall effects. If desired, a switch and/or a control could be retained so that the simulated quadraphonic could be disabled or adjusted at any time, according to requirements.

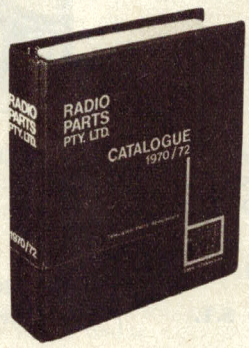
But what about the expense of the extra loudspeakers? What about the problems of locating them in a small listening room where the audience has to be seated close to the rear wall?

This may, in fact, be the most common situation.

In such a case, the extra loudspeakers will almost certainly have to be mounted high up in the rear corners of the listening room. In such a position, large loudspeakers would be an eyesore and it may be necessary to

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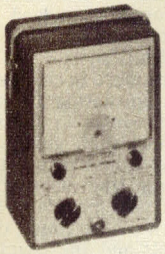
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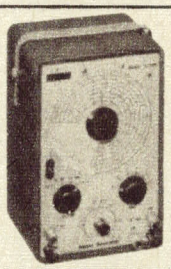
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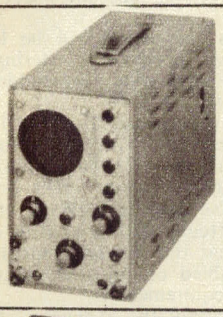
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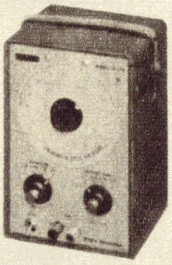
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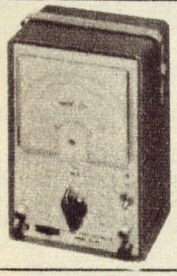
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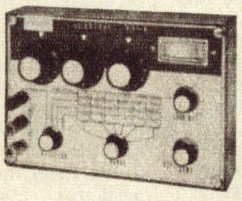
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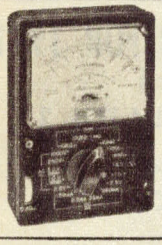
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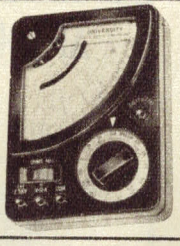


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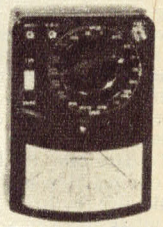


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consider small, cheap loudspeakers, in boxes that will be large enough to house them but not large enough to provide an adequate enclosure in the acoustic sense.

Would such loudspeakers be worth considering?

The answer, fortunately, is "yes".

One reason for this is that, with the majority of records, the heavy bass is common to both channels, and therefore subject to heavy cancellation in the difference signal. What bass component there is, need only be reproduced at lower level along with the rest of the difference signal, and is shared by two loudspeakers, anyway.

It is reasonable to suggest, therefore, that the extra loudspeakers can be of modest variety. Our advice, therefore is to use single-cone loudspeakers, with modest top response and a fairly low natural bass resonance. Low frequency speakers intended for use in compact systems would appear to be very suitable. They would have favourable bass characteristics, limited high frequency response and modest sensitivity, which would help to keep their acoustic output down.

In the writer's experimental set-up the high frequencies still seemed a little too prominent on some records and a very simple corrective measure was found to produce the right results. In series with the interconnecting lead a choke was inserted, taken from a discarded loudspeaker divider network.

In some transistor amplifiers the loudspeaker terminals may be at a DC potential relative to chassis. Use two electrolytics as shown to act as a non-polarised blocking capacitance.

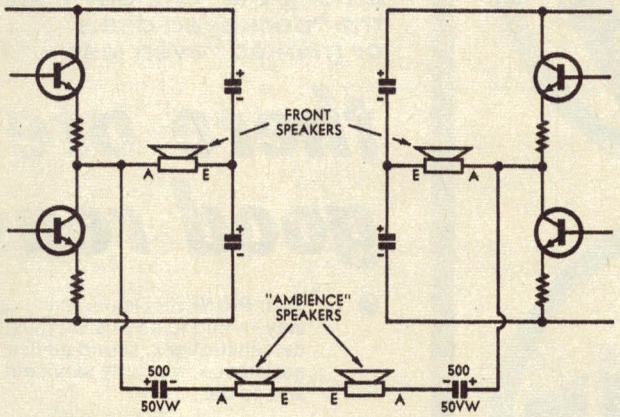


Figure 11

specifications, provided they are not so modest as to actually overload on typical signals. For a typical listening room, a couple of 5-inch or 6-inch loudspeakers would appear to be a reasonable choice.

How should they be baffled?

A fully enclosed box is probably not a good choice, because it would need to be quite large to avoid raising the bass resonance of the loudspeaker and producing a boom in the 150-200Hz region. A smallish, decorative box is therefore indicated, which will permit radiation from both sides of the cone. And, since ambience is being sought, this is not necessarily a bad thing.

How should these rear loudspeakers be phased in relation to the main units?

Argument here and overseas has produced two diametrically opposed viewpoints. One suggests that the cones should travel nominally in the same direction "so that the path between them should neither be stretched nor compressed". The other is that they should travel in opposite directions so that they will nominally "co-operate in compressing or rarefying the air in the room".

In fact, for the reasons stated, the rear loudspeakers will play little part at the bass end while, at other frequencies, phase relationships will be so random at the listening position that argument about phasing seems pointless. All we do suggest is that the rear loudspeakers be mounted as symmetrically as possible relative to the listening position and wired out of phase in respect to each other.

One more point should be made:

Since the difference signal will tend to contain a preponderance of higher frequency components, propagation of the difference signal into the room will have the effect of adding to the total high frequency signal present. It will give the illusion of treble boost.

The effect will be aggravated if the rear loudspeakers are of the wide-range twin-cone

The inductance required will vary in each case with the impedance of the rear loudspeakers, whether or not there is additional series resistance, the treble response of the loudspeakers and the amount of attenuation that is decided upon.

As a guide, we show the type of wooden former on which these indicators were customarily wound. Such a former will typically accept 200 turns of 18B&S or 19SWG gauge enamelled wire giving an inductance of about 1mH. If you can get hold of a small quantity of wire of about this gauge, a choke can be wound up and the number of turns manipulated by trial and error to give any desired treble attenuation. If you don't fancy winding and unwinding turns, with a little care, a few tappings can be brought out and the section used which gives the desired results.

Finally a work about the stereo amplifier. With a valve unit, the output terminals are almost invariably connected to the secondary of an output transformer, with one side grounded to chassis. There are no DC potentials to worry about and nothing drastic is likely to happen if you make a wrong connection. It is simply a matter of identifying the "earthy" or "minus" terminals and the two "active" terminals, and connecting as indicated.

With transistor amplifiers, the method of connection of the additional loudspeakers will vary, according to the configuration of the output stages. If the amplifier has balanced positive and negative supply lines or has a single output coupling capacitor in each channel, the method of connection will be the same as for valve amplifiers – the additional loudspeakers are simply strung between the "active" terminals of the existing loudspeakers.

If, however, the amplifier uses a capacitive divider network to couple the signal to the loudspeakers, the method of connection is

(continued on page 115)

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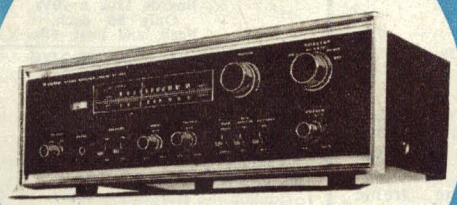
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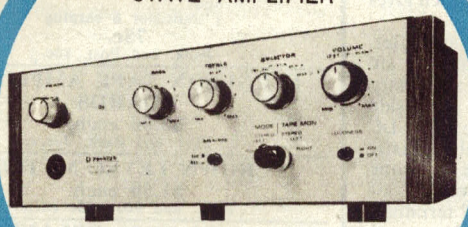
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CLASSICAL RECORDINGS

Reviewed by Julian Russell

Berlioz' Requiem - "magnificent production"

BERLIOZ – Requiem Mass. Ronald Dowd (tenor); Wandsworth School Boys' Choir and London Symphony Orchestra and Chorus conducted by Colin Davis. Philips Stereo 6700019/1-2.

Berlioz' Requiem, after many years of totally unjustified neglect, has at last won a recognised place among the world's greatest liturgical music. Admittedly the problems of an adequate performance are many and expensive. It requires a very large body of performers, even more than might be assembled for a spectacular performance of one of the big operas such as "Aida" or "The Mastersingers" but without the compensating reward of something dramatic for the audience to watch.

It needs endless patience in rehearsal, because no matter how big an operatic production might be, most of those associated with it already have some – and often intimate – knowledge of the music. The Berlioz Requiem is so seldom performed, at any rate until recently, that a new generation might have grown up since its previous performance and the whole has to be studied afresh by all the participants.

It has, however, been fairly frequently recorded since the coming of LPs; twice by Munch, once by Ormandy, and now again by Colin Davis for Philips. And I might state unequivocably at the outset that Davis' recording and performance leaves all the others for dead. The first side of this two-record set should give you a good idea of the quality of the whole of this magnificent production. It opens with the quiet beauty of the "Requiem Aeternam" with some enchantingly luminous singing from the boys' choir, and from this goes to the barely murmured "Kyrie" before the end of the first movement, swelling beautifully in volume to prepare the way for the final dwindling into silence. And all through the set you can hear just how great a value Davis places on silence. Then you have the great "Dies Irae" with, at the beginning, the boys' choir again prominently angelic.

Here you will notice how tight chromatic string passages constantly carry the tonality upward in the scale. Then fanfares from four brass bands placed at the four corners of the orchestra usher in the "Tuba Mirum" and the huge choir enters to the vast thunder of the timps in three and four parts. Despite the enormous volume of sound produced in this section there is never the slightest hint of distortion, though the dynamic range is about as wide as can be tolerated by modern equipment.

Although Berlioz demands huge resources for a satisfactory performance of his Requiem it is surprising how seldom all are used at the one time. The work abounds in quiet passages of the utmost tranquil beauty. And even at his most dramatic Davis is never less than reverent. As I wrote above, this first side can be taken as a fair sample of the variety of good things that occur all through the Mass. Davis' choice of tempos throughout always seem to me unerringly right. Each suits not only the mood but also the scoring of individual movements. And if you want warning in advance of the marvels that await you in this marvellous score and performance, there is an analysis in English, French and German in the accompanying brochure written in a manner that anyone with only the most elementary knowledge of music can understand. Using this in conjunction with the Latin text of the Mass, which is also provided, cannot fail to alert you to not only its great moments but its multitudinous subtleties.

Australian tenor Ronald Dowd gives a highly professional account of the solo tenor part and the orchestral playing and choral singing are beyond praise. Though it is early in the year to prophesy I am certain that this will be one of the great recordings of 1971. It must be, however good the others.

★ ★ ★

MAHLER – Symphony No 3. Marjorie Thomas (contralto) with the Chorus and Orchestra of the Bavarian Radio conducted by Rafael Kubelik. DGG Stereo 139337/8.

Mahler's Third Symphony is not an easy work to assimilate, even by devoted Mahlerians. It is one of the longest ever written. Indeed the first movement is so long and contains so much material that Mahler called it the "first part" and the five shorter movement that follow the "second part". It is a sprawling symphony that might well warrant the label Brahms put on Bruckner's symphonies – symphonic boa constrictors.

Although Mahler later denied that the work was written to a program, his first sketch labelled the whole symphony "The Gay Science" and the first part, "Summer Marches In". The short pieces that go to make up the second part he labelled "What the flowers of the meadows tell me", "What the animals of the forest tell me", "What the midnight tells me", "What the morning bells tell me", and "What the children tell me". Despite the composer's rejection of a program, if you keep these labels in mind while listening it will make comprehension of the symphony easier – at first hearing, at any rate.

To go into further details of the structure of this massive symphony would occupy all the space at my disposal here. Neville Cardus, in his first volume on the "Symphonies of Mahler", takes 31 pages to set it out, profusely scattered with musical examples which point out the relationship between the themes and their treatment. Those who wish to learn more about the symphony in a briefer form will find an excellent guide in the sleeve notes of this two-record set. Since the Mahler revival, the work has been often recorded and admirers of the composer will already have a good idea of the general structure.

So far I have always hailed Kubelik's readings of Mahler's symphonies as my favourite versions all round but I am not so sure about his Third. Temperamentally Kubelik seems a little less in sympathy with it than with the others I have reviewed from time to time in this column. He is too much of a poet to get the necessary brutality into the first movement, and, although it has some magnificent passages which run over many pages of the score the general effect is not quite expansive enough to make his reading entirely satisfactory. However, don't be put off by this, because in the shorter pieces that make up the second part, Kubelik the poet reveals all the beauties of these more lyrical pages. I think you will find enough to admire and enjoy in these movements to compensate for the slight shortcomings of the first part.

The orchestra, as usual, rewards Kubelik with complete involvement to his direction. The players are never less than generous in their response to a conductor they obviously like and admire. Moreover the performance requires engineering that reveals the multiple details of the complex score and this DGG has provided. As a recording its engineering is not surpassed by any of the previously issued versions by other conductors and orchestras. I certainly was not disappointed with this aspect of the production. And though to me personally there is something lacking in Kubelik's grasp of the magnitude of the symphony's first part I found ample compensation in all that follows. This is perhaps not quite so subjective an opinion as it might seem stated as baldly as it is here. I don't think there can be any two ways of presenting the first part of this monumental work in a manner that will make a cohesive whole. Yet strangely with all Kubelik's shortcomings I still found enough to give me enormous pleasure even in the movement where a little more grandeur of interpretation would have been welcome.

Kubelik is a conductor of Mahler to whom I always respond with admiration and affection. That I am not always in agreement with all he does to the Third Symphony will probably be shared by all who know this particular symphony well, and in some of its other recorded issues. On the other hand there is so much that is entirely admirable is Kubelik's reading that I would feel it a pity if this review put anyone off acquiring the recording without giving it a fair chance to speak for itself and not through me.

★ ★ ★

BRAHMS – Piano Concertos No 1 in D Minor and No 2 in B Flat Major. Claudio Arrau and the Concertgebouw Orchestra conducted by Bernard Haitink. Philips Stereo 6700018/1-2.

These two concertos are put out as a boxed set, and cannot therefore be bought separately, at all events at present. They are new recordings of the concertos by Arrau and are not to be confused with his 1961 recordings of the same works with Giulini and the Philharmonia. I am pointing this out because there is a curious difference in the quality of the two present recordings. The sound in the second concerto is unmistakeably richer than that provided in the first and the balance between soloist and orchestra much more satisfactory. In the first movement, particularly of the No 1, Arrau sounds disinclined to give his part the full weight of which we know him to be capable of giving it. In fact I prefer not only the sound but also the performance of the No 2

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to both these features in the earlier work. This is not to say that either Arrau or the recording of No 1 can be dismissed offhand as a complete dud. Far from it. There are not many pianists around today who could match Arrau even on an off day as he apparently had when he made the disc.

Apart from Arrau's reluctance to dominate the first movement of No 1 you have a second movement that is curiously rigid in conception. Some years ago, in conversation with Arrau, he told me that he didn't favour the inclusion of too many rubatos in any recording he made. His theory was, and probably still is, that these tend after a while to irritate the listener who knows in advance just when to expect them. He did not apply this rule to live performances because the audience attends to hear only the one performance of the work and a rubato might be welcome on the concert platform though tiresome when repeated on a recording. I am mentioning this in an effort to explain Arrau's unrelenting steadiness in the movement.

But having made these remarks about the first concerto, I can go on, to say that I cannot recall a performance, or recording, of the second that gave me the total pleasure I enjoyed when I listened to it in this set. Here you have Arrau not only at his most persuasive but also at his most poetic. You have only to listen to the magical entry of the piano in the slow movement to hear what I mean. And all through the concerto, which, incidentally, I always enjoy more than the first, Arrau asserts himself with splendid authority when this mood is needed and with exquisite lyricism when it is called for.

Moreover, the orchestra in No 2 seems to be in more complete rapport with the soloist than it is in the first. It is indeed so very lovely a performance in every way that I would be quite happy to buy this inseparable coupling with its slightly less enjoyable No 1 to be able to enjoy the superlative beauties of the second concerto whenever I wanted to listen to it. It is not unusual in cases like this for the issuing company to make such packages available as separate items at some future date. So if you want to be on the safe side, curb your impatience and wait until the B flat is put out alone.

★ ★ ★

WEBER – Clarinet Concerto No 1 in F Minor. Jacques Lancelot, soloist. Bassoon Concerto in F Major. Paul Hongne, soloist. Horn Concertino in E Minor. Georges Barboteau, soloist. The Bamberg Symphony Orchestra conducted by Theodor Guschlbauer. World Record Club Stereo S/4808.

The F Minor Clarinet Concerto is well-known to most music lovers and has been recorded many times. The F Major Bassoon Concerto, while perhaps not so familiar, has often been recorded too, though less frequently than the clarinet work. The Concertino For Horn and Orchestra in E Minor is, so far as I can trace, recorded here for the first time. In passing I might mention that it was originally put out on the French Erato label and this is the performance you hear. The soloist in the clarinet concerto is Jacques Lancelot who all through gives a polished, well considered and sensitive account of the work. He is sympathetically accompanied by the Bamberg Symphony under a conductor new to me, Theodor Guschlbauer.

But I think the outstanding item on the disc is the Bassoon Concerto, with the same orchestra and conductor, and Paul Hongne as soloist. One has come to think always of the bassoon as the clown of the orchestra, croaking little jokes when not supplying the bass line to the woodwind choir. As a solo instrument at its most eloquent it always reminds me of a grotesque lover with a sore throat serenading a scoffing mistress. At its most cheerful it tumbles about like a sad-faced booby. It is certainly the most put-upon member of the orchestra, the narrowness of its emotional range matched only by the harp. (I am omitting the percussion which has the dubious advantage of self-assertion.) But in the slow movement of this concerto the soloist and orchestra come as close to eloquence as is conceivably possible. Hongne is certainly a master of his instrument and Weber has provided both him and the orchestra with some attractive material, much of it reminiscent of the composer's fine opera "Oberon". And in the Finale, Hongne chuckles mischievously at some private malice.

Georges Barboteau, the soloist in the Horn Concertino, plays with perfect accuracy. There is never a bubble or badly pitched note. His tone, perhaps, has the usual squashy character that almost all French players of the instrument favour. However the ear soon adjusts to this. This concerto should be of considerable interest to all horn players though I cannot imagine it appealing, except as a curiosity, to the general musical public. Like all Weber's music it is unfailingly melodious though I did experience the feeling that I was listening to a musical lecture, full of erudition gracefully delivered. In all three concertos the accompaniments are eminently satisfactory and the balance excellent.

★ ★ ★

ELGAR – Symphony No 2 in E Flat Major. London Philharmonic Orchestra conducted by Sir Adrian Boult. World Record Club Stereo S/4516.

There are two unsurpassed conductors of Elgar's Symphonies – Barbirolli and Boult. Though their readings are as different as their temperaments both have indisputable validity. It would be profitless to compare them here. Both have their enthusiastic champions. Personally I could do with either. Each, when I am listening to him, seems at the time to be the better. At any rate Elgar is known to have varied his interpretations considerably when he conducted his own works, especially the symphonies. I find this account of the Second by Boult in every way admirable.

Those who know the second symphony well will recall the enormous number of tempo changes in the first movement, so many that it is not always practicable to observe them all. Boult observes as many as possible without destroying the continuity of the musical thought. Barbirolli, on the other hand, does tend to follow them more closely but at the expense mentioned above. For this reason, after having replayed the Barbirolli recording I feel a slight preference for the Boult.

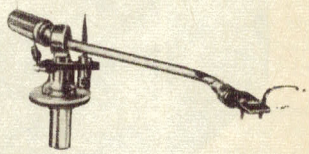
Boult's handling of the slow movement is superb, intense though never omitting relevant detail. Indeed I cannot recall ever having heard the beautiful oboe counter-theme so audibly and expressively played. Occasionally some of the detail in the scherzo becomes a little blurred, though its overall effect is fine. And the finale leaves absolutely nothing to be desired. The engineering is first rate though the placing of both first and second violins on the one side of the conductor does lessen the antiphonal effect introduced by Elgar for very good reasons. This, however, is a churlish quibble about a performance, and recording that gave me so much pleasure. A real bargain for Elgar lovers.

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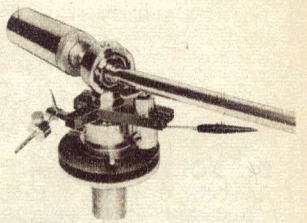
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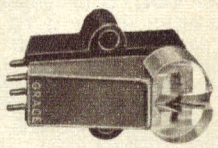
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. . . Tape Cassettes

J. S. BACH – Concertos for Violin, Strings and Continuo No 1 in A Minor and No 2 in E Major. Soloist and conductor David Oistrakh with Members of the Vienna Philharmonic Symphony Orchestra. (George Fischer, harpsichord).
Concerto for Two Violins, Strings and Continuo in D Minor. David and Igor Oistrakh with the Royal Philharmonic Orchestra conducted by Sir Eugene Goossens. (Harpsichord, George Malcolm.) DGG 923087.

Oistrakh's playing in the two solo concertos has all the distinction one has come to expect from this great violinist. His solos are given just the right weight so as not to stand out too prominently from the orchestra, rather they blend in as perfect a balance as I've ever heard achieved in these works. The orchestra, too is perfectly drilled yet pliant. It might be thought that such treatment could lead to some loss of detail in the solo parts, but this is most certainly not the case. Not a note escapes an attentive listeners's ear and Oistrakh's stylish phrasing and incomparable technique make this a quite outstanding performance. The fast movements have exhilarating zest, the slower ones unfailing sensibility. I enjoyed both concertos enormously.

Much more than I did the Double Concerto in which David Oistrakh is joined by his son, Igor. Nowadays they are known as King David and Prince Igor, and that's the way they sound here, because the father dominates the son in a way I am sure was never intended by the composer. This concerto might well have additional interest for Australian listeners since the Royal Philharmonic is conducted by the late Eugene Goossens, though neither orchestra nor conductor are in their best form in the work. But David Oistrakh's playing of the two solo concertos and the delicious freshness of their recording makes the whole cassette well worthwhile.

★ ★ ★

TCHAIKOVSKY – Symphony No 6 in B Minor ("Pathetique").
BRAHMS – Hungarian Dances Nos 1, 18, 19, and 20. Berlin Philharmonic Orchestra conducted by Herbert von Karajan. DGG923122.

The playing in this offers an interesting comparison to that in the foregoing cassette. Bohm's performance is a wonderful example of relaxed playing. Karajan, using the same orchestra, also wins playing of the utmost accuracy and intensity but seems to be working much harder to produce it. I am not forgetting the different character of the compositions, especially the emotional extravagances of the "Pathetique", which, however, Karajan never allows to become bathetic. It is perhaps Karajan's determination to keep the bathos out of his reading that makes his performance sound much more self-conscious than Bohm's.

The background noise is more than a little distracting. And among other distractions are Karajan's sudden accelerandos in the first movement and his unnaturally rigid meter in the March, the latter insistance a treatment that drains the music of much of its rhythmic interest. All things considered Karajan fails to convince me that Tchaikovsky's emotional splurges come from the heart and not the head. Here again the instruments are well spaced and the different timbres effectively reproduced?.

However with all its shortcomings I can imagine this cassette winning some popularity particularly as there is the bonus of the four Brahms dances, the last three of which might well be unfamiliar to many listeners. Some people like their Tchaikovsky Karajan style and after all, one cannot tie this composer down to the usual rules. Moreover the superb quality of the Berlin strings in the last movement is bound to find many admirers even among those who are not in sympathy with the conductor's style.

★ ★ ★

MOZART – Mass No 14 in C Major K.317 (The Coronation).
Maria Stader (soprano): Oralia Dominguez (contralto); Ernst Haefliger (tenor), and Michel Roux (bass) with the Elizabeth Brasseur Choir and the Orchestra of the Concerts Lamoureux conducted by Igor Markevitch.
Exsultate Jubilate K.165. Et Incarnatus Est K.427. Maria Stader and the Berlin Radio Symphony Orchestra conducted by Ferenc Fricsay. DGG922006.

Igor Markevitch is generally speaking an energetic conductor, a welcome feature in anyone directing the Coronation Mass. As a work by Mozart it is far from being out of the top drawer. True is has some interesting, and a few lovely, moments but for the rest the work needs the energy of a Markevitch to bring it off. From the very first bars the choir produces an impressive body of sound, though when their complete performance is considered there is not as much tonal variety as I would have liked to hear. The four soloists are in better balance with the orchestra – and organ – than is the chorus. The four blend very well indeed in the concerted items and are very pleasing in their solos. Whatever the work's shortcomings Markevitch makes it all sound very festive.

Maria Stader sings her two arias, Exsultate Jubilate and Et Incarnatus Est, with considerable distinction to an admirable accompaniment provided by Friscay and the Berlin Radio Orchestra.

★ ★ ★

MOZART – Symphonies Nos 39 in E Flat (K.543) and 36 in C (K.425) "The Linz". Berlin Philarmonic Orchestra conducted by Karl Bohm. DGG923009.

The all-round recording quality of this cassette is very good. The sound in Symphony No 39 is well spaced and the timbre of the different instruments faithful. Indeed I think I am safe in describing it as an exemplary sample of cassette recording at its present day best. A major contribution to the overall excellence is the beautifully limpid quality of the playing of the Berlin Philharmonic. The players never suggest over-drilling, though their discipline is faultless. To listen to the performance of the No 39 is to get the impression that Bohm is letting the musicians play much as they like – which means, of course, that they were so perfectly rehearsed that none of the hard work entailed is evident. It is a true example of the art that conceals art.

The many longish pauses in the slow movement of No 39 allow some slight background noise to become noticeable which, however, cannot be heard when the orchestra resumes playing. I know of no conductor today whose Mozart appeals to me as much as does Bohm's. His readings are always scholarly but never pedantic. There is no intrusion of the personality of the conductor between the music and audience. His performances sparkle in the right places, and where tenderness is needed they couldn't be made to sound more affectionate. ■

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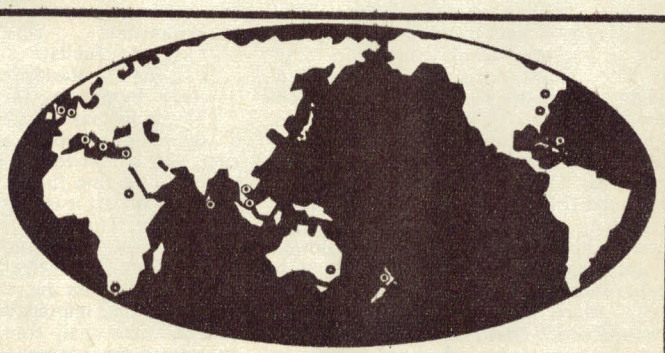
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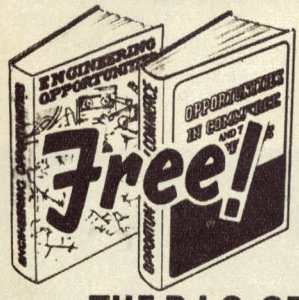
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I WALKED TODAY WHERE JESUS WALKED. Frank Boggs. Stereo, Word WST-8469-LP. (Available from Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)

Interest: Gospel, old and new.
Performance: Excellent.
Quality: Normal.
Stereo: Normal.

Frank Boggs is a Gospel artist, whose name has appeared from time to time, ever since these Gospel review columns have been in existence. His voice and style is similar, in many ways to that of Bev Shea in his younger days and he will almost certainly appeal to the same listening group.

The program is made up of traditional hymns to traditional settings, traditional hymns to modern settings and Gospel songs of more recent origin: I Have Come From The Darkness – A Quiet Place – I Walked Today Where Jesus Walked – God Leads His Dear Children Along – Jesus The Very Thought Of Thee – Fill My Cup, Lord – Redeemed – How Sweet The Name Of Jesus Sounds – How Tedious And Tasteless The Hour – Where Shall I Run, Lord – Overtones – Others.

Don't worry if some of these titles are unfamiliar. Frank Boggs' diction is excellent and you'll never be in doubt as to the message of the song. (W.N.W.)

★ ★ ★

GOD OF OUR FATHERS. The Mormon Tabernacle Choir, The Philadelphia Brass Ensemble and percussion. Richard Condie, conductor; Alexander Schreiner, organ. Stereo, CBS, SBR-235395.

Interest: Choir plus brass.
Performance: Virtually flawless.
Quality: Very clean.
Stereo: Excellent spread.

For this album, producer Thomas Frost had available the 375 voices of the Mormon Tabernacle Choir, the superb brass and percussion of the Philadelphia Orchestra and the huge 11,000-pipe organ of the Mormon Tabernacle in Salt Lake City.

Fortunately, he was wise enough to use this potential sparingly because only those with cast-iron ears could take too many tracks like "Onward Christian Soldiers", "Bringing In The Sheaves" and "God Of Our Fathers". But, as it is, these tracks merely add dimension to an album which, most of the time, is restrained, even restful. Having regard to the source, it seems almost superfluous to remark that, what the choir seek to do, they do superbly.

Other numbers, not already mentioned, include: Abide With Me – Rock Of Ages – Now The Day Is Over – The Church In The Wildwood – Softly Now The Light Of Day – I Need Thee Every Hour – Ten Thousand Times Ten Thousand – Nearer My God To Thee – Holy, Holy, Holy – God Be With You.

A good one for those who like traditional hymns, modestly embellished. (W.N.W.)

★ ★ ★

OLD TIME RELIGION. Johnny Cash and Jerry Lee Lewis. Stereo, Sun (Festival) SNL-933943.

Interest: Gospel, C&W and beat.
Performance: Okay if you like it.
Quality: Normal.
Stereo: Modest.

Quite a mixture, this one. First of all there are two distinct performers, Johnny Cash on side 1 and Jerry Lee Lewis on side 2. Johnny Cash starts off with a number that is no more devotional than a mention of the Good Lord: "If The Good Lord's Willing". Then he follows with three Gospel numbers "I Was There When It Happened", "Remember Me" and "Belshazar" (their spelling). Unaccountably, he finishes with "Goodnight Irene".

On side 2, Jerry Lee Lewis starts off in rather similar style with "Will The Circle Be Unbroken" but resorts to beat for "Old Time Religion", "Carry Me Back To Old Virginia" and "When The Saints Go Marching In". Then, just as unaccountably, he completes side 2 with a beat version of "Silver Threads", sufficient to set generations of silver-headed old ladies spinning in their graves.

As I said, a queer mixture but then some people may like queer mixtures! (W.N.W.)

★ ★ ★

THE CROSS COUNTRY SINGERS. Garry, Ray and Lindsay, with Ray Myers. Stereo, AAVR, BRC-009S. (Available from AAVR, 87a Mullens St, Balmain, NSW 2041.

Interest: Local C&W Gospel.
Performance: Pleasant, smooth.
Quality: Excellent.
Stereo: Normal

The lead group in this album comprise Gary Abrahams, Ray Barnett and Lindsay Wellings. They have strong support, however, in Ray Myers (piano), David Brainwood (Organ), Ken Kitching (Emmons pedal steel), Eddy McCarthy (drums), The Gospel Heirs (male vocal) and The Kaid Trio (female vocal).

While the original trio may warrant the C&W tag, the group, as here constituted, add up to a much rounder "City" sound. As far as this reviewer is concerned, that is all to the good! In fact, the record should find an appreciative audience from all age groups, with its smooth sound and gentle rhythm.

My guess is that you will not know many of the numbers but this is one of those albums where you'll respond to the melody rather than the words: I Saw The Light – Wings Of A Dove – The One Who Died For Me – Livin' In God's Country – His Hand On My Shoulder – Courage To Care – These Things Shall Pass – The King And I – They Tore The Old Country Church Down – House Of Gold – Pity The Man – Singing On The Mountain. Pleasant group sound and a safe buy. (W.N.W.)

★ ★ ★

AMERICA'S TWELVE FAVOURITE HYMNS. The Blue Ridge Quartet. Stereo, Canaan CAS-9637-LP. (Available from Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)

Interest: As per title.
Performance: Typical male quartet.
Quality: Normal.
Stereo: Two channel sound.

If popularity depended on the choice of numbers, this album could hardly miss. Rather than being the personal selection of an artist or producer, the hymns featured were selected in a poll conducted by the "Christian Herald" magazine. Here they are: How Great Thou Art – The Old Rugged Cross – What A Friend We Have In Jesus – Amazing Grace – In The Garden – Rock Of Ages – Beyond The Sunset – Abide With Me – Whispering Hope – God Will Take Care Of You – Ivory Palaces – Jesus, Saviour, Pilot Me.

The Blue Ridge Quartet gives them a fairly uniform treatment, with backing from group pianist Kenny Gates, organ, a small string orchestra and rhythm string bass. There is the occasional embellishment, solo or monologue but, by and large, it is a fairly conservative presentation suited to the kind of audience which would most appreciate these very well known hymns. One for the older generations. (W.N.W.)

Reviews in this section are by Neville Williams, Harry Tyrer Gil Wahiquist, Philip Pik.

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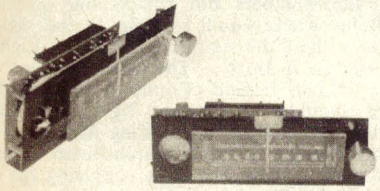
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THE WORLD OF JOHANN STRAUSS. Volume 2. The Vienna Philharmonic Orchestra, conducted by Willi Boskovsky and Hans Knappertsbuch. Stereo, Decca series 259, SPA-73.

Interest: The Vienna of Strauss.
Performance: Fine.
Quality: Excellent.
Stereo: Good.

Unless your record collection is already overloaded with Viennese, you shouldn't miss this one at $2.59. Always easy on the ear, this tuneful, romantic music is played with obvious enjoyment by the well-known Vienna Philharmonic. There are nine tracks in all: Tritsch-Tratsch Polka – Accelerations Waltz – Annen Polka – Radetzky March – Leichtes Blut Polka – Gipsy Baron Overture – Artist's Life Waltz – Neue Pizzicato Polka – Emperor Waltz.

Definition and balance are good and those with loudspeakers having good low-down response will hear some really profound bass, especially in the Radetzky March.

In fact, I listened to this album with simulated quadraphonic, as discussed elsewhere in this issue and it seemed to lend itself particularly well to the treatment. However, this is by no means a pre-requisite to enjoyment of the album. It sounded fine played in normal stereo, as intended. Recommended. (W.N.W.)

★ ★ ★

DANCE OF THE HOURS. Various orchestras and conductors. DGG "Privilege" series, stereo 2539 011/2. (Two disc boxed set.)

Interest: Popular ballet music.
Performance: Pleasant enough.
Quality: Very good throughout.
Stereo: See review.

As is intimated by the title of this two disc set in the DGG "Privilege" series, this is music from the ballet. Side one has a recording of the "Swan Lake" ballet suite, opus 20 played by the National Philharmonic Orchestra of Warsaw, under Witold Rowicki. This was originally issued as a mono only recording in 1962, backed by a similar suite from "The Sleeping Beauty". Despite the "stereo" appellation on the disc label, this is still plainly a mono recording, and no attempt has been made to produce an artificial stereo effect. On this occasion, the backing is the "Firebird" suite, from the Stravinsky ballet, played by the Radio Symphony Orchestra of Berlin, under Lorin Maazel.

The Poles' view of "Swan Lake" emphasises the tragedy of the swans' sad fate, and right from the solemn opening chores given our vibrato by the cellos, one is conscious of this. Although I found this just slightly overbearing, I was also aware of the way the musicians had fully committed themselves to this performance. No superficial approach here, but a deeply felt performance by all concerned.

I personally find the "Firebird" music difficult to enjoy without the complementary contributions of the dancers, since the music and the choreography are so intimately worked out in this work. However, for those who feel differently, this performance by the Berlin Radio musicians is a very valid one, and has been very well recorded. There is no question of the stereo spread here, it is widely and evenly spread.

Music from the Manuel de Falla ballet "The Three Cornered Hat" begins side 1 of the second disc, and I was surprised to find that the selection was not the familiar second suite, but four items from the original score. However, these are the dances from which the No 2 suite was arranged, so the music sounds familiar enough, although different from the more usually recorded suite. This, as well as Falla's "Ritual Fire Dance" which follows, are also played by the Berlin Radio Symphony under Maazel. Once again, the performance satisfies, without calling for any superlatives, and the sound and stereo spread are of the same high standard noted above.

The last side has pleasant enough versions of the waltz from Gounod's "Faust"; Borodin's "Polovtsian Dances" from "Prince Igor"; and finally, the piece from which this set takes its name, Ponchielli's "Dance of the Hours".

At $4.50 a disc, this "Privilege" series cannot be classed as bargain price or budget records, but they do represent excellent value for money. (H.A.T.)

★ ★ ★

THE BIG ONES. Ted Heath and his music. Decca, stereo PFS 4182.

Interest: Hits with a swinging sound.
Performance: Extremely good.
Quality: Likewise.
Stereo: Very effective.

This very recent release by Ted Heath, recorded in Phase 4 Stereo, is once again a reminder of the extremely good quality reproduction obtainable nowadays from discs – certainly a far cry from as little as five years ago. Equally good is the entire performance, arranged on this occasion by Roland Shaw. Each number has retained its original melody, yet Heath has still been able to impress his own flamboyant style on each of the numbers: Spinning Wheel – Light My Fire – (I Can't Get No) Satisfaction – Nights In White Satin – Woman, Woman – Get Back – In The Year 2525 – Don't Ya Hear Me Calling To Ya – Honky Tonk Woman – A Whiter Shade Of Pale – Love Me Tonight.

The instrumentation tends to be a bit on the brassy side, but the sound is not really that of a brass band only, as many instruments such as the guitar, organ etc, are included. Whatever the name for such a combination, the sound is certainly good. (J.P.P.)

★ ★ ★

SPARKLING OVERTURES. Royal Philharmonic Orchestra; Sadler's Wells Orchestra. Conductor, Vilem Tausky. His Master's Voice (EMI) stereo, Series 259, SOELP 9545.

Interest: Operetta overtures.
Performance: Highly competent.
Quality: Satisfactory.
Stereo: Varies.

In assembling this program of overtures from popular operattas, EMI have undoubtedly put the best items first. Side one starts with Johann Strauss's overture to "Die Fledermaus", almost universally regarded as the finest operetta ever written. This is followed by the overture to the second great Strauss success, "The Gipsy Baron". Both are perennial favourites, with their uninterrupted flow of beguiling melodies. Both are played with dash and precision by the Sadler's Wells

Orchestra, a small but highly competent group. The same orchestra plays the next item, from Lehar's "Land of Smiles", which probably rates next to the two Strauss works in popularity. The big tune of the overture is the well-known song "You Are My Heart's Delight", made famous by Richard Tauber.

The rest of the program is played by the Royal Philharmonic Orchestra, a much more substantial body than the Sadler's Wells group, and a very fine body of musicians. Unfortunately, they are given the potboilers to play, and although these contain some quite pleasing melodies, they cannot compare with the pieces mentioned above. The titles are: Le Docteur Miracle (Bizet) – Les Deux Aveugles de Tolede (Mehul) – Fra Diavolo (Auber) – La Poupee de Nuremberg (Adam) – La Vie Parisienne (Offenbach). They are all lighthearted works, and all qualify for the adjective "Sparkling" promised by the disc title. I would place the age of the Sadler's Wells recordings as around the early 1960s, to judge by the clean but unspectacular sound and limited stereo spread. However, the Royal Philharmonic tracks seems to be later; the sound is fuller and the stereo spread much more convincing. (H.A.T.)

★ ★ ★

THESWEETEST SOUNDS. Pepe Jaramillo and his Latin American Rhythm. Columbia Studio 2 Stereo (EMI) Series 259. SOEX 9682.

Interest: Piano and rhythm in LA style.
Performance: Patchy.
Quality: Disappointing.
Stereo: Well defined.

Pepe Jaramillo plus Studio 2 Stereo sounds like a very attractive proposition at $2.59, and will no doubt be regarded as such by those who favour Jaramillo's style of smooth piano playing with bass and percussion backing. However, I did feel that Jaramillo is below his best in some tracks here, and that the recording was not quite up to the excellent standard one normally expects of Studio 2. For one thing, the balance is less than perfect, with the bass rather too prominent, necessitating considerable bass cut for comfortable listening. Also, the piano tone was rather hard and metallic in the middle range. The tracks which made the best impression were "Eso Beso", which is nicely arranged to include some silvery semi-quavers, as well as having a guitar giving a touch of added interest; and "Boa Noite" which flows nicely. The worst was a dreary arrangement of "Lara's Theme".

The other tracks are pleasant enough, comprising: Nicola – Quiet Night of Quiet Stars – Get Out of Town – Guantanamera – Moonlight in Mexico – Love Me With All Your Heart – The Sweetest Sounds – Montego Bay – Meditation – How Insensitive. Reasonable enough for budget record buyers, but those who want the best would do well to consider more recent Jaramillo discs at full price, such as the very appealing "Latin Piano in Japan". (H.A.T.)

★ ★ ★

LATINO DANCING. Roberto Delgado and his Orchestra. Polydor stereo 222003.

Interest: Dancing and listening.
Performance: First class.
Quality: Excellent.
Stereo: Well spread.

After listening to numerous discs of this type I have come to the conclusion that the only thing which distinguishes the run of the mill recording from one which makes



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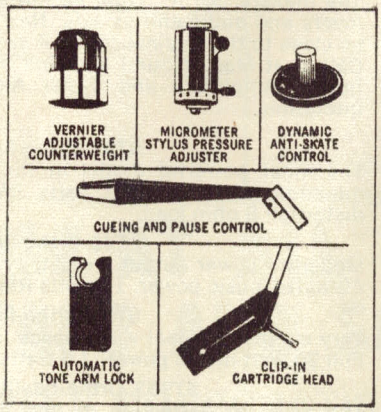
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entertaining listening is the skill of the arranger. Here, there is none of the featureless strings backed by a monotonous rattle of Latin American percussion so often found in dance discs. For a start, there is an unusual line up of instruments, including a Hammond organ, which are skilfully blended into first class arrangements. Then, of course, Roberto Delgardo and his orchestra are specialists who rank among the leading exponents of Latin American dance music. Finally, there is the excellent Polydor recording, renowned for high quality sound. If the titles please, nobody need have any doubts about this one.

Mas Que Nada – This Guy's In Love With You – Soul Limbo – Cuando Sali de Cuba – Acalpulco Zephyr – Batucada – Grazing in the Grass – The Look of Love – Up Cherry Tree – Brazilian Afternoon – Peru – Summer Samba. A disc which is virtually impossible to fault. (H.A.T.)

★ ★ ★

TANGO. Andre Silvano and his Orchestra. Concert Hall, stereo SPS-1302.

Interest: As per title.
Performance: Average.
Quality: Nothing startling.
Stereo: Not very effective.

Tangos have been around for a long time and many musicians have given their interpretations to a wide variety of compositions, past and present. Here Andre Silvano has apparently chosen to present the numbers in a setting of some years ago. Whilst this style is eminently suitable for dancing, to me the more recent interpretations have so much more to offer in terms of life and variety. Tune after tune has the same arrangement, same instrumentation and expression. If you intend to just listen to the record I would be cautious in choosing it, but if dancing to it is what you're after, this record would perhaps not be a bad choice. The numbers are: Poema – Ole Guapa – Jalousie – Mama – Caminto – Una Lagrima Tuva – Une Derniere Fois – Violetta – Adios Muchachos – A Media Luz – Rodrique Pena – La Cumparsita. (J.P.P.)

★ ★ ★

HAWAIIAN NIGHTS. Basil Henriques and his Waikiki Islanders. Columbia Studio 2 Stereo (EMI) SOEX 9692 (Series 259).

Interest: Hawaiian Night Club band.
Performance: Uninspired.
Quality: Very good.
Stereo: Two distinct channels.

I can't get very enthusiastic about this routine recording of popular melodies. The only thing about it which makes it at all different from any second rate performance by any second rate band is the pedal guitar played by Basil Henriques, although I should mention the occasional use of that delicate instrument the celeste, which is growing in popularity. The rest of the line-up comprises piano, vibes, acoustic guitar, string bass and percussion. They play with neither enthusiasm nor conviction. If you like Island style music, our own Rob E. G. sounds much more convincing, and is certainly more enjoyable.

Included in the 12 tracks are such popular numbers as Love Is Blue – The Last Waltz – A Man Without Love – You Go To My Head – Up, Up And Away. The quality of the Studio 2 Stereo recording is entirely satisfactory, but the division of the material into virtually two distinct and separate channels, with virtually no middle, is unusual for this system. (H.A.T.)

THE GOLDEN TRUMPET OF NINI ROSSO. Durium (Festival) stereo SDRL-933929.

Interest: Straight trumpet.
Performance: Stodgy.
Quality: Good standard.
Stereo: Normal.

Nini Rosso is apparently popular in Italy, from whence this disc originates, and this surprises me. I have always regarded the Italians as having considerable discernment in musical matters, who would demand more than Rosso offers, which is slow ballad-type material, requiring little in the way of technique, played in serious, unswinging fashion. His tasteless playing of that delicate melody "Jeux Interdit" should offend the musical susceptibilities of his compatriots – but, as I said, he apparently has his following.

I can only advise those who might be tempted by the title of this disc, and the admittedly popular tunes included in the selection, to ask for a demonstration of a track or two before buying. If what you hear appeals, there is certainly nothing to complain about in either the sound quality or the supporting musicians, who go a long way to make the music sound pleasant. For me, however, Rosso's style has nothing to offer.

Some of the well-known numbers included in the selection are: Jeux Interdit – Manha de Carnaval – More – Theme from "Romeo and Juliet" – Theme from "A Summer Place" – The Shadow Of Your Smile. (H.A.T.)

★ ★ ★

BEACH PARTY. James Last. Polydor, stereo 2371 039.

Interest: James Last.
Performance: Exemplary.
Quality: Polydor's usual.
Stereo: Used with imagination.

This album once again shows the tremendous versatility of James Last. As a composer, arranger, conductor and trumpet player he is to my way of thinking unrivalled in his ability to interpret an extremely wide field of music. He has produced a number of records that are really outstanding in musicianship and, thanks to Polydor, in quality as well. This record is no exception to the extremely good quality this company produces consistently.

This time, Last has tried his hand at beach party music and, with remarkable success. He shows a keen sense for appreciating the mood of each number and has accordingly given them his own interpretation. Each number has a strong vocal lead, balanced by a delicate and light instrumental backing. Despite the singular type of lead, however, he has managed to give the listener quite a variety in presentation of these current and popular numbers:

Cecilia – Once On A Sunday Morning – Blowin' In The Wind – Kumbayah – Everybody Get Together – Happy Brasilia – El Condor Pasa – Washington Square – Proud Mary – John Kanaka – Mademoiselle Ninette – Give Peace A Chance.

Even if you're not yet a James Last fan, sample a few tracks and you might just change your mind. (J.P.P.)

★ ★ ★

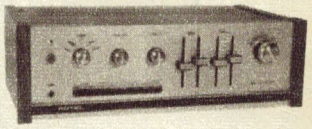
THE ANDY WILLIAMS SHOW. Andy Williams. CBS, stereo SBP 233875.

Interest: Songs from above show.
Performance: Truly his own.
Quality: Mostly good.
Stereo: Surprisingly good.

I don't think there are many people not familiar with the popular "Andy Williams

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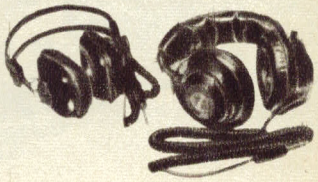
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THE ENCYCLOPEDIA OF THE ORGAN, Vol 3. The Romantic and Symphonic Age (2nd Period), the great romantics – Cesar Franck. Andre Marchal at the Grand Organ of Saint-Eustache, Paris. World Record Club stereo S/4804.

Interest: Organ classics.
Performance: Splendid.
Quality: Expertly recorded.
Stereo: Normal.

This third disc maintains the high standards set by the first two. The organist, the blind Frenchman Andre Marchal, is a worthy collaborator for the great Marie-Claire Alain, and the instrument he plays is a fine example of the great romantic organ, despite a somewhat chequered history. The original organ, with 68 stops, three manuals and two pedal boards was developed from an organ moved from the Abbey of St Germaine-des-Pres. Following the destruction by fire of this instrument, a new organ was installed in 1854, but considerable trouble was experienced in the early years of its life, and several restorations were necessary, the last completed as recently as 1967. Nevertheless it is a very impressive sounding instrument. A full specification, as well as a detailed summary of the stops used throughout the recital, are given in the leaflet accompany the disc.

There is an enormous gap in style between the pre-classical lightweight writing of the seventeenth century composers presented in Vols 1 and 2 in this series, and the large scale cyclic writing of Franck's "Grande Piece Symphonique" which takes up the whole of side two of this recital. This momentous works occupies a special place in the organ literature, as it is recognised as the first organ symphony. As in many of Frank's larger works, it is cyclic, but otherwise it is a product of its period; that is to say, the post-Beethoven era. Serenely beautifully and excitingly vigourous in turn, its appeal is timeless.

The two pieces on side one also have qualities of greatness. First comes the "Fantasy in C Major" which is a three movement work in free sonata form, consisting of (to quote the program notes provided) "an allegretto framed by two andante. The first part of this tryptich is a kind of expressive canon upon which floats the soprano's moving melody. A pastoral dialogue between flute and trumpet forms the centre section of the work . . . the end of the work creates a unique and personal feeling of serenity and rapture". An equally successful work completes the side, the "Prelude, Fugue and Variation". Despite its rather formal title, it is replete with flowing melodies, the cantilena used in the two outer movements being particularly appealing. (H.A.T.)

The "Andy Williams Show" series shown recently on television. So without further ado let me briefly comment on the record itself.

This recording is presumably a selection of numbers presented during a number of shows. Applause and even musical bridges (short pieces of rhythm played between numbers) as well as station breaks have been included. I'm not quite sure that these inclusions will be appreciated by the public at large. For some reason the level at which they have been recorded is very high and especially on the applause this tends to be rather annoying.

Otherwise the recording is of a remarkably good standard and is available in mono and stereo. The numbers (without including the musical bridges, etc) are: They Long To Be Close To You – Joanne – Never My Love – Make It With You – El Condor Pasa – Snowbird – Leaving On A Jet Plane – What Are You Doing The Rest Of Your Life – Spanish Harlem – Hello, Young Lovers. (J.P.P.)

★ ★ ★

THE JIM NABORS HOUR. Tomorrow Never Comes. Arranged and conducted by Paul Weston. Stereo, CBS SBP-233,833.

Interest: Varied vocal program.
Performance: Good, very good.
Quality: Clean, well balanced.
Stereo: Average.

It is some time now since Jim Nabors stepped out of his televison role as an inoffensive, rather comic figure, to reveal himself as a fine vocalist.

From the title, one would assume that the items on this album are from a television or radio show, though "half-hour" would be a more accurate description of the playing time. The titles are pleasantly varied from popular to devotional, from driving rhythm, through sentimental to a big tenor sound. The titles:

Tomorrow Never Comes – Games People Play – Jean – I Can't Help It – You Must Have Faith – You'll Never Walk Alone – A Day In The Life Of A Fool – I Really Don't Want To Know – It's My Life – Take My Hand, Precious Lord – San Francisco.

One I can certainly recommend. (W.N.W.)

★ ★ ★

THE GOLDEN AGE OF SONG, Vol 2. Various artists. His Master's Voice (EMI) mono only, OXLP 7527.

Interest: Voices of the past.
Performance: Famous in their day.
Quality: Generally poor sound.

Here is another collection of famous recordings of the 78rpm era, from the archives of EMI. If you are old enough to remember "Master" Ernest Lough, the boy treble, sing Mendelssohn's "Hear My Prayer" with the famous aria "Oh, For The Wings Of A Dove", you will probably know most, if not all, of these: Paul Robeson and Elizabeth Welch singing "I Still Suits Me" from the first "Showboat" film; Militza Korjus in the Cavatina "Una Voce Poco Fa" from "The Barber of Seville"; Denis Noble in the "Factotum" aria from Rossini's "Barber of Seville"; Oscar Denes with Lizzi Waldmuller singing the delicious laughing duet "Mausie" from "Viktoria and her Hussar"; Anni Frind singing "Nuns' Chorus" from "Casanova"; Richard Tauber in "Il Mio Tesoro" and "Dalla Sua Pace" from Mozart's "Don Giovani"; Erich Kunz in the number which has virtually become his signature tune, "Vienna City of My Dreams".

Some of these recordings are quite old. I would place the oldest as dating from the late 1920s, and the youngest from the late 1930s, with the possible exception of the Eric Kunz number, which sounds as though he

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re-recorded it for an LP disc. I found that for some tracks it was necessary to resort to some savage treble cut to reduce the background noise, but with this taken of, one soon adjusts to the poor quality sound. (H.A.T.)

★ ★ ★

EXCITEMENT. Ron Goodwin and his orchestra. Columbia Studio 2 Stereo (EMI) TWO 318.

Interest: Tunes from the movies.
Performance: Nicely scored, expertly played.
Quality: Excellent.
Stereo: Evenly spread.

Ron Goodwin occupies much the same place in the British film industry as Henry Mancini does in the American one. As composer, arranger and conductor of his own orchestra, his name has appeared in the credits of numerous films. That he is very competent in all three departments can be verified from the selection presented here, which includes the main themes from the following films: 2001: A Space Odyssey – Women in Love – Dr Zhivago – "Z" – Where Eagles Dare – Lawrence of Arabia – The Apartment – Ben Hur – Romeo and Juliet – Battle of Britain. The selection is completed by "Tender is the Night" and Goodwin's arrangement of the traditional English melody "Scarborough Fair", which has become very popular in the Simon and Garfunkle arrangement.

This is all very attractive music, and is expertly arranged and played by Goodwin and his orchestra. The respective arrangements of Mancini and Goodwin make a nice study in contrasts. Whereas Mancini relies heavily on a large string section to provide a lush cushion of sound, Goodwin favours a more balanced orchestra in which the brass particularly are prominent. This makes his performances sound rather more lively and interesting, but in some past performances by this combination I have had to point to a rather too robust treatment of some delicate passages. I am happy to say that no such situation exists here. In summary, an interesting disc, with a well played selection of pleasant tunes. Those who have a particular liking for "Lara's Theme" from the "Dr Zhivago" film may be interested to know that the arrangement here is a close approximation to the original. (H.A.T.)

★ ★ ★

THE LATIN WORLD OF EDMUNDO ROS, Vol 2. Decca (EMI) stereo SPA 71, Series 259.

Interest: LA dance music.
Performance: Expertly done.
Quality: Good standard.
Stereo: Normal.

Those with a taste for Latin American dance music will certainly need no introduction to Edmundo Ros, who is now one of the best known names in this field in the world. He did not acquire this reputation for nothing, and his ability to make his music entertaining listening as well as fine for dancing is well demonstrated in this disc. The selection has evident appeal: Spanish Gypsy Dance – Tico-Tico – Barcarolle – Melodie D'Amour – Desafinado – In a Little Spanish Town – The Wedding Samba – Brazil – Isle of Capri – I Talk to the Trees – One Note Samba – I've Grown Accustomed to Her Face.

The only weak point in Ros's performances, in my opinion, is his tendency to vocalise, and regrettably he demonstrates his limited vocal resources in a number of tracks here. Apart from this (and no doubt there will be many who will not agree with me on this point), the disc is easy to listen to, and should be fine for dancing. Good buying at $2.59. (H.A.T.)

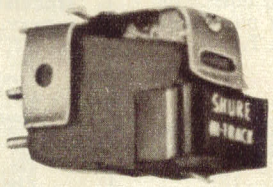
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STRINGS FOR PLEASURE PLAY SIMON AND GARFUNKLE. Music for Pleasure stereo MFP A 8192.
Interest: Simon and Garfunkle hits.
Performance: Fine.
Quality: Good modern sound.
Stereo: Normal.

If you like your pop tunes to be played by the string section of a full scale symphony orchestra, you should have nothing to complain about in this release. The tunes are certainly some of the best from the talented pen of Paul Simon, and they sound surprisingly effective when arranged for string orchestra. The titles are: Mrs Robinson – Scarborough Fair – Leaves that are Green – Feelin' Groovy – At the Zoo – Bridge Over Troubled Waters – The Sound of Silence – The Boxer – April, Come She Will – Homeward Bound – I Am a Rock – El Condor Pasa. Skilfully arranged, and expertly played, they make entertaining listening. The excellent quality of the modern recording makes this $1.99 release that much more attractive. (H.A.T.)

★ ★ ★

STRANGE WORLD. Nina and Frederick. Columbia (EMI) mono OEX 9683.
Interest: Folk singers.
Performance: Exudes charm.
Quality: Good mono sound.

The last Nina and Frederick disc was issued just 12 months ago, and here I use the word "last" in the final sense. Nina has now retired from the entertainment field to take up her real vocation of being Baroness von Eyland in the hereditary castle of the Eylands in Denmark – a role much more suited to her regal dignity. The last I heard of Frederick, he was bent on continuing his entertaining career as a solo act, but he seems to be making little progress in this direction. If he continues with the type of material included in the couple's final disc, in which they sang some incomprehensible lyrics composed by Frederick, I doubt whether we shall hear much more of him.

I was surprised to find this disc with mono sound, since Nina and Frederick have made a number of stereo discs. Presumably these tracks are fairly old ones and, although the sound is clean enough, one does miss the extra dimension that stereo adds. However, it will cost you only $2.59 if you decide to buy it and for this you get the following 12 tracks: Hush Little Baby – Reincarnation – Inch Worm – Hebrew Song – Where Have All the Flowers Gone – Puff The Magic Dragon – One More Parade – Strange World – The Old Maid Song – Tiritomba – Little Boxes – Los Ejes de Mi Carreta. This material is all very typical of that with which the pair made their name in the entertainment world, so if you enjoyed this more than the rather different material they were singing later in their career, I don't believe you will be disappointed. (H.A.T.)

★ ★ ★

A GIRL NAMED SAM. Samantha Jones. Penny Farthing Records (Festival), stereo SPFL-933987.
Interest: A new singer.
Performance: Promising.
Quality: Mostly good.
Stereo: Used tastefully.

A girl named Sam. Certainly an unusual title for any record – let alone a girl. Her full name is Samantha Jones believe it or not. This is her first recording and I must say that I found it a surprisingly good performance in spite of this. What no doubt helped her tremendously was her background training which included working as the girl singer in "Around the World with the Beatles".

Here, she shows considerable potential not only in "straight" singing, but also in the handling of a mixture of songs of varied styling. The tracks that appealed to me most were "You Make Me Feel Like A Natural Woman" and "Until Tomorrow". The remaining numbers are: The Feeling That I Get – Today (Without You) – Taking The Heart Out Of Love – I'll Never Fall In Love Again – I Go To Sleep – Do I Still Figure In Your Life – In The Morning – Come To Me Slowly – Put A Little Love In Your Heart – I'm Sorry But I Think I Love You.

Although not all up to the same standard, I nevertheless think that you won't be disappointed in this first album. (J.P.P.)

★ ★ ★

THAT'S THE WAY IT WAS. John Gary. Stereo, RCA Victor LSP-4233.
Interest: Organised nostalgia.
Performance: Smooth.
Quality: Good.
Stereo: Normal.

While many singers work hard to generate and sustain a youth interest, John Gary has been doing very well, thank you, entertaining their parents in plushy clubs. And it is logical enough that he should turn back the clock to revive some of the numbers from earlier decades, in the style and with the orchestrations of the time. But why drag in 20-second snippets from old recordings and, above all, a segment of King Edward's abdication speech? A reasonable idea for an album is compromised by pointless gimmicks.

However, in between, John Barry sings in his very smooth, very pleasant style: That's The Way It Was – The Good Old Days – Baltimore Oriole – Me And My Bundle – Try A Little Tenderness – Don't Forget – It's A Lonesome Old Town – I Got A Woman – Why Did It End So Soon?

Well enough done but limited appeal. (W.N.W.)

★ ★ ★

CAPITOL'S COUNTRY FESTIVAL. Various artists. Capitol, stereo SENC 9644.
Interest: C & W favourites.
Performance: Impressive overall.
Quality: Fine.
Stereo: Normal.

This one is a sampler and with 14 different tracks each with its own artist it can't but help appeal to almost any C & W fan. To show you exactly what you will be getting, I've listed below all the 14 numbers with the artists.

Gentle On My Mind, Glen Campbell – The Price I Pay To Stay, Jeannie C. Riley – Sixteen Tons, Tennessee Ernie Ford – Orange Blossom Special, The Buckaroes – Since I Met You Baby, Sonny James – Harper Valley PTA, Billie Jo Spears – Big In Vegas, Buck Owens – Okie From Muskogee, Merle Haggard and the Strangers – With Lonely, The Hagers – Right Or Wrong, Wanda Jackson – Wabash Cannon Ball, Hank Thompson – Deck Of Cards, Tex Ritter – Wings Of A Dove, Ferlin Husky – Ode To Billie Joe, Bobbie Gentry.

I have little to add except to say that at $2.59 you couldn't wish for better value. (J.P.P.)

★ ★ ★

THE HOLLIES EVOLUTION. The Hollies. World Record Club, stereo S/4819.
Interest: Pop tunes, Hollies' style.
Performance: Not their best.
Quality: Not very good.
Stereo: Two track mono.

According to the label on the record, the master pressing was made from an original Hollies recording. Perhaps this accounts for

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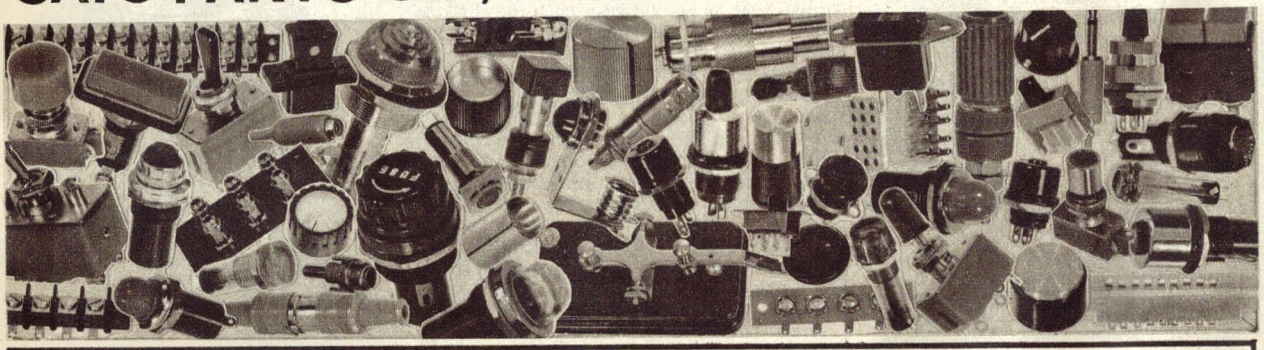


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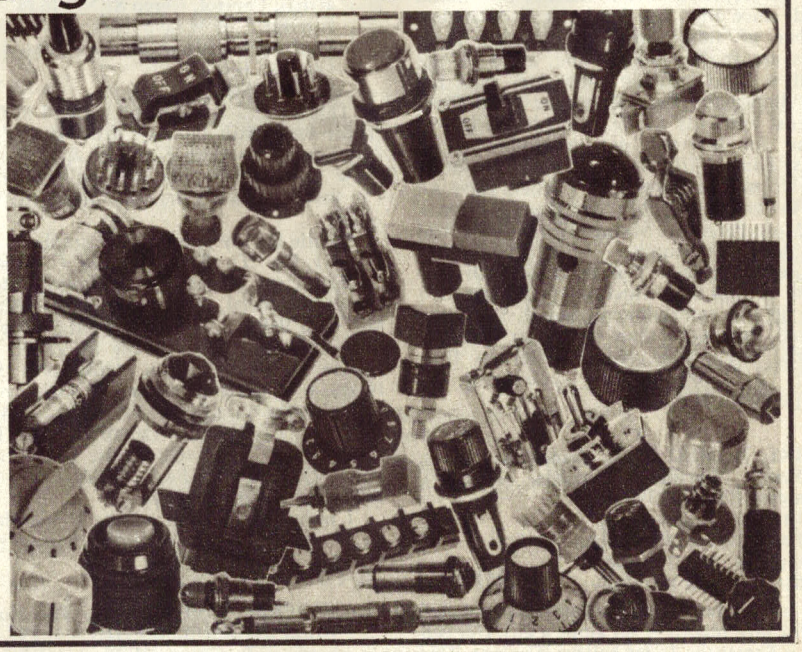
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the rather obvious lack of quality in the sound, a surprising circumstance where World Record Club releases are concerned. I'm afraid that unless you can tolerate a lot of distortion, not just in the instruments, but in the voicing as well, you are going to be disappointed in this new release. Stereo spread is also about non-existent and really should be called "two track mono", for that's just about all it is, with vocals on the right and accompaniment on the left. But if you're happy with just listening to the lyrics you could well enjoy the album's 12 tracks: Then The Heartaches Begin – Stop Right There – Water On The Brain – Lullaby To Tim – Have You Ever Loved Somebody – You Need Love – Rain On The Window – Heading For A Fall – Ye Olde Toffee Shoppe – When Your Light's Turned On – Leave Me – The Games We Play. (J.P.P.)

* * *

THE VENTURES 10TH ANNIVERSARY ALBUM. The Ventures. Two record set. Liberty (Festival) stereo SLY2-102.
Interest: Leading instrumental group.
Performance: One of their best.
Quality: Clean and well-balanced.
Stereo: Effective.

Remember "Walk Don't Run"? It was the public's first introduction to the Ventures and what an introduction it was. It soared to the top of the hit parade in a matter of weeks and stayed there for quite a while. In existence now for 10 years, the group is still just as popular. Perhaps the key to its success lies in its ability to take almost any song or tune and mold it into a fresh and unique instrumental sound. Instrumentation is by no means limited, ranging as it does from electric guitar to violin. Some terrific cymbals work highlights most numbers.

This two record set features 23 tracks in all, mostly from the 70s. I found "Let It Be", "Good Morning Starshine", "Never My Love", "Those Were The Days" and "Blowin' In The Wind" the most outstanding tracks. Space does not permit me to list all 23 tracks, but some of the others are: Spinning Wheel – Delilah – Strangers In The Night – Sweet Caroline – Eleanor Rigby – Michelle and The Sounds Of Silence. Be it just to listen to in solitude, or rock to at a party, the sounds of the Ventures will surely please you. (J.P.P.)

* * *

PAUL ROBESON SINGS. With piano and orchestra. Mono, HMV series 259, OELP-9617.
Interest: Famous basso.
Performance: Characteristic of singer and period.
Quality: Clean but limited range.

Those who remember the golden days of radio, will remember no less the voice of Paul Robeson. And they will remember, too, the songs with which he was identified, even early in his career. This album carries a round dozen of them: Songs My Mother Taught Me – Drink To Me Only – At Dawning – Loch Lomond – Ho! Ho! (The Wagon Song) – Climbing Up (The Mountain Song) – All Through The Night – Congo Lullaby – The Killing Song – Water Boy – Steal Away – Joshua Fit De Battle Of Jericho.

In re-recording these early numbers from the original sources, EMI engineers have managed to sidestep noise and distortion. While the reproduction sounds somewhat dull by modern standards, it is certainly not unpleasant. Musically, one can expect some current interest in both the performer and the performances of the period but I imagine that the main interest in the album will be from those who were young when Robeson was young! (W.N.W.)

JOHN WILLIAMS PLAYS SPANISH MUSIC. John Williams, solo guitar. CBS stereo SBR 235393.
Interest: See title.
Performance: Faultless.
Quality: Some background noise.
Stereo: Hardly matters.

The young Australian guitarist John Williams elects here to give us a program of lighter short pieces by Spanish composers, some of which he has transcribed himself. One of his transcriptions is Albeniz' beautiful "Cordoba", and I was surprised to learn from the sleeve note that, despite the popularity of this delightful melody, it has never previously been transcribed for guitar. On the whole, this recital is sheer delight (the slight reservation arises from the inclusion of the hackneyed "Tango in D", also by Albeniz), and one which every record buyer who favours music in the Spanish idiom should investigate.

The remaining items in the program comprise: Asturias, from "Suite Espanola" (Albeniz) – Canarios (Sanz) – Fandango (Rodrigo) – Nocturno (Torroba) – Waltzes Poeticas (Grandados, transc Williams) – Sonata in D (Mateo Albeniz) – Danse de Corregidor, Millers Dance, from "The Three Cornered Hat" (Falla) – Fisherman's Song (Falla) – Madronos (Torroba) – Two Traditional Catalan Songs, La Nite Nadal and El Noy de la Mare – La Maja de Goya (Granados). John Williams' superb technique is not in the least strained in presenting these pieces, and the degree of expression which he wins from his instrument adds greatly to the listener's enjoyment.

The recorded sound is clean without being exceptional, but to accommodate the very generous program included, the disc has been cut very close to the label, and sound quality deteriorates towards the end of both sides, with a noticeable worsening of signal to noise ratio. (H.A.T.)

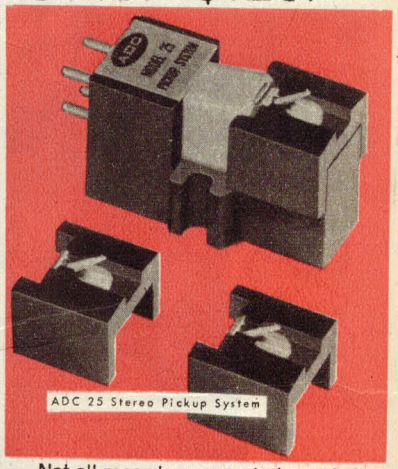
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PIANO MUSIC OF CHOPIN. Adam Harasiewicz and Vladimir Ashkenazy. Heliodor stereo 89 646.
Interest: See title.
Performance: First class.
Quality: Very good.
Stereo: Not significant.

Although the year still has a long way to go I am going to stick my neck out and say that this recording on the low price Heliodor label ($2.50) will be 1971's biggest bargain for Chopin admirers. The two pianists are among the brightest stars from the younger generation of performers, and their playing here is quite superlative. There are none of the disturbing drastic changes of tempo which appears to be the vogue among some players nowadays, nor are there any overdone rubatos. Where rubato is used, it is with discretion and taste. It is also interesting to notice the distinctive styles of the two performers, which make for a study in contrasts. Ashkenazy is all sparkling brilliance with the crispest fingerwork possible and slightly brittle tone. Harasiewicz can play just as fast, and his fingerwork while clean, is slightly less crisp, but his tone is firm and full. Both are great musicians, artistically as well as technically.

The program is a very generous one. The major work in the Harasiewicz recital is the G minor Ballade (an exemplary performance). He also provides a Nocturne, two Mazurkas and one Etude. Ashkenazy offers the F major Ballade (No 2) and the Scherzo No 4 in E, as well as two Etudes and two Mazurkas. Presumably this recording is a few years old, but if so it wears its years very well, with clean sound and good dynamic range. My advice is – don't miss it. (H.A.T.) ■

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MC14/FP

LIBERACE PLAYS THE CLASSICS. Music for Pleasure stereo MFP-A8208.

Interest: Classical snippets.
Performance: With his usual flair.
Quality: Good.
Stereo: Normal.

While recognising that Liberace is not in the same class as Rubinstein, Horowitz and other great classical pianists, one can still appreciate that he is nevertheless a very competent keyboard performer, and that he has given millions of people a great deal of pleasure. Undoubtedly he has introduced a great many listeners to classical melodies which they might not otherwise have appreciated, and in thus broadening their musical horizons has performed them a service.

Here Liberace, with orchestral accompaniment elects to play 11 popular classical melodies, plus the pseudo classic "Intermezzo" from the film "Escape to Happiness". First movement from "Moonlight" Sonata (Beethoven) – Waltz of the Flowers (Tchaikowsky) – To a Wild Rose (MacDowell) – Contentedness (Schumann) – Lullaby (Brahms) – Melodies from "Unfinished" Symphony (Schubert) – The Swan (Saint-Saens) – Chant D'Amour (Stojowski) – Serenade (Schubert) – Andante Cantabile from Symphony No 5 (Tchaikowsky) – Child Falling Asleep (Schumann). The quality which all these pieces has in common is a fine melody, and the disc should give considerable pleasure to those who appreciate Liberace's brand of entertainment. The sound quality is satisfactory, with genuine stereo spread. (H.A.T.)

QUADRAPHONIC SOUND . . .

(continued from page 95.)

different, since the voice coils of the loudspeakers will be above chassis potential. This means that DC blocking capacitors must be connected in series with the additional loudspeaders to avoid creating a DC path between the two channels via the loudspeakers. The method of connection is shown in figure 11. Two 500uF/50VW electrolytic capacitors are connected in series with the additional loudspeakers so that together they form a non-polarised capacitor. There may or may not be a voltage across the network depending on the DC balance between the amplifiers.

If you are not certain as to what configuration is used in your solid state amplifier then you should either check the circuit diagram or measure the DC potential of the loudspeaker voice coils with respect to chassis of the amplifier. If it is zero, then the method of connection shown in figure 9 can be used. If not, use that shown in figure 11.

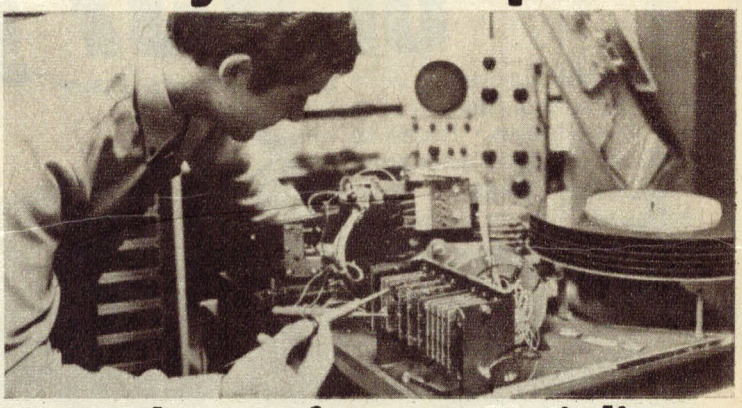
In this diagram, the loudspeaker connections have been marked "A" and "E" to avoid confusion with the voltage polarity markings in the circuit. The "A" (active or positive) end of the voice coil is usually designated with a red or green spot or washer; the "E" (neutral or negative) end is either designated with a black spot or left unmarked. The polarity of the electrolytic capacitors within the amplifier will, of course, depend on the polarity of the supply voltage and whether NPN or PNP output transistors are used.

The polarity of the electrolytic capacitors coupling to the "difference" loudspeakers is strictly not important, provided they are effectively in series, with like polarities together. However, it makes sense to connect them with positive to the amplifier, in the case of a positive supply rail, and negative to the amplifier in the case of a negative supply rail.

Some readers may wonder if the additional loudspeakers will not constitute an excessive load for their amplifier. Whether or not this is the case can be determined simply as follows: In the worst case, where the amplifier channels are delivering completely contrary and out-of-phase signals, the load on each channel will consist of the main loudspeaker and one ambience loudspeaker in parallel. Thus if four 16-ohm loudspeakers are used in a "quad" system the worst load presented to the amplifier will be 8 ohms in each channel. This is a good argument for using ambience loudspeakers with a higher impedance than the main units.

In practice, this effect has been discounted by overseas enthusiasts on the basis that the chance of presenting the amplifier with a catastrophic load condition is relatively remote, especially if ambience loudspeakers with twice the impedance of the main units are used. ■

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TRADE REVIEWS AND RELEASES

New Battery Eliminator from A & R

The A&R group have submitted for review a sample of the most recent addition to their line of Regulated Battery Eliminator supplies. Designated type PS141, it is a simplified and less expensive version of the existing type PS104 supply, and intended to perform a similar role.

As the name suggests, this unit is intended to replace the internal batteries of such equipment as battery operated tape recorders, medium output power amplifiers, record players and transistor radios. It can in fact be used to power any low-voltage equipment which requires a fairly well regulated, hum free supply.

The instrument is fairly compact and measures 4in wide by 2-5/8in high by 5¾in deep. It weighs approximately 2½lbs, the bulk of the weight being contributed by the power transformer. The case is made of 20 gauge steel and should give more than adequate physical protection to the circuitry inside. A matt grey paint finish is applied to all exterior and interior surfaces.

As the supply is intended mainly to replace dry cells, it has accordingly been provided with a number of output voltages, in 1.5 volt increments. The lowest range is 4.5V followed by 6.0V, 7.5V, and 9.0 volts. These are all regulated but an additional unregulated range is also provided, giving a nominal 12 volts under full load. Voltage selection is by means of a selector plug situated on the front panel. The maximum continuous current that can be drawn is 0.5A on all ranges, with a fuse wired in the output lead to provide sustained overload protection. Access to the fuse is also from the front panel, as may be seen from the illustration.

The regulation is specified by the manufacturer in terms of the drop in output voltage from no load to full load. The figures quoted are as follows: Approximately 0.8V drop on the 4.5 and 6.0 volt ranges, 0.5V drop on the 7.5 and 9.0 volts ranges, and 3.5V drop on the unregulated 12 volt range.

Ripple is stated to be less than 0.2% up to the 9 volt range and less than 4% on the unregulated 12 volt range, both figures measured at full load.

The semiconductor devices used are all silicon, the circuit consisting of a simple shunt zener regulator feeding an emitter follower. The various output voltages are obtained by connection of the base of the emitter follower power transistor to the appropriate tap on a voltage divider network placed across the zener diode.

A two pin polarised socket serves as the output connector. Although this type of connector is perhaps not very convenient for laboratory or experimental use, it is certainly safer for domestic use as the risk of accidental shortcircuits is minimised. And the unit is after all intended mainly for the latter type of application.

The layout and construction of the unit leave little to be desired. Especially commendable is the protective sheet of insulating material placed over the power transformer inside the unit. This should prevent accidental contact with the mains terminals on the transformer during any normal servicing.

Tested in our laboratory, the sample unit performed remarkably well. Although no tolerance figures were given for the voltage ranges, we found them all to be within 5% of the nominal value. This should be more than adequate for domestic use and industrial applications. The voltage regulation was found to be well within specification on all ranges.



Compact and conveniently styled, the PS141 provides a range of voltages.

The ripple specifications carried no qualifications as to whether the ripple voltage was to be measured peak-to-peak, as is generally the case, or on an average or RMS basis. As ripple voltages are mostly anything but pure sinusoids they tend to be difficult to evaluate on the latter basis, and for this reason the peak-to-peak value is usually chosen. Using this method, the sample unit did not quite meet its specifications. The ripple we measured was at worst 0.33% at 4.5V falling to 0.22% at 9V. On the unregulated 12 volt range it rose sharply to 10% which is 6% higher than the makers claim, assuming the same method of evaluation was used.

However, considering the application of the supply this result is probably not serious. As the maximum value of the ripple voltage we measured was only 25mV on the 9V range, it should not give rise to any noticeable hum on the output of battery operated equipment connected to the unit. A point to bear in mind also is that the ripple voltage will fall as the load current is decreased. Typically we measured only 5mV at a load current of 50mA. Even for the larger transistor radios this is about the maximum average consumption at normal listening levels.

To sum up, we found the supply an entirely adequate performer considering its intended application. At price of $19.95 retail it should prove an attractive item on the domestic market. We understand that trade discounts are available where applicable.

Further details may be obtained from A&R Electronic Equipment Pty Ltd at 32-46 Lexton Road, Box Hill, Victoria 3128, or from their distributors in each state. (J.P.P.)

Danish Loudspeakers

Do-it-yourself audio enthusiasts should be interested in a new line of loudspeakers from Denmark. Distributed in Australia by International Dynamics (Agencies) Pty Ltd, the "Seas" range of loudspeakers comprises a 21TV-EW 8inch woofer, a 25TV-EW 10inch woofer, and a matching 87H 1½inch dome tweeter.

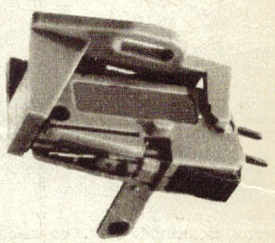
The 10-inch woofer and the tweeter are in fact used in an imported American loudspeaker system, and while it is not often seen in Australia, this system has very high repute overseas. For this reason, it was with much interest that we received the sample units for review. Since we did not have the specifications of the speakers themselves to hand at the time of writing, we have used the abovementioned system as a guide. The power handling capacity of this is quoted as 35 watts, with a crossover frequency of 1500Hz. Frequency response is 47 to 20KHz,±5dB. The enclosure is a ducted port system with heavy damping to control any "lumpiness" in the bass region.

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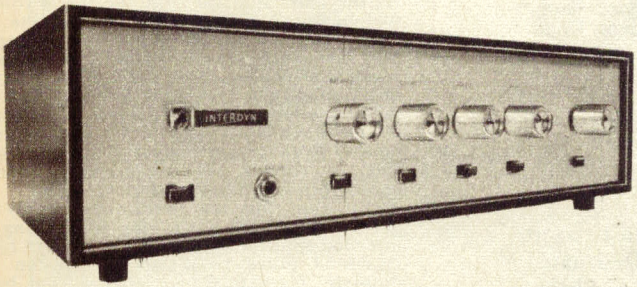


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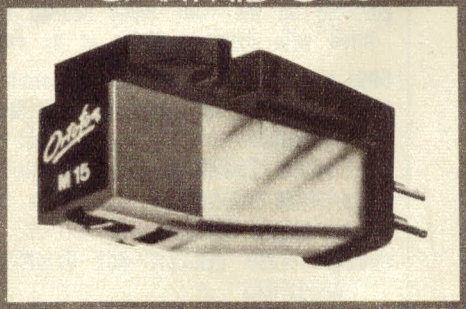
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DANISH LOUDSPEAKERS . . .

with a synthetic rubber roll surround to achieve a very low "free-air" resonance. The chassis is a light but rugged aluminium diecasting. The magnet system is alnico and the voice coil diameter on both models is 1½inches.

The tweeter uses the same magnet system which is in this case attached to a 4-inch diameter anodised aluminium mounting flange. Again, the voice coil diameter is 1½inches. It has no cone to speak of (no pun intended), but instead has a very soft plastic dome attached directly to the voice coil. A diaphragm as small as this approaches the ideal "point source" and this is born out by the excellent high frequency dispersion of the tweeter.

Since the loudspeakers were supplied without enclosures, we decided to mount the 8-inch woofer and tweeter in a 1.3 cubic feet enclosure we had on hand. The enclosure was completely sealed and we "crossed over" to the tweeter via a capacitor at 1500Hz. The enclosure was lightly filled with acoustic absorbent material to lower the "Q" of the system.

On test, with the system coupled to a high power transistor amplifier, the woofer showed up very well at the bass end. Bass was well sustained to about 80Hz, tapering down to 50Hz and then rising to a modest peak at around 40Hz. However the response of the tweeter was not so promising, the output rising steadily from around 3KHz to a peak at 10KHz, and then rolling off rather rapidly.

On music the system sounded very promising, but we were a little unhappy with the mid-range performance. Further development work with a more elaborate cross-over network and perhaps the addition of a mid-range loudspeaker would perhaps bring some really worthwhile results. While we have remarked on the apparent lack of smoothness from the tweeter, this is not really noticeable on music, the excellent dispersion of high frequencies tending to compensate for the tapering response on the extreme highs.

The transient response of the woofer/tweeter combination was outstanding, and as this would predict, the loudspeakers were found to really excel on music with plenty of percussion backing. Efficiency of the system was low, as could be expected from the modest magnet structures, but it could be driven to adequate levels with a typical 10 watt/channel amplifier. On the other hand, power handling was more than adequate. The system handled more than 35 watts on musical peaks, using any normal amount of bass boost.



What our tests did establish, then, was the undoubted potential of these loudspeakers. Time did not permit a listening test for the 10-inch woofer but we would expect a similar performance. International Dynamics have advised us that the loudspeakers are supplied with constructional data for enclosures or alternatively, they are supplying completely finished systems.

Retail price of the loudspeakers including sales tax is as follows: 25TV-EW $29.80; 21TV-EW 8-inch woofer $24.80 and 87H tweeter $19.80. Seas loudspeakers are distributed to high-fidelity retail outlets throughout Australia by International Dynamics (Agencies) Pty Ltd, 4 Duke Street, Abbotsford, Victoria 3067. (L.D.S.)

"Soldavac" De-soldering Tool

A new desoldering tool has recently made its appearance on the Australian scene. It is the "Soldavac", one of a range of soldering tools made by Edsyn Inc, of California. The sample unit pictured has been submitted to us for review by Associated Services Pty Ltd, of 110 Tynte Street, North Adelaide, South Australia 5006.

With the advent of the printed wiring board, which is becoming ever smaller and being fitted with more complex devices as time goes on, the problem of unsoldering items from these boards has become a major one. The main objective is to remove as much of the solder from the joints as possible, so that removal of the item may be effected.

From time to time, a new device appears on the market, with the specific purpose of helping to unsolder joints. These have been successful in varying degrees. The latest addition to this range is the Soldavac.

Some of the claims made for the Soldavac are: It is made of shatter-proof plastic material. The replaceable tip is made of teflon or similar temperature resistant material. It is designed for one hand operation and is easy to use.

An inspection of the tool reveals that it consists essentially of a barrel about 6in long and 7/8in diameter, with a tip assembly at one end. A spring-loaded plunger is fitted inside the barrel. A short arm is attached to the plunger, whereby the tool may be "loaded", by compressing the spring and engaging a catch. A lever on the body is depressed at the required moment, releasing the catch and the spring fires the plunger back to its neutral position. The movement of the plunger tends to create a vacuum behind it, thus causing a strong suction via the small tip.



Two curved mouldings, one on each side of the barrel, fit the fingers and give the requisite degree of control over the tool.

The Soldavac may be readily and easily dismantled for cleaning and servicing. Full details for these and other operations are given in a booklet supplied with the tool.

On test, we found that after just a minute or two of practice the tool was easy and convenient to use. Perhaps more important, it did the job of sucking off the molten solder in a satisfactory manner. It should be pointed out that as with other such devices, the tip has an internal diameter of only about 1/8in.

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DESOLDERING TOOL . . .

so that only a small area can be covered at a time. It is sometimes necessary to have more than one attempt at a particular area, to clear it properly.

We found that some of the solder formed a lining inside the tip after only a few operations. This is partially ejected, by a thin shaft protruding from the plunger, when next the tool is loaded. The piece of solder is then easily removed with the fingers. But apart from the solder removal just outlined it is necessary to go through a routine cleaning procedure at regular intervals. For this purpose, the tip assembly is removed, after the tool has been loaded. A brush is then used to clean out the solder from within the chamber.

Even this cleaning process is not sufficient on a long term basis, some solder being left inside. For a thorough cleaning, it is necessary to dismantle the tool completely. The component parts are then carefully cleaned before reassembly.

We would be the first to admit that the problem of desoldering is not an easy one to solve. At the same time. we feel bound to comment that despite the Soldavac, the problem has not yet been completely solved. While this tool does the job intended for it, we found the more detailed cleaning routine in particular, to be very tedious and time consuming. Possibly some careful thought and practice on the part of the user would reduce this chore to a minimum, but it would still be necessary.

Another point which we noticed is that slivers of solder tend to get mixed up with, and embedded in the "vital parts" of the unit. It would appear that the sealing washer on the plunger is replaceable, and could thus be changed when it becomes unuseable. However this would not prevent the interior of the barrel from gradually becoming scored, and thus reducing the effectiveness of the unit.

In spite of this criticism, it is still likely that the tool may be found worthwhile in development laboraties and particularly in the kits of service technicians. Private persons who do a lot of building and experimenting should also find the Soldavac useful.

The price is quoted at $6.75, free of sales tax. Further inquiries may be directed to Associated Services Pty Ltd, 110 Tynte Street, North Adelaide, South Australia 5006. (I.L.P.)

New Series of Switches from MSP

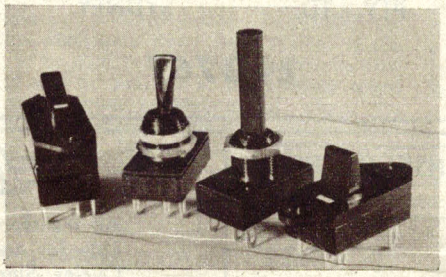
A new range of moulded switches has been announced by Manufacturers Special Products Pty Ltd. Designated the "625" series, the switches are intended for both mains and low level applications.

Four different styles are available in the 625 series, namely the rocker (code 625RK), toggle (625TG), rotary (625RT) and slider (625SL). Models in each style provide the configurations SPST, SPDT, DPST, and DPDT.

All models have silver plated contacts, and are suitable for low level signal use as well as for mains power switching. Ratings at 250V AC are 5A for resistive loads, and 3A for inductive loads with a nominal power factor up to 0.75. Ratings for DC with a resistive load are 0.5A at 250V, and 5A at 12V. Maximum switch-on surge current rating is 40A at 350V peak.

The 625 series has been designed and developed in Australia. The switch bodies and rotary style spindle are moulded from glass reinforced nylon, while the actuators for the toggle, slide and rocker styles are acetal resin. Ultrasonic welding is used to ensure high reliability of the switches under high humidity and high temperature conditions.

Solder lug terminals are standard on the



switches currently available, but quick connect lugs will be available shortly. Nominal size of the switches is 1.062in x 0.625in x 0.671in (rocker 1.031in deep). exclusive of actuators and rotary spindle.

All styles are now available ex stock, at competitive prices. Inquiries should be directed to MSP at 47 York Street, Sydney, or offices in other states.

Multi-purpose Liquid Adhesive

A new, one-component liquid adhesive that bonds rubber, metals, plastic, wood, glass, porcelain and many other materials in a few seconds, is now available from Industrial and Medical Electronic Company.

Called Permabond, the new adhesive is a compound of alpha-cyanoacrylate monomer. Permabond is colourless, transparent and impervious to most chemicals, weather and temperatures. It is ready to use without catalysts, heat, mixing or solvents, being applied with merely the pressure of a finger.

Permabond flows very easily into crevices, and bonds with great strength. It is claimed to be very economical, because it need be applied to only one surface, and one drop covers a full square inch. About 30,000 one-drop applications are available from a pound of the adhesive, at less than one-fourth cent per application.

Largely because it does not require heat or solvent evaporation for polymerisation, Permabond is virtually shrink-free. It conforms to Military Specification MIL A-4050B issued Oct 20, 1969.

Typical electronic applications include bonding polycarbonate to polycarbonate in a current converter; fibre to phenolic in a circuit breaker; copper to rubber and iron to brass in miniature motors; nickel plated brass to rubber and to the same brass material in the pickup arm of stereophonic record players; bonding PVC to PVC and polystyrene to iron in headphone; brass to iron in a tape recorder head; polystyrene to polystyrene and rubber, as well as aluminum to rubber and brass, in a tape recorder transport. In a variety of miniaturised parts, this adhesive easily fills tiny spaces.

A product of Permabond International, of New York, Permabond is available in Australia from Industrial and Medical Electronic Co, of 6th floor, 288 Little Collins Street, Melbourne.

NOW ENCEL OFFERS BETTER SOUND FOR LESS COST WITH NEW 'SEAS' SPEAKERS

Australian enthusiasts have snapped up earlier shipments of famous "SEAS" speakers so fast that Encel is now extending the range. Many more types will soon be available. "SEAS" offer sound quality that no other speakers at a similar low price can match!

JUST ARRIVED
"SEAS" Model 21TV-GD
An 8½" dual cone unit. Wide frequency range from 40-18000 Hz 8 ohm impedance, 16 watts power handling.
Encel Price $10.50.

"SEAS" Model 25TV-ED
A 10" dual cone unit with frequency range from 25-15000 Hz. 8 ohm impedance, 20 watts power handling. **Encel Price $12.50.**

"SEAS" Model 30TV-Coax
A 12" co-axial, wide range (30-20,000 Hz) speaker. 8 ohm impedance, 24 watts power handling.
Encel Price $34.80.

OTHER WANTED "SEAS" SPEAKERS. Model 21TV-EW
An 8½" "woofer" of exceptional response Frequency range 35-2000Hz. Impedance 8 or 15 ohms, 30 watts power handling.
Encel Price $24.80.

MODEL 25TV-EW
A 10" "woofer" with frequency range 30-1500Hz Impedance 8 ohms, 30 watts power handling.
Encel Price 29.80.

MODEL 87H
(Dome Tweeter) High Loading, low distortion speaker with frequency range 1,500-20,000Hz. Impedence 4 to 8 ohms 35 watts power handling, with crossover network.
Encel Price 19.80.
Note: All prices quoted include Sales Tax.

EE110C

■ AUSTRALIA'S GREATEST HI-FI CENTRES

ENCEL ELECTRONICS PTY.LTD.

MELBOURNE: 431 BRIDGE ROAD, RICHMOND, VICTORIA. 3121. TEL: 42 3762.
SYDNEY: 257 CLARENCE STREET, SYDNEY, N.S.W. 2000. TEL: 29 4563, 29 4564.

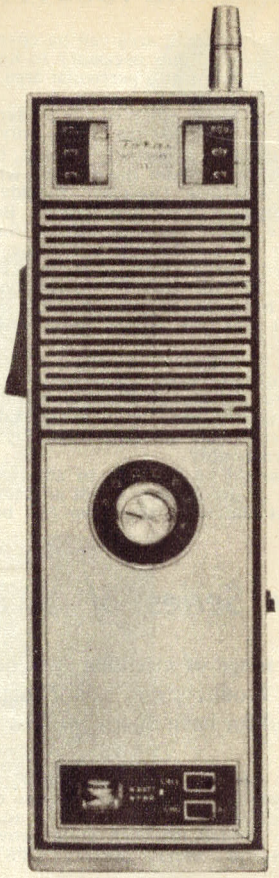
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POWER +

WALKIE TALKIE by TOKAI

5 WATT HAND HELD BASE STATION

with call tone, battery saver, squelch, etc.



We specialise in repairs for all brands of transceivers.
Or we'll trade your old sets on new ones.
There's always a selection of used equipment to choose from.

PETER SHALLEY ELECTRONICS PTY. LTD. 127 YORK ST. SYDNEY

29 7021 **29 3767**

STEP DOWN TRANSFORMERS.

SECONDARY VOLTS	TYPE NO.	RATING DIMENSIONS V.A.	AMPS	H.	W.	L.	WEIGHT LBS.
FUSEMASTER RANGE – Enclosed In Steel Cases							
6	TS6 60B	60	10	5	3¹⁄₈	7	6¹⁄₂ lb.
12	TS12 12B	12	1	2¹⁄₈	2¹⁄₈	5¹⁄₈	2 lb.
12	TS12 30B	30	2.5	4¹⁄₂	3	6	4 lb.
12	TS12 60B	60	5	5	3¹⁄₈	7	6¹⁄₂ lb.
12	TS12 125B	125	10.42	5¹⁄₄	4¹⁄₄	9	11³⁄₄ lb.
24	TS24 30B	30	1.25	4¹⁄₂	3	6	4 lb.
24	TS24 60B	60	2.5	5	3⁵⁄₈	7	6¹⁄₂ lb.
24	TS24 125B	125	5.2	5¹⁄₄	4¹⁄₄	9	11¹⁄₄ lb.
24	TS24 200B	200	8.33	5¹⁄₄	4¹⁄₄	9	14¹⁄₂ lb.
32	TS32 30B	30	.94	4¹⁄₂	3	6	4 lb.
32	TS32 60B	60	1.88	5	3¹⁄₈	7	6¹⁄₂ lb.
32	TS32 125B	125	3.9	5¹⁄₄	4¹⁄₄	9	11³⁄₄ lb.
32	TS32 200B	200	6.25	5¹⁄₄	4¹⁄₄	9	14¹⁄₂ lb.
32	TS32 300B	300	9.4	5¹⁄₄	4¹⁄₄	9	18 lb.
32	TS32 500A	500	15.6	6¹⁄₄	5¹⁄₄	6¹⁄₂	26 lb.
32	TS32 750A	750	23.44	8¹⁄₄	6¹⁄₄	8¹⁄₄	38 lb.
32	TS32 1000A	1000	31.35	8¹⁄₄	6¹⁄₄	8¹⁄₄	51¹⁄₂ lb.
115	TS115 30B	30	.26	4¹⁄₂	3	6	4 lb.
115	TS115 60B	60	.52	5	3¹⁄₈	7	6¹⁄₂ lb.
115	TS115 125B	125	1.09	5¹⁄₄	4¹⁄₄	9	11³⁄₄ lb.
115	TS115 200B	200	1.74	5¹⁄₄	4¹⁄₄	9	14¹⁄₂ lb.
115	TS115 300B	300	2.61	5¹⁄₄	4¹⁄₄	9	18 lb.
115	TS115 500A	500	4.35	6¹⁄₄	5¹⁄₄	6¹⁄₂	26 lb.
115	TS115 750A	750	6.53	8¹⁄₄	6¹⁄₄	8¹⁄₄	38 lb.
115	TS115 1000A	1000	8.7	8¹⁄₄	6¹⁄₄	8¹⁄₄	51¹⁄₂ lb.
115	TS115 2000A	2000	17.4	10¹⁄₂	8¹⁄₄	8¹⁄₄	79 lb.
SOLDERING IRON TRANSFORMERS – Enclosed in pressed steel cover – suitable for Mica or Oryx Soldering Irons.							
5, 6, 7,	TS7 20	20	2.85	3¹⁄₈	2¹⁄₈	2¹⁄₄	2¹⁄₂
10, 11, 12,	TS12 40	40	3.33	3¹⁄₈	2¹⁄₈	3¹⁄₄	3¹⁄₂

FERGUSON

All transformers in this range are suitable for connecting to a 240 volts, 50 Cycles, Single phase supply and, where applicable, comply with Australian Standard C126 - 1950 under approved Number N158.

FUSEMASTER RANGE:—

All transformers housed in steel cases ("A" and "B") fall into the above category.

A TYPE

- Fuse protection of output
- Three core primary Flex 6'6" long
- Conduit or grommet knockouts
- Primary and Secondary Terminal Blocks
- Carrying handle
- Provision for wall mounting
- Two outlets provided on 125W rating and over.

B TYPE

- Fuse protection of output
- Three core primary Flex 6'6" long
- Carrying Handle
- Provision for wall mounting

Available from recognised electrical wholesalers

FERGUSON TRANSFORMERS PTY. LTD.

331 HIGH STREET, CHATSWOOD, N.S.W. • P.O. BOX 301, CHATSWOOD, 2067.
TELEPHONE 40-0261 (8 LINES) • TELEGRAMS: "FERTRAN."

TRADE RELEASES — in brief

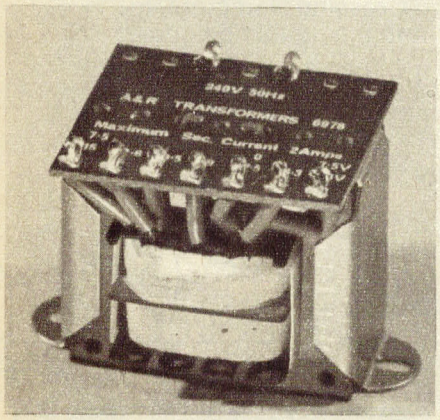
TECNICO ELECTRONICS, a division of Pye Industries, PO Box 12, Marrickville, NSW 2204. Agent for Princeton Applied Research Corp, USA. **Polarographic analyser,** model 174. Using the latest ICs and new packaging concepts, this multi-purpose instrument brings the techniques of pulse, differential pulse, and current-sampled polarography within the reach of every laboratory. It has sensitivities for metals in the 10- molar range and comparable sensitivities for organic systems. Features include: 80V potentiostat for three electrode operation: current sensitivities as high as 20nA full scale: variable pulse amplitude for differential pulse polarography; scan rates from 0.1 to 500mV/sec; plug-in circuit boards for quick, easy service.

DC INDUSTRIES PTY LTD, 32 Smith Street, Collingwood, Vic 3066. Agent for Techni-Rite Electronics. **Single channel recorder building block,** model TMD, for installation in a portable instrument where shallow depth and horizontal chart travel are required. Original equipment manufacturers can purchase these building blocks to install in their own equipment rather than develop a recording apparatus to their own design. The TMD-50 features: the same pen and motor amplifier as used in Techni-Rite recorders; two paper speeds, 25 and 50mm/sec; standard 150ft long chart. The only separately furnished item, standard with each TMD-50, is a transformer for stylus heat and amplifier power.

RUTHERFORD ELECTRONICS PTY LTD, PO Box 30, North Balwyn, Vic 3104. Agent for National Semiconductor Corp, USA. **Zener diode,** type LM113, provides a temperature compensated reference at 1.22V (typical). Packaged in a two-lead TO-46 package, the diode is synthesised using transistors and resistors in a monolithic integrated circuit. It has the same low noise and long term stability as modern IC op amps. Features: low dynamic impedance, breakdown voltage changes 6mV for current change from 0.5mA to 20mA; temperature range from -55 to +125 C; voltage drift typically 0.1%C; standard tolerance is 5%, with 2% and 1% available on special order.

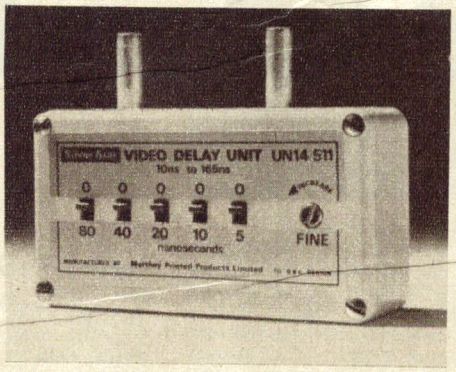
Step-down Transformer

A&R TRANSFORMERS PTY LTD, PO Box 170, Box Hill, Vic 3128, have released a new addition to their range of small step-down transformers. Designated type



PT6978, the unit is provided with six voltage taps, giving 15V – 12.6V – 10.5V – 9.0V – 7.5V – 6.3V. The current rating on all taps is 2 amps max. The transformer measures 2½in high by 2-5/16in long by 3-9/16in wide and weighs approximately 2lbs. Price quoted is $4.44 plus tax where applicable. Further inquiries should be directed to the above address or to any of the company's state distributors.

MATTHEY GARRETT PTY LTD, 160 Rocky Point Road, Kogarah, NSW 2217. Agents for Matthey Printed Products Ltd, UK. **Silver Star variable delay line unit,** model UN14/511. This addition to the Matthey range of 75-ohm equalised delay line modules, designed to a BBC specification, offers rapid and accurate selection of any delay time from



10nS to 165nS. One application of the unit is in colour television mixing equipment when it is necessary to reset temporarily the fine trim of delays in signal trains going to the mixer. The unit measures 4½ x 2½ x 1¼in, and is fitted with MUSA plugs.

LEVIANT INTERNATIONAL INC, 641 Lexington Avenue, New York, NY 10022, USA. **Electroless tin solution.** Claimed to reduce the cost of tin plating printed circuits, the solution does not require mixing, has unlimited shelf life and stability, and will plate 5 to 10 millionths of an inch bright tin at room temperature, 75 F. At higher temperatures, 165 to 175 F, the rate of deposition is 0.004 to 0.006in per hour. The material plates selectively on copper and copper alloys only. It will not plate on gold or silver contact points, eliminating the need for masking.

McMURDO (AUSTRALIA) PTY LTD, PO Box 312, Clayton, Vic 3168. Agent for International Electronic Research Corp, USA. **Heat dissipators,** for TO-8 style ICs having diameters up to 0.55in. The base, or dissipator, accepts square or circular IC lead patterns to 0.4in, and the clamp portion of the assembly is available with a 0.515in or 0.562in diameter hole. In natural convection, 8W may be dissipated for a 70 C case temperature rise. In forced air systems, 100ft/min air flow allows the IC to be operated at 13W with the same 70 C case rise. The IC would dissipate only about 1W for this temperature rise without a dissipator. Standard dissipators and clamps are made of black anodised aluminium. Other finishes are available.

CMC ELECTRONICS, a division of Cambridge Marketing Corp, 150 Wells Avenue, Newton, Mass 02159, USA. **Photoelectric control** model Phopac 101. The first of a line of low cost, high performance, self-contained photoelectric control devices, the Phopac 101 responds to the making or breaking of a light beam. It can start, stop or change the direction of material flow or product handling without physical contact by means of isolated 2A contacts. Range is 12ft with a bare 20W bulb. Features include: mechanical life of 10 million cycles, cycling at a rate of up to 1200 counts a minute; insensitive to stray light, the acceptance zone is a 5 maximum cone starting from a ½in diameter lens; all-silicon solid state unit; operates from line voltage 105 to 270V AC 50/6Hz, and at temperatures from -5 to 140 °F.

SOLARTRON ELECTRONIC GROUP LTD has announced that the Australian branch of the group has been replaced by the autonomous company, Schlumberger Instrumentation Australia Pty Ltd, from February 1, 1971. The company represents

CASSETTE SALE

Made by Audio Magnetics U.S.A.

Fit all compact cassette recorders — Philips, Sony, National, Sharp, etc. Less than wholesale.

C.60, 99 cents; C.90, $1.65; C.120, $2.25. Post 10c.

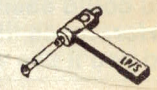


At last, direct from America, the unique cassette head cleaner. Removes deposits from the recording head with a non-abrasive polishing action. Fits all compact cassette recorders and playback units.

$1.50

DIAMOND STYLII

Single ... $3.00
Double .. $4.00



1 Diamond, 1 Sapphire

Send your old stylus or make and numbers for correct replacement.

RAY-O-VAC BATTERIES

Fresh stock less than half price.



	List	Price
509	1.20	50 cents
2364	1.50	50 cents
276P	1.50	50 cents
2362	1.15	35 cents
216	.60	15 cents

RADIO MART

338 PITT ST.,
SYDNEY, N.S.W.
BOX 4913, G.P.O. 2001

There's something amazing about our new $7.50 operational amplifier:

It only costs $2.35

New from Fairchild for April.
The µA777 precision operational amplifier.
You could easily pay $7.50 for an op-amp. with performance like this. Check the comparison chart and you'll see what we mean.

Typical Performance Figures			
	µA777C	µA725C	Units
Input Offset Voltage Drift	4	.6	µV/°C
Input Offset Current Drift	10	10	pA/°C
Price — 100 up	$2.35	$7.50	

The µA777 provides long term thermal stability for less than one-third the price of comparable I.C's.

You also get low offset voltage and offset current. Low input bias current. Low input noise voltage. And large common mode and differential voltage ranges. All for the 100 up price of only $2.35.
The low, low price of the µA777 is typical of the newly priced range of Fairchild Linear I.C's.
A range that includes general purpose and operational amplifiers, products for professional and instrumentation applications and special function devices like the Zero Crossing Detectors, the Voltage Regulators and the double balanced modulators.
Ask for the new price list. It shows all of the products and the new low prices. And, of course, there's tons of data.
In beautiful Fairchild green.

FAIRCHILD APRIL

★ ★

Melbourne 723 4131, Sydney 439 7508, Adelaide 37 7723, Auckland N.Z. 57 9307. **DISTRIBUTORS** Melbourne — Radio Parts Group 329 7888, J. H. McGrath & Co. Pty. Ltd. 663 3731, Sydney — George Brown & Co. Pty. Ltd. 29 7031, Brisbane — Douglas Electronics Pty. Ltd. 97 8222, Perth — Precision Electronics Pty. Ltd. 81 4900, Adelaide — General Accessories Pty. Ltd. 23 4022, Auckland N.Z. — John Gilbert & Co. Pty. Ltd. 3 0839.

FAIRCHILD
AUSTRALIA PTY. LTD.
420 Mt. Dandenong Rd.
CROYDON, VIC. 3136

FC.1585

NEW MOTOROLA SEMICONDUCTORS

Several semiconductor devices developed recently in the USA by Motorola Semiconductor Products Inc are now available in Australia through Motorola Semiconductor Products, Suite 204, 37-43 Alexander Street, Crows Nest, NSW 2065.

"Button" silicon rectifiers, MR751 series. These are 6A silicon rectifiers in a plastic, axial-lead case and provided in four working peak reverse voltage ratings — 100, 200, 400, and 600V. They are primarily intended for low and medium current applications with conventional printed circuit board mounting. With economical heat-sinking techniques, 10 to 25A applications can be handled by these rectifiers. Features include: forward voltage drop 0.9V (max); reverse current 0.25mA (max) at rated DC voltage; inrush surge current capacity 400A.

Stripline Functional Circuits. These circuits, now totalling 20 devices, provide common circuit functions not economically implemented using discrete transistors, yet simpler than complex integrated circuits. Essential to the low prices is the use of a copper lead frame like the Motorola TO-92 strip, permitting assembly and encapsulation on the stripline facility. The functional circuits are supplied in low-profile plastic packages designed to use minimum printed circuit board area but with maximum pin spacing for easy, reliable soldering. The 4, 6, 8 or 9-lead cases can be installed using automatic insertion equipment. The range includes flip-flops, voltage regulators, general purpose and audio amplifiers, and an electronic attenuator.

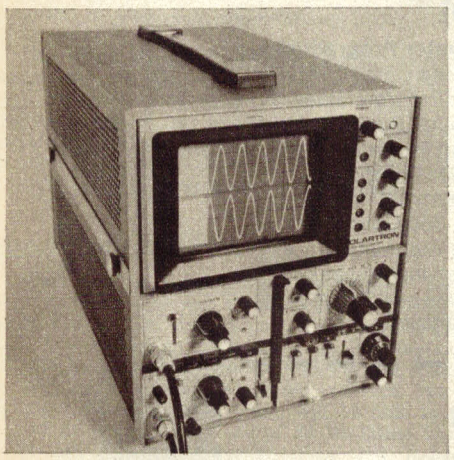
Dual-gate MOSFETS, type MPF120-122. These are low-cost, plastic flat-pack cased devices intended for high-performance amplifier/mixer applications in communications equipment, IF strips, and colour demodulators. The MPF120 is an RF amplifier to 105MHz with two separate channels. The MPF121 is a VHF amplifier to 200MHz, and the MPF122 is a mixer with guaranteed performance at 104 and 244MHz. They feature efficient AGC control, low cross modulation distortion, low feedback capacitance, high power gain, and gate diode protection.

Plastic SCR family. This family of plastic SCRs has a 0.9A current rating at various working voltages and three temperature ranges. The MCR101-104 group operate over the −65 to +85 degrees C temperature with reverse voltage ratings from 15 to 100V. They are suitable for high-volume lamp and relay drivers, small motor control, large thyristor gate drivers, and sensing/detection applications. The slightly higher priced MCR115 and 120 units are rated at 150V and 200V respectively and operate up to 110 degrees C. The 2N5060-64 series offers −65 to +125 degrees C operation, reverse voltage ratings from 30V to 200V, 50uA reverse and forward blocking currents, and 200uA gate trigger current.

---

the following members of the Schlumberger group: Solartron, UK; Schlumberger GMBH, West Germany; Societe d'Instrumentation Schlumberger, France? Compagnie de Compteur, France; Weston Instruments, USA; Weston Archbald, USA; Exatest, West Germany; Daystrom, UK; Schlumberger Products (Heathk).

Among the latest instruments available from Schlumberger Instrumentation Aust is the Solartron CD 1740 oscilloscope. This is a



compact, portable, high-quality oscilloscope which incorporates all solid-state circuits, including FET input stages, glass fibre printed circuit boards, and a protected power supply. Other features are: display 80 x 100mm with internal graticule; bandwidth from DC to 50MHz at 5mV/cm dual trace, with 7nS risetime and 30nS visible signal delay; dual time bases with 10 operating modes; fully automatic triggering over full bandwidth with bright baseline under no-signal conditions; tracefinder button is incorporated. The instrument measures 267 x 223 x 409mm, weighs 12.5Kg, and is supplied complete with a moulded front panel cover and a waterproof dust cover.

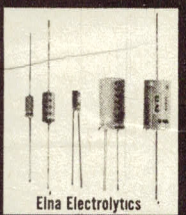
INBUCON (AUST) PTY LTD, 122 Arthur Street, North Sydney, NSW 2060, has announced the appointment of Dr John A. Ovenstone as managing director. Dr Ovenstone was previously professor of computer science and director of the computing centre at the University of Adelaide from 1964 to January this year. He has also provided part-time services as a management and special consultant to various government and industrial organisations. He holds a Bachelor of Science degree, with first-class honours in mathematical physics, from the University of Sydney, and is a Doctor of Philosophy in mathematics (Cambridge). He is a fellow of the Australian Computer Society, a member of the Australian Mathematical Society, and a member of the Operations Research Society of South Australia. Inbucon (Australia) is a member company of the international group of management consultancy and services companies.

HEWLETT-PACKARD AUSTRALIA PTY LTD, 22-26 Weir Street, Glen Iris, Vic 3146, has announced the opening of a Brisbane sales office at 75 Simpsons Road, Bardon, Qld 4065. The manager is Mr Paul Dunn and the telephone number is 36 5411. The company has also announced the following staff changes: Mr Jim Creed to the newly created position of electronic product sales manager from southern district manager; Mr Michael Muller to analytical product sales manager from a product specialist appointment; Mr Bill Thomas as calculatory DMI sales manager from northern district field engineer.

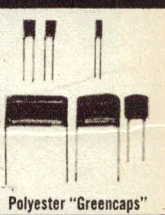
GEC-ELLIOTT AUTOMATION PTY LTD, 15 Whiting Street, Artarmon, NSW 2064, is marketing the English Electric Valve Company's range of electronic tubes in Australia on an exclusive basis since January 1, 1971. The following product range is now available: TV camera tubes; power grid tubes for communications and broadcasting; industrial rectifier and oscillator tubes; radar tubes, including magnetrons, klystrons, hydrogen thyratorons, duplex devices, and display tubes; cathode-ray tubes for professional and instrument use; travelling wave tubes. ■

SOANAR ELECTRONICS

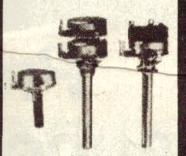
For Your Every Component Need



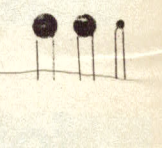
Elna Electrolytics



Polyester "Greencaps"



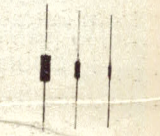
Noble Potentiometers



TYK Ceramic Discs



ITT Diodes and Rectifiers



Fox Resistors

New 1971 20 page catalogue available

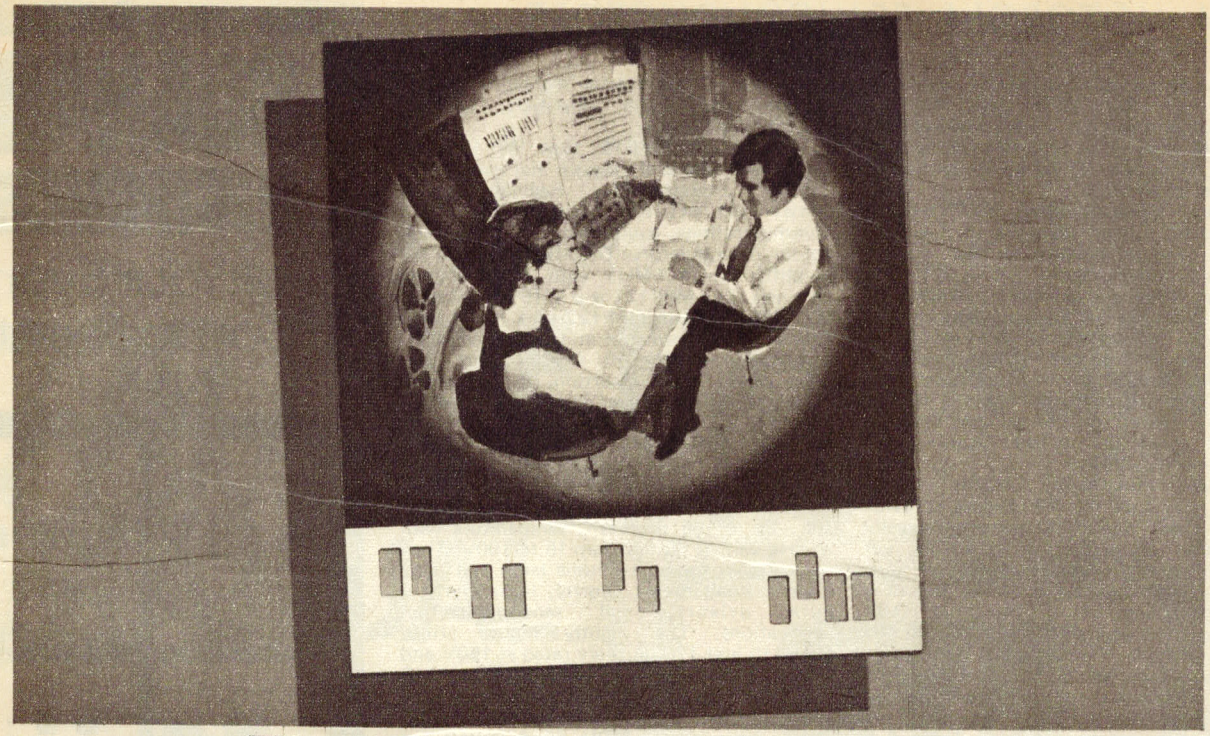
SOANAR ELECTRONICS Pty. Ltd.

SOANAR GROUP

SALES OFFICES
VIC.: 30-32 Lexton Rd., Box Hill 89 0238.
NSW: 82 Carlton Cr., Summer Hill. 798 6999.
SA: 470 Morphett St., Adelaide. 51 6981.

INTERSTATE AGENTS
QLD: R. A. Venn Pty. Ltd., Valley. 51 5421.
WA: Everett Agency Pty. Ltd., West Leederville. 8 4137.

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Industrial Electronics
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TECHNICAL BOOKS AND PUBLICATIONS

Guide to Industry

ELECTRONICS MANUFACTURERS OF WESTERN EUROPE AND USA. Published by Noyes Data SA, Zug, Switzerland. Paper covers, 131 pages, size 10¾ x 8½in. Price 80 Swiss Francs.

The names and addresses of over 10,000 companies associated with the electronics industry are listed in this volume, arranged alphabetically under their respective countries; from small manufacturers of specialised components to the enormous corporations with world-wide interests. Most of the companies listed are manufacturers, but also included are importers, exporters and wholesalers.

The countries represented are Austria, Belgium, Denmark, Finland, France, Germany (West), Ireland, Italy, Holland, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and USA.

No other information is carried to supplement the name and address, either in regard to the companies range of products or its connections. The listing is presumably intended mainly as a check of addresses before mailing.

The review copy came from the UK associate of the publisher, Noyes Data SA, 49 Welbeck Street, London WIM 7HE. (H.A.T.)

Pulse Circuits

SEMICONDUCTOR PULSE CIRCUITS, WITH EXPERIMENTS by Brinton B. Mitchell. Published by Holt, Rinehart and Winston, Inc, New York, 1970. Hard covers, 6½in x 9½in, 379pp, many circuits and diagrams. Price in Australia $11.10.

This book has been written primarily as a laboratory/tutorial guide for technician training courses. However its scope and depth of treatment would appear to make it also suitable as a lab guide for junior electronics courses at college and university levels.

In the book the author describes the essentials of design, analysis and synthesis of each of the basic pulse and switching circuits, as implemented using modern semiconductor devices. He also gives details of practical laboratory experiments investigating the design or analysis of each type of circuit. Each of the 20 chapters into which the book is organised deals with a separate type of circuit and is provided with a set of tutorial problems dealing with both the analysis of the circuit and the lab experiment.

As the aim of the book is to cover basic concepts, rather than to provide a thorough knowledge of all possible types of practical switching circuitry, various simplifications and omissions have been made. Most of the semiconductor devices involved are treated as "ideal" switching elements, and only saturated bipolar transistor switching circuits are discussed. This approach seems fairly justified, although it may ultimately prove a little unfortunate in view of the growing importance of current-mode logic and other applications of unsaturated switching.

The content of the book seems to be quite up to date, dealing with such subjects as unijunction and tunnel diode switching circuits as a matter of course. The text is clearly and concisely written, and well served by illustrations.

In short, a well-produced book which should be of considerable interest to technical college students and junior engineering undergraduates.

The review copy came from the Sydney office of the publisher, and we are advised that copies are in stock at all major bookstores. (J.R.)

Tape Recorders

TAPE RECORDERS by H. W. Hellyer, AMRTS, AIPRE, Assoc AES, MSSM. Published November 1970 by the Fountain Press, London. Hard covers, 239 pages, 8½ x 5½ inches, freely illustrated by pictures, circuits and diagrams. Price in England 45s.

This is a further volume in the "How To Choose and Use Series" being published by Fountain Press, and is a companion volume to John Earl's "Tuners And Amplifiers" recently reviewed in these pages.

In that review we suggested that the publishers seemed rather optimistic in implying that readers could toil through several such volumes to enable them to effectively select the kind of hi-fi equipment that they wanted. Most would have been affected by mental indigestion before they got that far!

However, what we said about the earlier book also applies to this one: it is packed full of useful information on its chosen subject. In fact, the remark applies even more so because there are no sections which have to be ruled out as inappropriate to the Australian scene.

The book opens with the "Background Story", which begins where such stories usually begin, but which progresses to the present and then suggests likely trends for the furture.

Chapter 2 looks at basic principles. The treatment is fairly superficial but adequate for the reader who needs to be told what happens, without too many of the whys and hows! This continues in succeeding chapters to cover heads, decks, tracks and speeds. Portable tape recorders have a chapter to themselves, as also do microphones.

The practical side dominates the remainder of the book with chapters on "Special Applications", "Cleaning, Splicing and Lubrication", "Frequency Correction, Bias and Alignment", "Servicing the Deck" and "Tests and Measurements".

All told, I would rate the book as being excellent for reading by the many tape recording enthusiasts who are numbered amongst our readers. It would appear to be well written and is freely illustrated.

Our review copy came directly from the publishers, Fountain Press Ltd, 46-47 Chancery Lane, London. Local booksellers will almost certainly receive stocks in due course. (W.N.W.)

Hi-Fi Year Book

HI-FI YEAR BOOK, 1971, edited by Colin Sproxton. Published by IPC Electrical-Electronic Year Books Ltd, London. Hard covers, 422 pages, 8½ x 5in, illustrated. Price in Australia $3.15, postage 45c.

The editors of this annual publication are presumably well satisfied with its format and contents, as it has changed hardly at all over

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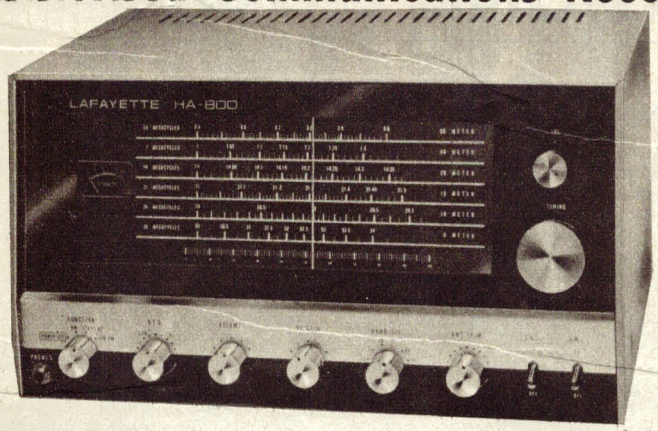
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the several years during which this reviewer has had the opportunity to see it. Basically, it is a catalogue of good-quality audio equipment available in the UK, with brief descriptions and specifications. In addition, as in previous issues, the 1971 edition contains a number of well written articles of interest to users of audio equipment.

The articles are: Distortion, Noise and Dynamic Range, by Gordon J. King; Demonstration Discs, by W. A. Chislett; Hi-Fi Limitations and Specifications, by John Borwick; Taking the Plunge (subtitled "Practical advice for newcomers on the problems of buying Hi-Fi"), by Colin Sproxton; Making the most of Radio Reception, by R. S. Roberts and ABC of Pickup Parlance, by Donald Aldous. These articles are all quite short, and some of them are appropriate only to the UK scene, but much of the information should be of value to the Australian reader seeking basic advice.

However, the main interest and usefulness of this book is the directory section, containing several thousand entries which cover the whole range of domestic audio equipment. Here again, the book has certain limitations for the Australian reader, since some of the equipment listed is not available here, and some equipment that is available will not be found in the listings. Nevertheless, bearing in mind the modest price of the book, these limitations need not be regarded as too serious. Most of the major manufacturers in the field whose products are available on the Australian market are represented in the listings.

The editor of the book points out that the specifications quoted are the manufacturers' own, but adds the comment that experience has shown that these are reliable in virtually all cases.

The production of the book is to a high standard. The use of good quality paper has resulted in type and half tones which are particularly clean and sharp and the hard covers are clad in what appears to be a hard-wearing linen. While this may appear to be extravagant for a year book, which in theory becomes obsolete in 12 months, it does provide for the hard usage which the book will encounter in some situations – trade users for example. However, the alternative of a cheaper paperback edition would seem desirable for the average user.

Our review copy came from Technical Book Co, 289-299 Swanston Street, Melbourne, from whom supplies are available. (H.A.T.)

Servicing . . .

HOW TO FIX TRANSISTOR RADIOS & PRINTED CIRCUITS. New revised second edition by Leonard C. Lane. Stiff paper covers, 256 pages, 8½ x 5 inches, freely illustrated. Published by TAB Books, Blue Ridge Summit, Pa 17214, USA. Price in Australia $6.15 or $9.95 for the hard cover version.

A good many servicemen, technicians and hobbyists are in danger of being left behind by the almost universal swing to solid-state devices and to the printed wiring boards and miniature components that are almost a part of it. They may still be working with valve-type equipment, to be sure, but it will not be too much longer before such equipment will be pensioned off for all time.

For those who are facing such a brink, this book would seem to offer a very useful bridge to the future – and one that will not demand an excessive effort to erect.

It is not a textbook of the kind that a student would use undergoing formal training.

The language would probably be too pictorial and sketchy for such a purpose.

But this is no great drawback for the practising technician, serviceman or hobbyist, who is more concerned with filling out existing knowledge than working to the requirements of a formal syllabus. In fact, the book is written with just such people in view.

Chapters 1 and 2 deal with "Semiconductor Fundamentals" and "How Transistors Work". The material has to be brief and even superficial to fit into 50 pages but the terms and the language of semiconductors is there and it is up to date.

Chapters 3, 4 and 5 deal in turn with "Basic Amplifiers", "RF and IF Stages" and "Detectors, AGC, and Audio Amplifiers". The emphasis is on radio receivers and items of home entertainment equipment other than television. This is reinforced by chapters on auto radios and FM radios.

The remaining part of the book, comprising some 80 pages, covers facts, tools and testing relevant to the solid-state era; it discusses servicing methods and winds up with a chapter on printed wiring boards.

Freely illustrated with circuits, diagrams and pictures, it is the kind of book which many may well be looking for. As the author says: A book that is designed to help people "get their feet wet" in solid-state and its allied techniques.

Our copy came from Grenville Publishing Co Pty Ltd, 401 Pitt St, Sydney, 2000. (W.N.W.)

FM Broadcasting

FM FROM ANTENNA TO AUDIO, by Leonard Feldman. Published by W. Foulsham & Co Ltd, Slough, Bucks, England, 1970. Hard covers, 5½in x 8¾in, 159pp, many circuits and diagrams. Price in Australia $5.10. Available in hard covers only.

At the time of writing this review, an inquiry has just been opened into the feasibility of FM broadcasting in Australia. As most readers will be aware, we have never had a regular FM broadcasting service and doubtless many will be hoping that something positive will come out of the present inquiry. I mention this simply because it may well have quite an influence on the sales of this and similar publications.

In common with many other books originally published by Howard W. Sams & Co Inc, Indianapolis, this edition is one which has been republished in England with an introductory chapter added for the special benefit of English readers. The author has a background, both academic and in practical experience to fit him for the task of writing on the subject of FM broadcasting and reception.

The first chapter discusses the merits of AM and FM broadcasting systems, drawing comparisons between the two. The second chapter deals with Noise and Interference in FM, and looks at the advantage of noise free reception of FM. Possible types of interference, including noise within the system, adjacent channel interference and "capture" effect are discussed.

Chapter 3, while it is headed Signal Propagation and Receiving Antennas, also looks at broad transmission principles, including frequency multiplication techniques to get the requisite deviation. Chapters 4, 5 and 6 deal with the various aspects of receiver circuitry, with past practices, compared with current design trends. The last two chapters cover FM Receiver Measurements and FM Receiver Alignment. The information given in the latter chapters is well set out and adequately illustrated with diagrams, tables and CRO pictures and it would seem that all necessary information is given to carry out these processes fully.

Spot reading and a general perusal of this book indicates that the author has a style which is pleasant to read, and the impression is also gained that a large amount of information is included in a relatively small volume. I would not hesitate to commend this book to readers interested in the FM system. At the same time, consideration may have to be given to the future of FM broadcasting in this country. Our review copy came from Grenville Publishing Co Pty Ltd, 401 Pitt St, Sydney 2000. (I.L.P.)

LITERATURE—in brief

HEARING AIDS, by Edith L. R. Corliss, National Bureau of Standards Monograph 117, issued October, 1970, 26 pages, price 35c US. This extensively revised version of NBS Circular 534 contains information on several topics related to hearing aids that should materially assist the hard of hearing faced with the problem of deciding which instrument gives him the greatest benefit. After an elementary account of some pertinent properties of sound and hearing, including the effects of resonance and "recruitment", it describes the general characteristics of hearing aids and offers advice on how to judge the performance of an instrument (some tests are included), how to select a hearing aid from among those commercially available, and how to care for it after it is obtained. Sources of further information are indicated, including some other publications on hearing aids. Order prepaid, in US exchange and including an additional one-fourth for postage, from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402, USA.

TELECOMMUNICATION JOURNAL, Volume 38, No 2, February, 1971. Published by the International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland. Contains the following articles: Comparative evaluation of modern transmission media for global communications, by B. M. Dawidziuk and H. F. Preston; Telecommunications and education, by A. Villanueva; On the eve of the World Administrative Radio Conference for Space Telecommunications, by J. Rusak. Under the heading of "Ideas and Achievements" are features on Television in Nigeria and ATS-F experiments. The section on "Union Activities" carries reports on a meeting of CCITT Working Party XIII/2 (traffic engineering), an IFRB seminar on radio frequency management, and a seminar on rural telecommunications. A booklet describing the celebration of World Telecommunications Day in 1970 is included as a supplement to this issue.

INFOTECH LTD, Nicholson House, High Street, Maidenhead, Berks, England, has announced a series of reports written by computer specialists from the USA, Europe and Japan. Known as "The Infotech State of the Art Reports", they will be published monthly and each will deal with a single issue facing the computing community. The first 400-page volume, "The Fourth Generation", became available at the end of February. Ten further reports will follow this year, and 12 in 1972.

The remaining titles for 1971, in chronological order from March, are: Giant Computers; Real Time; Computing Terminals; The New Technologies; Computer Networks; High Level Languages; Application Technique; Incompatibility; Interactive Computing; and Software Engineering. Each report costs $80 per single copy, or $660 for a subscription to all 11 titles published this year.

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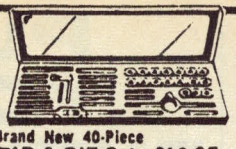
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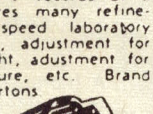
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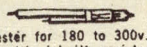
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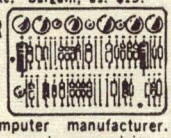


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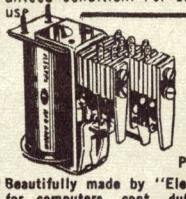


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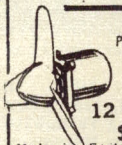
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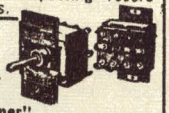


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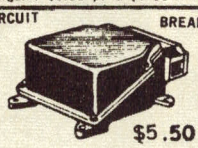


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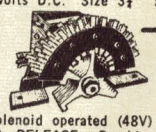
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and Amsterdam. Each report contains: edited transcripts of papers presented at the relevant lecture; edited technical discussion between speakers and delegates; additional papers specially commissioned from authorities not able to appear at the lecture; and an analysis of this material. Each report is supported by an extensively researched bibliography and cumulative indices cross-referencing all other published reports in the series.

LIST OF COAST STATIONS, 4th edition, 1970. Published by the International Telecommunication Union, Switzerland. Price 19 Swiss francs. According to the Radio Regulations, this list should be on board every ship carrying a radiotelegraph station. It is not compulsory but in all cases very useful on board ships with a radiotelephone installation. It should also be of great assistance to shipowners, transport and travel agencies, etc. The list is published every two years, kept up-to-date by supplements every six months, and is published in a consolidated three language edition (English, French and Spanish).

The list contains: A preface which consists of a table of allocation of international call sign series, a table of blocks of coast stations identification numbers, a table and a chart showing zones and watch-keeping periods for ship stations of the second and third categories; an alphabetical list of coast and port stations; particulars of coast and port stations throughout the world. The data listed includes: The name and type of station, the radiotelephone call sign, the frequencies used, the class of emission and power for each frequency, indication of the type of service available (public, official, restricted, etc), working hours, charges for radiotelegrams and radiotelephone calls and accounting authority, geographical position, and services provided by the station (weather broadcasts, notice to navigators, traffic lists, medical advice, telex and telephone numbers of stations taking part in rescue operations, etc).

Inquiries should be addressed to Standard Book Suppliers Pty Ltd, 134 Gilles Street, Adelaide, SA 5000.

CORNING GLASS WORKS, PO Box 38 Liverpool, NSW 2170, has available a one-page data sheet, EPD RAD-3, describing Corning's new NC3 miniature glass tin oxide resistor with 50ppm temperature coefficient stability and 1% tolerance. The newest and smallest of the NC-style resistors, the NC3 is rated at 1/20W at 125 degrees C, and is designed to meet or exceed the requirements of MIL-R-10509, characteristic C. It has a body length of 0.145in and a body diameter of 0.062in. The data sheet lists other physical characteristics and performance parameters.

STANDARDS ASSOCIATION OF AUSTRALIA has introduced a subscriber service for rulings and amendments to the SAA Wiring Rules, AS CC1, Part 1. The service has been introduced to provide the electrical industry with an accurate, prompt and easily accessible means of keeping copies of the rules up-to-date, and thus facilitate interpretation and application of the rules. For $15 annual fee, subscribers will receive 10 copies of each ruling and every amendment issued during the year. Additional copies will cost 25c a year. The rulings and amendments will also be available for individual purchase from SAA offices.

The rulings will be supplied on punched single sheets with a new sheet for each rule on which a ruling is given. This will simplify filing in rule number sequence. All previous rulings which are still applicable are available from SAA in loose leaf sets of approximately 80 pages for $1 per set. They are cross-referenced to the present rule numbers. Special printed binders for the rulings are $2 each. The subscription year commenced on February 1, 1971. Subscriptions should be sent, as soon as possible, to SAA, PO Box 458, North Sydney, NSW 2060.

MULLARD-AUSTRALIA PTY LTD, 35-43 Clarence Street, Sydney 2000, has announced that "Mullard Outlook" will cease publication and that future information on techniques, new products, etc, will be per medium of Philips Miniwatt publications.

INTERNATIONAL TELECOMMUNICATION UNION (ITU), Place des Nations, 1211 Geneve 20, Switzerland, has published the "General Plan for the Development of the International Network in the Region Asia and Oceania (Tehran 1970)". The "Tehran Plan" as it is commonly known has been prepared by the CCITT Secretariat on the basis of the work of the plan committees for this region. It replaces the Melbourne Plan of 1965. The book includes: List of existing telecommunication circuits (1969) and those forecast for the years 1974 and 1978; traffic forecasts; maps of regional arteries; regional routing plan; telephone and telex numbering plan, together with lists of circuits for the aeronautical fixed services, ICAO and IATA, and the meteorological services, WMO.

The Tehran Plan is published in a trilingual edition (English, French and Spanish). The format is 29.7 x 42cm, and the book has 110 pages with three coloured maps and 11 tables. The price is 92 Swiss francs to members administrations and 114 Swiss francs to others.

STANDARDS ASSOCIATION OF AUSTRALIA, 80 Arthur Street, North Sydney, NSW 2060, is seeking comment on a draft standard for electromagnetic interference terminology to form a chapter of AS C50, International Electrotechnical Vocabulary. Issued as Doc 1679, the draft defines the terminology used to describe electromagnetic interference in standard publications and textbooks. The terminology has been chosen in the interest of simplicity and clarity, and to facilitate international understanding. Copies of Doc 1679 may be obtained from the various offices of the association in all capital cities and Newcastle. Comment on these definitions from persons or organisations interested in the field of electromagnetic interference should be forwarded to the head office or any branch office not later than April 30, 1971.

ELECTRONIC MEASURING AND MICROWAVE NOTES, Issue 1970/3. Published by nv Philips' Gloeilampenfabrieken, Eindhoven, the Netherlands. This issue describes a general-purpose laboratory oscilloscope, the PM 3372, and its associated units. Over half the available space is used to describe the circuitry and mechanical construction of the main frame. The balance has descriptions of the probes and the following plug-in units: dual trace unit PM 3372; high-sensitivity low-drift amplifier PM 3332; single trace vertical amplifier PM 3334; four trace vertical amplifier PM 3344: Spectrum analyser PM 3379; plug-in test unit PM 3363. The issue also includes nearly four pages of applications of the PM 3370 oscilloscope. Inquiries to Philips Industries Ltd, Box 2703, GPO, Sydney 2001.

NATIONAL SEMICONDUCTOR CORPORATION, USA, has published a bipolar transistor reliability report. The seven-page report discusses reliability processing options, JAN-TX preconditioning tests, JAN-TX burn-in, and HTRB test results. Inquiries to Rutherford Electronics Pty Ltd, PO Box 30, North Balwyn, Vic 3018.

NEW DEVELOPMENTS, Issue B051, December, 1970. A new products guide published by Jacoby, Mitchell & Co Pty Ltd, 469-475 Kent Street, Sydney 2000. Contents include: Bell & Howell recording oscillograph; Advance integrating digital voltmeter and dual trace oscilloscope; Assmann announcing system; Melabs circulator/isolator; Telonic broadband oscillator; PRD miniature microwave power monitors; Shackman instrumentation camera; TRW SSB RF communication transistors; Comark DC microvoltmeter; Gossen dwell angle meter; Quan-Tech automatic resistor noise test system; Siliconix snap varactor; Kyoritsu FET volt-ohm milliammeter. ■

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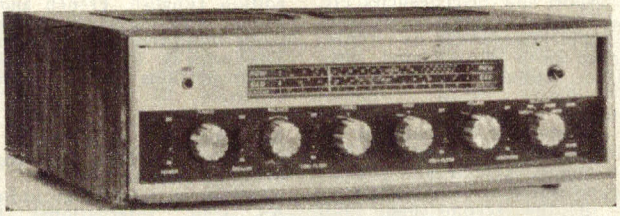
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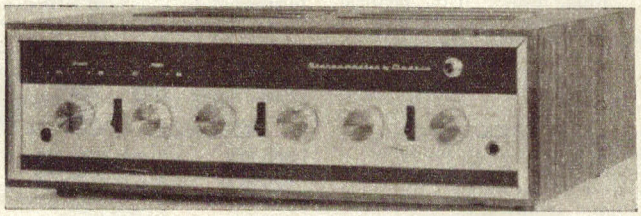
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EQUALISED:
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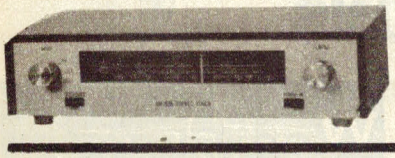
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AMATEUR BAND NEWS AND NOTES

by Pierce Healy, VK2APQ

Eyeball DX'ing--on a Grand Scale

Well-known Australian amateur Keith Howard, VK2AKX, has recently returned from a trip through fourteen countries in Europe, Asia and Africa. His experiences testify to the fellowship of amateur radio throughout the world.

Relatively few Australian amateurs have had the opportunity of visiting or meeting their counterparts in foreign countries. Fewer still have equalled the experiences of Keith Howard, VK2AKX, well-known for his work in the Youth Radio Club Scheme and as president of the Westlakes Radio Club. The following story of Keith's travels by boat and train, the personalities associated with amateur radio he met and the radio societies he visited, is from notes on the highlights of the trip which he sent me soon after his return.

Before giving brief details of the highlights of the trip, some of Keith's impressions should be of interest. "Really I was very impressed by the fact that wherever one goes, amateurs are very much alike. However, I was particularly impressed with the direct Government aid given to help the amateur radio "sport" in the socialist countries. The obvious enthusiasm of all, both young and old, seemed to be at least partly a result of this help.



Outside the "Box 88" building in Moscow. From left to right, Ivan UW31D, Keith VK2AKX, Vera Sjiridova (Committee Sec of RSF), and Nikolai Kazansky UA3AF (Secretary, RSF)

"I was also very impressed with the magazine 'Radio' in the USSR, which now has a circulation of over one million copies monthly, and all without advertisements. Each issue carries constructional articles equal to the products of all the Australian and USA amateur publications put together, as well as all the DX and other amateur news. And the circulation is growing".

Keith's saga began with the trip aboard the MV Cathay from Sydney, calling at Brisbane, Hong Kong, Keelung (Republic of China), Osaka and Yokohama in Japan.

In Hong Kong, Roy Chalu, editor of "OHM" magazine was the first of the many personalities associated with amateur radio whom Keith met during the trip.

In Osaka, many well-known 'JA' operators were visited, in particular Harry JA3DKY and Mac JA3USA. Conducted tours of the highlights of EXPO 70 were made by courtesy of members of the JARL. Extreme hospitality was extended by all, especially by those who visited the EXPO station JA3XPO.

The next stage was from Yokohama by the MV "Khabarovsk" to Nakhodka in Siberia (Soviet Far East) then by the "Vostok" train to Khabarovsk in Siberia, and on to Moscow aboard the train called "Rossiya".

In Moscow the hosts were Ivan UW3ID, president of Radio Sports Federation of USSR and Nikolai UA3AF, secretary of the RSF, both officials of the Central Radio Club. A half-day visit was made to the famed "Box 88" Moscow. This occupies a huge building in suburban Moscow, with five floors of workshops and laboratories, lecture rooms for theory and Morse code, and a magnificent library with all copying facilities for abstracts. The large and efficient QSL bureau has four permanent employees. The building also provides display areas and a trophy room. An outside wall of the building features a magnificent ceramic mural. Here Keith was presented with copies of all the USSR awards, an excellent array of outstanding certificates.

The trip from Moscow to Helsinki via Leningrad was made by train.



Keith Howard, VK2AKX (seated) with Harry Yamasita, JA3DKY at the EXPO station JA3XPO in Osaka.

The visit to the Helsinki Radio Club was most interesting. The club is set in beautiful parklands, just across from the State Broadcasting House "Yleisradio". Keith met many members, including Armas OH2NB, president of the SARL (the National Radio Society of Finland), Raimo OH2KK, leader of the Market Reef expedition and Martti OH2BH, leader of the Albanian DXpedition.

The 'shacks' of several members were visited, and most of the big DX operators of the SARL were met. A feature of the visit was a screening of the complete film of the Market Reef expedition.

From Helsinki a passenger ferry was the mode of transport to Tallinn, Estonia, where officials and members of the Tallinn Radio Club UK2RAA extended a very warm welcome. Those met included Enn UR2AR; Arvo UR2CW; Juhani UR2EW; and August UR2TAX. Two half-day visits were made to the Central Radio Club in the old YMCA building in Tallinn. The club has excellent workshops and a radio storeroom full of lovely disposals gear. An excellent multiple operator 'shack' layout for contest operation is a feature of the club, together with an array of four element cubical quad antennas.

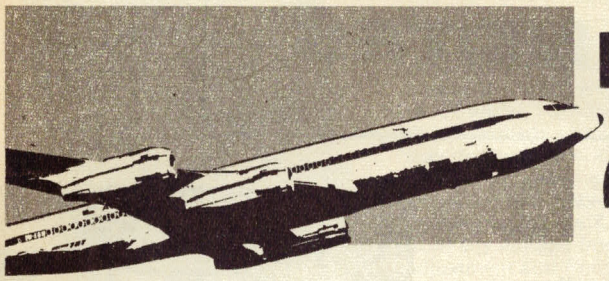
The building housing the Tallinn Radio Club is shared with other recreational groups, including a gliding club. Keith received splendid hospitality during his visit from Enn UR2AR, and his wife Moonie at their home in suburban Tallinn.

The next stage of the journey was from Tallinn to Riga, in Latvia, by train and then by air via "Aeroflot" to Vilnius, Lithuania. Members of the Central Radio Club of Vilnius made a presentation to Keith of the Lithuanian Award for the first personal UP2/VK contact recorded by the club. The boys from the club are very anxious to make further contacts on the air with 'VK' stations. Aegis UP2BA and Geib Misiunas both helped to make the visit a very pleasant experience.

Warsaw, Poland, was the next point of interest. Here, very warm hospitality was extended by Chris SP5HS, secretary of the

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, NSW, 2200.

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PZK (National Radio Society of Poland) and representative on the International Amateur Radio Union; Zofia SP5YL, wife of Chris and QSL manager for PZK, and Stan SP5BS.

A visit was made to a small radio club, SP5PEK, with sixteen members. The club has a first class 'shack', with mountains of gear supplied mostly by the state; also a meeting room and workshop.

From Warsaw Keith travelled to Berlin, DDR, by train. Members of the German Central Radio Club made him a presentation of the "Sea of Peace" award, and also provided a conducted tour of the very modern 'shack' of the Central Radio Club. This has excellent VHF broadcast facilities as well as full HF, including teletype installations. Gerhard DM2AWD, was most helpful during the visit. A short visit was also made to West Berlin. Continuing his trip through Europe by train, Keith visited Dresden, DDR; Prague, Czechoslovakian SSR; then to Vienna in Austraia by the "Windobona Express" and on to Zagreb in Yugoslavia, aboard the "Orient Express".

At Zagreb many amateurs at the headquarters of the SRJ (national amateur radio society) extended a warm welcome, including the duty operator, Svetozar, YU2REM. Among the interesting activities seen at the club was preparations being made to distribute 88 Trio 510 Transceivers to "YU" amateur operators. The club is also very active in producing original design equipment, such as VHF transceivers for sale to members. Great interest is also shown in colour television.

Very warm hospitality was extended to Keith by Marijan YU2CO; Tony YU2DD and by Matija YU2DB, who holds both Silver and Gold Tesla Awards and a Presidential citation from Marshal Tito, for outstanding achievements associated with amateur radio.

The journey from Zagreb to Rijeka was aboard the "Kvarna Express". This was followed by motor coach to Pula and Trieste, Italy, then train to Venice, Milan, Turin and on to Geneva by the "Rome Express".

In Geneva, wonderful hospitality was extended by Mick HE9TWY, past secretary and Ted F8RU, president of the International Amateur Radio Club. Also from high officials of the International Telecommunication Union, including an Australian, Mr R. Butler, deputy secretary-general of ITU. On-the-air contacts into Australia were made with ease from the IARC station 4U1ITU.

During the visit to Geneva everything was arranged by the members of the IARC.

Paris was the next stop, arriving by the "Golden Arrow Express". Then from Calais by British Rail Ferry to Dover and London.

A visit was made to the Radio Society of Great Britain. Here long talks with Roy Vaughan, now past editor of "Radio Communication" and Roy Stevens, G2BVN, Secretary of Region 1 Division of the International Amateur Radio Union, brought to light many interesting facts relating to the world of international amateur radio.

While in London Keith made a visit, arranged by Mr Butler in Geneva through the Australian Post Office representative, to the Post Office Tower.

The return trip home was made aboard the "Northern Star", sailing from Southampton to Freemantle via Las Palmas, Canary Islands, Capetown and Durban, South Africa.

In Las Palmas, Antonio EA8GK extended an invitation to Keith to visit his 'shack' and provided a tour of the city and surroundings. Keith was able to arrange verification for Antonio's Cook Award.

During the short stay in Capetown members of the SARL (National Radio Society) including the president "Willy" ZS1BF and Koos ZS1AW, made the visit most enjoyable. A visit was made to the headquarters of the SARL to see the QSL bureau, also a brief inspection of the Hamrad Store, a well-known disposals "Mecca".

In Durban an extensive tour of the city and surrounds was arranged by Ken ZS5FD and Tage ZS5FE, including visits to various 'shacks'. A contact with Australia was made from ZS5FE. Really wonderful hospitality was extended by Ken ZS5FD and Mrs Cousens; Arthur ZS5D; and husband and wife team Albert ZS5GK and Muriel ZS5KG.

The final stage of the trip was overland across Australia from Perth to Sydney on the "Indian Pacific Express".

In addition to the places briefly recorded in the foregoing was a tour of inspection of Ostankino TV tower in Moscow (world's tallest – over 1700 feet high), also a visit to the VEF radio works in Riga, Latvia. There were many others of historical and cultural interest.

In his notes on the trip, Keith concludes with the following acknowledgements:

"Grateful thanks to Bill Hall, VK2XT for the good communications work at the Australian end, and to all other members of the Hunter Branch who contributed to radio communications successes.

"Special thanks to Allan VK3AHW and Bill VK2WC who went out of their way to make STD telephone calls to fix skeds at very unusual hours.

"Thanks to officials and members of JARL; RSF; PZK; DARC (East); SRJ; IARC; RSGB; SARL (Finland); and SARL (RSA) for excellent hospitality and facilities offered during tour. Also to Don Miller and Pierce Healy of WIA for badges and car stickers for presentation to overseas amateurs, and to Frank Boundy, VK2ZFX and Graham VK2ZUB for supply of pennants".

Those who know Keith personally will no doubt agree with me that he must have made an excellent ambassador for the Australian amateur service. Although there were no official overtones regarding the trip there is little doubt that the Australian amateur has become better known on account of his social meetings with officials of the various societies. Likewise, seeing the work and hearing the views of members of the societies visited must have been for him a most interesting and enlightening experience.

SPECIAL VE-VK THIRD PARTY AGREEMENT

To facilitate the post-launch exchange of information about the Amsat-Oscar B satellite, the Canadian and Australian authorities have concluded a special agreement. Accordingly, the exchange of third-party traffic relating to the technical experiments to be conducted with A-O-B will be permitted between Canadian and Australian radio amateurs, for a period beginning with the launch of the satellite and ending four months after it ceases to transmit. (QST Feb 1971)

OVERSEAS NEWS

MALTA: The Malta Amateur Radio Society now have their headquarters in an old and historic building. Known as the Zabbar Gate, the building originally formed a part of the fortifications erected by the Crusaders. The members of MARS are carrying out restoration work on the building and converting it for use as a meeting place for members and other society activities.

SWITZERLAND: Some slight modifications to regulations governing amateur radio in Switzerland came into force during 1970. The

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CONNOISSEUR SCU1 CERAMIC STEREO CARTRIDGES*

Diamond stylus (replaceable). High vertical and horizontal compliance, with channel separation and flat response over wide frequency spectrum. Encel price $13.50.

QUALITY LUSTRE ST510D TONEARM*

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Note:—All prices quoted include Sales Tax. Write for full information on all these items and authoritative technical reviews on items marked *

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KITS

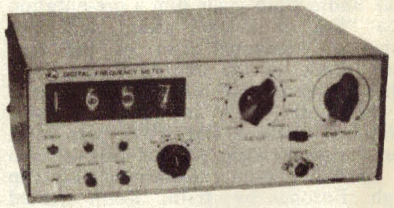
AMPLIFIERS — PREAMPLIFIERS — TUNERS — CONTROL UNITS — GUITAR UNITS — INSTRUMENTS — INVERTERS — CONVERTERS — RECEIVERS — TRANSMITTERS — REGULATED POWER SUPPLY — TRANSISTOR AND VALVE TYPES.

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March — May 1970

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1. 5in wide range.
2. 1963. 3in cal.
3. Audio.
4. 1966. 3in.
5. 1968—Audio.
6. Electronic SW.
7. W/band Preamp.

MULTIMETERS and V.T.V.M.'s
8. 20K ohm/Volt protected M/M.
9. Probe for above.
10. Protected D.C. M/M.
11. Meterless V'meter.
12. A.C. Millivoltmeter
13. A.C. Solid State Millivoltmeter.
14. Solid State A.F. Millivoltmeter.
15. Noise Distortion Millivoltmeter.
16. Standard V.T.V.M.
17. 1966—V.T.V.M.
18. 1968—V.T.V.M.

BRIDGES
19. Standard R/C.
20. 1966. R/C.
21. 1968 R/C and Signal Injector.

TV INST.'s
22. Sweep and marker Generator.
23. Dual sweep Gen.
24. Silicon diode. sweep Gen.
25. Silicon diode noise Gen.
26. Pattern Gen.
27. Trans. pattern Gen.
28. Wild range pulse gen.

AUDIO INST.'s
29. 1960 Audio Osc.
30. 1962 High perf. audio Gen.
31. Crystal locked std.
32. Electronic tuning standard.
33. 1965. Solid State audio osc.
34. Direct reading A.F. meter.
35. Sq. wave Gen.
36. 1967 transistor audio Gen.
37. Additive frequency meter.
38. A.F. tone burst gen.
38A. 1968. Solid state A.F. Generator.

R.F. INST.'s
39. 6-band service oscillator.
39A. Trans. wave meter.
40. "Q" meter.
40A. Crystal Calibrator —Solid state.
40B. Digital freq. meter.
40C. 1969. Dip Osc.—Solid state.
41. G.D.O. wide range.
42. G.D.O. adaptor.
43. Trans. service osc.
44. Simple signal injector.
45. Transistorised signal tracer.
46. Transistorised osc.
47. Basic test osc.
48. Transistor test
48A. IF. Align Osc.

MISCELLANEOUS INST., ETC., KITS
49. 1960. Trans. Tester.
50. 1968. Transistor test set.
51. Valve and Transistor tester.
52. Electronic Stethoscope.
53. Moisture alarm.
54. Electronic Pistol range.
55. Transistor Geiger Counter.
56. Light beam alarm.
57. Burglar alarm.
58. Flasher unit.
59. Transistor alarm.
60. Electronic switch.
61. Photo Timer.
62. Direct reading impedance meter.
63. Electronic anemometer.
64. S.W.R. indicator.
65. Simple proximity alarm unit.
66. Metal Locator.
67. Electronic metronome.
68. Bongo Drums.
68A. Keyless organ.
68B. Theremin.
68C. Laser unit.
68D. Color organ.
68E. Stereo Headphone Adaptor.

BATTERY CHARGERS
69. Universal unit.
70. 1 amp unit.

REGULATED POWER SUPPLIES
71. Transistor, 9v.
72. Transistor, fully protected supply.
73. 1966 H.T. unit.
74. 1968 lab. type. 0-30v supply.
74A. Simple pwr. supply.

VOLTAGE-CURRENT CONTROL UNITS
75. Vari-watt unit.
76. Vari-tach. motor speed control.
77. 2KW auto-light dimmer.
78. 4KW auto. light dimmer.
79. Model train control unit.
79A. Vari Light Dimmer.
80. Model train control unit with simulated inertia.
81. Above-hi-power.
82. No. 81 with simulated inertia.

TACHOMETER UNITS
83. 6 or 12v Std.
84. 6 or 12v Mullard.
85. 6 or 12v with dwell angle.
86. Tachometer and dwell angle unit for service stations.

TRANSISTOR IGNITION
87. Ro-Fo. 6 or 12v.
88. Hi-Fire 6 or 12v (transformer).
88A. C.D.I. unit.
88B. Electronic Ignition.

POWER CONVERTERS
89. D.C.-D.C. 60w.
90. D.C.-D.C. 40w.
91. D.C.-D.C. 40w. 12v—input.
92. D.C.-D.C.70w. 12v—input.
93. D.C.-D.C. 100w 12v—input.
94. D.C.-D.C. 140w. 24v—input.
95. D.C.-D.C. 225w 24V —Input Q.

HIGH-FIDELITY AMPLIFIERS MONO UNITS
96. Hi Fi 3.
97. Mullard 3.3.
98. Mullard 5-10.
99. Mullard 5-10. transistor.
100. Transistor 20w.
101. Transistor 60w.

STEREO UNITS
102. Mullard 2-2.
103. Mullard (v) 3-3.
104. Mullard (t) 5-5.
105. Mullard (t) 5-5.
106. Mullard (v) 10-10.
107. Mullard (t)10-10.
108. Philips Twin 10.
111. Hi-Fi 60 Plus 60. P/M 128.
112. Playmaster 2-2.
113. Playmaster 3 plus 3.
114. Playmaster unit 3.
115. Playmaster unit 4.
116. Playmaster 10 plus 10
117. Playmaster 101.
118. Playmaster (t) 105.
119. Playmaster (t) 113.
120. Playmaster (t) 115.
121. Playmaster (v) 118.

P.A. UNITS
122. 10 watt std.
122A. Mullard 20w Solid state.
122B. Mullard 40w. Solid state.
123. 25 watt std.
124. 35 watt std.
125. 30 watt (t).
126. 100 watt std.
127. Stereo P.A.

GUITAR UNITS
128. 10 watt std.
129. 25 watt std.
130. 35 watt std.
131. 50 watt std.
132. 70 watt (t).
133. Playmaster 102.
134. Playmaster 103.
135. Playmaster 40w. 116.
136. Playmaster 60w 117.
137. Guitar fuzz box.
138. Guitar Waa-Waa.
139. Reverb unit.
140. Guitar preamp.
140A. Guitar 50w. Solid State P/M 125.

STEREOGRAMS
141. Playmaster 105.
142. Playmaster 106.
143. Playmaster 107.
143A. Playmaster 124.

CONTROL UNITS
144. Playmaster No. 9.
145. Playmaster No. 10.
146. Playmaster No. 104.
147. Playmaster No. 112.
148. Playmaster No. 120.
149. Mullard 2v.
150. Mullard 3v.
151. Philips Miniwatt.
152. P/M 127.

PREAMP UNITS
153. Transistor—Mono.
154. Transistor—Stereo.
155. Transistor—Silicon. mono.
156. Transistor F.E.T. mono.
157. Transistor dyn. mic. mono.
158. Above-Stereo.
159. Playmaster 115 F.E.T. Stereo.
160. Playmaster 115 mag.
161. Sound projector.

MIXER UNITS
162. Trans. 4 ch. (1966).
163. Trans—4 ch. (1967).
164. Valve—4 ch.

TUNER UNITS
165. Playmaster u/style.
166. Playmaster No. 11.
167. Playmaster No. 114.
168. Playmaster No. 122.
169. Playmaster No. 123.
170. Philips Miniwatt.
180. Trans—Long range.

TAPE UNITS
181. Trans. Preamp.
182. Playmaster 110 (M).
182. Playmaster 110 (S).
183. Power Unit 110.
184. Adaptor 110.
185. Playmaster 119 Adaptor.
186. Transistor V.O.X.
187. Tape Actuated relay.
188. Mullard Trans Tape Amp.

RECEIVERS
189. Fremodyne 4. 1970.
190. Fremodyne 4 R.F.Sect. only.
191. Synchrodyne.
192. Communications RX.
193. Deltahet RX.
194. 3 Band Double Change S/het RX.
195. Explorer VHF Transistor RX.
196. Interceptor S Semi-Comm. RX.
197. 1967 All-Wave 2.
198. 1967 All-Wave 3.
199. 1967 All-Wave 5.
200. 1967 All-Wave 6.
201. 1967 All-Wave 7.
202. Transporta 7.
203. Transistor 8 3 Band.
204. 3 Band 2V RX.
205. 3 Band 3V RX.
206. All Wave 1970 i/C 2.
207. Versatile Mantel Set.
208. All-Wave Transistor 3
209. A.B.C.
210. 1968 F.E.T.
210A. I/C TRF RX.
210B. R.F. Preamp.
210C. "Q" Multiplier.
210D. 1970 Communications. Solid state.

TRANSMITTERS
211. 144 MHz 50W. Linear Final.
212. 144 MHz 20W.
213. 144 MHz 20W.
214. 144 MHz 18W.
215. 144 MHz S.S.B.
216. 3 Band A.M.
217. Basic 3 Band.
218. 5 Band. S.S.B.
219. 1967 S.S.B.

CONVERTERS
220. 50 MHz
221. 144 MHz. 1970.
222. 50 and 144 MHz Crystal Locked.
223. 1965 S/W.
224. 1965 S/W 2 Band.
225. 1966 3 Band.
226. Basic S/W.

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227. Remote Unit.
228. 7, 8 and 9 H.F. and V.H.F.
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minimum age for obtaining an amateur transmitting licence was lowered from 17 to 15 years.

There was also approval given for an increase in the maximum plate dissipation allowed for the final stage of a transmitter. The changes were:

Class 1 – from 20 to 50 watts

Class 2 – from 100 to 150 watts.

Operation of repeater stations is allowed on the 70cm and two metre bands. Due to the restricted width of the two metre band only the transmitting or receiving end of a repeater may be located in it, while the other part must operate on the 70cm band.

Of the 917 amateur licences in force at the beginning of 1970 in Switzerland, 790 were members of USKA (the National Amateur Radio Society). In addition there were 655 associate members.

Reciprocal licensing agreements exist between Switzerland and fifteen countries, namely Austria, Belgium, Canada, Finland, France, Germany, Kuwait, Luxembourg, Monaco, Netherlands (including Netherlands Antilles), Portugal, Qatar, Sweden, the United Kingdom and the United States.

GERMANY: In addition to the usual annual training course held for radio amateurs in the Volkswagen city of Wolfsburg, the Distrikt Neidersachsen of the Deutscher Amateur Radio Club, the German national society, have made plans to hold the first ever international training course. The course will be conducted at Easter 1971 and will be open not only to members of the DARC and German nationals, but also to members of the Region 1 societies in the International Amateur Radio Union.

The training course will include lectures on techniques, laws and regulations for amateur radio, and training in Morse code. As the language used will be German, participants will need to have at least a working knowledge of it. The approximate cost of the course including full board, accommodation and lectures will be A$40.00. Participants will be required to pay their own travelling expenses to and from Wolfsburg.

NEW AWARDS

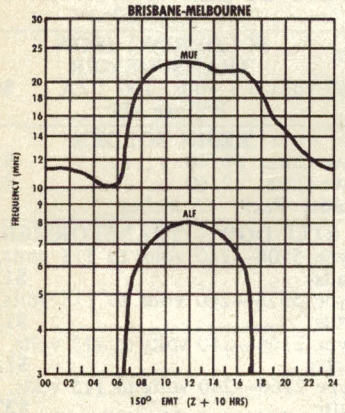
The CQ DX Award: Sponsored by "CQ Magazine", this new award bears close resemblance to the DXCC and is issued to those submitting proof of contact with at least 100 countries (as per ARRL list) since 15th November 1945.

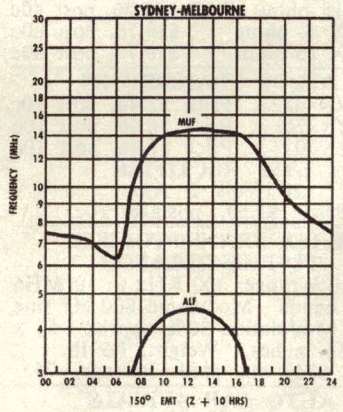
Separate awards are issued for two-way single side band and two-way CW contacts. Endorsements will be issued for 150; 200; 250; 275; 300; 310 and 320 countries, and to promote multi-band operation a Low Band Endorsement will be issued to those contacting 100 or more stations on any combination of 3.5MHz and 7.0MHz bands. A 28MHz endorsement will likewise be given to

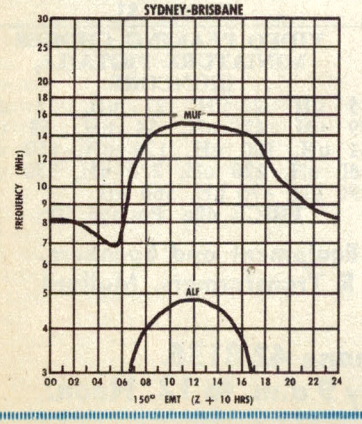
IONOSPHERIC PREDICTION CHARTS – APRIL

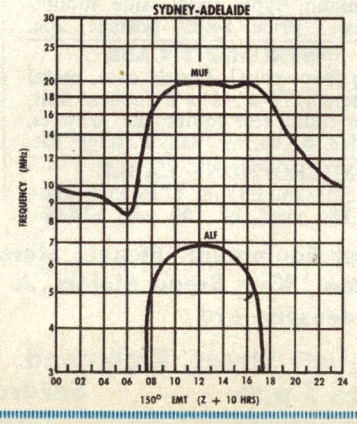
As an experiment, we are publishing this month four radio propagation prediction charts based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. Reproduced below, the charts give the predictions of maximum usable frequency (MUF) and absorption limiting frequency (ALF) for four or the most widely-used interstate circuits, during the month of April 1971. They should therefore be of interest to many operators working on the HF bands.

Comments from readers regarding the inclusion of these charts as a regular feature are invited, and should be sent directly to Pierce Healy at the address given on page 133.









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5-inch Reels:
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900 feet Acetate $2.25
900 feet Mylar $2.80
1200 feet Mylar $3.75
1800 feet Mylar $5.75

5½-inch Reels:
900 feet Acetate $2.40
1200 feet Acetate $3.40
1200 feet Mylar $3.75
1800 feet Mylar $4.75

7-inch Reels:
1200 feet Acetate $3.00
1200 feet Mylar $3.75
1800 feet Acetate $4.50
1800 feet Mylar $5.00
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Empty Reels (unboxed):
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VERNIER DIALS
Ratio 8 to 1 Reduction, Scale 0-10.
Type T 501 1½ inch diameter $2.00
Type T 502 2 inch diameter $2.75
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LOW PASS FILTERS
A "Cabena" Low Pass Filter will fix TVI. Cut-off frequency, 30 MHz; attenuation at 60 MHz better than 30 dB; insertion loss, negligble. Impedance 50-72 ohms.
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8 watts r.m.s. per channel. Input for magnetic, crystal and ceramic type microphone. P.V. cartridges, tape recorder input and output, tuner input, stereo headphone jack.
Reduced to $55.00. Postage, $1.20.

PACK OF RESISTORS
100 Resistors of ½ and 1 watt rating.
Price, $1.75. Postage, 20c.

FIVE-CORE CABLE
5 x 5/0076. Ideal for Intercoms, Telephones, etc. New. **100yd rolls, $17** (postage 75c), **or 20c yd.**

STEREO HEADPHONES
Professional quality (well known brand). Large earpads, standard stereo plug, 6ft lead.
Price, $5.75. Postage, 50c.



SPECIAL
1 WATT TRANSCEIVER
13 TRANSISTOR, 3-CHANNEL and Call System.
Specifications:
Circuit: 13 Transistors, 1 Diode, 1 Thermistor. Range: Up to 10 miles (depending on terrain, etc). Frequency: 27.240 MHz (PMG approved). Freq. Stability: Plus or minus 0.005 per cent. Transmitter: Crystal controlled, 1 watt. Receiver: Superheterodyne, Crystal controlled. Antenna: 13 Section Telescopic. Power Source: 8 UM3 1.5 volt pen batts. Size 8¼in x 3¼in x 1¼in. Weight: 25oz. Other features: Leather carrying case, battery level meter, squelch control, earphone jack, AC adapter jack, etc.
Price, $75 A PAIR.
Usual price $165.
Single units available $40 each.
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6A7 15 ohms " " $5.50, post 40c
8A7 8 ohms " " $7.20, post 40c
8A7 15 ohms " " $7.20, post 40c
12CMX 8 ohms $10.75, post 80c
12CMX 15 ohms $10.75, post 80c

DELCO TRANSISTORS
Type 2N441 .. Price $2.40, post 10c
Type 2N278 .. Price $6.00, post 10c
Type 2N301 .. Price $7.40, post 10c

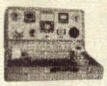
LT91 RECTIFIER
20 Volt 2 Amp.
Price $1.50, postage 10c.

TE-16A TRANSISTORISED TEST OSCILLATOR
Frequency range: 400 KHz to 30 MHz in five bands. Modulated 800 Hz sine wave. Modulation 30% approx. 5¼ x 5¼ x 3¼ inches. Weight, 1.5 lb.
Price, $24, tax paid. Postage, 75c.

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Hirschmann, type 300N, side mounting, new. Price, $4.50, postage, 20c.

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Sloping front panel. Plastic case, metal front panel, 7¼ x 4¼ x 5 inches. Suitable for radio, test equipment, projects, etc. Price, $3.50, inc. tax. Postage 10c.

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Type 15P1/24, E3748, 1/16 inch diam
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Using integrated circuit, in hardwood carrying case, contains all parts for 150 different projects inc. IC, diode and Transistor Radios, electronic switches, relays, alarms, test equipment, etc. etc. VERY GOOD VALUE.
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OC44 .... 90c		AF116 .... 80c	
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AC128 .... 80c		BF115 .... 80c	
BA100 .... 30c		OA90 .... 30c	
OA91 .... 20c		OA95 ..... 30c	

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Type PS64—240 volts to 6 or 9 volts. 300 mA $12.50
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ADCOLA M70 1/8inch tip, 240 volt $8.00
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SCOPE 4 volts AC/DC, 100 watts, $6.40
MINISCOPE $6.00
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240 volts 3.3 volts, 100 V/A .. $6.40
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Five-Core, 60/40 ..... $2.50
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Solder Pack, 42 inches 18c

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Type 5506—240 volts to 115 volts, 20 watts $12.00
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Type 2164—240 volts to 115 volts, 100 watts $16.30
Type 2166—240 volts to 115 volts, 250 watts $32.00
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15 uH, 22 uH, 27 uH, 33 uH, 39 uH, 47 uH, 56 uH, 68 uH, 82 uH, 100 uH, 120 uH, 150 uH, 180 uH, 220 uH, 270 uH, 330 uH, 390 uH, 470 uH, 560 uH.
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Any altered or forged QSLs will result in permanent disqualification. To quote the rules: "Fair play and good sportsmanship in operating are required for all amateurs working towards CQ DX Awards. Continued use of poor ethics will result in disqualification . . ."

Applications should be made on the official application form, available from CQ magazine. This should be sent with the relevant QSLs to an authorised checker (eg, an officer of a recognised society) for endorsement, and then sent with eight IRCs to Jerry Hagen, WA6GLD, PO Box 1271, Covina, Calif, 91722, USA. Applications for endorsements after the issue of the basic award need only consist of a list of QSLs but specific cards may be asked for; please enclose an IRC with these applications. An Honour Roll in CQ magazine will list all those with totals over 275 who have updated their totals annually.

Thunder Bay Award: This award commemorates the amalgamation of the twin Canadian cities of Fort William and Port Arthur into the new city Thunder Bay on 1st January 1970. The award is made for working, or hearing five stations in the new city after 1st January 1970.

Send log details and 10 IRCs to: Lakehead ARC Awards Committee, PO Box 571, Stn "P", Thunder Bay, Ontario Canada.

IONOSPHERIC PREDICTIONS

This is just a note to remind readers of the request made in the February 1971 issue of these notes, for details of propagation conditions noted in relation to the VHF bands. Such reports would be very much appreciated by the Ionospheric prediction Service.

Already a few reports have been sent in relating to the 52-54MHz band. It is also known that several DX openings have occurred.

An appeal is made to 52MHz operators to make extracts from their logs relating to their activities, and in particular to DX contacts made. Details of times when the band was monitored but no openings occurred should be also included in a report.

Remember any technique developed due to ionospheric research will also be of benefit to the Amateur Service.

INTERNACIA LIGO DE ESPERANTISTAL RADIO-AMATOROJ

The recently formed International League of Esperantist Radio Amateurs (ILERA) held its inaugural meeting in Vienna in August 1970 during the 55th Universal Congress of Esperanto.

Honorary secretary is Ken Sly, G4MR, 200 Nevills Road, Letchworth, Herts, who will be pleased to supply further information on the ILERA to interested persons.

CYPRUS

The awards manager of the Cyprus Amateur Radio Society Iain Morris, ZC4IM has indicated that it does not seem likely that there will be an early restoration of amateur licenses on the island. A falling off in the number of members in the society has caused a serious drop in revenue and the club has therefore decided that it cannot continue to support the Cyprus Award. This award will be discontinued on March 31st 1971 and apologies are extended to those who have already applied for the award but have not received their certificates.

It should be noted that ZC4 calls are issued to members of military organisations in the Sovereign Base Area, and that licensees refrain from giving full QTH details over the air for security reasons. As they are often moved to other parts of the world at short notice, this can lead to difficulties with direct QSLs when ZC4s give the bureau address (PO Box 216, Famagusta). All cards sent to this bureau go via the world bureau. Cards for QSOs three or more years ago may not reach their destination and it is suggested that IRCs for return postage be sent with such cards, to ensure that they will be returned if they cannot be forwarded.

JAPAN – NEW REGULATION

The Japanese authorities have amended their laws to allow the use of special amateur club stations by alien amateur operators. The first of these stations was JH1YDR, the Kashiwagi Amateur Radio Club Station, whose operator is Armin H. Meyer W3ACE, the United States Ambassador for Japan.

It has been stated that US amateurs will be accorded similar privileges to those for the particular licence class held in the US. Application forms and assistance are available from the Japan Amateur Radio League.

WIA YOUTH RADIO SCHEME

An interesting explanation has been put forward as one reason why the Wireless Institute of Australia Youth Radio Club Scheme has become so popular among high school students. This is that the students are joining the scheme not so much with the ultimate aim of obtaining the Amateur Operator's Certificate of Proficiency and become an active amateur radio operator, but rather in order to gain a general understanding of electronics.

In view of the vast inroads electronic techniques are making in all phases of industrial activity, this outlook on the part of students would certainly seem logical. And it is certainly true that various organisations are coming to regard YRCS certificates as an indication of the overall aptitude and interest level of the holder, even when application is made for a position not associated with radio communication.

But even if this is a partial reason for YRCS popularity, organisers of the YRCS are not worried. They argue, and rightly so, that once a former YRCS member has settled in a career, either in the field of electronics or in some other field, he may very likely turn to amateur radio as a hobby. And he will still retain a good background knowledge of the subject, thanks to his training as a member of the YRCS.

CORRESPONDENCE SECTION: On Sunday February 7th, Howard Rider, VK3ANE, supervisor of the Victorian Division of the Youth Radio Club Scheme, and Don Reid, VK3EI, editor of "Zero Beat" the national magazine of the YRCS, attended a conference of YRCS officers in Sydney. Both Howard and Don gave some pertinent points on YRCS activities in an interview on VK2WI. Particular reference was made to the Correspondence Section of the scheme.

In explaining the exact function and purpose of the Correspondence Section, Don Reid made this comment: "The Correspondence Section is a section to cover

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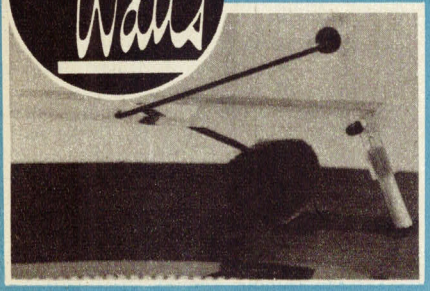
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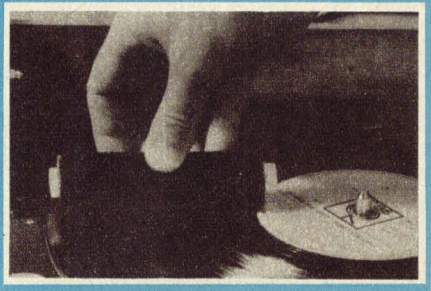
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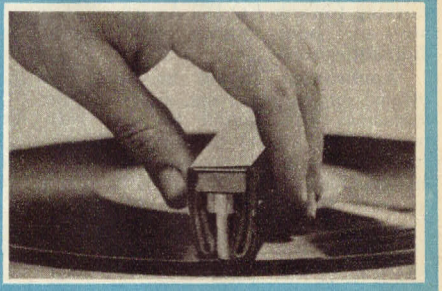


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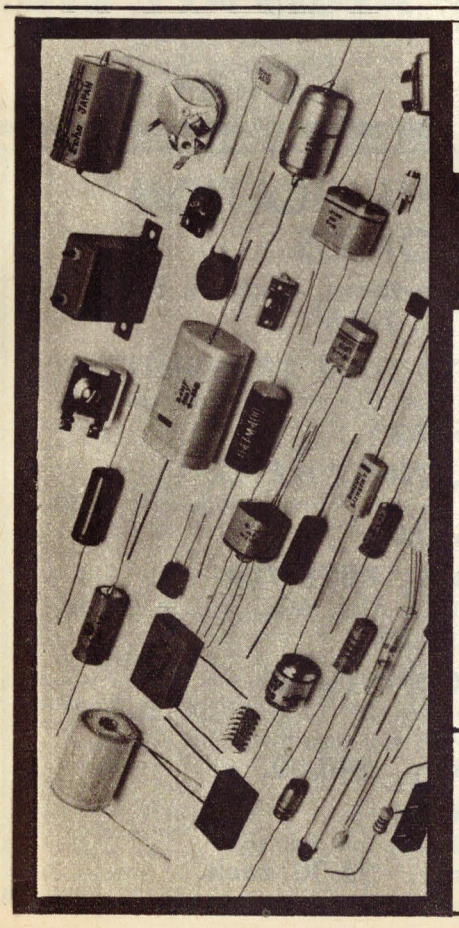
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AMATEUR JOURNALS

It has occurred to the writer of these columns that local amateur operators might appreciate brief references to interesting articles and other items featured in current issues of various amateur journals, particularly those from overseas. This may assist readers in finding an article about which they have heard, and perhaps also help them to seek out new articles on subjects of particular interest.

Items of interest noted in journals received this month are as follows.

Radio Communication (Journal of the RSGB): The January 1971 issue (Vol 47, No 1) includes articles entitled

"The One Transistor Wobbulator"
"Microwaves – 100MHz and Up"
"Trapezoid Modulation in Amateur Transmitters"

QST (Journal of the ARRL): The February 1971 issue (Vol 55, No 2) includes articles entitled

"Quads vs Tri-Band Yagi"
"Quick and Easy Portable/Mobile Operation"
"New Ideas for 2M Kilowatts".

FEDERATION INTERNATIONALE DES RR AMATEUR CHEMINOTS

The International Federation of Railway Radio Amateurs (FIRAC) exists to promote contact and friendship between railway radio amateurs throughout the world. There are national groups in operation in all European countries, in the USA and several other countries.

Regular contacts are made between European stations on Sunday mornings and with USA stations on Saturday evenings (GMT); also with other stations by agreement. The federation would like to hear from any group wishing to participate in regular or occasional schedules.

Information is available from: Ronald Hooper, G3SCW, Station House, Tavistock, Devon; or Owen Wade, GW3YVC, 1 Lomond Crescent, Cardiff CF2 6ES.

WIA ACTIVITIES

During the Easter holidays the Federal Convention of the Wireless Institute of Australia will be held in Brisbane. This will be the thirty-fifth occasion that representatives from the six Divisions of the WIA have met to discuss and plan for the future well-being of the Institute. Items on the agenda will probably include ITU, IARU, Region III and local administrative matters.

NEWSOUTH WALES

Commercial development of the Atchison Street area has begun to pose problems for the New South Wales Division. The acquisition of several adjoining narrow fronted properties by large development organisations has already taken place, and multi-storey buildings are being erected in very close vicinity to the Wireless Institute Centre. Overtures have already been made to the Institute by several such organisations.

Multi-storey development has already taken place up to the eastern boundary of the WIC property. Maintaining the value of the Institute property will become a problem should the development of the properties on the western side be promoted, because council ordinances prevent high rise buildings being erected on properties as narrow as the area of the WIC.

Central Coast Field Day: The annual Field Day of the Central Coast Branch of the NSW Division WIA was held on Sunday February 21st, 1971.

The weather conditions were excellent and this together with the fine facilities of the Gosford Showground ensured that the event was an outstanding success. The attendance was 355, higher than has been recorded for several years. The total number of licensed amateurs registered was 132. From the comments heard there seems little doubt that this Field Day has become the most popular held in the NSW Division.

There were field events for the contest minded and competitions for all. A large display of some of the latest commercial amateur band equipment proved very popular, as was a stall offering a selection of the ever-popular disposals gear. There seemed to be plenty of buyers at all the display centres.

An excellent demonstration of amateur television was given by Horrie Lapthorne, VK2HL and George Collie, VK2ZDC. Although only over a relatively short path, the excellent two-way ATV-communication on 432MHz demonstrated the capabilities of the well-designed and constructed equipment used.

On the social side, there were many enjoyable meetings between old friends, both among the ladies and the OM's. The day also provided the opportunity for YRCS members to discuss various projects, and those who had in recent years obtained their amateur operator's licence were able to exchange ideas and tell of their experiences in getting on the air. In addition it allowed the older members to discuss such things as the trend towards the use of commercial equipment, and compare this with the days when they first went on the air, with entirely home built equipment.

One group which could be seen discussing various aspects of amateur radio over a cup of afternoon tea could together claim more than 300 years experience in amateur radio. In the group were:– VK2CZ; VK2EO; VK2HZ; VK2VL; VK2VN; VK2WD; VK2YP; VK2AND; and your correspondent VK2APQ.

Thanks from all who attended go to the ladies and members who worked to provide

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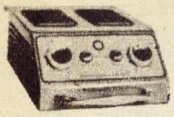
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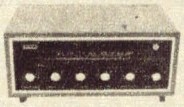
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WHISTLE FILTER for above set for 8kc bandwidth (can be altered to 9, 10 or 11Kc). No. 128, $4. Post 10c.



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579—64.A.8	711—67.A4	741—69.P.5	727—68.8.T
683—64.A.9	723—68.5.T	747—69.C.10	728—68.0.9
678—65.O.9	731—68.M.12	746—69.P.9	
679—65.M.9	736—69.5.T	$3.00	$3.20
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In 5MC out 250 Mv. Bass and treble 20DB. No. 724C $29
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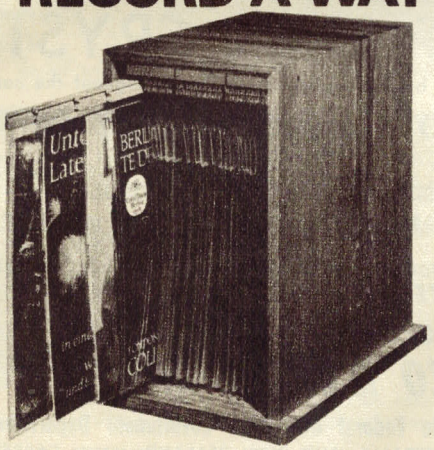
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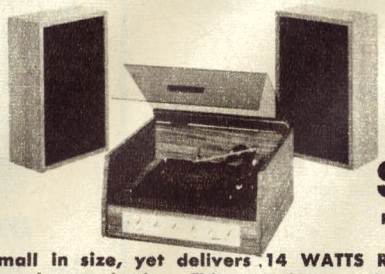
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SPECIFICATIONS: Fitted with 3-speed Record Player
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morning and afternoon teas, as well as the hot dinners. The committee have also expressed their appreciation to the exhibitors and the many trade houses who donated items as prizes for the winners of the various events.

Contest results were:–

Overall winner:	Carl Palmer	VK2ZGX
Mobile scramble –		
HF Section	Les Baber	VK2RJ
144MHz Tunable	Dick Norman	VK2BDN
146MHz Net	Carl Palmer	VK2ZGX
Telephone scrambles –		
	Doug Friend	VK2ZZI
	Carl Palmer	VK2ZGX
	Leon Skeers	Assoc
144MHz Hidden transmitter hunts		
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	Brian Jones	VK2ZHF
144MHz pedestrian hunt		
	Dave Andrews	VK2AWZ
Quizes – Amateur	Stan Lloyd	VK2AYL
Ladies	Ellen Leary	–
Ladies Scavenger Hunt	Mrs Howard	–

VICTORIA

Geelong Amateur Radio and Television Club: On 1st and 2nd May, 1971 the Geelong Amateur Radio and Television Club will be holding their convention, which is known as the "Geelong Hamfest".

The venue will be the East Geelong Free Library Hall. The program will commence on the Saturday evening with a dinner, followed by entertainment. On Sunday various events of interest to the amateurs will take place, including competitions, hidden transmitter hunts, disposals sales, and so on. Amateurs holidaying in the area or passing through will be welcome to attend.

Application forms to attend the convention will be sent to those who write to the club secretary, Mr R. Wookey, Box 520, PO Geelong, Victoria 3220 (Geelong 21-2674).

The club meets regularly every Friday evening at 2-10 Strorrer St, East Geelong, at 8 pm. Visitors are always welcome.

WESTERN AUSTRALIA

Discussions at the January meeting of the Western Australian Division resolved the amount by which the annual membership subscriptions should be increased. The meeting agreed that the membership fees for the ensuing year would be:

Full member	$7.00
Associate	$6.50
Student	$3.75

The increase is $1.50 less than the council suggested in the case of full and associate membership, and $1.25 more for the student rates.

It was also moved "That members of ten years standing may be granted relief concerning membership fees due to adverse circumstances, upon application to Council. Where such privilege is extended it shall be reviewed annually".

The venue for all meetings has been changed from Surf House to Science House, 10 Hooper Street, West Perth. General meetings are held on the third Tuesday of the month commencing at 8 pm. All correspondence should be sent to the Hon. Secretary, N1002, GPO, Perth 6001. ■

"ONE IN A MILLION"

The following is an extract from a commentary written by Michael J. Owen, VK3KI in a recent issue of "Amateur Radio". We reproduce it, by arrangement, in the belief that it makes some very worthwhile points.

If you live in India and you are a radio amateur, you are literally "one in a million" – for in a population of 500 million people there are only some 450 licensed amateurs.

Some of those 450 licensed amateurs are by any standard well off. Most are not. Most are not active. They cannot compete with their equipment built with the components available to them, or with the SSB stations of the rest of the world. Who works any AM stations on 20 metres these days? Of course components are not the only problem; I was repeatedly told while in India that hobbies are not in the blood of Indians – a hobby is an expression of a restless, Western society.

The IARU and we in our regional organisation seek the development of amateur radio in countries like India. We seek to achieve this partly because we believe in what we do and we wish to share it, also partly because we believe that by contributing in some small way to the development of technology in countries like India we are doing something useful in the world around us, and partly for our own protection.

India, to use it in the present context as an example, has, like us, one vote at International Telecommunications Union Conferences. Why should it vote to support amateur radio unless amateur radio is contributing something to its national life? The VHF spectrum is a good illustration of the present development of our hobby in that country. In New Delhi I met an amateur who is able to transmit and receive on 2 metres. There used to be two Americans and an Australian in New Delhi and together they formed a net on Sunday mornings. Now the two Americans and the Australian have left and the local amateur awaits the appearance of someone else to talk to on 2 metres. Any frequency higher than 148MHz may as well not exist – in India you just cannot get the components.

One in a million – that is the problem in India, and the problems of amateur radio in India are the problems of India. The two are inexorably intertwined. Is it even realistic to talk of national amateur radio societies and their international organisations rendering meaningful assistance? I do not believe that the solution lies in giving, for example, complete SSB (and expensive) transceivers. This sort of charity obviously demonstrates that amateur radio is in fact a rich man's hobby. It teaches nothing and achieves little. The long term solution must be through the education system – such as it is. In India, education is not compulsory. This involves persuading those responsible for education that amateur radio as part of say, science in clubs and schools, is a valuable tool for developing the technology of India.

Some individual amateurs have had and have used their presence in India to assist amateur radio. One example is an Australian, Howard Ryder, VK3ZJY. During his stay in India as a technical specialist working with the Colombo Plan, he taught other amateurs how to build their equipment from locally-available products. He was the Australian who started the 2 metre net I have referred to. I do not know whether he will ever realise the affection that those whom he assisted have for him.

Amateur radio needs more people like Howard Ryder in places like India – people who are prepared to work amongst Indians and to know the back streets of Chandnichowk.

A small boy who has never been to school and will never go to school, and who begs with head bowed while a taxi waits at a traffic light, will never be a radio amateur. But there are others who do attend school, who one day given the right training may become radio amateurs. It is these people that we must seek to influence.

Perhaps in our lifetime we may see in India "one in a quarter of a million" ■

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LISTENING AROUND THE WORLD

by Arthur Cushen, MBE

MW reception improves as sunspot count falls

The rapid fall in the sunspot count which is now occurring has been welcomed by medium wave listeners, since it has resulted in improved reception throughout the hours of darkness.

During some 35 years of listening on the broadcast band, and building up a collection of 2,000 verifications from MW radio stations in 136 countries, the writer has spent many thousands of hours listening between 520 and 1600KHz. In the hours of darkness between dusk and dawn, it is possible in southern New Zealand to hear signals from all continents, but the effects of seasonal changes on transmissions from different parts of the world are very noticeable.

American signals are heard at dusk throughout the year, from 8 pm local time in summer to 4 pm in winter. After dark, Australia and most of Asia come through after midnight. At dawn, signals from Europe and Africa are received, and these are best during March and September, when equinoxial conditions give equal hours of daylight and darkness over the route.

Without a doubt, of the 1,100 stations from North America verified, the signals on the 250-watt channels are the most fascinating. The frequencies of 1230, 1240, 1340, 1400, 1450 and 1490KHz are set aside for local stations. There are over 200 such stations on each frequency, with power limitation of 250 watts at night and 1000 watts during daytime operation. These channels provide spasmodic listening, and any of these stations, from any part of North America could be heard, when weather and other conditions are right.

One evening in January two signals from the Central time zone, one from Kentucky and the other from Missouri, came up above the general chatter with enough material for positive identification.

The 50KW signals on many channels are heard most nights, and then, during our summer, openings from 11 pm NZT (1100GMT) onwards are possible. At this time, stations commence their day's broadcasting from New York, stations on the West Coast start signing on at 2 am (1400GMT); and then the Hawaiin stations sign on around 4 am NZT (1600GMT).

The fascination of medium-wave or broadcast band DXing is that it provides the unpredictable in reception. Short-wave stations are expected to be heard over great distances, but not low powered stations designed to serve only a local audience. Stations from every state in the USA have been heard in NZ, except New Hampshire, Vermont, Rhode Island and Maryland. These four are the most difficult to receive in NZ, because of distance: their early sign-off for the day, before reception is possible in New Zealand; and the use of the same frequencies by many stations closer to New Zealand. Over 170 Californians have been verified, and over 70 in Texas.

RECENT CHANGES

The frequency changes which take place on March 6 concern most international broadcasters, but are never as large as the changes for summer and winter reception, which take place on the first Sunday in November and May.

AUSTRIA: Austrian Radio will use the following new frequencies: 200-2200GMT, 11790KHz; 0400-0600, 7250; 2000-2200, 7180; 2300-2400, 9690; 0200-0400, 11725; 1600-1800, 17850; 1600-1800, 9745; 1800-2000, 9765; 0400-0600, 17785; 1400-1600, 17705; 0600-0800, 21720;1200-1400, 11860.

NEW ZEALAND: Radio New Zealand in its service to Australia from 0900 to 1145GMT has replaced 11705 with 11780KHz.

SWEDEN: Radio Sweden is to continue to use 11895KHz for its service to Australia

RECENT VERIFICATIONS

Many of our readers report the receipt of unusual verifications over the past few weeks:

FINLAND: The Finnish Broadcasting Company at Helsinki confirmed reception on 9585KHz with a new card. The card shows a map of Finland over which is placed a pair of headphones. The address of the station is The Finnish Broadcasting Company, External Service, Kesakatu 2, Helsinki 26, Finland.

SOUTH YEMEN: Bob Padula has received a card confirming the reception of the broadcast of the station on 5060KHz. This country was formerly Aden. In the letter they apologised for the delay as the report they verified was over two years old. Four IRCs were sent with the original report, as well as several follow-up letters being sent in order to obtain the verification.

CONGO REPUBLIC: Bob Padula, Melbourne has received a map type verification card from the Brazzaville station reported on 9715KHz. The verification was received in 11 weeks by registered airmail.

VENEZUELA: Our verification from Radio Angostura, Ciudad Bolivar confirmed reception of YVSX on 6120KHz. An airmail letter was received together with an excellent pennant and nine coloured postcards of the area. According to the verification, they also operate YVSW on 1100KHz, YVSX 6120KHz, and YVSFM. The letter was signed by the Director, Snr Guerra Madriz. The station address is Apartado 31, Ciudad Bolivar, Venezuela.

SATELLITE RELAY

The first publicised relay of programs via satellite was made on January 23, when programs from Trans World Radio in Monte Carlo were received by their relay station at Bonaire.

According to Harry Weatherley, Mt Waverley, Vic, the station was heard on 11910KHz with a program originating in Monte Carlo and rebroadcast by Bonaire. The transmission was from 2200 to 2217GMT. The announcer stated that a special verification card was being issued to listeners who accurately reported this transmission.

FEBA EXTENDS SCHEDULE

The Far East Broadcasting Association, Seychelles, has now been in operation for 18 months and is gradually extending its schedule. Reception in New Zealand has been fair at 1400GMT when they commence a service of request music for listeners in India. Chris Davis, Featherston, NZ reports reception from sign-on at 1230GMT, when

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. All times are GMT. Add 8 hours for WAST, 10 for EAST, and 12 hours for NZ.

Australia tops popularity poll

The International Short-wave Club Popularity Poll for 1970 found Radio Australia to be the most popular station with listeners. Radio Australia replaced Radio Nederland at the top of the poll, and the number of votes cast was the highest yet.

A total of 30,836 votes were cast for some 116 stations. Votes came from all parts of the world, including the Soviet Union and ships at sea. Listeners in Indonesia returned a large number of votes. The returns indicated strongly that propoganda stations are not popular. Radio Moscow, Radio Peking, Radio Tirana and Radio Havana Cuba, which broadcast many hours a week, did not get in the first 12. Listener awareness of political influence on radio stations was also reflected in the result. Radio Portugal dropped from the first 12, while Radio South Africa increased in popularity.

The following were the placings with the previous poll position shown in brackets.

1.	Radio Australia	(7)
2.	BBC World Service	(2)
3.	Radio Nederland	(1)
4.	Voice of America	(6)
5.	Deutsche Welle	(3)
6.	Radio Japan	(–)
7.	Radio Canada	(5)
8.	Radio South Africa	(9)
9.	HCJB, Quito, Ecuador	(–)
10.	Radio Malaysia	(–)
11.	Swiss Radio	(4)
12.	Radio Sweden	(10)

Those stations with no placing shown for the last poll were not in the top 12 in the 1968 poll.

they have a transmission in several Indian dialects. The English Service is from 1400 to 1530GMT, transmission concludes at 1630GMT.

The transmission for morning reception in India has been extended to 0030-0400GMT. This service, formerly on 15185KHz, moved to 11920KHz, and more recently to 11730KHz. English programs have been observed at 0245GMT. The mailing address of FEBA is PO Box 234, Victoria, Seychelles.

COURSE FOR BEGINNERS

Radio Nederland, Holland, recently ran a series of talks under the title "All Round DXers Course", in which various experts contributed articles on the hobby. The station now realises that there is a need for a course for beginners, dealing with the first steps to be taken in short-wave listening. Radio Nederland's technical expert, Jim Vastenhoud, has compiled the course, and it is available free from DX Jukebox, Radio Nederland, PO Box 222, Hilversum, Holland.

During DX Jukebox on Thursday at 0645GMT on 11730 and at 0815GMT on 9715KHz, the station is now running an audio course, which covers all methods for the reproduction of sound. This should be of interest to those readers who want to get better quality reproduction from their equipment. Enrolment in this course is also free.

MUSICAL IDENTIFICATION

All short-wave stations with an international service have a musical identification signal, as well as a spoken announcement, which makes it easy for foreign listeners to identify the station.

One of our readers in Tasmania has recently sent to us the musical score of the themes used by four stations he has not been able to identify. To transcribe the identification signal on to paper is in itself some feat, but it is difficult to identify stations solely by this means as there are over 100 of these signals in regular use. The time, frequency and type of program heard is of greater help to us in identifying stations. The music which had been written could be identified as Radio Peking, Russian Home Service, etc, but this does not give the listener information as to the location of the transmitter, which can be ascertained if the frequency is known.

KGEI'S FUTURE PLANS

Radio KGEI, San Francisco, ran into difficulties in the November-March frequency period, and had to use three channels for its transmissions to South America. The station first used 15280KHz from 2230-0200GMT, 9695 0200-0400, and 9670KHz from 0400-0500GMT. Due to congestion in the 31-metre band, KGEI's first request for a frequency in this band was turned down, and they were given 9695KHz, which was also being used by Radio South Africa. At 0400GMT they had to vacate this channel, because it was also being used by Radio Free Europe, and move to 9670KHz for the last hour of the transmission.

For the March-April period KGEI is operating:

GMT	KHz
2230-0300	15280
0300-0500	11955

From May 2, KGEI will be using 15280KHz for the entire schedule, 2230-0500GMT.

According to the Assistant Chief Engineer of KGEI, Thomas Tweddell, a new 250KW transmitter is close to being operational. He hopes to be sending out notice of on-air testing shortly. As it is a prototype model, unexpected problems may come to light as they go along, so that it is impossible to predict a firm date.

SIGNALS FROM AFRICA

Some interesting signals are being received from Africa in the 60-metre band both at dusk and dawn:

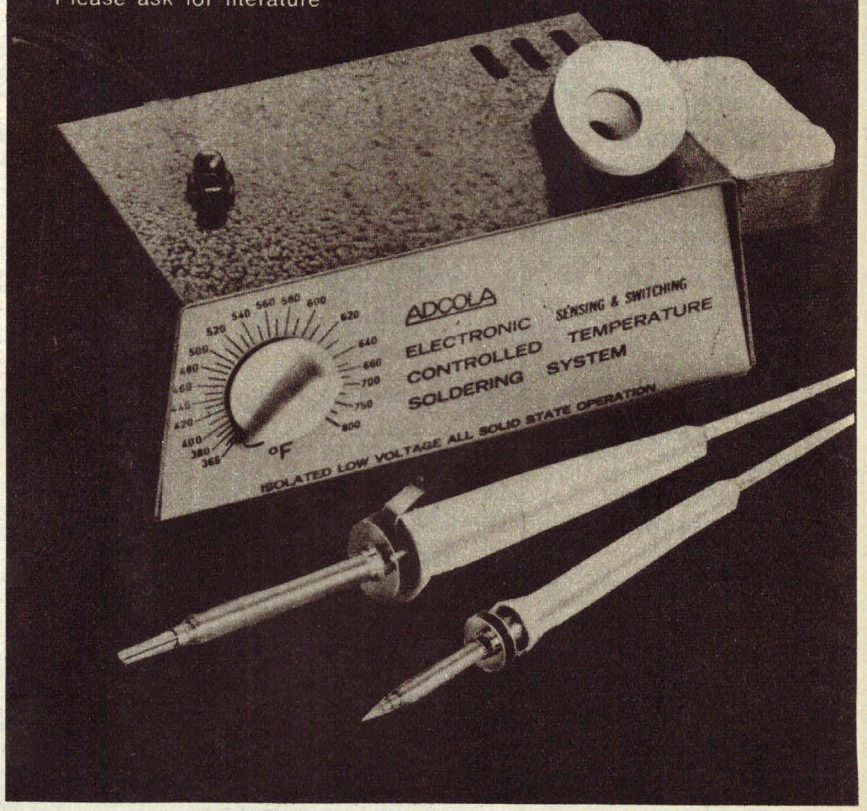
4820KHz Angola has been heard with a Portugese program at 1840GMT.

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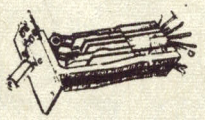
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5Y3	$1.75	12SK7	50c
6C4	50c	VR65	25c
2 x 2	75c	VT4C	75c
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7" x 3600'	$6.00	46c

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C60 $1.15; C90 $1.75; C120, $2.25
Post 13c.

BYER 77 Mk. 1

Rack Mounting Tape Recorder, ex A.B.C. 7$\frac{1}{2}$-15 I.P.S. Full track tested **$150.**

Microphone. Professional S.T.C. type 4017. **$20.**

Marconi Video Oscillator type TF885A 0-12 M/cs. **$75:**

A.W.A. SIG GENERATOR

UHF 70-150 M/cs

$65.00

Pye 4 Channel Crystal Locked Oscillator, 1.5-30 M/cs. New.
$25.

TRANSPONDER APX6

with Lighthouse Tubes. Can be converted to 1200 M/cs. **$17.**

WHEATSTONE BRIDGE

Top grade.
In Multiples up to 1,000.

$65.00

Deitch Bros.

70 OXFORD STREET, SYDNEY 2010

SORRY, NO C.O.D.

4865KHz Mozambique with a Vernacular program at 1800GMT.
4870KHz Radiodifussion du Dahomey, Cotonou French news at 0615GMT.
4880KHz Kinshasa, Congo has a program in French at 1745GMT.
4904KHz Fort Lamy, Chad, has a French program at 1730GMT.
4915KHz Nairobi, Kenya has a Swahili program at 1930GMT.
4915KHz Accra, Ghana heard in English and local language from 0600 to 0715GMT.
5035KHz Bangui, heard with a French service at 1930GMT.
5047KHz Lome, Togo has been observed with a lesson in German at 0640GMT.
5050KHz Dar es Salaam has news in Swahili at 1900, and then follows a program of African music.

ENGLISH FROM SUDAN

An English news bulletin has been noted from Radio Omdurman, Sudan at 1745GMT. Two frequencies have been received with this program, 11835 and 4994KHz, and John Mainland, Wellington, reports good reception at this time. Bob Wagner of Balwyn, Vic, reports similar reception, and has noticed that after the news and popular music a transmission in Arabic commences at 1758GMT.

CEYLON EXPANDS SERVICES

This month Radio Ceylon is to extend its services to the Middle East, North Africa and Europe. "World Bulletin" reports the Director of Ceylon broadcasting as saying, in a note to Parliament, that the news service is to promote tourism and Ceylonese products via short-wave service. It is presumed that the 100KW transmitter will be used.

Radio Ceylon has been noted running past its normal sign-off time of 1700GMT on occasions, reportedly during the period of the full moon, when an all-night transmission takes place of chanting and prayers between 1700 and 0100GMT. This program in Sinhala is carried on 540, 600, 570, 640, 700, 1310, 3385 and 4870KHz.

CONGO'S POWERFUL VOICE

The most powerful radio transmitter in black Africa has just been inaugurated in Kinshasa by General Mobutu, to celebrate the fifth anniversary of the Republic of the Congo. The two 600KW medium-wave transmitters were installed in record time by the French contractors, who also built two 300-foot masts. The new transmitter is expected to be well received throughout Africa and as far as Europe. General Mobutu has called this transmitter the biggest tom-tom in Africa.

RADIO CANADA SW CLUB

The Radio Canada Short Wave Club bulletin, which has been sent to members since the club's commencement in September 1967, ceased publication with the January – February issue. The bulletin in future is to be part of the Radio Canada program guide, issued four times a year. The program guide has a circulation of 160,000 copies. The Radio Canada Short Wave Club is an important part of listener relations and the new arrangements with the program guide will make listeners more aware of club activities. With the program schedule going to 160,000 listeners throughout the world the new venture will enable more listeners to learn about the Club in its aims in promoting friendship among DXers.

Naturally there will be a reduction in the material which can be published and the "DX Parade" has been deleted. At Club headquarters a penpal club for members has been formed, and on occasions special reprints of interesting material will be sent out to members.

Readers who are interested in learning about the Radio Canada Short Wave Club can obtain this information from PO Box 6000, Montreal, Quebec, Canada. The Radio Canada Short Wave Club program is broadcast every Saturday at 0845GMT on 5970 and 9630KHz.

FREE STATION LIST

The ORF, Vienna, Austria, is offering a series of lists of stations in Latin America free to its listeners. A list of the addresses of the Brazilian radio station is already available. Further lists are in preparation and will be available shortly.

A correct reception report must be submitted with requests for lists. The address for reports is: Austrian Radio, Short Wave Service, Technical Department, A-1041, Vienna, Austria.

DENMARK EXPANDS SERVICE

Some readers will be aware that at the end of 1969 Radio Denmark ceased its popular English programs from Copenhagen, and continued on short-wave only in Danish, with English announcements at the opening and closing of transmissions.

A report from Copenhagen states that a Government investigation into short-wave broadcasting has come to the conclusion that short-wave broadcasting should continue, and be expanded. Two new high power transmitters are to be purchased, and an expanded service from Copenhagen should be possible in the near future. At present Radio Denmark continues to broadcast programs only in Danish to various parts of the world.

RELAY FOR CYPRUS

According to "World Bulletin", despite British pressure to prevent a Radio Monte Carlo relay station being installed on Cyprus, Sometra has received permission to build there. The British claim that this relay station will interfere with their radar station at Cavo-Kili and the broadcasting centre at Cavo-Greco. An agreement has been signed between Radio Monte Carlo and the Cyprus broadcasting authorities.

PRIZE WINNING LETTER

One of our readers, Roy Hallett, of Regents Park, NSW, was one of the 12 winners of a recent letter contest conducted by the English section of Radio Canada in Montreal. Roy Hallett wrote his 100-word letter on an aspect of Radio Canada programming, and on the international broadcasting sphere as he saw it. He won a recording from the CBC. His letter stated "Where an international broadcasting service is a responsible body, international broadcasting offers one the opportunity of obtaining information without having to contend with censorship, which can be imposed by local news media. 'Latitude' enables me to relate thinking in Canada and current events, and feel close to the people through information offered through the program. The feature is long enough to allow transmission of a substantial coverage of a given subject, and long enough when reception conditions are poor and listening itself is an effort."

The judges thought the letter interesting comment on international broadcasting in general, and on one of Radio Canada's programs in particular. "Latitude" is broadcast on some of the longer transmissions, and is heard in the South Pacific transmission on Saturday right after "Country Style."

JAMMING AT HIGH LEVEL

Some idea of the degree of jamming of short-wave broadcasts is given in a recent item in the Deutsche Welle program magazine. Before August 21, 1968, jamming had been reduced to its lowest level since World War II. Only some programs of West European stations such as the Bulgarian language programs of the Voice of Germany were jammed.

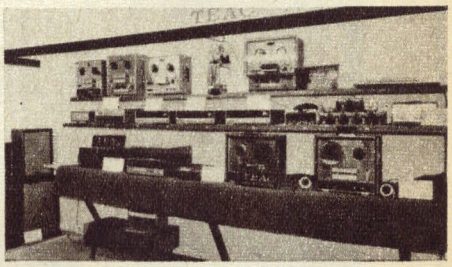
This situation changed completely at the moment of the Czechoslovakian invasion. Since that day all programs in Russian, Czech and Bulgarian languages of West European stations have been jammed. The most important jammers with high capacity are to

A unique invitation . . to enjoy sound satisfaction!

The Professional Consultants at the Convoy Technocentre of Sound have created the most unique group of sound studios ever. You are invited to select your particular system in a pleasant and relaxed atmosphere comparable to your own home. Park in our private car park at the front door.



THE CONNOISSEURS ROOM is where you hear the world's top sound equipment. JBL speakers shown are Olympus, Sovereign, Baron, and the New Aquarius Range in white or walnut. At right, McIntosh Amplifier, TEAC 7030, Ferrograph, Recorders, Pioneer Tuner-Amp remote control.



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SPECIAL TAPE RECORDER ADJUSTMENT

Our technicians can adjust your Hi-Fi tape recorder so that it gives optimum performance on the brand of tape you use. You can have your Hi-Fi equipment and tape recorders serviced by experts at the Technocentre.

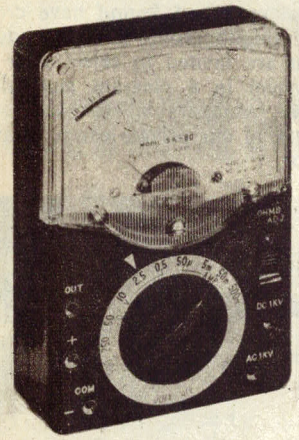
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Phone 357-2444

NEW RH (Radio House) RANGE OF MULTIMETERS

MODEL RH-80 $18.00 Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current: 50uA, 5mA, 50 mA, 500 mA

Resistance. 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ

Decibels. —10 + 62 ib

Accuracy. DC±3%, AC ±4% (of full scale)

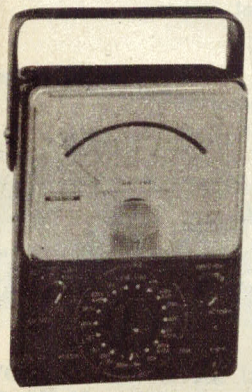
Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

MODEL RH-100 $39.75. Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

● Overload Protected by Dual Silicondiodes ● Double-jewelled ± 2 per cent Meter ● ±1 per cent Temperature-stabilised Film Resistors ● Polarity Changeover Switch ● Mirror scale, instruction for operation with circuit diagram.



SPECIFICATIONS:

DC Volts: 0.6, 3, 12, 60, 300, 600, 1200V (100,000Ω/V)

AC Volts: 6, 30, 120, 300, 1200V (10,000 Ω/V)

DC Current: 12μA, 300 μA, 6mA, 60mA, 600mA, 12 amps DC and AC Current 12 amps.

Resistance: 20KΩ, 200KΩ, 2MΩ, 20MΩ

Decibels: —20 to + 17, 31, 43, 51, 63.

Accuracy: DC±3 per cent, AC± 4 per cent (of full scale)

Batteries: Two 1.5V dry cells, size AA, "Eveready" 915

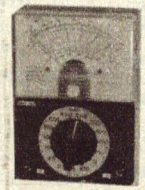


NEW TYPE Y-3 MULTI-METER

MEASURING RANGE: D.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). A.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). D.C. Current: 150 mA. Resistance: 0-100,000 ohms. Complete with 1.5 volt battery and test leads. Size: 3¾" x 2¾" x 1¾".

Checked, Packed and Posted — $9.50. Limited Stocks.

"HANDYMAN" RH 150 $11.50



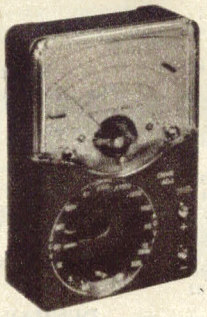
CHECKED PACKED & POSTED FREE

Pocket-size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS

DC Volts 2½, 10, 50, 250, 1000.
AC Volts 10, 50, 250, 500, 1000.
DC Current, .1, 25, 250 M/amps.
Resistance, 20K and 2 megohms.
Decibels, —20db = +62db .7K/c.
Capacitance, .0001, .01, .0025, .25 mfd.

MODEL RH-20 $13.95. Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000 (20,000/V)

AC Volts: 10, 50, 250, 500, 1000 (10,000/V)

DC Current. 50 uA, 25mA, 250mA

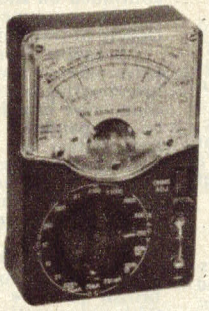
Resistance. 7kΩ, 700kΩ, 7MΩ

Decibels. —10 +22 (at AC/10V) +20 +36 (at AC/50V). Upper frequency limit 7kc.

Batteries: Two 1.5V dry cells.

With Meter Protection $15.00

MODEL RH-55 $20.00 Postage 50c



30,000 Ohms per Volt DC
14,000 Ohms per Volt AC

SPECIFICATIONS:

*DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V (30,000 ohms/V.

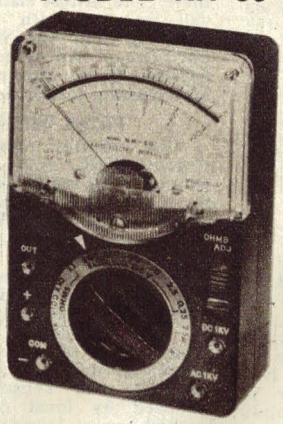
*AC Volts: 12V, 60V, 300V, 1200V (14,000 ohms/V).

*DC Current: 60 A, 12mA, 300mA.

*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.

*Decibels: -10 db +23 db.

MODEL RH-60 $25.00 Postage 50c



50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 25 uA, 5 mA, 50 mA, 500 mA

Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ

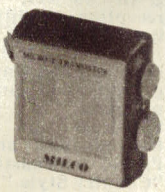
Decibels. —10 +62 db

Accuracy: DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells.

Models RH-80, -55, -60 are:—

● Overload-protected by dual silicon diodes ● Mirror scale ● Double-jewelled ±2% meter ● ±1% temperature-stabilised film resistors.



LATEST MODEL MICRO RADIO

7 transistors, uses 1 standard Penlite battery size 2½in x 2½in. The only miniature radio using standard batteries (refill battery 10c). Complete with instruction leaflets.

Pack and post $39.75.

FLASHLIGHT BALL POINT PEN S-88

Lights up automatically when pen cover is in position for writing. **$2.00 posted.**

Bright illumination. Modern shape with silver finish. You can write when it is dark. Spare parts available. Two batteries 30c. Pen refill 15c. Globes 15c.

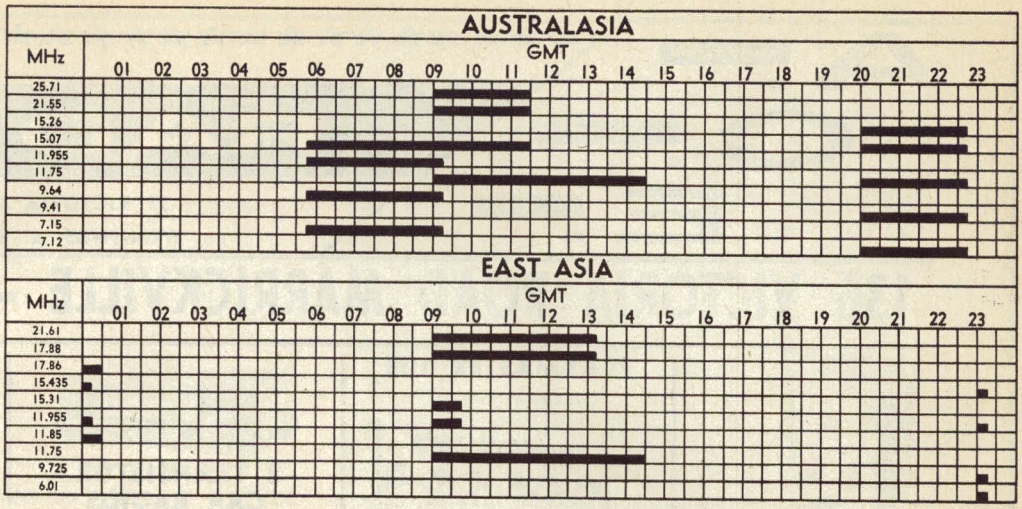
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WORLD SERVICE

SCHEDULE

This chart shows the regular BBC World Service frequencies and schedules for April, 1971. (Published by arrangement with the BBC.)



be found in the USSR. Experts estimate over 300 are in use with several local jammers in Bulgaria and CSSR. The 15MHz band has the highest jamming rate. During prime reception time in Europe 1800-2200GMT nearly 31 channels out of 71 cannot be used because of jamming. The same chaotic situation caused by the USSR and Red China exists in the bands in Asia.

There are different ways of jamming. The best known and usually most effective is a loud buzzing sound. Another way of jamming may be achieved by broadcasting with normal program material on the frequency to be jammed. Finally Red China uses a new method called "White Jamming". This is a hissing sound, and is very effective.

FLASHES FROM EVERYWHERE

ETHIOPA: Radio station ETLF in Addis Ababa can be heard with its missionary programs in English at 1900GMT on 11910KHz. This session includes news at 1930GMT. Another news bulletin in English has been heard on 11890KHz from 0530-0550GMT. The transmission is well received and most of the news items concern Africa.

RWANDA: The Deutsche Welle relay station at Kigali is heard in German on 15380KHz from 1830 to 2210GMT, and again from 2030 to 2240GMT, at which time they use the additional frequency of 11956KHz. A further program for Africa is heard at 0315GMT on 7225KHz.

THAILAND: According to Radio Australia's DX Session, the Educational Broadcasting Station, Bangkok has been heard recently to sign on at 1057GMT. The station is using 3202KHz. Programs have been in Thai with some English, and mostly national music.

MALAYSIA: A report in "World Bulletin" lists Radio Malaysia, Kuala Lumpur as using 11930KHz from 0600 to past 0800 for programs in Malay. The same service is carried on 9710KHz. It is presumed this new frequency replaces 9515KHz, but our observations indicate that Radio Malaysia is still using 9515KHz at around 0900GMT.

INDONESIA: According to a verification letter received by Nicholas Repin, Bellevue Hill, NSW, Radio Angkatan Udara, Djakarta, verified reception on 11320KHz with a letter and Christmas card. The schedule is given as 0500-0800, 1000-1400GMT. The letter, signed by F. H. Hasibuan, was received in two months.

COLOMBIA: La Voz de Colombia, Bogota, has been observed on 6020KHz at 1100GMT. This frequency was regularly received about 15 years ago. The station seems to have returned to this channel in recent months.

PARAGUAY: ZPA10 Radio Nacional, reported in these pages as being heard on Sundays at 0930GMT on 6015KHz, has confirmed reception of the broadcast. An Australian listener has received this in the form of a 10th anniversary pennant and station letter head. This was issued by Gerado Malley Mora, via registered airmail, in response to a Spanish report, for reception during October 1970.

DOMINICAN REPUBLIC: Radio Cristal has been observed with its interval signal at 0920, earlier than its scheduled sign-on time. The program commences at 0930GMT on 5010KHz. ■

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FOR ISOLATING FAULTS IN TRANSISTORS, DIODES AND OTHER SEMI CONDUCTORS, FINDING DRY JOINTS AND BAD CONTACTS. PROTECTING HEAT SENSITIVE COMPONENTS WHILST SOLDERING, CHECKING THERMOSTATS AND THERMAL CUT-OUTS.

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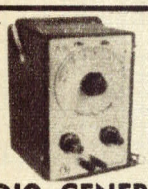
A.C.E. RADIO

AMPLIFICATION COMMUNICATION ELECTRONICS

PHONE 51-3845
51-7008

37 VICTORIA AVENUE, MIDDLE COVE
WEEKENDS & AFTER HOURS 40-5391

136 VICTORIA ROAD MARRICKVILLE — 51-3845



AUDIO GENERATOR

De Luxe Model TE—22D.

Freq. range, Sine 20 cps—200KC. SQ, 20 cps—25KC. Output Voltage Sine 7V. SQ. TV P.-P. Output Impedance 1000 ohms Acc. 5 per cent. 4-range attenuation. 1/1. 1/10, 1/100, 1/1K. Printed circuit. 240V A.C.

$42.95

SIGNAL GENERATOR

De Luxe Model TE20D.

Freq. Range 120 KC—500 Msc 7 Bands. Accuracy 2 per cent Output 8V. Provision for Xtal. Suitable for self-calibration Marker generator. Printed circuit. 240 V.A.C.

$31.50

TYPE 3000 RELAYS

50, 100, 500, 1000, 2000, 4000 ohms. DPDT. 75e ea. 15c post.

FOLDED ALUMINIUM INSTRUMENT BOXES

6" x 4" x 2"	$2.45
5¼" x 3" x 2"	$1.95
5" x 3" x 4"	$2.45
4½" x 1⅝" x 2¼"	$1.75
4" x 2" x 2"	$1.55
4" x 1½" x 2"	$1.55
3¼" x 2¼" x 1½"	$1.65
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Pack and Post 35c

BLANK ALUMINIUM CHASSIS

6in x 4in x 2in	$1.90
8in x 5in x 2in	$2.25
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NEW POWER TRANSFORMERS

240VAC, 50cps. Primary standard fil. windings.

385VCT 80MA	$3.75
325VCT 80MA	$3.75
385VCT 60MA	$3.00
385VCT 50MA	$3.00
325VCT 40MA	$3.00
240/240 60MA	$2.50
125MA filter choke	$2.00
100MA filter choke	$2.00
50MA filter choke	$1.25

Add Pack and Post.

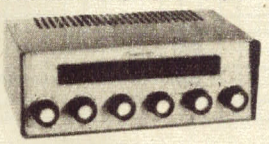
NEW SPEAKER TRANSFORMERS 3 WATTS

10K	15 ohms
10K	8 ohms
10K	3.7 ohms
15K	3.7 ohms
5K	15 ohms
5K	8 ohms
5K	3.7 ohms
7K	3.7 ohms
8K	15 ohms

$1.50 EACH

Post. 35c.

PLAYMASTER 106



HI FI STEREO AMPLIFIER

10 watts R.M.S. per channel. Freq. Response 30-20,000 cps. Inputs—crystal or ceramic cartridge. Tape. Separate bass, treble, balance. High gain broadcast band tuner. Slide rule dial. Excellent reception in country areas.

WIRED AND TESTED $94.75

Rotating Distress Emergency Beam



Red—Visibility ½ mile. 12V D.C. operation. Waterproof. Complete with heavy duty suction Cap. Size 3½in dia. x 5½in.

$5.75.

Pack and Post. 25c.

Metal Speaker Boxes

6in and 8in sloping front. Suit wall or desk. $4.00.

Pack and Post. 50c.

TOP MOUNT CAR ANTENNA

Complete with Coax lead and plug

Standard Telescope	$2.95
Lock down	$4.00
Spring Loaded	$4.00

LOTRING LIGHTWEIGHT SOLDERING IRON

240V AC, 30 watts	$6.50
12V DC 30 watts	$6.50

Weight 2½ozs.
Heating Time 1.8mins.

G.D.O. UNITS

Post: N.S.W. 50c, I'state 75c.
T.E. 15 Transistorised, 7 Band. 360 Kc to 270 Mcgs.

$39.75

TV BOOSTER

240 V.A.C. Especially designed for fringe area reception. Also up to 3 TV sets can be operated off common aerial for improved signal strength.

$15.95

Post Free

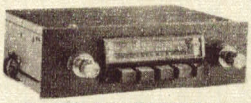
MODEL TE-65 V.T.V.M.

D.C. V 0-1.5-5-15-50-150-500-1,500 V. Rms. A.C.V.0-1.5, 5.5-15-50-150-500-1,500 V. Rms. 0-1.4-4-14-400-1,400-1,400-4,000 V. P.P. Resistance: RX10, 100.1K, .10K, .100K, 1M, 10M. Decibel—100dB minus-plus 65db.

240 V.A.C.

$43.75

TECH. P.V.58, $40.50.

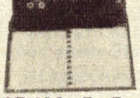


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Speaker Selection. 5", 6", 8", 7" x 5" or 6" x 9".

De Luxe Push Button Model. $55.75.



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Frequency Meter, 125 KC—20 MCS. Complete Calibration book —100 KC crystal. 240 V AC supply.

BRAND NEW	$75.
USED GOOD ORDER	$49.50

NEW C.R.O. TUBES

3AP1-906 3in	$2.75
CV112 5in	$2.00
VCR97 6in	$3.75
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CV1522 1¾in	$2.25

CAPACITOR DISCHARGE IGNITION SYSTEM

Kit of parts as per E.A. Aug. 1970

$27.95

Reverberation Units

Latest design to suit organs, stereo, guitar, any hi-fi equipment.

$5.75

Post Free.

SOLENOIDS—RELAY

12V DC Coil resistance 120 Ohms. 4-pole change over contacts, 10 amps.

$1.75

Pack and post. 25c.

12V 2 AMP. TRANSFORMER

240 VAC 50CPS prim.

$3.00

Pack and Post. 50c.

NEW GRAMMO MOTORS

240V. A.C.
3 Speeds. $2.75.
Post: 40c.

DYNAMIC LO-IMP STEREO PADDED HEADPHONES

With cord and stereo plug.

$3.50

Pack and Post., 50c.

BLOWER MOTOR

240V A.C. Complete with 5 feet 2" dia-flexible hose.

$15.00

DEVICES

Thyristor BTY 79-4000	$3.75
BTY 79-500	$4.25
C22D 200v 7.5A	$3.60
BRIDGE RECTIFIER	
PA 60. 600v 8 amp	$5.25
C106YI 30v	$1.55
LT91 Selium 2A-20v	$1.50

BRAND NEW

LIGHTING PLANTS

Johnson 1 h.p. Engine
12V, 30 amp. Generator.

$72.00

TR-1935 TRANSCEIVER

V.H.F. 10 channels Crystal locked. Freq. 100—155 MCS. Inbuilt 28 V DC Supply. AM. 10 watts power output.

$35.00

AN/APX-6 TRANSPONDER TXRX

900-1200mcs.

Complete with cavity tuning resonator, digital counters, 2C42-2C46 lighthouse tubes. 28V D.C. blower motor.

$17.50

HI-FIDELITY TWIN CONE SPEAKERS

Aust. made. 8 to 16 ohms.

6in .. $9.00 10in .. $10.75
8in .. $9.50 12in .. $12.75

Postage:
Interstate 80c.
N.S.W.. 50c.

INDICATOR UNIT 6"

12 STANDARD MIN. VALVES
1 CRYSTAL COMPLETE E.H.T. Supply No H.T. Supply
Suitable for CRO conversion
19" x 8" x 8" .. $19.75

INSTRUMENT CASES

Sloping Front. Hammertone Finish

9" x 6½" x 7¼"	$4.75
7" x 6½" x 7¼"	$4.45
6" x 6" x 6"	$4.20
5¼" x 3" x 2"	$2.75

Receiver-Indicator UNIT

Type R-65/APN-9, 3BPI C.R.O. tube with Mu-Metal Shield and Socket. 33 valves. 2 x 2—5Y3 — 6Y6 — VR105 — 6SA7 — 6N7 — 2 x 2 SJ7, 3 x 6 SL7, 3 x 6SK7, 7 x 6H6, 13 x 6SN7.

Inbuilt super-het. Receiver designed for reception of pulsed waveform.

4 channels, 1750KC—2020KC.

$19.75

WANTED

Communications Receivers Test equipment. P.A. Gear. Large or small surplus stock. Best prices. Call, write or phone any time.



GUITAR AMPLIFIERS

14-watt, 4 Inputs. Base and Treble Boost. 2 Twin-cone Speakers.
17-Watt 4-Channel. Base and Treble Boost. Two Twin-cone Speakers $83.85

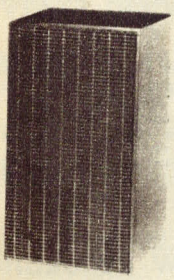
35 WATT

4-Channel, Bass and Treble Boost. 4 Twin-cone Speakers, **$119.00.**
Vibrato with foot control and 2 preset controls for frequency and intensity. $10.50 extra on above models.

14 watt, etc $69.50
17 watt $83.85
35 watt $119.00

3 WAY HI-FI SPEAKER SYSTEM

Famous Onkyo Imp. 8 ohms.
20 watt 8" woofer 30-3000 cps $17.50
30 watt Mid Range 6" 600-10,000 cps $9.50
40 watt horn tweeter 5000-22000 cps $7.95
Oiled Teak Cabinets to suit $26.75
0—150MHZ 75 Ohms



MULLARD MAGNAVOX

Designed bookshelf enclosure with 6WR twin cone and 3TC tweeter $26.75 ea.
Super bookshelf enclosure with 2 x 6 WR .. .. .. $36.75 ea.
Hi-Fi enclosures with magnavox 8WR or Rola C8MX .. 8 watts RMS .. .. $36.75 ea.
With 2 x 8WR or 2 x 8CMX 15 watts .. .. .. $45.00 ea.
With 12WR—10 Watts $45.00 ea.
8 or 15 ohms available.
All cabinets are constructed of Pineboard and Veneered with Oiled Teak Formica and are complete with crossover network — Tweeter — Innerbond packing.

PLAYMASTER 127 STEREO CONTROL UNIT

For tape replay, Magnetic, disc. and crystal cartridge input. Radio fully described Nov. 69 issue E.A.



KIT SET $49.50

Wired and Tested $59.50.
Pack and Post 75c.

128 STEREO AMPLIFIER

64 Watts per channel
Kit set $89.00
Wired and Tested $109.00

SONATA PIGGY-BACK GUITAR AMPLIFIERS

Professional quality — valve circuitry 2 channels—4 Hi. Imp. inputs. Each channel has a separate volume control. Bass and treble boost controls. Standby switch. Vibrato with speed and depth controls—on/off foot switch with plug and lead. Voice coil matchings—4-8-16 ohms. Black vynex carry cabinet.
40 watt model $110.75
60 watt model $143.00
Black vynex covered speaker enclosures to match above amplifiers.
40 watt lead $94.00
40 watt bass $110.00
60 watt lead $115.00
60 watt bass $128.00

50 WATT SOLID STATE GUITAR AMPLIFIER

E.A. July and August Issue Kitset, including Cabinet.
$98.00
Wired and Tested.
$114. 00

COMPACT HI POWER ENCLOSURE

E.A. Jan. 71.
30 watt, complete as described.
$51.50
Magnavox 8-30 Speaker .. **$17.50**

GUITAR AMPLIFIER 150 WATT SOLID STATE

Multi-purpose wide range frequency response. 2 Channels. 4 inputs. separate Bass and Treble Controls. also separate volume controls. Can be operated Mono or Stereo. Black Vynex covered **Carry Cabinet 175.00**

ALL SILICON TRANSISTOR SOLID STATE STEREO AMPLIFIER



240V AC powered, 8 watts RMS per channel inputs for magnetic ceramic, and crystal cartridge, also recorder and radio tuner. Hi-Fi frequency response speaker matching 4-16 ohms. Size 10½in x 6½in x 3½in. Attractive oiled teak cabinet.

$54.00

CASSETTE TAPE DECK

4 Track—Stereo
Famous make. Complete with Pre-Amplifier. 2 dynamic microphones. Plugs and Cables. 240v A.C. Operation. Connect Direct to your Stereo Amplifier **$147.50**

$147.50



LEADER SIGNAL GENERATOR LSG II

240 V AC operated. 6-band 120 KC to 390 Megs. Provision for crystal.
Post N.S.W., 75c; Interstate $1.25.

$49.50

ORGAN KEYBOARDS

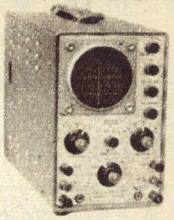
49-Note. Complete with Switching System.
$72.00
13-note. Pedal Claviers. Complete with Switches.
$39.50

WIDE BAND OSCILLOSCOPES

VERTICAL AXIS
Deflection sensitivity (at 1 kc) 0.1 V p-p/cm.
Frequency Characteristics. 1.5 cps —1.5 MC.
Input Impedance. 2 M ohms 25pF. Calibration Voltage IV p-p/cm.

HORIZONTAL AXIS
Deflection Sensitivity 0.9V p.p /cm
Frequency Characteristics 1.5 cps —800 KC.
Input Impedance 2 M ohms 20 pF. Sweep Oscillator (5 Range) 10 cps —300 KC.
Synchronisation Devices Internal (Positive and Negative, External).
Power 240v AC 50/60 cps.
Cathode Ray Tube 3KF1F.

3-inch $102.75



5 Meg Bandwidth Push-Pull vertical and Horizontal Amplifiers, 8 positions, high sensitivity, vertical Amplifier Frequency Compensated on all positions. Calibrated .02 to 600 volts. Hard time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

5-INCH $118.75

GUITAR SPEAKERS

12" 50 watts RMS $47.50
12" 20 watt $27.50
12" 15 watt $19.75
12" 15 watt Twin Cone .. $22.50
Pack and Post 70c

RHYTHMATIC ELECTRONIC RHYTHM UNIT

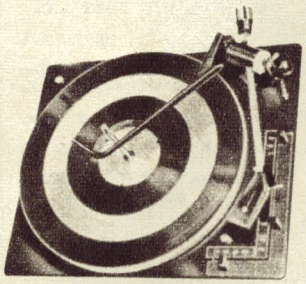
Solid-state, battery operated. Excellent accompaniment for guitarists. 6 rhythms, variable tempo control. volume control. Can be powered from external supply.

$67.00

Post.. 50c.

STEREO RECORD CHANGER

C109 — MA65 — MA70 — MA75
(Picture of record change taken from page 152 March, 71 E.A.)



Current models, 4 speeds, automatic or manual operation. Standard model $28.50
Ceramic cartridge, Sapphire Stylus Standard model with 12in turntable $34.00
Deluxe model with 12in turntable. Cueing device, Ceramic cartridge Diamond Stylus $40.00
Deluxe model as above with — adjustable counter balance, 2 spindles, calibrated stylus pressure control added $46.50
Deluxe model as above with 12in Diecast Heavyweight Turntable, 4-pole Shielded motor, Suitable for Magnetic cartridge .. $56.50
The latter two record-changers can be supplied with magnetic cartridge and diamond stylus at $10 extra.

PLATFORMS

Teak Platforms, suit above changers, **$9.00.** Fully moulded tinted perspex covers, suit platforms 17¼in x 13½in x 4in

BLANK PLATFORMS
$8.50.

AUTOMATIC RHYTHM UNIT
10 RHYTHMS
AND PERCUSSIVE INSTRUMENTS
240v A.C. OPERATION.

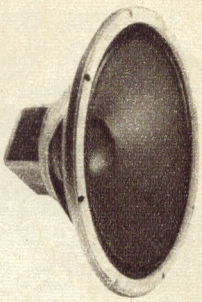
$125.00

B.S.R. 4 TRACK

STEREO TAPE DECK.
3 speeds, 7in spools. 3-digit counter Fast forward—fast rewind.
$48.50.
Fitted with third head for monitoring. $55.50.

SINCLAIR Z30

Integrated 20 watt Hi Fi Amplifier Complete with instruction manual
$14.45



15" PIONEER

15in Pioneer Low Frequency Speaker. Imp. 8 ohms. Power, 30 Watts. R.M.S. Designed especially for use with Bass Guitar or Electric Organ. Also ideal for Stereo Woofer Speaker.

$30.00

T.E. 46 RESISTANCE CAPACITANCE

Bridge and Analyser.
Capacity 20pf to 2000mfd Resistance 2 ohms to 200 megs. Also tests power factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs, at 600V.
Indications by eye and meter.

$53.75

VOLT A.C.

VARIABLE TRANSFORMER.
0-260V, 10 amp **$49.50**
0-260V, 5 amp **$37.50**
0-260V, 2½ amp **$25.50**

A.C.E. RADIO

AMPLIFICATION · COMMUNICATION · ELECTRONICS

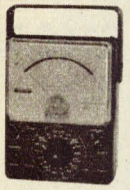
★★★★★★★★★★★★★★★★★★★★

PHONE 51-3845
51-7008

37 VICTORIA AVENUE, MIDDLE COVE
WEEKENDS & AFTER HOURS 40-5391

136 VICTORIA ROAD MARRICKVILLE — 51-3845

KAISE
MODEL SK-100



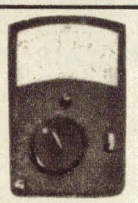
VOLT-OHM-MILLIAMMETER

HIGH SENSITIVITY
100,000 Ohms per Volt DC
10,000 Ohms per Volt AC

SPECIFICATIONS:
- DC Volts: 0.6, 3, 12, 60, 300, 600, 1200V.
- AC Volts: 6, 30, 120, 300, 1200V.
- DC Current: 12uA, 300uA, 6mA, 60mA, 600mA, 12A.
- AC Current: 12A.
- Resistance: 20K ohms, 200K ohms, 2M ohms, 20M ohms.
- Decibels: Minus 20 to plus 17, 31, 43, 51, 63.
- Accuracy: DC plus minus 3%, AC plus minus 4% (of full scale).
- Overload Protected by Dual Siliciondiodes.
- Double-jewelled plus minus 2% Meter.
- Plus minus 1% Temperature-stabilised Film Resistors.
- Polarity Changeover Switch.
- Scale with Mirror.

Price $34.75. Post 75c. Interstate $1.00.

K 20 CT330



K 20 CT500

CT. 330 20K. OPV

D.C. Volts 6, 6, 30, 120 600 1200, 3,000, 6 000 AC Volts 6, 30, 120, 600, 1,200. D.C. Current .06-6, 60, 600mA Resistance, 6K, 600K., 6meg., 60meg.. D.B. minus 200 to plus 62, 5 Ranges. Specially suitable for transistor use.

$16.45

MODEL SK-44
30K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.6, 3, 12, 60, 300, 600, 1200, 3000.
A.C. Volts: 6, 30, 120, 300, 1200.
D.C. Current: 30uA, 6mA, 60mA, 600mA.
Resistance: 10K ohms, 1 M ohms, 10 M ohms, 100 M.
Decibels 20 cps plus 17, 31, 43, 57, 63.
OVERLOAD PROTECTION.
SPECIFICATIONS
Post 50c. Interstate 75c.
$19.25

MODEL SK-20
20K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.25, 2.5, 10, 50, 250, 1000.
A.C. Volts: 10, 50, 250, 1000.
D.C. Current: 50aU, 25mA, 250mA.
Resistance: 7K, 700K, 7 Meg.
Decibels: Minus 10 cps plus 22 (at A.C./10V) plus 20 cps plus 36 (at A.C./50V). Upper freq. limit 7 Kc.
OVERLOAD PROTECTION.
$13.50.

NEW SPEAKER SPECIALS

8-16 OHMS

5¼ins	$3.35
6ins	$4.15
8ins	$4.85
4ins x 2ins	$3.45
5ins x 3ins	$3.45
6ins x 4ins	$4.25
7ins x 5ins	$4.85
9ins x 6ins	$6.25
3in Pillow Phone 8 ohm	$2.45

MODEL SK-70
30K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
D.C. Volts: 0.5, 2.5, 10, 50, 250, 500, 1000.
A.C. Volts: 10, 50, 250, 500, 1000.
D.C. Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 7K, 70K, 700K, 7 Meg.
Decibels: Minus 10 cps plus 62 db.
OVERLOAD PROTECTION
$19.95.
Post 50c, Interstate 75c.

MODEL SK-60
50K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.25, 2.5, 10, 50, 250, 500, 1000.
A.C. Volts: 10, 50, 250, 500, 1000.
D.C. Current: 25uA, 5mA, 50mA, 500mA.
Resistance: 10K, 100K, 1 Meg. 10 Meg.
Decibels: Minus 10 cps plus 62 db.
OVERLOAD PROTECTION.
$22.75.
Post 50c, Interstate 75c.

MODEL SK-55
30K OHMS PER VOLT D.C.
14K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.6, 3, 12, 60, 300, 1200.
A.C. Volts: 12, 60, 300, 1200.
D.C. Current: 60uA, 12mA, 300mA.
Resistance: 10K Ohms, 1 M ohm, 10 M ohms.
Decibels: Minus 10 cps plus 23 db.

$19.95

S.W.R. METERS

0-100MCS.
1KW. POWER OUTPUT.

$14.75

Pack and post 75c.

MODEL SE-405

0-150 MHZ 75 Ohms. 2 K.W.

$27.50

SIGNAL INJECTOR

MODEL 250-B.
TRANSISTORISED.

$7.95

SIGNAL TRACER

Operates in conjunction with 250-B

$4.95

DYNAMIC MICROPHONES



CARDIOID. UNI-DIRECTIONAL
On-off switch. Hand held or stand mount.
Freq. response: 80-10,000 cps.
Sensitivity—60DB/1000 cps.

Model—UDM-103. 50K-600 ohms	$16.45
Model UDM-104. 50K	$13.95
Model UDM-3. 50K (Stand mount only.)	$12.95
Hi Imp Dynamic DM 203	$8.75
Crystal Lapel	$1.75

AMPLIFIERS PUBLIC ADDRESS RANGE 240V-AC



MINIATURE P.A. AMPLIFIER
15 WATTS OUTPUT
Multi Match Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing

P.P. EL-84 output	$42.50
30 Watt. As above, EL-34 P.P.	$57.50

Public Address Range.
All models available with either multi-tapped 600 ohm line or 15 ohm Voice Coil.
Solid State 240V A.C.

20 Watt	$49.50
50 Watt	$69.50
50 Watt 240 A.C. plus 12v. D.C.	$89.00

All have input for 2 microphones or 2 Magnetic or Crystal P.U. With Mixing.



P.A. SPEAKERS

8 WATT.
8in Units in Waterproof Projection Horns.
15 Ohm Voice Coils.
Price $16.75
Line Output Transformers to suit. **$1.75 extra.**

MICROPHONE STANDS

Floor Model. 6ft adjustable with heavyweight cast-iron base.

$11.75

8" TABLE MODEL

$3.50

Flexible Goose Necks.

9in	$2.75	18in	$4.35
12in	$3.50	24in	$5.00

ELECTRIC GUITAR

PICK-UP UNITS.
Separate volume, tone control.
$9.75

SPEAKER COLUMN

VINYL COVERED—TEAK—
33in x 10in x 10in. Complete with 4 heavy duty 6in Speakers. 25 watts— 4, 8, or 16 ohms.

$32.50

TAPE CASSETTES

TENSILISED MYLAR

C 60	$1.25
C 90	$2.00
C120	$2.75
Head Cleaners	$1.75

MECCA-SOUND MATE SOLID STATE CASSETTE TAPE RECORDER

2 track, mono. 8 transistors. Battery operated. Auxiliary input for recording records, TV, radio. Complete with microphone with remote control switch and table stand. Provision for external 7½V DC supply. Battery record level indicator.

$54.00

Pack and post 75c.

NEW RECORDING TAPE

7in Mylar 3600ft	$5.00
7in Mylar L.P. 1800ft	$3.00
7in Mylar D.P. 2400ft	$4.35
3" 300ft Poly	50c
5" 900ft Poly	$2.00
5" 1200ft	$2.30
5" 1800ft	$2.75
7" 1200ft Acetate	$2.50
5" 500ft Acetate	$1.50

HI-FI STEREO HEAD PHONES



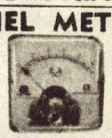
DE LUXE MODEL WITH INDIVIDUAL TONE CONTROL

$12.95

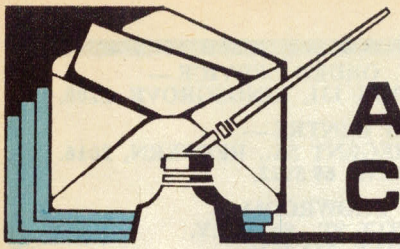
20—12000 cps	$5.60
20—18000 cps	$9.00

Pack and Post 35c.

PANEL METERS



Clear Plastic Flush Mounting
1¾ins, 2ins, 3ins, 4ins.
Full range available.
From 50uA—10A DC, 15 VDC, 500 VDC, 300 VAC, VU and S.
Also
Edge Mtrs,
VU—Stereo Balance.
Send for price list. S.A.E.



ANSWERS TO CORRESPONDENTS

CROSSOVER NETWORKS: I recently bought some very expensive stereo hi-fi equipment and since I want the best possible sound reproduction I should like some information on loudspeaker connections. I have a 12in 40W woofer, a 20W tweeter and 20W mid-range unit, all with an impedance of 8 ohms. Should I connect these in series or parallel and should I employ a capacitor? If so, what value? **(M.W., Guildford, WA.)**

● For best results you should use a properly designed crossover network, and put the loudspeakers in a cabinet of correct dimensions. We suggest you contact the loudspeaker manufacturer or his distributor and ask for their recommendations for the particular units you have. You would certainly not connect the units in series – or in parallel either, for that matter!

DELTAHET RECEIVER etc: Congratulations on the release of the Deltahet Mark 2 Receiver, preliminary details of which I have just read in the January issue. A very fine effort. In view of these latest developments, the comments in Let's Buy An Argument (now Forum), May and July, 1962, make interesting reading in retrospect. Such circuits as the Solid State SSB Transmitter, Digital Frequency Meter, Solid State Volt-Ohm Meter, etc, leave little to be desired. How about rounding off with a digital multimeter, measuring current and voltage, both AC and DC, together with resistance, to an accuracy of say .01%? After 22 years of reading, I still find Electronics Australia a most stimulating journal.**(E.Z., Wellsford, NZ.)**

● The Staff of Electronics Australia has just taken a bow! More seriously, we are pleased to read that you derive such satisfaction from many of our projects and the magazine generally. As E.Z. was one of the initial "stirrers" on the subject of communications receivers, we understand your special interest in the new solid state version of the Deltahet Receiver. The Deltahet seems to have captured the imagination of many readers over the period of its existence. Yes, we agree that the comments in Let's Buy An Argument, on communications receivers, do make interesting reading in retrospect. We appreciate your interest and request for a digital multimeter. However, such projects as those already mentioned, take an enormous amount of development time and effort, to produce the final articles. As a result, we can only manage to produce such articles over extended and irregular intervals.

14-YEAR-OLD READER: I wish to compliment you on an excellent book – I call it a book because it is more than a mere magazine. I read each issue through several times as it becomes available. I would like to know if there is a 72MHz model control band in Australia. Also, have you ever published a nomogram for determining the inductance of coils, together with the relative formulas? How many years of tertiary training are required to become an engineer, and does one have to be apprenticed first or does he proceed straight to college or university? **(G.McK., Maryborough, Qld.)**

● Thank you for the complimentary parallel, G.McK., that is certainly a new one on us! According to the Form R.B.195 as issued by the PMG's dept., there are only two bands for model control in Australia, viz, 26.957 to 27.282MHz; and 40.66 to 40.70MHz. As yet, we have not published any abacs and their associated formulas relating to inductance of coils. Your last question can be answered best by your State Education Authority through their Vocational guidance section. In general, however, an engineering degree or diploma involves secondary education to matriculation level, then five years or more at a university or technological centre of comparable standing.

DOLBY SYSTEM: The Dolby A301 is a stereo unit, not a single channel as you suggest in the article in your February issue. One unit comprises two independent signal processors, each capable of being switched to record or playback. Unless monitoring is undertaken at the time of original recording, only one A301 is required per dual stereo system. Editing is said to be easier direct from the processed tape without the playback processor being used. Dolby B-type cassette pre-recorded tapes were released late in 1970 by Decca, Ampex and Vox. Catalogue numbers for Decca are SXC-6355, SXC-6419, SXC-6447, ZRC-584 and PFC-4183. On the subject of B-type cassette recorders, figures are outstanding: up to 15KHz and S/N ratio of more than 50dB. Dolby has set down high standards for B-type recorders, one stipulation being that wow and flutter be below 0.2% RMS. Naturally, this must raise the cost of any cassette recorder. **(N.C., Ferntree Gully, Vic.)**

● Thanks for the observation, although it really does not change the picture to any extent. The full Dolby system is likely to remain part of professional situations only. We would have reservations about the idea of editing through an uncorrected channel. Easy, perhaps! But how valid can editing be, based on subjective reactions, when the editor is not hearing the end result? Yes, a few tapes may have been released but whether they herald a flood or a drought remains to be seen. The specifications may also look impressive but one cannot be sure that they will appear in typical tapes and machines. If our article sounded cautious, it was because we were being influenced by present attitudes as much as by promises for the future.

AUDIO EFFECTS: I should like to add my compliments on your magazine. I am particularly interested in audio effects, and would like you to publish circuits for bass, treble and vibrato controls for guitar amplifiers. If you cannot publish these, can you advise me where I could obtain these circuits? **(J.R., Darra, Qld.)**

● We can only assume you are a new reader, as we have published a number of circuits for electric guitar effects in recent years. For example: August, 1964 Vibrato and Tremolo (1/EM/12). November, 1964, LDR Type Vibrato Tremolo (1/EM/13). August, 1967, Fuzz Box (1/GA/10). October, 1967 Reverberation System (1/GA/12). November,

"ELECTRONICS AUSTRALIA" INFORMATION SERVICES

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: For a 20c fee, we will supply data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for project data will be answered more speedily if the projects are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c per page.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to six months old the cost is the face value, plus 5c surcharge. From seven to 12 months, 10c surcharge; over 12 months, 20c surcharge. Package and postage is 10c extra per issue. Please indicate whether a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design.

"ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia", Box 2728 GPO, Sydney, NSW 2001. 4/71

PRE-PAK electronics

MAIL ORDER SERVICE —
P.O. BOX 131, KINGSGROVE, 2208.

SALES CENTRE —
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THIS MONTH ONLY!

New self-service disposals centre at 95-97 Regent St, Redfern. Bargains for personal shoppers only. You name your own price on many lines — If your price is reasonable, we accept!

COMPUTER PANELS

Ex Honeywell Computers, exclusive to Pre-pak. Average four to twelve transistors, plus ten to fifty diodes, plus resistors and capacitors, on each pane, approx. 100 asst. parts.



4,000 mfd 50v capacitors	$1.50
6,000 mfd 75v capacitors	$2.25
6,000 mfd 150v capacitors	$2.25
34,000 mfd 40v capacitors	$3.00
Relays, high-speed mercury wetted contacts	40c
Multi-pin connectors, gold-plated pins	40c
Transformers from	50c
Circuit-breakers, low voltage ½A, 1A, 2A, 3A, 5A, 10A, 15A	75c
Circuit-breakers, high voltage 5A, 10A, 15A, 20A	$1.00
Solenoids 30v coils, 30A, 50A contracts	$1.00
10w modular hi-fi amplifiers	$7.50
6w modular hi-fi amplifiers	$5.00
Philips tuner modules	$6.00
BSR tape decks, 3-speed, 4-track from	$10.00
Compact audio oscillator valve type	$6.00
Ex-army No. 128 transceivers	$7.50

READ THIS:

We will sell your surplus at your price for only 10% commission or we will buy any type of disposals equipment. No junk please!

TRANSISTOR RADIO KIT $7.50

A complete six-transistor radio kit, includes P.C. board, gang, semiconductors, speaker and battery, with instructions. These sell in the stores for $15.00.

POLYTRON MODULES

R010 RF OSC/Mixer Module	$3.95
1022 IF Amplifier, high sensitivity 455KHZ	$7.95
AO51 Audio Amplifier, 200 mw, 6v battery	$5.95

Add Ferrite aerial, tuning gang, volume control and speaker to build powerful 8-transistor radio.

To: PRE-PAK ELECTRONICS,
P.O. BOX 131, KINGSGROVE, 2208.

PLEASE SEND INFORMATION ON —

[ ] SINCLAIR EQUIPMENT [ ] HI-FI EQUIPMENT
[ ] POLYTRON MODULES [ ] SPEAKERS
[ ] KITS [ ] METALWORK [ ] MAG. CARTRIDGES

TO .....

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..... POSTCODE .....

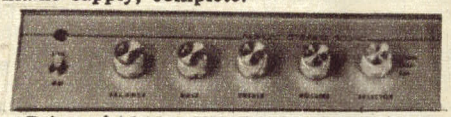
SINCLAIR PROJECT 60

Z30 20W amp	$14.90	PZ5 power supply	$17.60
Z50 40W amp	$18.75	PZ8 power supply	$26.50
A.F.U. filter	$26.50	PZ6 power supply	$

Stereo sixty pre-amp and control unit $34.25
Chassis suit Z30 system, teak front panel $12.00
Complete amplifier kits, including associated parts .. $80.00
Demonstration facilities now available!

3W Stereo AMP Kit SA.1.

Based on Plessey SL1403A, attractive case with aluminium knobs, mains supply, complete.

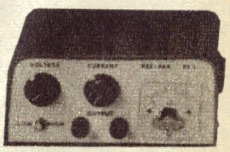


Price: **$46.00** 3W RMS. Post, $1.00.

3W Mono AMP Kit MA.3.

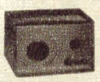
Includes Plessey SL-403A, all parts, chassis and case and treble controls. MA—3 Kit, **$15.90.** Post, 50c.
MA—4 Kit, with mains power supply, **$23.90.**

P.S1 20v REGULATED POWER SUPPLY



Variable, regulated, short-circuited projected power supply with voltmeter, variable current cut-out.
Complete kit, ... **$27.50.**
Post, $1.00.

AO.1 AUDIO OSCILLATOR KIT



As in E.A., June, '70, complete kit with battery, case knobs, etc. 20HZ-20KHV. Price: **$14.50,** post, 50c.

CLUB MEMBERS SPECIALS

BC108	40c	OA91	20c
BC109	45c	1NG14	20c
2N3055	$1.90	2N4443 SCR 400v 6A	$2.20
2N2160 UJT	$1.50	PA-234 1w l.c.	$5.75
2N3638	50c	PA-237 2w l.c.	$9.35
40408	$1.50	PA-246 5w l.c.	$11.50
40409	$1.50	TAA-300 1w l.c.	$3.60
SL403A	$8.90		
EM404	25c		

CAPACITOR DISCHARGE IGNITION

G.T.S. by Stratronics. Unconditionally guaranteed 6 months.

De luxe	$39.95
Competition	$48.00
Marine	$59.00

Pre-pak Electronics C.D.I. Kit contains all parts, easy to assemble, **$27.75,** post 50c.

HI-FI SPEAKERS 8 or 15 OHM

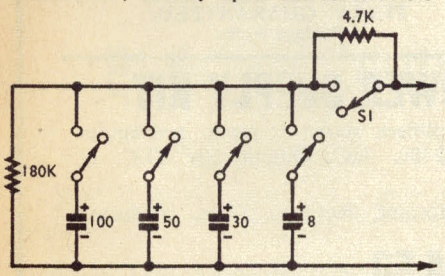
6½-inch 30HZ-15KHZ 6w RMS, **$12.30,** post 50c.
8-inch 30HZ-15 KHZ 8w RMS, **$13.20,** post 50c.
10-inch 30 HZ-15KHZ 10w RMS, **$13.20,** post 50c.
12-inch 30HZ-15KHZ 10w RMS, **$14.50,** post 50c.
8-inch 40HK-8KHZ 30w RMS Woofer, **$21.00,** post $1.00.

1968 Guitar Preamp with Vibrato (1GA/14). February, 1969 Guitar Treble Boost Preamp (1GA/15). May, 1969 Waa Waa Unit for Guitar Amplifier (1/GA/16).

● In addition we have published various circuits for monophonic organs, a theremin, electronic bongos and an automatic rhythm generator. Project reprints for all these items are available from our Information Service for 20c each. The numbers quoted in brackets after the project titles are the file numbers. They will help provide correct identification of the project required.

"HEALING" CAPACITORS: Compliments to Mr Pik on his R&C substitution boxes. However, I would suggest a modification to the service C box to avoid "healing" any open-circuited electrolytics in the set under test. It would involve one extra switch and one extra resistor connected into the circuit as shown. **(H.S., Bulimba, Qld.)**

● Thank you H.S. for your comments and constructive suggestion. To clarify the thought behind your suggested modification to other readers, perhaps we should explain the term "healing" as used in this sense. In this instance it refers to the process whereby the discharge current of the capacitor under test fuses its own internal or external high resistance joint(s). The discharge current is caused by the connection of the "dead" substitution capacitor directly across the suspected capacitor. Invariably, however, this fusing process provides only a temporary cure. Just how often this occurs in practice is a much debated point. Some may argue that, if after substitution of a suspected capacitor the equipment behaves normally and continues to do so after the removal of the substituted capacitor, it is a wise precaution to replace it in any case. But we leave this decision, and including that of H.S.'s modification, entirely up to the constructor.



To use the modified Service C-Box, one simply opens S1 prior to connecting the leads to the piece of equipment. After a few seconds the switch is closed. In this way the charge current of the capacitor(s) in the C-Box as well and the discharge current of the capacitor under test are limited.

MODIFYING STEREOGRAM: I have a commercial stereogram in a one piece unit, using three local loudspeakers on each side. The bass is not as heavy as I would like it. Can I house the loudspeakers in two separate boxes? Would a cardboard tube help, as described in your recent issue? **(K.H., Greystanes, NSW.)**

● The limitation on bass output may be a function of the cartridge or the circuitry, as much as of the loudspeakers. Designers of single-unit stereograms have to go easy on bass response, because of likely problems with acoustic feedback through the cabinet structure. It is possible also that you may be expecting exaggerated bass, which will not be provided by simply re-housing the loudspeakers. Separating the loudspeakers from the cabinet would improve the stereo spread, which would be an advantage in itself. However, as our articles have sought to point out, there is more to achieving a good bass characteristic than mounting the loudspeakers in a box and inserting a vent tube. The whole thing has to be designed as a system. Since the stereogram uses MSP brand loudspeakers, it may be worthwhile to write to that company in the hope that they will have a suitable enclosure design for the particular loudspeakers. The 5-inch middle-range loudspeaker would probably have to be separately enclosed within the main box so that the air pressure from the main units would not "pump" the 5-inch cones. The tweeters probably have fully sealed housings already. The address of Manufacturers Special Products Pty Ltd is 47 York St, Sydney 2000.

MEGGER: Over the last few years I have purchased your magazine every month and have found it very worthwhile. I am trying to make a small transistorised "Megger" but without much success. I was hoping you may have published a circuit or have access to one. **(B.G., Bendigo, Vic.)**

● We are pleased you find our magazine so enjoyable B.G. We will endeavour to keep up the standard. So far we have not published a design for a high voltage insulation tester. There are several available on the market today and this generally tends to make the economy of home construction less attractive. However, if readers show sufficient interest we will investigate the possibilities and if we come up with an economic design we will certainly publish a project along these lines. Thank you for the suggestion.

OLD LOUDSPEAKERS: Some time ago, I wrote to one of our local loudspeaker manufacturers requesting some information on old mains energised loudspeakers of theirs, which I hoped to use in a charity situation, where the price of new loudspeakers could not be met. They simply said they couldn't help and enclosed data on their current production loudspeakers. I suspect that they could give the information but refuse to do so, in the hope of selling new loudspeakers and boosting their profits. Admittedly they are in business to sell new loudspeakers but a little more humanity would have been appreciated. **(N.R., Chatswood, NSW.)**

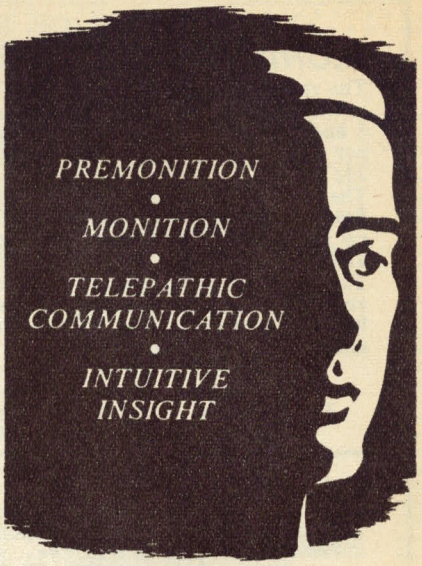
● Having had dealings with loudspeaker (and other) manufacturers over many years, we are reasonably certain that personnel would have changed, perhaps more than once, since the loudspeakers you refer to were in production. There would be no literature available and, if any data remained at all, it would be in a long-forgotten folder tucked away in some odd corner. It is not unusual for people who have been in the game long enough to recall products which are simply not known to the present staff in the factory concerned. We lean strongly to the opinion that the company genuinely did not have the literature you wanted and probably did not know where to turn to find even a record of the data. In saying this, we have not the slightest interest in defending their attitude. It's just the way things are in the average mass production situation where there is little incentive to maintain records beyond production and servicing requirements.

INERT CELLS: Can you tell me what kind of cell is an A Cell Inert S Mk I, as used in conjunction with a galvanometer in testing firing circuits. **(L.S., Herston, Qld.)**

● As we recall from our service days, A Cell Inert S is one which merely requires filling with distilled water to become activated. It then behaves like a normal 1.5V cell. This method of manufacture was used to ensure a prolonged shelf life.

MULTIPLE FREQUENCY TONE CONTROLS: In your future design schedules for stereo quality audio equipment, do you anticipate developing a stereo amplifier with controls that influence five separate ranges such as 60, 250, 1000, 5000, and 15000Hz? I feel this may be more useful than to simply modify the extremes with the usual bass and treble controls. The prices of such amplifiers are beyond the pockets of quite a few of us, and surely, the use of linear ICs and locally produced components could assist in making a home builder's project of the above a reality. Congratulations on a magazine of such broad appeal. Not only myself, but my wife enjoys the magazine – particularly the "Serviceman", even if most of it goes over her head! **(R.F., Dynnyrne, Tas.)**

● Although such an amplifier can be designed using the components suggested,



Behind Your Conscious Mind

WHY LIMIT YOURSELF to five senses? There is a greater world of realization behind your outer self. Impressions of these extrasensory powers occasionally arise. The strange feeling of impending danger—an intuitive hunch—receiving another's unspoken thought—these indicate unused potentialities. They are natural phenomena. To understand, develop, and direct them can transform your whole personality. They provide greater insight and personal achievement.

FREE BOOK

The Rosicrucians, a worldwide cultural organization (not a religion) have the facts about your extrasensory powers. A free book *The Mastery of Life* tells how you may share this practical knowledge. Use coupon or write to Scribe Y.S.T.

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Please send me a complimentary copy of the book "THE MASTERY OF LIFE."

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NEW RANGE OF RESISTORS, CONDENSERS & POTENTIOMETERS

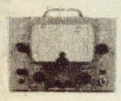
The resistors are mainly I.R.C. and Morganite and are in a wide range of values from 100 ohms to 3 meg. in ¼, 1 and 2 watt and include wire wound. LIST PRICE **$9.00** per 100. OUR PRICE $2.00 per 100. Post and packing 35c extra.

The condensers are in most popular brands and include Polyester, Paper, Mica, Ceramic and Electrolytic in values up to 8mfd. LIST PRICE **$11.00** per 100. OUR PRICE **$2.00** per 100. Post and packing 65c.

The pots, are all current types and include switch pots, and dual concentric, tandem, tab pots. etc. LIST PRICE **$12.00** per dozen. OUR PRICE **$2.50** per dozen. Post and package 60c extra.

FREE With each lot of resistors, condensers or pots. we will supply one new valve. Type 6U7G, 1T4.

Regret special values in resistors, pots and condensers cannot be supplied.



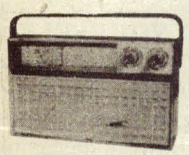
LEADER SIGNAL GENERATOR LSG11

240V A.C. operated, 6 band 120KC to 390 Megs. Provision for crystal. **$49.50**

Post N.S.W., 75c; Interstate, $1.25.

NEW TRANSISTOR 8 KIT SET

SPECIAL PURCHASE ENABLES US TO OFFER THIS KIT SET AT $24.00



DIMENSIONS 9" x 5" x 3" deep

- Complete kit of parts with circuit and full instructions.
- Eight transistors.
- Magnavox 5X3 speaker gives excellent fidelity.
- High sensitivity, suitable for city or country use.
- Heavy duty battery for economical operation.
- Modern design, plastic cabinet with gold trim.
- Dial calibrated for all States.
- Available in colours of off-white, red, black.

Post N.S.W., $1.25; Interstate, $1.75.

A TRANSISTOR PREAMP FOR MAGNETIC PICK-UP OR TAPE HEAD

Using 3 transistors per channel as featured in Electronics Aust. Complete kit of parts including transistors. P.C. board and resistors and condensers. Circuit and full details supplied.



Stereo Kit **$8.50.**

Mono Kit **$4.50.**

240V Power Supply **$4.50.**

State if required for Pick-up or Tape Head.

NEW HIGH STABILITY CARBON RESISTORS 1 p.c. and 2 p.c. TOLERANCE

These imported resistors are in ½ and ¼ watt with values from 50ohm. to 1 meg. 1% and 2%. In packets of 50 mixed values. LIST PRICE 20c each.

OUR PRICE $2.00 per packet of 50.

Post and packing, 20c extra.

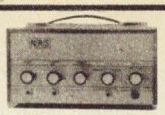
(Regret special values cannot be supplied.)

NEW IMPORTED SLOT CAR KITS AT LESS THAN HALF PRICE



Complete kit of parts, including 12V motor and full instructions.

$1.90 post 25c



NEW 25 WATT P. A. AMPLIFIERS

These amplifiers are suitable for installation in clubs, schools, restaurants, factories, etc. Wherever the amplification of speech or music is required.

$63 Freight extra

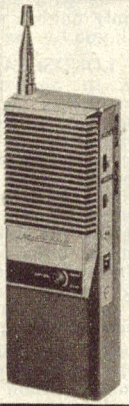
SPECIFICATIONS

Nominal power 25 watts. ● Inputs two microphone and pick-up radio with separate controls and mixing facilities. ● Tone control. ● Frequency response 30 to 18,000 CPS. ● Output impedance Line output (100, 166, 250, 500 ohms) or can be supplied with V.C. output (2, 3, 7, 8, 15 ohms). ● Dimensions 11in x 6in x 8in. Weight 25W 23lb. Freight extra.

NEW COLUMN SPEAKERS

Suitable for above Amplifier in walnut finished cabinet containing four 8" Rola Speakers Imp. 8 ohms. **$37.50.**

NO MAIL ORDERS



At last a breakthrough in the cost for high quality portable radio transceivers of the walkie-talkie hand-held type. We are introducing and offering for sale a fully PMG approved

MIDLAND 1 WATT TRANSCEIVER

for 27,240 kHz operation with switch provision for two additional channels, tone call signal, background noise squelsh control, battery voltage indicator, steel case with separate cover, good for five miles distance communication under average field conditions, with penlite cell-batteries for

ONLY $37.50 PER UNIT, FULLY GUARANTEED.

Postage extra.

NEW POWER SUPPLY KIT

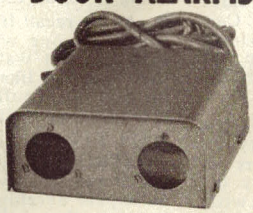
Ideal for small amplifiers, stereo or mono, test equipment, etc. Input 240v. A.C. Output 20v. D.C. at 1 amp.

Kit contains transformer, rectifiers, filter, condenser and circuit.

$4.50 Post 75c.

New Photo-Electric Burglar & Door Alarms at less than half price

DOOR ALARMS



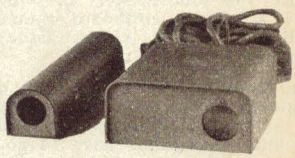
240V A.C. operation

$12.00

Post & Packing $1.25 extra.

Buzzer $1.25 extra.

BURGLAR ALARMS



240V A.C. operation

$16.00

Post & Packing $1.50 extra.

Buzzer $1.25 extra.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398

there would be considerable complexity around the control stages, even though the sections each side of these are straightforward. Without going into the technicalities of the tone control circuitry, we doubt if very many home builders would be prepared to lay out the extra expense involved in such a unit. Even then, only those who can fully understand what happens to the response curve when a certain frequency point is boosted or cut would be capable of operating such a system. In any case, we cannot see the justification for such a system, as the recording and playback curves used for modern disc and tape recordings are designed to give a proper balance of frequencies over the full audible range. The only people who would require selective filters of the type mentioned are broadcasting, recording, telephone or similar establishments. These people would use such a system to overcome the effects of, say, a lossy line or a prominent peak or trough in the response. Use of filters outside these professions tend to be something of a "gimmick". We feel that the simpler two-control circuits are safer and more useful, because there is less likelihood of users "painting themselves into a corner" (to use a colloquialism). We thank you for the comments about the magazine, and sincerely hope your wife continues to enjoy reading the "Serviceman" articles.

CD IGNITION: I am thinking of building a capacitor discharge ignition for my car, but as I missed several copies of "Electronics Australia" during 1970, I was wondering when the articles on CD ignition appeared in the magazine. **(G.B., Altona Nth, Vic.)**

• The articles on CD ignition appeared in August, September, October and November. In the August issue a conventional CDI was described, and in the September and October issues a photoelectric (point-less) ignition was described. The November article was entitled "Further thoughts on CDI". The File Nos for these projects are 3/TI/6 to 3/TI/9, respectively. Any of these may be obtained from the Information Service for the usual 20 cent fee.

RANGE FINDER: Has "Electronics Australia" ever published a design for a solid state range finder or pistol range indicator? If not, have you ever thought of doing so? **(S.T., Auburn, NSW.)**

• We have never described such a device and, frankly, we have never even thought about it, for the simple reason that yours is the first letter, as far as we can recall, which has ever raised the point. If any other readers are interested, and could give us some idea of the full requirements of such a device, we may take another look at it.

AMATEUR TEXTBOOKS: I have enjoyed your magazine for quite a while now, and was wondering if you have published the circuit for a transmitter or transceiver (preferably solid state) for the 6 or 2-metre bands. Also, could you recommend some books for the Amateur Operator's Certificate of Proficiency, as I am nearly old enough to be eligible to sit for the examination. **(G.R., Como, NSW.)**

• Our handsets published from May to July of last year are designed for the 6 and 2-metre amateur bands, and are solid state. Other than those, we have not published any solid state VHF transmitters. We have published a number of valve transmitters in the past, the most recent being a 6-metre transmitter in April 1964. The textbooks recommended by the PMG's Dept for the AOCP examination are as follows: RSGB Handbook, published by the Radio Society of Great Britain; Amateur Radio Handbook, published by the American Radio Relay League; and the Radio Handbook published by Editors and Engineers Ltd. For the regulations, the Handbook for Operators of Radio Stations in the Amateur Service, published by the PMG, is the applicable text.

RADIO: Unofficial history

At the outbreak of World War I in 1914, I was working in a small electrical laboratory situated in a semi-rural district in Victoria. The proprietor had his home on the property, and as he and his wife were both avid gardeners there were trees and shrubs surrounding both house and lab. He was also a radio amateur, and had a large aerial mast near one end of the lab building.

He was not able to use the radio equipment once the war had begun, of course, and had locked the small room at the end of the lab in which the gear was situated. However the mast was not dismantled, both because this would have involved a lot of effort, and because it didn't seem necessary.

We were manufacturing and repairing x-ray equipment at the time, and the chief even undertook to repair the x-ray tubes themselves. This involved exhausting the air from the tubes after the actual repair work, and heating the electrodes to drive out gas from the metal parts. As RF induction heating had not at this stage been invented, the heating was accomplished by energising the tube with high voltage from a heavy-duty transformer. The heavy current which flowed caused both the tube and transformer to produce a loud buzzing noise.

The chief was a late riser, and rarely appeared in the lab until after morning tea break. As he was the only one who had mastered the art of repairing the x-ray tubes, this often meant that he was still working in the lab long after we employees had left for the night.

Apparently someone passing by the property one night heard the ominous buzzing from the lab, and decided that secret radio messages were being transmitted. They must have passed on their suspicions to the authorities, for shortly after this the chief's late evening activities were being surreptitiously watched through the lab windows by security men secreted in the shrubbery.

How did he find out? Well, during the final heating and evacuation of a large tube, it rolled off the bench and upon hitting the floor imploded with a loud bang. It could easily have been mistaken for a firing cannon, and apparently was, because when the chief looked up from the wreckage, the moonlit vista outside the windows revealed men scrambling from beneath bushes, jumping down from trees, hurdling fences, and generally making a hasty withdrawal!

But officialdom, though routed, was not to be outdone. Shortly after this experience the aerial mast was dismantled, and taken by the authorities for safekeeping – just to be sure! (J.F., Monbulk, Vic.)

• Readers are invited to submit contributions to "RADIO: Unofficial History" and a publication fee will be paid for those used. Stories must be humorous and they must be true. Letters must be signed and the locale of the story indicated as a mark of good faith. The Editor reserves the right to rephrase contributions as necessary to preserve uniformity of style.

AMPLIFIER: I want to make a cheap, reasonable quality, transistorised stereo amplifier, suitable for connection to a gramophone turntable. I would like to know whether you have published any of these. **(M.B., Caulfield, Vic.)**

• We have published a number of stereo amplifiers, M.B. As you want a low cost one, we suggest the "Three Plus Three", published in August, 1968 (File No 1/SA/28). Others you may consider are the "Ten Plus Ten", April 1969 (File No 1/SA/30); and the "Playmaster 129 Microcircuit Stereo Amplifier", October 1970 (File No 1/SA/33). Any of these may be obtained as reprints from the Information Service for the usual fee.

LASERS: I would appreciate it very much if you could send me some information regarding the construction of a cheap plastic laser ray. I have searched for this information at libraries, but could not find anything. **(A.A., Richmond, N.S.W.)**

• The only laser we have described was a low power, He-Ne gas unit. This was described in August, 1969, and in the following October we published modifications to enable it to be used as a communications device (experimental). Copies of these articles (File Nos 2/MS/18 and 2/MS/19) are available for the usual fee, through the Information Service.

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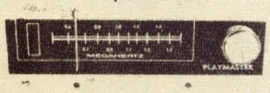
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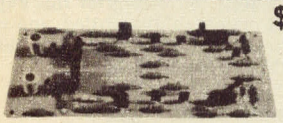
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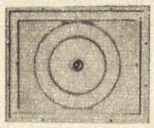
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DELTAHET . . . from page 57

by-pass capacitors and the two capacitors across the transformer secondary, are wired into the total stage, with short, direct leads. C91 on the supply line was wired into the prototype from the lug on the strip next to T11, to the nearest earth lug at the end of the crystal oscillator box. We used a tantalum capacitor here, although a polyester type would be satisfactory. Its function is to further reduce 1MHz crystal oscillator harmonic breakthrough.

At this point, the tuned circuits of the 32MHz low pass filter may be "dipped" to frequency. As mentioned before, each circuit must be isolated from all other circuits while this is done. However, C72 and C73 must be earthed. L8 and L10 are dipped accurately to 40MHz and L9 is dipped to 25MHz. The most accurate reading is obtained when coupling to the dip oscillator is reduced to a minimum, consistent with a definite dip. Having adjusted the circuits to frequency, they may be wired together and to the outside circuits.

The crystal oscillator and harmonic generator, and the 100KHz multivibrator stages are all that are left and these are mounted in such a way that the same two mounting screws are used for both assemblies. The trimmer C64 should be fitted first. It will depend upon the mounting provision as to how this is done and the only comment is that if you use the type which requires a two hole mounting, then it may be necessary to pack up one of the mounting pillars with a flat washer or two, to get a level which may otherwise be upset by the flange on the surrounding shield box.

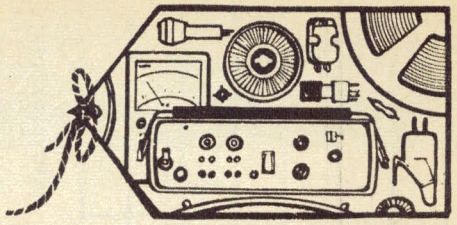
As mentioned earlier, one of the crystal oscillator board mounting screws also serves to hold the crystal socket in place, with a suitable brass spacer between the socket and the board. The screw is countersunk to suit the socket, and must be longer than the round head counterpart at the other end of the board.

Once again we used extra nuts on the screws to stand the board off the chassis by about 3/8in. With this board set in place, there should still be enough screw length above the chassis to take the 100KHz multivibrator board, and stand it off in a similar manner by about ¼in. During this process, external leads from each board should be attended to. To complete the crystal oscillator wiring, the stator of the trimmer is connected. If the rotor is not earthed by its mounting, an earth wire should also be run to the earth lug nearest to the crystal socket. The metal case of the crystal must also be earthed, in the interests of harmonic reduction. A suitable metal clip is devised and a lead run from it to the same earth lug just mentioned When the 100KHz multivibrator board is fixed, its external wiring may be fitted. The lead to the switch S6b must be run in a light coaxial cable, earthed at both ends. Another lead of particular interest is that from C46 to the first section of the tunable IF gang. We fixed a 2-tag strip under the nearest stand off pillar screw, and terminated the lead to the free lug. Another piece of hookup wire about ¾in long was also soldered to this lug, and bent so that it was in front of the window of the gang frame nearest the rotor plates for C99a. This will be adjusted later on.

Although we have not shown it on the circuit, the indicator lamp is fed directly from the 12.6V winding on the power supply transformer. It should also be noted that the 12.6V is nominal only and may in fact be closer to 14V. This should be taken into account, particularly if the indicator lamp is

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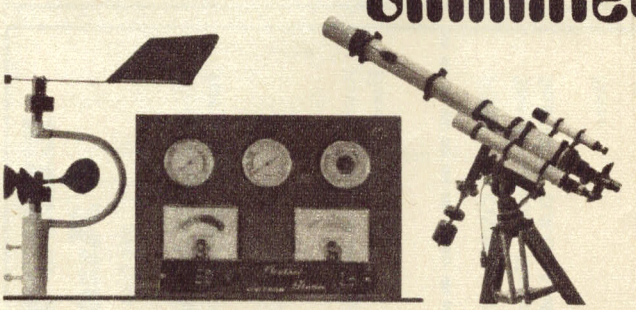
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DELTAHET ... from facing page

rated at 12.6V and not 14V as we have called for in the parts list. In the interest of long life of the lamp, a series resistor may be added with a value such that there is still sufficient light.

This just about completes the construction of the complete receiver. But before progressing further, a check should be made to see if anything has been overlooked. It may be worthy of mention at this stage that there are bunches of wires at various parts of the receiver and they may be neatly brought together and laced, to give a professional appearance. There is also some wiring above the chassis, quite a bit of this related to the .001uF feed through capacitors. One or two instances are wiring which should be kept away from under chassis stages and the rest involves the boards which are mounted on top of the chassis. This wiring can be run neatly and held down at strategic points with solder lugs under convenient screws, or it may be laced where desired. ■

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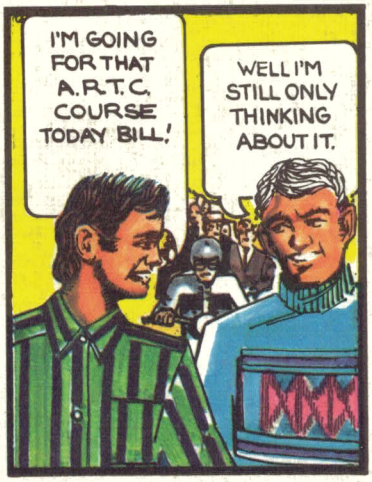
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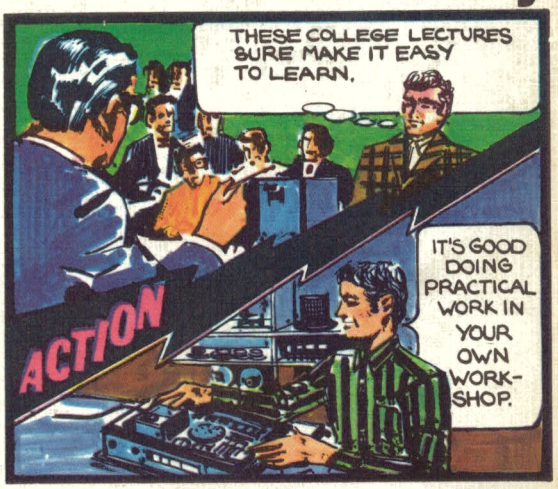
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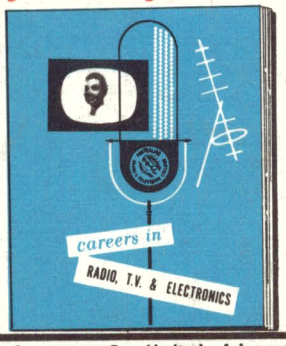
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